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SOCIO-BEE
Community for Change

**Grant Agreement No: 101037648**
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**Wearables and droneS for CIty Socio-Environmental Observations and Behavioural Change**

# Deliverable

## D2.2 - Profiling and instruments for CS Bees & Bears identification.R2

| | | | |
|---|---|---|---|
| Work package No. | **WP2** | Work package Title | Engagement, Behavioural Change and Pro-Environmental Stewardship |
| Task No. | **T2.1** | Task(s) Title(s) | Typology of Bees & Bears – Citizen and stakeholder profiling and segmentation for CS activism |
| Lead beneficiary | | **UDEUSTO** | |
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# List of definitions & abbreviations

| Abbreviation | Description |
|---|---|
| CA | Collective Action |
| CoP | Community of Practice |
| CS | Citizen Science |
| DB | Drone Bee |
| DoA | Description of Action |
| ECSA | European Citizen Science Association |
| HKU | STICHTING HOGESCHOOL VOOR DE KUNSTEN UTRECHT |
| IBER | Ibercivis Foundation |
| JRC | Joint Research Centre |
| LGTBIQ+ | Lesbian, gay, bisexual, transgender, intersex, and queer |
| QB | Queen Bee |
| SCT | Social Cognitive Theory |
| SAT | Social Learning Theory |
| T*x.x* | Task *x.x* |
| VUB | Vrije Universiteit Brussel |
| WB | Worker bee |
| WP *x* | Work Package *x* |

# Executive Summary

The H2020 SOCIO-BEE project aims to encourage citizens to take an active role in the fight against climate change through citizen science using disruptive technologies such as drones, and wearables articulated by a digital framework called AcadeMe. More specifically, SOCIO-BEE aims to involve different segments of citizens (young people under 16 years of age, older adults over 65 years, and people who commute by car or through public transport in large cities or suburbs) in different scientific endeavours: (i) identifying environmental issues related to air quality; (ii) raising informed hypotheses or "what-if" scenarios for mitigating or reducing emissions of air pollutants; (iii) designing collective interventions or experiments that help to prove if the hypotheses hold or are wrong; (iv) collect information and data to support the hypotheses through disruptive technologies involving as many people as possible from the aforementioned segments; (v) to analyse and visualize the information obtained from various data sources; and (vi) to communicate the results to raise public awareness, stimulate behavioural change and create new public policies for environmental protection. In essence, to involve citizens in what we call the Citizen Science Loop. Among the many challenges faced by the SOCIO-BEE project, there are two which connect with the citizen science participants. On the one hand, to identify and involve citizens (both people who are already aware of environmental issues and those who for some reason are less aware or passive regarding climate action). On the other hand, to encourage scientific vocations among the different target populations. It is worth to mention, that SOCIO-BEE is not a project related to bees or about ethology. However, it is inspired on the way bees behave in their colonies and hives. As such, in this text, in Chapter 2, the reader will read about bee roles, and hives. It is only a metaphorical way of mimicking tasks and duties from bees to the citizen scientists.

This deliverable is the second iteration of T2.1 and it delves into the first user-centred challenge defined above. Thus, it seeks to establish the main characteristics and a more detailed description of the different bee roles compared to what was provided in the Description of Action (DoA) [1] and in D2.1 [2]. For doing that, it compares the results of an inductive and deductive process to define the main socio-economic and cultural aspects of the different bee-roles to participate in citizen science campaigns related to air pollution mitigation. Moreover, this deliverable also addresses the barriers that must be unlocked to create sustainable and replicable hives and to understand what the main motivators (drivers) are to foster participation in the SOCIO-BEE campaigns. Finally, it is worth mentioning the provision of a new six questions-based instrument to objectively assign bee roles to citizens. The questionnaire proves its merits in differentiating larvae and bee roles (i.e., differentiate people that are akin to participating in CS campaigns against reluctant people).

Furthermore, the questionnaire also helps identify queen bees based on questions related to knowledge of air quality which is the factor that helps differentiate those salient bee roles from the rest. Differentiation between drone and worker bees has been not achieved with the proposed method according to the presented results as there are latent variables that were not measured to differentiate these two similar roles. Finally, it is worth mentioning two aspects. The first one is the uniform distribution of bee roles among surveyed countries (~25% queen bees, ~50% of worker bees, ~20% of drone bees and ~10% larvae). The second one is that this deliverable only focuses on the identification and definition of bee roles. For a better understanding of how to identify and collaborate with bear roles, the readers should review D2.6 [6].

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# 1 Introduction

Defining bee roles and shaping their main characteristics along with their drivers and barriers to participating in SOCIO-BEE campaigns are the main objectives of this deliverable. The point of departure is the Citizen Science hive metaphor, which integrates citizens, depicted as bees (larvae, queen, worker, and drone bees). Therefore, the outcome of this deliverable is a comprehensive study of the factors that make a citizen closer to a bee role than another in terms of participation in Air Quality (AQ) campaigns.

Diverse people with different mindsets and a mix of willingness to get involved in Citizen Science will participate in the SOCIO-BEE interventions. Therefore, it is advisable to define a series of tools and methodologies to understand who those citizens are, what could drive them to become Citizen Scientists, support Citizen Science (CS) actions, communicate the results of a CS campaign and/or lead pro-environmental action groups. Furthermore, all the citizens in the three pilot sites (Ancona, Maroussi, and Zaragoza) will collaboratively contribute to the success of the CS-based campaigns. In essence, project-contributing people (i.e., people who will be engaged and enrolled by SOCIO-BEE) should learn the main principles of collaboration and the protocols that are established by SOCIO-BEE to take part in the activities planned either physically or virtually.

In the first iteration of this deliverable (D2.1) [2], SOCIO-BEE members produced the theoretical foundations of the bee roles and hives inductively. That deliverable reported a series of identified barriers that impede a pro-environmental collective action based on CS to be a success. The second iteration is this document (D2.2). It consolidates the previous inductive findings by shaping some facts into bee-roles descriptions (e.g., Queen bees seem to be more knowledgeable of AQ conditions and causes than other bee roles, or Larvae stand out for being the role with the least knowledge, awareness, or intentions to act in favour of the environment). To this aim, a questionnaire was created and delivered to more than 2000 European Citizens in Spain, Greece, Italy, Belgium, The Netherlands, and Germany. The questionnaire tested the new tool that facilitates automatic bee-role identification.
Furthermore, it helped to obtain the target populations' main socio-economic and cultural characteristics. The objective was to link the bee roles with those factors under study. Finally, the questionnaire provided the means to better understand the barriers and drivers of different people from different latitudes in terms of participation in CS campaigns. The results provided in this document only focused on the Mediterranean cultures as the SOCIO-BEE pilots are running in Greece, Spain, and Italy. Therefore, the analysis of the central northern EU sample is beyond the scope of this deliverable. Also bear identification is out of the scope of this manuscript as their involvement and lease were largely addressed in D2.6 [6].

## 1.1 Purpose of the document

This deliverable has three main purposes listed next. On the one side, it provides a more detailed description of the different bee roles compared to what was provided in the Description of Action (DoA)[1] and D2.1 [2]. Furthermore, drivers for the creation and development of the hive, and barriers that may hinder the participation of bees in them have been identified first inductively (from knowledge of D2.1) and then deductively (new content from the previous version) through a questionnaire delivered to more than 2000 people in EU. The third contribution or purpose of the document, also new in relation with its predecessor, is to explain a new tool/instrument (i.e., a six-questions based questionnaire) to enrol newcomers to the hive ecosystem and automatically understand their bee role, their motivations to join a collective pro-environmental action driven by CS, and the potential hurdles for participation.

## 1.2 Relationship with other deliverables

This deliverable is based on D2.1. It will establish and confirm the understanding of the different roles and responsibilities of the participants in the CS-interventions and experiments that will be conducted over the course of the project. Therefore, it has a lot of connections with other tasks throughout the whole project. First, it is tightly aligned with all the tasks of WP2. Tailored and successful engagement will only occur if the people with whom we will work are correctly identified and characterized. While D2.1 explored the potential bee roles and their drivers and barriers to participate, this deliverable confirms some assumptions and prove false others. In essence, D2.2 through its deductive approach, establish the right characteristics of the different bee roles to differentiate them at recruiting time.

WP3 has also strong connections. In that WP, the use cases definitions are described. In those use cases the bees and bears are the leading actors. WP4 deliverables should consider the main responsibilities and roles of the participants in the hives to assign them appropriate micro-tasks and/or provide them bespoke recommendations to collect more evidence to back the hypotheses defined in the experiments. WP5, and especially T5.3 (pilot planning and KPI definition) and T5.4 (pilot preparation) are also tightly coupled to this deliverable as this will serve to understand which segments of the population we will work within the different pilots. Finally, it has strong connections with T6.3 which establishes the foundations of a strategy for equal, inclusive, diverse, and non-discriminatory participation of citizens in the SOCIO-BEE platform.

## 1.3 Organization of the document

In Section 2, the overall methodology that researchers followed to provide inductive and exploratory content is explained through four differentiated stages. Section 3 explains the deductive approach followed through devising and delivering a survey that will inform SOCIO-BEE campaigns. Section 4 shapes and expands on the main results from the questionnaire where information is provided breakdown by Mediterranean country but also by bee role. Finally, Section 5 concludes the deliverable by proposing the main takeaway messages for defining the right strategies in the second pilot iteration in the early months of 2024.

# 2 Overall Methodology for Inductively Defining Bee-roles & Barriers identification

The challenge of creating and shaping the stakeholders' characteristics must be tackled through an interdisciplinary vision following a triangulation approach. Therefore, this Section will review the overall research methodology that was applied in T2.1 to define the different bee roles the main responsibilities of participants in the hives, and the barriers that they will encounter for participation. We call this initial process the inductive approach as it tried to define the foundations from a new theory more qualitatively.

The inductive research process was carried out between October 2021 and February 2022 - see Figure 2, with the participation of a multidisciplinary team of researchers and practitioners with different backgrounds (engineering, social sciences, behavioural sciences, law, product/process design, and business). As can be observed in the roadmap (Figure 2), we divided into four different phases the research objectives towards the creation of this deliverable and the formal definition of the theoretical model as the main outcome. It departed from the above-mentioned SOCIO-BEE hive metaphor and

consisted of non-linear, path-dependent phases in which inductive observations and insights were matched with the body of knowledge and an intensive literature review to produce a usable model. Phases 0-3 were exclusively conducted by DEUSTO's researchers, while Phase 4 included the insights and knowledge of external partners (VUB, HKU, ECSA, and IBER).

**Phase 0 (departing point)**: SOCIO-BEE concept map & roles definition. In this phase, a Jamboard[1] document was created (see Figure 1) with separated templates by bee role. Researchers from different disciplines had to work in groups to define together intrinsic and extrinsic determinants of the different roles using sticky notes. At the end of the design-thinking phase, each group presented their results by answering these questions:

1. *What are the key personality traits and characteristics for each role?*
2. *Who are they in real life?*
3. *What is their willingness to participate and barriers?*
4. *How to become one of them?*

**Phase 1 & 2 (Common understanding of the different roles in the SOCIO-BEE hive metaphor)**: In this stage, it was decided to not remove any idea from the ones provided by the three groups. The focus was put on understanding if the information provided among different disciplines and backgrounds coincided or not. Once all the information was put together, the researchers realized that the inputs provided in the Jamboards came from different angles of research. Some scholars offered expert knowledge about the characteristics of the bee roles while others put the focus on backing their inputs on the existing body of knowledge. Therefore, it was decided that one representative of each field of knowledge had to volunteer to work in a focus group to put the main ideas and findings in a document and to articulate a preliminary model to shape the bee roles and their characteristics. In essence, the leaders sought:

1. *An agreement on the main theories and frameworks that help define the main roles characteristics and key factors fostering/preventing citizens from becoming one of the bee roles;*
2. *An agreement on the inclusion of a new concept/role: Larvae;*
3. *An agreement on not to define further the bear role as this will be thoroughly done in T2.3;*
4. *A preliminary theoretical model.*

**Phase 3 (Iterative refinement of the theoretical model):** In this stage, the researchers realised that all the factors identified were like those already provided by the existing literature on forming pro-environmental behaviour. Thus, two types of factors will affect the behaviour of the bees and their willingness and readiness to participate in collective pro-environmental action:

1. ***Internal:*** *those corresponding to the characteristics of the people such as values, belief, knowledge, awareness, and consciousness.*
2. ***External:*** *apart from social norms, contextual factors (institutional, social, economic, gender, etc.) and their cultural context were identified as the main axes of influence towards pro-environmental behaviour.*

Nevertheless, the SOCIO-BEE scholars sought to expand the concept of pro-environmental involvement. They tried to tight this concept to providing a collective view of the action in which the self and collective agency play a crucial role. In this regard, it was realised that this collective dimension followed a similar process to the Community of Practice. Therefore, both theoretical foundations of the Theory of Commons

[1] https://jamboard.google.com/d/1o7GXh3ASPOrs0ASVv9Hw9X_Pb_j0_ZmzvIGO_GoPMhc/edit?usp=sharing

and the Community of Practice helped dramatically to frame the involvement and future collaboration in the hive.

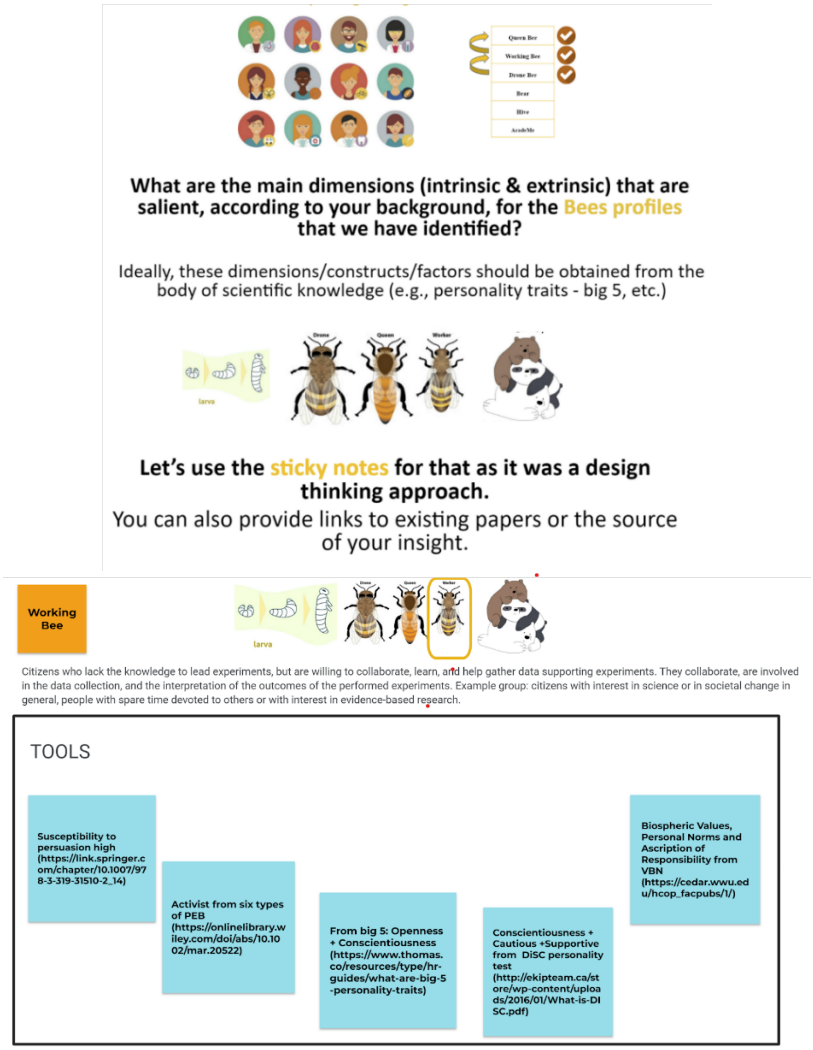



*Figure 1. Instructions of the Jamboard created and distributed to researchers by discipline (top part of the Figure) along with an example of the sticky notes provided for worker bees (bottom part of the Figure).*

This sense of mutual learning, while observing the process of contributing towards a shared endeavour (e.g., enhancing the air quality) and the trust and perceived efficacy of the group performance[2], made the researchers to use Bandura's Social Cognitive Theory (SCT) as a framework for modelling the expected behaviour of bee roles on the hives. After some iterations, the main phase 3 findings/results were:

1. *Incorporate the theories of Commons and the Community of Practice in the final model.*
2. *Use SCT as a framework for determinants and factors affecting bees' behaviour in hives.*
3. *Create a taxonomy with two levels of depth in each of the main factors of SCT.*
4. *Provide tangible characteristics, a formal definition, and tools to measure each of these factors defining the queen, worker and drone bee roles.*

[2] Collective efficacy refers to expectations that one's group is able to achieve social change through collective action.

5. *Identifying initial barriers that prevent the participation of bees in hives and the elements that might limit the inclusiveness of the hive.*

**Phase 4 (Expert's validation in a physical Workshop):** In this final endeavour towards consolidating the emerging model, a group of researchers prepared a series of participatory interventions with experts from SOCIO-BEE project (see Table below). During the workshop the experts (N=18) were assigned to different tasks to:

1) Provide their own insights regarding the understanding of the different bee roles. For that, they were provided with the same Jamboard of the Phase 1 presented above.
2) Validate the different theories and theoretical angles to understand what increases the willingness and readiness to participate in a pro-environmental collective action (which is the main objective of SOCIO-BEE project).
3) Provide more insights about potential barriers that prevent the citizens' participation in CS-campaigns and to identify which of the barriers have a higher impact over the different roles.

For these two final tasks a Miro board to foster the co-creative process was set[3].

*Table 1. Participants from different disciplines who joined the physical workshop.*

| Partner | N. of researchers/practitioners involved |
|---|---|
| **Deusto- Engineering faculty** | 5 |
| **Deusto- Social Sciences faculty** | 3 |
| **Deusto-Business School** | 3 |
| **VUB** | 1 |
| **ECSA** | 2 |
| **IBERCIVIS** | 1 |
| **HKU** | 3 |

[3] https://miro.com/app/board/uXjVObVfgCE=/?invite_link_id=213244828160

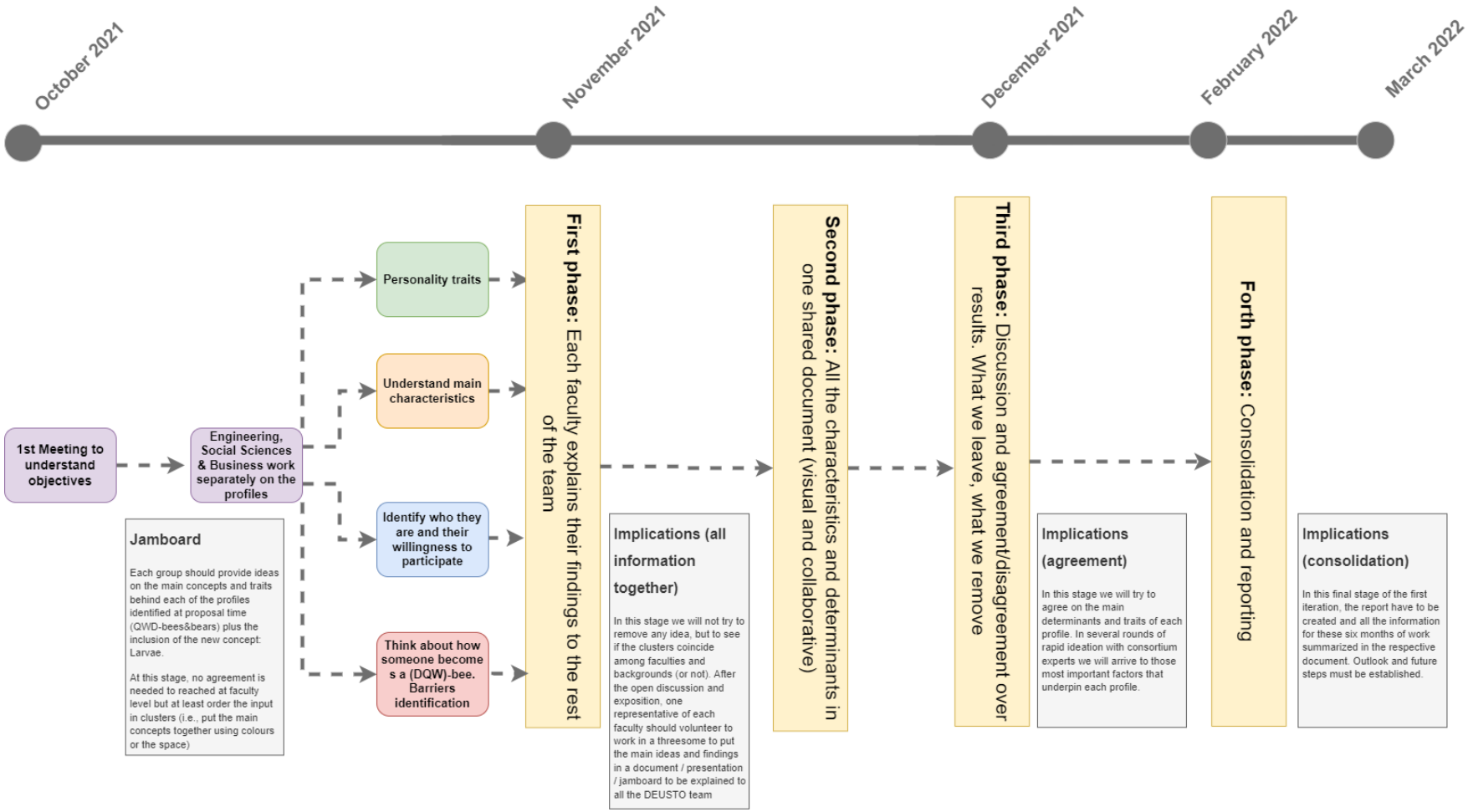



*Figure 2. Phases followed to accomplish the initial definition of the hives, bee roles and barriers.*

## 2.1 Shaping bee roles through Personas

All citizens irrespective of their social, cultural, or economic reality will participate in SOCIO-BEE. They will exhibit different drivers and barriers to join pro-environmental collective actions. Therefore, if some of these factors could be collected from participants by using an instrument (e.g., a questionnaire), it seems feasible to segment the population into the different bee roles in a way to understand citizens' willingness and readiness for participation in pro-environmental CS collective actions.

Therefore, in Deliverable 2.1 we tried to capture these boundaries through a Persona's development[4]. Personas are fictional characters which someone can create based upon a research endeavour to represent the different user types that might use SOCIO-BEE outcomes. Creating Personas will always help to better understand users' needs, experiences, behaviours, goals, and hurdles. It can help to recognize that different people have different needs and expectations, and it can also help to identify with the user we are designing for. Thus, the examples created with this Personas approach should be understood as user case approximations that exemplify some of the real individuals that can be beneath each of the bee roles. The personas archetypes were based on data reviewed on the body of knowledge and the expert knowledge gained during the different workshops conducted on the initial stages of the project. Please note that socio-cultural or economic demographics are not covered in the following Persona templates to prevent the creation of stereotypes. Our understanding is that everyone can become whatever bee role if they have the will and the ability to remove the barriers that have been identified. This was also true for the second phase related to the deductive process.

The departing point for this theoretical exercise was the description of the bees provided in the DoA [1] (see Table 2). In the following, the persona description for queens, workers, drones, and larvae is provided.

*Table 2. Initial description of bee-roles provided in the DoA identifying some potential groups that can perform the assigned role*

| Concept / Role | Description |
|---|---|
| **Queen Bees** | Knowledgeable citizens interested in leading CS-based activities and who engage fellow citizen scientists and citizens in an action group (i.e. a CS hive) to collaborate towards fighting against climate change. **Example group: Teachers, activists, science students or people interested in what-if testing** |
| **Worker Bees** | Citizens who lack the knowledge to lead experiments, but are willing to collaborate, learn, and help gather data supporting experiments and interpretate of the outcomes of the performed experiments. **Example group: citizens with interest in science or in societal change in general, people with spare time devoted to others or with interest in evidence-based research.** |
| **Drone Bees** | Citizens who do not care or are unaware of the potential impact of CS fighting against Climate Change but can be *inform*ed and *consult*ed. They do not collaborate in the citizen-science driven pro-environmental campaigns, but they may influence the co-creation of such experiments and are made aware of their results. They can reflect and adequate their green behaviour accordingly. **Example group: lay citizens, over 40+ with children with time constraints, journalist, etc.** |

[4] https://www.interaction-design.org/literature/article/personas-why-and-how-you-should-use-them

### 2.1.1 Queen bees

Queen Bees (QB) are the leaders of the hives, so they participate and coordinate collective activities. They are knowledgeable citizens interested in leading CS-based activities and who aim to engage fellow citizen scientists and citizens in an action group (i.e., a CS hive) to collaborate towards fighting against climate change. They must understand all the barriers that can be present when a new hive is going to be created. This role is related to the following Bandura's factors (recall, the Social Cognitive Theory depicted in Figure 3).

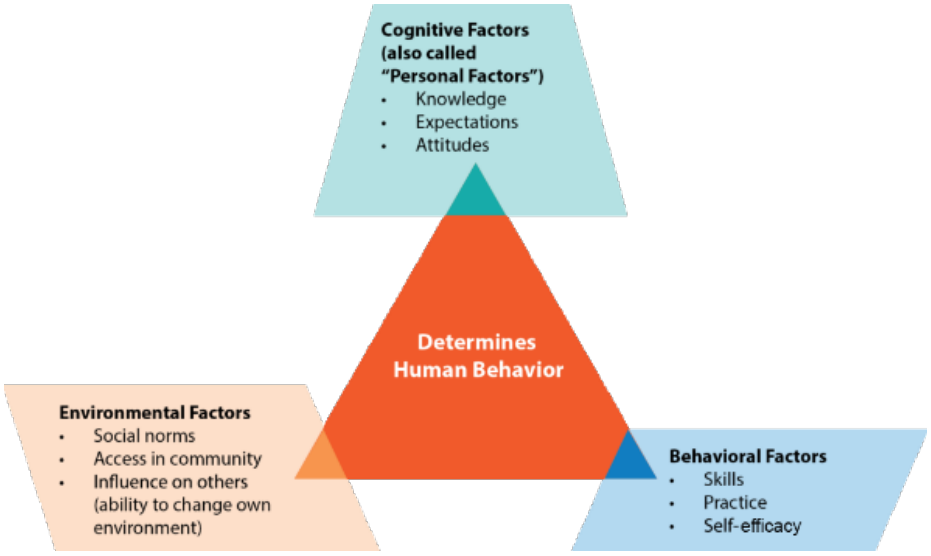



*Figure 3. The three aspects of forming pro-environmental behaviour based on Bandura's theory*

- **Related to cognitive factors and behavioural factors.** The experts who were consulted during Phase 4 suggested that they seem to stand out having experience, knowledge, pro-environmental values, and attitudes. Moreover, they present efficacy, and possibly all pro-environmental habits that their environments and personal situation enable them. They are motivated for the climate cause; they believe in the self and the collective efficacy of the group. Besides, they are an essential leading actor for collective endeavours and for all bees who make up the hive. For this reason, they need to have the necessary skills to motivate other bees and they must be capable of transmitting this motivation and beliefs to others, engaging fellow citizen scientists and citizens to start, and maintain, to participate in the collective activities related to citizen science.
- **Related to environmental factors**. They promote collective actions to change social norms to make others think and act more sustainably. Furthermore, they influence others to change their environments to drive the pro-environmental change.

Only the lack of support from institutions can make them desist from their endeavour. The barriers that impede action are a lack of policies related to air pollution mitigation that promote similar objectives that SOCIO-BEE pursues, lack of physical spaces to develop activities related to air-quality (e.g., rooms to co-create), finance, or budget. In Table 3, we can see how a potential senior queen bee called 'Lea' might score in the factors selected to characterize bee-roles.

*Table 3. Archetype of a Queen-bee*

| LEA | | |
|---|---|---|
|  | **Environmental knowledge** | High levels of environmental awareness and ascription of responsibility |
| | **Values** | Solidarity, Rational Empirical Change Agent, Reciprocity, Altruistism, Biospherism |
| | **Emotional involvement** | High locus of control, and high scoring in meaningful experience |
| | **Attitudes** | Responsibility and priorities, Motivation, Empathy, Linkage, Openness. |
| | **Skills** | Communication, Teamwork, Active listening, Caring, Leadership, Responsibility, Negotiation, Conflict management. |
| | **Practices and Habits** | Structuring, training |
| | **Self/Collective-Efficacy** | Extremely high self-efficacy and trust in collective efficacy |
| | **Social and cultural drivers** | Homophily, Empathy, Linkage, Proximity, Openness |
| | **Institutional factors** | – |
| | **Economic factors** | – |
| **Description**[5] | | |
| The thing that Lea enjoys the most is watching children play in the grass. This image has a calming effect on her. She is constantly considering how she may be more sustainable in her daily life, in her purchases, with the technologies she employs, etc. When other people want to listen to her, she strives to educate and raise awareness, pushing them to take action to save the world. Some of them listen, and others do not. When she was younger, she made many mistakes trying to be sustainable. She did, however, gain more knowledge with time. Some of her everyday habits could be changed, while others could not. She is aware of her own limitations, knows herself, and chooses what she is prepared to alter. She believes that the picture she adores will only be | | |

[5] Socio-cultural or economic demographics are not covered in this Persona template. The aim is to focus on drivers and barriers to define the bee role and less on personal traits that may entail the creation of stereotypes. Everyone can become a queen-bee if they have the will.

| possible in a few years if we learn to be sustainable, and she is willing to go to any length to ensure that it is preserved. | | |
|---|---|---|
| **Personal Quote (Goals)** | **Main Barriers** | **Main motivations** |
| *"It is our problem. Our home is in a big danger, and we must do whatever we can to rescue our planet"* | - Lack of organization support<br>- Distrust in policymakers<br>- Lack of financial resources<br>- Lack of time or personal situation that makes the collaboration impossible. | - Self/collective-efficacy<br>- Meaningful experiences<br>- Others: worker bees and hives<br>- Sense of responsibility |

### 2.1.2 Worker bees

Worker bees participate intensively in the collective activities of the hive. For this reason, these bees need to be aware, have self-efficacy, and have skills that allow them to work in a team. Furthermore, they must have pro-environmental values and attitudes as these will drive their action and involvement. Their social environment might push them forward to participate in these pro-environmental activities or the feel of responsibility might make them participate in hives as they bring knowledge, skills, time, and know-how. Regardless of the reason why they started to collaborate, they are active in the hives, and they are the more abundant role. Their main task are aiding in the development of hypothesis statements, helping on data collection, analysing of results, or procuring validation activities.

This role is related to the Social cognitive Theory factors in the following way:

- **Related to cognitive factors**, they need to be aware of the ongoing situation in which they participate. In the beginning, their values might be low, but they will develop as they participate more in collective activities.
- **Related to behavioural factors.** To start participating in the hives, they need to believe in the efficacy of the group. As their awareness and level of participation increase, breaking their barriers, they will change and improve their habits, their daily behaviours, and their team skills (communication, active listening, responsibility, negotiations, teamwork, and conflict management).
- **Related to environmental factors,** these are the factors that can be more different among worker bees. Some worker bees have a social environment that incentives them to participate and give them the knowledge needed. However, others may not have this social support. In this second case, these people can find pro-environmental support and motivation in other people of the hive. See the following Persona of 'Mia' for an example of a worker bee.

*Table 4. Archetype of Worker bee*

# MIA

| | |
|---|---|
| **Environmental knowledge** | Ascription of responsibility, mid-high degree of knowledge. |
| **Emotional involvement** | High internal locus of control, Low emotional reaction |
| **Values** | Solidarity, Altruistism, Reciprocity, |
| **Attitudes** | Responsibility and priorities, Motivation, Openness, |
| **Skills** | Communication, Teamwork, Responsibility, Caring, |
| **Practices and Habits** | - |
| **Self/Collective-Efficacy** | High |
| **Social and cultural drivers** | Empathy, Openness, |
| **Institutional factors** | – |
| **Economic factors** | – |

**Description**

Mia adores nature and is always at ease when she is in the forest. She goes to the park near her house when she is having a particularly bad day. She relaxes on the grass and is cut off from the rest of the world. One day, she came across a new public initiative that aimed to promote more green zones in towns. She was enamoured with the idea so, on her own, she tried to do everything she could to see that idea coming true. However, this policy was eventually rejected. She was upset and irritated when she learned about it. A few years later, she found out that her beloved park was demolished to construct new buildings; and she hadn't even been to the park in months. She felt like something was taken away from her and she felt compelled to act. Her friend informed her about a group that strives to expand the number of green spaces in cities and is now conducting research to demonstrate the value of green spaces in the city in reducing pollution.

| Personal Quote (Goals) | Main Barriers | Main motivations |
|---|---|---|

| | | |
|---|---|---|
| *"I know the problem is really big and I try to do my best, but sometimes it is hard for me to take action"* | -Lack of knowledge about the best way to act<br>-Negative or insufficient feedback<br>-Lack of time, resources, or personal situation<br>-Lack of incentives to act<br>-Old behavioural patterns | - Self-efficacy and collective efficacy<br>- Meaningful experience in actions<br>- Respect and instinct to protect natural environments<br>- Bring its skills to the group |

### 2.1.3 Drone bees

Drone Bees are citizens who do not care a lot about the potential impact of CS fighting against Climate Change but can be informed and consulted. They do not collaborate in the pro-environmental campaigns actively, but they may influence the co-creation of such experiments and are made aware of their results so that they can reflect and change their green behaviour accordingly. Drone bees can be involved in the data collection. However, this is not their main role at all on the hives. Drone bees are good at disseminating information and spreading result to the world. Drone bees can be journalists but also people present in social media (e.g., Twitter/X, Instagram, Facebook, YouTube, TikTok) that spread the word from their personal/professional accounts. They are very aware of the barriers of communication and inclusion, so to democratize results they use plain-own languages to be widely understood. This role is related to the SCT factors and barriers in the following way:

- **Related to cognitive factors,** they have some degree of knowledge, so they carry out outreaching actions. Their pro-environmental values and attitudes will not stand out in comparison with the worker bees or queen bees.
- **Behavioural and environmental factors** play a key role in defining this role. They explain why drone bees are mobilized into action, although they share many cognitive factors with workers or even queen bees.

They have the necessary cognitive factors to be aware of, but they do not participate in, collective action. Perhaps this is because their personal circumstances do not allow them to take part, because they do not sufficiently believe in collective actions, or because their old behavioural patterns are a barrier that they cannot easily overcome. In addition, some environmental barriers, such as the social norm of their environments or the lack of institutional or economic support, can be the reason they do not participate. However, they fight against these barriers, conducting dissemination actions to engage fellow citizens in collective actions and sharing knowledge in plain language. See the Persona of 'Teo' below an example of a potential drone bee.

*Table 5. Archetype of a Drone bee*

| TEO | | |
|---|---|---|
|  | **Environmental knowledge** | Some degree of sense of responsibility and knowledge. |
| | **Values** | Solidarity and biospherism |
| | **Emotional involvement** | – |
| | **Attitudes** | Responsibility and priorities |
| | **Skills** | Communication, Responsibility, |
| | **Practices and Habits** | He may or may not have pro-environmental habits. |
| | **Self/Collective-Efficacy** | Maybe have some degree but it is not central to its role |
| | **Social and cultural drivers** | – |
| | **Institutional factors** | – |
| | **Economic factors** | – |
| **Description** | | |
| His daily agenda is always packed, and he doesn't have time to do anything else. He is constantly daydreaming about doing things or meeting new people. However, he is scarce on spare time. He is committed to the extent that he can because of his agenda. Although he recognizes that it is insufficient, he is not able to do more. He recognizes he wouldn't be able to change his way of life, but he would do what he could to promote the active involvement of others. When he finds something that attracts his attention, he tries to spread the word resending social media messages he sees and attempting to raise awareness among his networks. One day, he began to use social media more frequently. At first, he did it because of his profession. However, eventually he began to do it because he enjoys it. He decided to make a good use of his time in order to promote environmental awareness. Today, he uses TikTok to teach others. His followers, mainly their family and friends, love these informal videos, and he feels that he is doing the right thing. | | |
| **Personal Quote (Goals)** | **Main Barriers** | **Main motivations** |

| | | |
|---|---|---|
| *".Love to give voice to the ones striving to demystify the infinite limits of planet"* | - Lack of time or personal situation that makes the collaboration very unlikely.<br>- Lack of trust.<br>- Old behavioural patterns. | Sharing information and knowledge with others, awareness building |

### 2.1.4 Larvae

Larvae are citizens who do not care or are unaware of the potential impact of CS fighting against Climate Change. In contrast to drone bees, they do not participate in dissemination activities or other pro-environmental activities. Maybe the social norms do not allow them to participate, or maybe their situation does not enable them to do it. However, if they are feed with the right honey or royal jelly (e.g., information that can make them think differently), they can become one of the bees of the SOCIO-BEE hive. This archetype is widely represented in society, and they present all the barriers to participate in the collective actions. Therefore, understanding what barriers are more important than others will help to create engagement strategies to unlock their willingness or readiness to participate.

See the following Persona called 'Ura' for an example of the factors and barriers that articulate the archetype. She is characterised as a young woman. However, she might also be a young person or an (aged) adult (recall that socio-demographics are not central to the SOCIO-BEE roles proposal).

*Table 6. Archetype of Larvae*

| **URA** | | |
|---|---|---|
|  | **Environmental knowledge** | Lack of sense of responsibility, Lack of knowledge. |
| | **Values** | Rational Empirical Change Agents but the collective action prevents her to act |
| | **Emotional involvement** | Loss aversion.<br>Emotional blocking of environmental values |
| | **Attitudes** | Individualism |
| | **Skills** | Communication, Negotiation, Responsibility |
| | **Practices and Habits** | Non-pro-environmental habits |
| | **Self/Collective-Efficacy** | None |

| | | |
|---|---|---|
| | **Social and cultural drivers** | – |
| | **Institutional factors** | – |
| | **Economic factors** | – |

| **Description** |
|---|
| Ura is a passionate girl. Perhaps not in age, but yes in awareness, she has always heard people talk about climate change, pollution, and other challenges. She has never gone beyond those distant words that talk to her about a problem that makes it appear to have nothing to do with her at first. Amid the hustle and bustle, she's never had time to stop and think, to reflect. She is always expected to have an opinion on these issues as if it were something natural and instinctive, but she always feels as if she lacks the knowledge to know exactly what is going on. Perhaps one day, this larva will learn how to acquire the knowledge required to comprehend what is going on. |

| **Personal Quote (Goals)** | **Main Barriers** | Main motivations |
|---|---|---|
| *"I have a lot of problems and I cannot take care of the planet; it is not my responsibility. Politicians and big companies are responsible, and they should solve this, not me."* | - Lack of time or personal situation that makes the collaboration impossible<br>- Lack of sense of responsibility<br>- Emotional blocking of environmental values<br>- Environmental issues are not a priority<br>- Lack of trust in themself and in the group's ability to develop a pro-environmental action<br>- Lack of interest<br>- Old behavioural patterns | They don't participate so they don't have a motivation for it. However, with the right royal jelly (e.g., purpose, incentives, motivation) they can become a new bee of the hive. |

## 2.2 Understanding the barriers that prevent bees from participating in SOCIO-BEE hives

In the previous Section, the main barriers that affect the bees and that may hinder their participation were reviewed. Nevertheless, a more detailed definition of when a barrier can occur in the lifecycle of the hive (creation, development, and consolidation) will facilitate the creation of engaging and notable strategies to overcome them in the second pilot iteration. Therefore, the Table 7 below provides an overview these interlinked factors only for the bee roles (recall, that Larvae profile exhibit all the barriers when it comes to join hives as they do not participate in them, so they are not reflected in the next table).

*Table 7. Matrix that interweaves the bee-roles, the lifecycle of the hive, and the main barriers that might appear.*

| Role | Stage | Activities within the Stage | Barriers |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **Queen Bee** | Creation | Role definition | Lack of meaningful experience in actions.<br>Lack of resources (time or personal situation) for proper engagement with the project.<br>Lack of external support (organizational or financial).<br>Too much effort over time.<br>Existing values prevent building pro-environmental collective action.<br>Distrust in policymakers. |
| | | Citizen's awareness & concerns | |
| | | Recruitment | |
| | Development | Training & hypothesis statement | Lack of external support (tools).<br>Too much effort over time. |
| | | Definition and conducting CS experiments | |
| | Consolidation | Outcomes & replicability | Lack of means to disseminate results/conclusions.<br>Distrust in policymakers.<br>Low power.<br>Lack of skills. |
| **Worker bee** | Creation | Role definition | Lack of resources (time or personal situation) for proper engagement with the project.<br>Lack of skills.<br>Lack of motivation.<br>Lack of incentives to act.<br>Old behavioural patterns (e.g., comfort).<br>Perception of 'too much hassle'.<br>Existing values prevent building pro-environmental collective action.<br>Lack of meaningful experience in actions. |
| | | Citizen's awareness & concerns | |
| | | Recruitment | |
| | Development | Training & hypothesis statement | Lack of skills.<br>Diminishing motivation over time.<br>Lack of technical knowledge.<br>Lack of notion of agency.<br><br>Negative or insufficient feedback of behaviour.<br>Perception of 'too much hassle'. |
| | | Definition and conducting CS experiments | |
| | Consolidation | Outcomes & replicability | Lack of motivation.<br>Lack of skills.<br>Lack of means to disseminate results/conclusions. |
| **Drone bee** | Creation | Role definition | Lack of motivation.<br>Environmental issues are not a priority.<br>Lack of meaningful experience in actions.<br>Old behavioural patterns.<br>Lack of skills.<br>Lack of notion of agency.<br>Lack of resources (time or personal situation) for proper engagement with the project.<br>Lack of trust in the group ability to develop a pro-environmental action.<br>Lack of sense of responsibility. |
| | | Citizens' concerns | |
| | | Recruitment | |

| | | | |
|---|---|---|---|
| | Development | Training & hypothesis | Not applicable |
| | | Definition and conducting CS experiments | |
| | Consolidation | Outcomes & replicability | Low power |

# 3 Overall Methodology for Deductively Defining Bee-roles and Identifying Barriers & Drivers

On summer 2023 it was decided to conduct an online survey to shape the initial knowledge grasped from the inductive process described in the previous Section. The objective was to go for a more quantitative way to analyse the segmentation of the citizens. Furthermore, the deductive approach was designed in a way that contributed to assess if the hypothesis of having four bee roles was right or not. Moreover, the idea of the survey provided a robust framework to validate the citizens' drivers, and their motivations or barriers to participate in CS campaigns such as those of SOCIO-BEE.

## 3.1 The survey

The online survey, that can be consulted in the Appendix of this deliverable, was devised to better understand European Union (EU) residents' motivations and behaviours related to climate change and pro-environmental activities related to air quality and citizen science. The questionnaire was delivered to six EU countries through the online platform Prolific[6] in which the respondents were fairly paid for their time (~11.5€/hour). The online platform allowed screening options and to balance the sample to equally have a distribution in gender or other categories such as age or parenthood. Three out of the six selected countries were Mediterranean countries (Spain, Greece, and Italy) – all of which are countries where SOCIO-BEE is developing its pilots. The remaining three countries (Belgium, Germany, and The Netherlands) were selected by VUB and DEUSTO to represent a Central/Northern part of Europe. We selected these three countries for comparative purposes with the Mediterranean sample and because their long tradition on projects related to Citizen Science [3]. While in total more than 2000 answers were collected from the overall sample, in this deliverable we put the focus on the countries represented by SOCIO-BEE project (N=1059). As such, the results that will be presented hereafter and shared with pilot cities will be more in line with the socio-cultural traits of the sample population. Moreover, the outcomes from the survey can better inform the design on the new campaigns in 2024.

### 3.1.1 Personal data collected

In the preamble of the questionnaire, we explained to respondents that the questionnaire was compliant with the legal principles imposed by the new European General Data Protection Regulation 2016/679 (GDPR or AVG), which has been in force since 25 May 2018. The personal information collected was related to:

- Age

[6] https://www.prolific.com/

- Gender
- Level of education
- Country of residence
- Employment status
- Composition of household
- Category of household income
- IP address

Some of these variables would be needed to explore potential links with the bee roles. For example: For the age distribution we can seek how age influences the distribution of bee roles. Also, we can obtain insights into whether age groups are more inclined to assume specific roles within the hives. Regarding the earning, it can be investigated the relationship between earnings and the roles bees undertake or to identify any patterns or trends regarding economic status and bee roles. Parenthood: It has its merits to explore how the presence of children correlates with bee roles or to seek if any bee role preferences is linked to people with children. Gender aspects are always relevant to be explored. For example, it can be analysed whether gender plays a role in determining bee roles; discovering any gender-related disparities in hive participation or also to evaluate the gender distribution (while quite balanced is slightly higher percentage of males).

### 3.1.2 Cultural variables

Beyond the socio-economic information and demographics, we were interested on exploring factors or constructs that can help to better shape the bee roles and their willingness to participate in SOCIO-BEE campaigns. In some cases, direct questions can be linked to some constructs (e.g., previous knowledge on CS). In other cases, different items (usually Likert based questions) were computed/aggregated to score on specific constructs (e.g., AQ Awareness, AQ Intentions, AQ Knowledge, AQ Policy). Finally, some questions over one construct (e.g., barriers and drivers) were converted to rankings that facilitate the ordering to better understand what aspects hinder or facilitate the most the participation of citizens on AQ-related campaigns. In essence,

- **Air Quality Awareness:** That was a metric made up by different items from the questionnaire. The aggregation resulted on a categorical variable of five levels (from very low to very high) that helped researchers to understand the level of awareness about AQ issues of the people who answered the questionnaire.
- **AQ Intentions:** That was a metric made up by different items from the questionnaire to understand the intentions of the participants to perform pro-environmental actions or join pro-environmental campaigns. The aggregation resulted on a categorical variable of five levels (from very low to very high intentions).
- **AQ Knowledge:** That was a metric made up by different items from the questionnaire. The aggregation resulted on a categorical variable of five levels (from very low to very high) that helped researchers to understand the knowledge of the participants about AQ issues (e.g., what cause Air Pollution or what are its effects).
- **AQ Policy:** That was a metric made up by different items from the questionnaire. The aggregation resulted on a categorical variable of five levels (from very low to very high) that helped researchers to understand the knowledge and trust participants have on how policies enhance

the air that they breath and to assess the impact citizens can have on the policies on air pollution or other related environmental topics.

- **Previous Knowledge about CS:** Yes / No question to assess whether participants have prior knowledge on CS.
- **Preferred communication source channel:** That was a multiple-choice question where participants had to reflect on the preferred channels to receive AQ information (e.g., from scientist, government, physicians, media, etc.).
- **Barriers to participation on CS campaigns:** That was one of the aspects we decided to assess in a ranking way. For that, we converted Likert-based answers to each of the nine barriers into a binary representation. The selection of the barriers was brough from the barriers identified in the inductive process.
    - Barriers that received a score of 4 or 5 in the Likert scale were tagged as very important for each respondent.
    - Barriers that received a score of 1, 2 or 3 the Likert scale were tagged as barely important for each respondent.
- **Drivers to participate on CS campaigns:** That was one of the aspects we decided to assess in a ranking way. For that, we converted Likert-based answers to each of the thirty-two drivers into a binary representation. The 32 determinants (see Figure 4) were found following the research of Hassenzahl et al.[7] and from another EU-project where DEUSTO is involved, and a similar approach is being applied [4]. In this research, a list of psychological needs, which can be a source of positive experiences and satisfying events, is described. The card deck provided by Hassenzahl et al. consists of eight 'need' cards and a cover letter with a guideline about what those needs were about. The 'needs' were "Relatedness, Security, Competence, Popularity, Stimulation, Autonomy, Meaning, and Physicalness". Apart from these needs, a new one called "Financial need" emerged related to access to budget as it is sometimes a driver to participate in campaigns (e.g., those that give incentives to the users).
    - Drivers that received a score of 4 or 5 in the Likert scale were tagged as very important for each respondent.
    - Drivers that received a score of 1, 2 or 3 the Likert scale were tagged as barely important for each respondent.

[7] https://www.experienceandinteraction.com/tools/

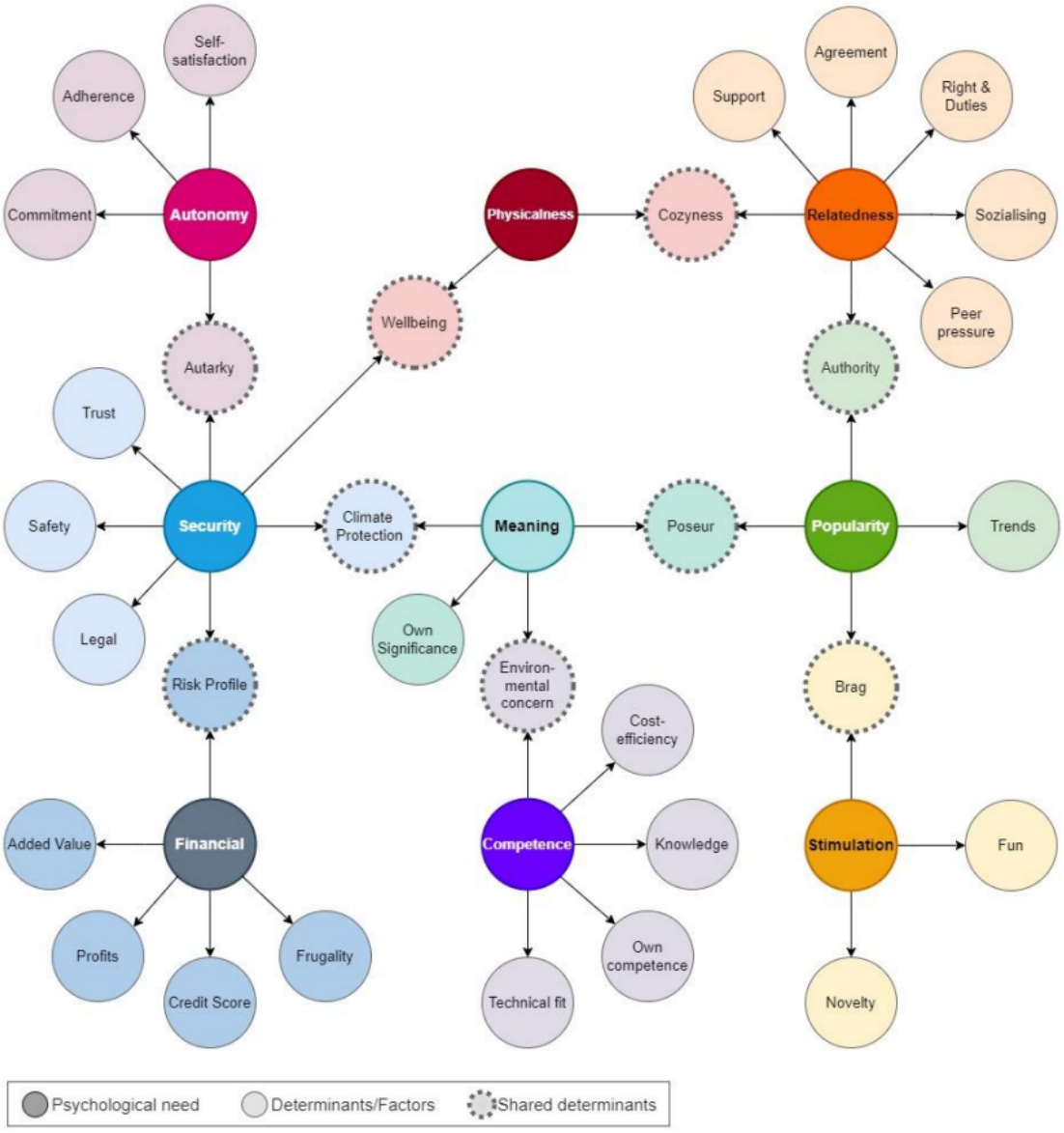



*Figure 4. Codification of the 32 determinants (drivers) clustered on the eight socio-psychological needs plus another cluster related to financial aspects.*

### 3.1.3 The bee role questionnaire

To easily understand what bee roles each respondent might be associated with, DEUSTO researchers created a six-item-based questionnaire. The answers from the instrument helped to cluster each person to a predetermined bee role of those that were identified on the inductive process. In essence, the instrument helped to associate respondents automatically with the following roles:

- **Queen Bees:** Leaders of the Hives, so they participate and coordinate collective activities. They are knowledgeable participants interested in leading CS initiatives and who also aim to engage

others to participate. They understand the barriers that can be present in the creation of a new Hive, but they have trust in the community to overcome them.

- **Worker Bees:** They participate intensively in collective activities organized by the Hive. These Bees are aware; they have self-efficacy and skills that allow them to work in the team. They have pro-environmental values and attitudes driving their involvement. These are typically the most active Bees in the Hive, and they take up a variety of tasks from data collection to analysis.
- **Drone Bees:** They are available to acquire information and be consulted. They do not actively collaborate in the campaigns but may participate in co-creation activities and receive information on their results and ponder on their consequences. Their main role is increasing and raising awareness and making connections with people with decision power to make changes.
- **Larvae Bees:** They are still unaware or unable to join (e.g., lack of time, lack of willingness, etc.) local campaigns to better understand the causes of climate change. In the same vein, they still do not participate in dissemination activities or other pro-environmental actions in their cities. However, if they receive the right honey or royal jelly (information, motivation, or incentives - internal or external -) they can become one of the previously described Bees.

It must be said that at the moment the questionnaires were delivered, no data analysis of the sample population was performed to validate if the idea of the bee roles was valid or not. However, we wanted to explore its potential applicability to define engagement profiles on an easy way. While the six questions can be consulted on the Annex, we prefer to put them here to facilitate their assessment. As can be observed, the questions are related to some already predefined characteristics of the bee roles but also to the level of commitment they would like to devote to campaigns (either on time, on experience or skills).

**Q1.** I would be willing to participate in collecting air pollution data while walking or roaming the city and no more (e.g., one or two hours of commitment per week to go to specific points close to the area where you usually roam) **– associated with worker bee role.**

**Q2.** I would be willing to study the outcomes of the air pollution campaigns and learn how to interpret the results (e.g., two to three hours of commitment per week to join other peers to collectively understand the data and information that is collected to make sense of it) **– associated with worker and queen bee role.**

**Q3.** I would be willing to approach people I know to collaborate with me to gather more and better air pollution data (e.g., one day of commitment per week to think about ways and strategies to involve more people in the pro-environmental campaigns. This includes recruiting skills but also communication competences to easily make others understand your goals). **– associated with worker bees and queen bee role.**

**Q4.** I would be willing to organise data collection campaigns on my neighbourhood / community (e.g., one day of commitment per week to define steps to carry out the pro-environmental campaign. Coordination and organizational skills are a plus to help running the campaigns successfully). **– associated with queen bee role.**

**Q5.** I can or I would like to reach out to third parties (e.g., policymakers, business actors, scientists, etc.) to promote changes in my neighbourhood / city / region based on the results of the collected air pollution data (e.g., one or two hours of commitment per week to spread the word about the results in social media, newspapers, or through other channels such as the citizens' mailbox or other communication means). **– associated with drone bee role.**

**Q6.** I can or I would be willing to share outcomes of the campaign with others and alert them on the consequences of air quality on our health and planet (e.g., one or two hours of commitment per week to assembly other peers and citizens to collectively think about ways to make a change in your neighbourhood / city / region). **– associated with drone bee role.**

#### 3.1.3.1 Bee role calculation

*Table 8. How items from the identification instrument score on each bee role.*

| Question number | Associated role |
|---|---|
| **Q1 -** | WB |
| **Q2 -** | WB & QB |
| **Q3 -** | WB & QB |
| **Q4 -** | QB |
| **Q5 -** | DB |
| **Q6 -** | DB |

Role assignments were based on responses to a five-point Likert scale to each question considering the scores they provide on each answer. The calculations are as follows:

- **For WB: Add scores of Q1, Q2 & Q3 → Then Average**
- **For QB: Add scores of Q2, Q3 & Q4 → Then, Average**
- **For DB: Add scores of Q5 & Q6 → Then, Average**

The average category with the highest score was the role closer and assigned to each respondent. In the case of draw/tie on the score, the prevalence on the hierarchy of the hive was followed in the following order: Queens, Workers, Drones. That is, if a respondent scored 4 points in Queen bee role and Worker role, Queen bee was assigned to it.

In case the highest role of all the roles has a score of 2.5 or less, they are directly assigned to the larvae role.

### 3.1.4 Confidentiality and respondents' rights

We explained that all identifying information will be removed prior to the publication of any of the resulting data. Data analysis will be based on the aggregated information resulting of the survey. Furthermore, we insisted on explaining that personal data may only be accessed and processed by VUB and Univ. of Deusto and will not be shared with third parties. The collected data was stored and secured in accordance with the guidelines of the VUB (i.e., the data will only be stored on OneDrive of VUB so that means that prior to anonymization the data is therefore never stored on unprotected personal computers, handhelds or other end-user devices and is never forwarded by e-mail). The data are collected and processed for the sole purpose of the research project SOCIO-BEE.

Respondents had the right to withdraw their consent for the processing of your personal data at any time, however that did not affect the lawfulness of the processing prior to the withdrawal of consent. Respondents had the right to access and correct their data. Also, they had the right to erase their data, to limit their processing, to object to their processing and to transfer their data to third parties. Finally, they had the right to lodge a complaint about the handling of their data through their national Data Protection Authority.

# 4 Findings & Analysis

## 4.1 Descriptive socioeconomic variables

In this section, the deliverable examines the potential relationships between bee roles within the hives and various socioeconomic variables on the Mediterranean sample. Recall that the participants were recruited through an online platform and that we tried to get a balance on their age range but not in their country of origin (as can be observed engaging seniors in the online platform was more difficult than other age ranges. Another aspect to take into account is that the distribution by country is skew to Italian and Spanish participants). Each variable captured was analysed to uncover its influence on the distribution and dynamics of bee roles. The following variables were studied: Age, Earnings, Children, Sex/Gender, AQ Awareness, AQ Intentions, AQ Knowledge, and AQ Policy. As can be seen in the following distribution, the number of respondents per country are not the same.

Socioeconomic variables of each country

| | **Greece (N=188)** | **Italy (N=498)** | **Spain (N=373)** | **Overall (N=1059)** |
|---|---|---|---|---|
| Age | | | | |
| 18-25 | 65 (34.6%) | 208 (41.8%) | 103 (27.6%) | 376 (35.5%) |
| 26-39 | 55 (29.3%) | 120 (24.1%) | 111 (29.8%) | 286 (27.0%) |
| 40-59 | 60 (31.9%) | 151 (30.3%) | 145 (38.9%) | 356 (33.6%) |
| 60 or older | 8 (4.3%) | 19 (3.8%) | 14 (3.8%) | 41 (3.9%) |
| Sex | | | | |
| Female | 83 (44.1%) | 235 (47.2%) | 178 (47.7%) | 496 (46.8%) |
| Male | 105 (55.9%) | 253 (50.8%) | 187 (50.1%) | 545 (51.5%) |
| Non-binary | 0 (0%) | 10 (2.0%) | 8 (2.1%) | 18 (1.7%) |
| bee_role | | | | |
| Queen | 48 (25.5%) | 124 (24.9%) | 90 (24.1%) | 262 (24.7%) |
| Worker | 90 (47.9%) | 238 (47.8%) | 177 (47.5%) | 505 (47.7%) |
| Drone | 43 (22.9%) | 106 (21.3%) | 75 (20.1%) | 224 (21.2%) |
| Larvae | 7 (3.7%) | 30 (6.0%) | 31 (8.3%) | 68 (6.4%) |

### 4.1.1 Age distribution

The age distribution varies among countries. Greece has a higher percentage of survey participants in the 18-25 and 40-59 age groups. Italy, on the other hand, has a significant proportion in the 18-25 age group. Spain's distribution is more evenly spread across the 26-39 and 40-59 age groups.

These diverse age distribution patterns suggest that the SOCIO-BEE project effectively captures the interest of individuals across various age groups, even before a formal engagement. Understanding these age distributions lays the foundation for tailoring future engagement methods and content that resonate with these diverse age groups.

### 4.1.2 Gender distribution

The distribution of participants by gender shows a slight majority of males across all countries (Greece: 55.9%, Italy: 50.8%, Spain: 50.1%, Overall: 51.5%). Females constitute a significant portion, with non-binary participants in Italy and Spain forming a smaller but notable percentage.

The gender distribution appears relatively balanced, with only a slight male predominance. This balance is crucial for ensuring diverse perspectives and experiences in citizen science activities within SOCIO-BEE.

### 4.1.3 Hypothetical bee role distribution

Analysing the distribution of bee roles (see also Figure 5) indicates that worker bees are the most prevalent role in all countries and overall: Greece (47.9%), Italy (47.8%), Spain (47.5%) and overall (47.7%). Larvae have the lowest representation in all countries. This latter finding makes sense as usually the social-desirability bias appears on sustainability related questionnaires [5].

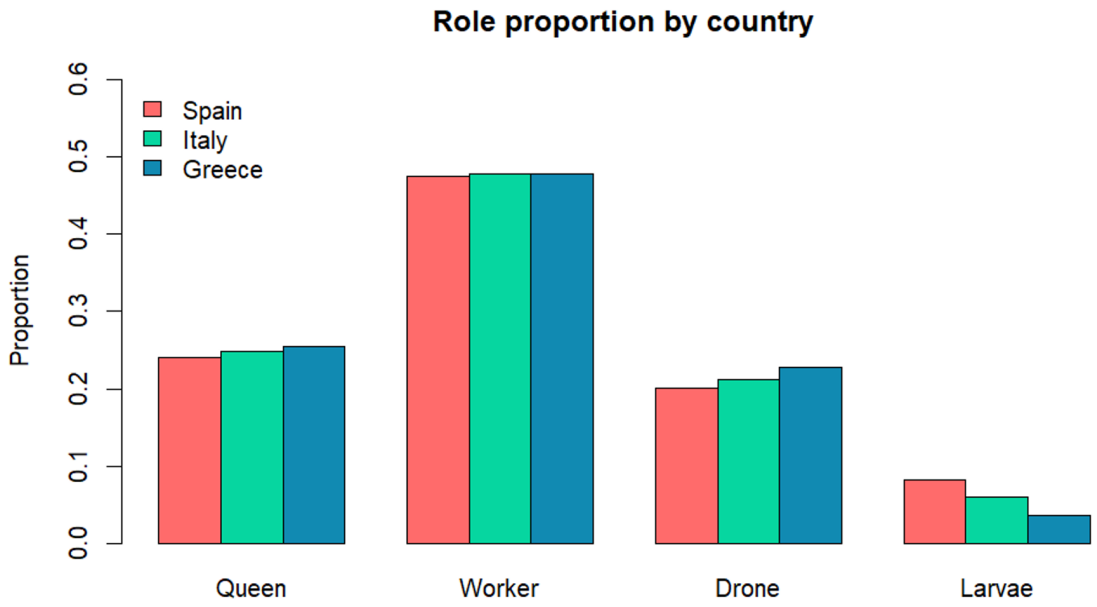



*Figure 5. Bee role proportion per Mediterranean country*

The consistent pattern in the distribution of bee roles across countries emphasizes the prevalence of worker bees. This uniformity is valuable for creating a shared understanding of bee roles, simplifying the development of engagement strategies and instruments applicable across different regions.

The proportion of queen bees is consistent across the three countries, with Greece having the highest percentage at 25.5%, followed closely by Italy (24.9%) and Spain (24.1%). Greece has the highest percentage of worker bees (47.9%), followed by Italy (47.8%) and Spain (47.5%). The distribution of drone bees is also relatively consistent, with Greece (22.9%) having the highest percentage, followed by Italy (21.3%) and Spain (20.1%). Larvae have the most significant variation in distribution among the countries. Greece has the lowest percentage of larvae (3.7%), while Italy has a notably higher percentage (6%), and Spain has the highest percentage (8.3%).

The fact that the distribution of roles is relatively similar in all three countries (Greece, Italy, and Spain) can be seen as important for the task's outputs. The consistency in the distribution of bee roles across different countries suggests that the concepts of these roles are relatively universal or at least consistent across these Mediterranean countries. This cross-cultural validity is important because it indicates that the definitions and understanding of these roles can be applied consistently in the context of the SOCIO-BEE project. Furthermore, the similarities in role distribution enhance the generalizability of findings and profiles developed within the SOCIO-BEE project. When the role distribution is consistent across countries, the insights and instruments developed for one country are more likely to be applicable and relevant in other countries as well.

From a project management perspective, having similar role distributions simplifies resource allocation, streamlining the project efforts and resources. It allows for more robust and reliable profiles that are based on a common understanding of bee roles, making the resulting profiles more accurate and applicable in different contexts. Lastly, a consistent role distribution ensures that policies and strategies for citizen engagement can be developed and applied more uniformly across the participating countries. Overall, this distribution consistency is important for cross-cultural validity, generalizability, resource allocation, robust profiling and policy and strategy development. This consistency contributes to the project's effectiveness in understanding and engaging citizen scientists across different regions.

## 4.2 Analysis of role differences and associations

We employ chi-square tests of independence to explore potential connections and associations between the roles played by citizens and various socio-economic and cultural variables. Specifically, we report the influence of age, earnings, family dynamics, and gender on the selection of bee roles, as well as the role-specific implications for air quality awareness, intentions, knowledge, and policy. After finding some associations between variables on specific countries but also collectively "Mediterranean column" (see in bold values in the Table 9 below), we tried to better understand the reasons for these significant p-values levels (see next section for a post-hoc analysis).

*Table 9. Positive association between some variables and the bee role on the Mediterranean sample as a whole and also breakdown by country (variables in bold represent the p-values below 0.005 after conducting a chi-square test)*

| | Mediterranean | Spain | Italy | Greece |
|---|---|---|---|---|
| Age | 0.161 | 0.417 | 0.794 | 0.136 |
| Earnings | 0.341 | 0.576 | 0.292 | 0.298 |
| Children | 0.288 | 0.664 | 0.747 | 0.456 |
| Sex | 0.225 | 0.725 | 0.117 | 0.579 |
| AQAwareness | **≤0.001** | 0.338 | **≤0.001** | 0.502 |
| AQIntentions | **≤0.001** | **0.001** | **≤0.001** | 0.190 |
| AQKnowledge | **≤0.001** | **0.001** | **≤0.001** | 0.505 |
| AQPolicy | 0.332 | **0.018** | 0.184 | 0.555 |

Based on the provided p-values from the chi-square tests of independence, we report below a more specific elaboration on the relationship between bee roles and socioeconomic variables:

*Table 10. Outcomes on the association test between bee roles and socio-cultural constructs.*

| Socioeconomic Variable | Elaboration |
|---|---|

| | |
|---|---|
| **Earnings** | The p-values for earnings in all countries (0.341 for Mediterranean, 0.576 for Spain, 0.292 for Italy, 0.298 for Greece) suggest that there is no significant association between bee roles and earnings. **This implies that individuals' income levels do not appear to influence their automatic assignment based on the six-questions to a bee role within the SOCIO-BEE project.** |
| **Children** | The p-values for having children in all countries (0.288 for Mediterranean, 0.664 for Spain, 0.747 for Italy, 0.456 for Greece) indicate no significant association between having children and bee roles. **This suggests that having children does not play a significant role in determining the bee roles participants take on.** |
| **Gender** | The p-values for gender in all countries (0.225 for the Mediterranean, 0.725 for Spain, 0.117 for Italy, 0.579 for Greece) suggest no significant association between gender and bee roles, except for Italy where a p-value of 0.117 is close to the conventional significance level of 0.05. **This implies that gender is generally not a determining factor in the selection or assignment of bee roles.** |
| **Air Quality Awareness, Intentions, Knowledge, and Policy:** | The p-values for AQ Awareness, Intentions, Knowledge, and Policy **show significant associations in the Mediterranean three countries as a whole (the collective approach)**. This indicates that there are notable connections between these variables and the selection of bee roles. However, when examining individual countries, Spain stands out with significant associations for AQ Intentions and AQ Knowledge. In contrast, Italy shows significance in AQ Policy. Greece, on the other hand, does not display significant associations for these variables. |

The absence of significant associations (with p-values ranging from 0.292 to 0.576) between earnings and bee roles across all surveyed countries (Mediterranean - collective, Spain, Italy, and Greece) suggests that participants' income levels do not play a substantial role in shaping their choice of bee roles. The lack of significant associations (with p-values ranging from 0.456 to 0.747) between the presence of children and bee roles indicates that family dynamics, specifically whether participants have children, do not significantly influence the selection of bee roles. While gender does not exhibit significant associations in most cases (with p-values ranging from 0.117 to 0.725), Italy stands out with a p-value of 0.117, approaching conventional significance levels. Significant associations are observed for AQ Awareness, Intentions, Knowledge, and Policy in the three Mediterranean as a whole, indicating notable connections between these variables and the selection of bee roles. Spain demonstrates specific significance for AQ Intentions and AQ Knowledge, while Italy shows significance in AQ Policy. Greece, however, does not exhibit significant associations for these variables. This suggests that participants' awareness, intentions, knowledge, and policy preferences regarding air quality play a substantial role in their choice of bee roles, with country-specific variations.

### 4.2.1 Post hoc analysis

We delved deeper into the data by conducting post-hoc analyses with Bonferroni correction for variables that exhibited significant associations with bee roles (those p-values in bold of Table 9). Thus, the focus is on the variables related to air quality awareness, intentions, and knowledge within the Mediterranean sample. The new p-values resulting from these pairwise comparisons aim to understand which are the bee roles who responded differently across the four roles represented. Thus, the post-hoc analysis helps to understand better why some variables presented an association with the bee roles, the direction of the association and the differences among the existing roles.

#### 4.2.1.1 Air quality awareness

As can be observed in Table 11, the analysis reveals that, in the Mediterranean sample, statistically significant differences were observed between the 'larvae' dimension in 'AQAwareness' with respect the remaining bee roles. More specifically, we can observe how this bee role scored higher in the Low category of the dimension (Recall: "Low category" groups the scores -very low- and -low- on the Likert scale. "High category" groups the scores -high- and -very high-. "Average category" stands for the average values in the 5 points Likert scale). That is, Larvae people account for having less awareness about AQ than other bee roles (who are answering according to the expectations based on the Mediterranean dataset). This information can be confirmed looking at Figure 6 where 38% of larvae roles scored Low or very low to 'AQAwareness' compared with smaller percentages of the remaining roles.

*Table 11. p-values for the post-hoc analysis on AQAwareness. Values in bold stand for being below the threshold of 0.05.*

| Dimension | Value | Low | Average | High |
|---|---|---|---|---|
| Queen | p values | 1.000 | 1.000 | 1.000 |
| Worker | p values | 1.000 | 1.000 | 1.000 |
| Drone | p values | 0.382 | 1.000 | 1.000 |
| Larvae | p values | **0.000** | 1.000 | **0.000** |

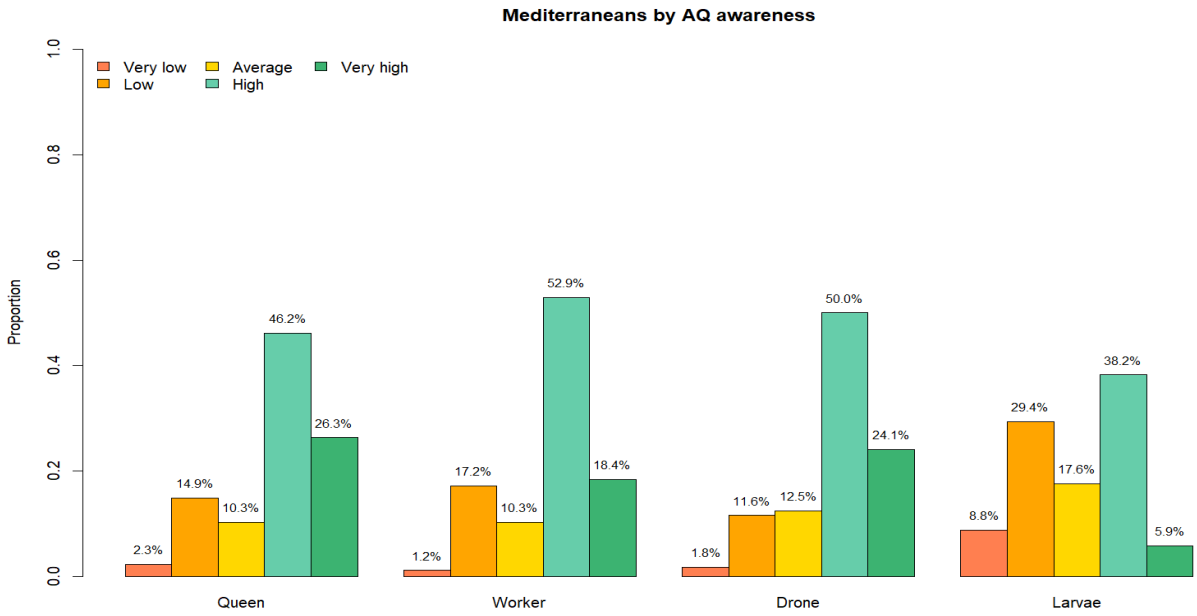



*Figure 6. Distribution of the answers to AQAwareness by bee role*

#### 4.2.1.2 Air quality intentions

For Air quality intentions, again the Larvae bees show a significant difference concerning the other roles in the 'Low' and 'High' categories for the Mediterranean sample. For understanding the direction of these differences, the reader must look at Figure 7. In this plot, in a glimpse one can understand that Larvae

people scored higher than the remaining roles in the “Low” category and lower in the “High” category. Thus, from the statistical data we can conclude that Larvae people present less intentions to behave in a way that the Air pollution can be reduced. Either for their own actions or anthropogenic activities.

*Table 12. p-values for the post-hoc analysis on AQIntentions. Values in bold stand for being below the threshold of 0.05.*

| Dimension | Value | Low | Average | High |
|---|---|---|---|---|
| Queen | p values | 0.259 | 1.000 | 0.477 |
| Worker | p values | 1.000 | 1.000 | 1.000 |
| Drone | p values | 1.000 | 1.000 | 1.000 |
| Larvae | p values | **0.000** | 1.000 | **0.000** |

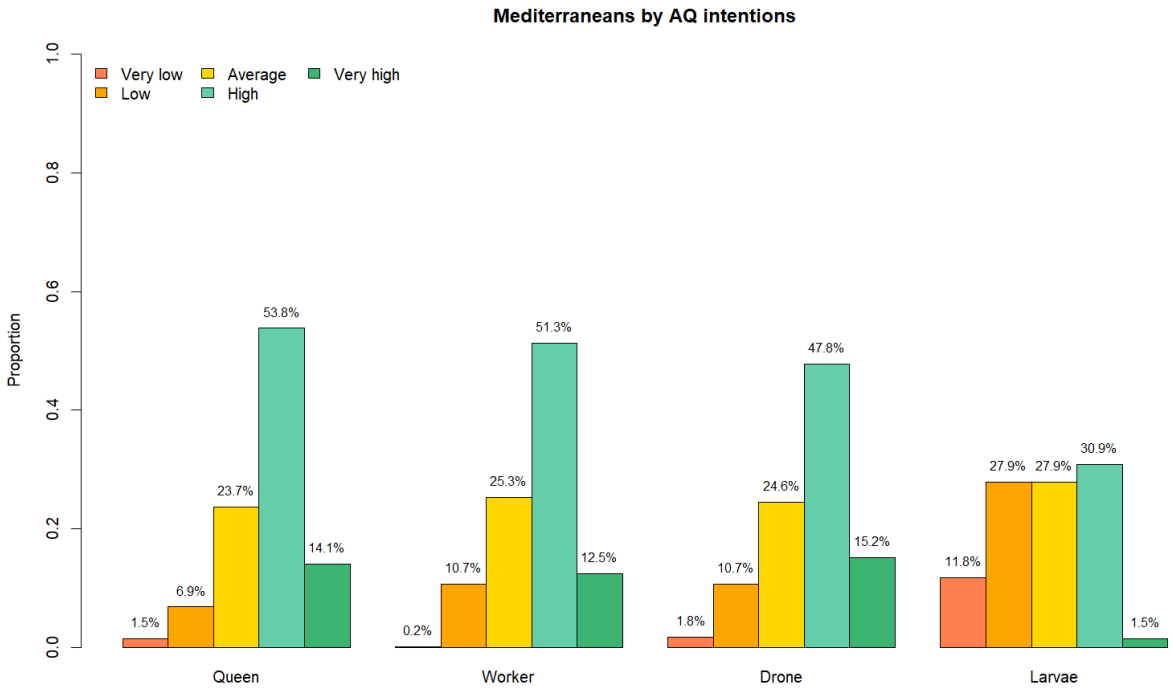



*Figure 7. Distribution of the answers to AQIntentions by bee role*

#### 4.2.1.3 Air quality knowledge

For Air quality knowledge, again the Larvae people showed a significant difference regarding the other roles in the 'Low' and 'High' categories for the Mediterranean sample. In this case, however, also the Queen bees scored differently in the High and Low categories but with the opposite direction as can be seen in the following Figure and Table. Thus, Larvae people are less knowledgeable on issues related to AQ compared to the rest of the group. On the contrary, Queen bees stand out for being the roles with higher knowledge on AQ because of their scoring on knowledge-related questions was higher than the other bee roles. This is an important finding as it suggests that with a similar questionnaire, we can differentiate not only bees between larvae and other existing bee roles, but that knowledge can be a

factor that helps differentiate queen bees from the rest. Asking participants about AQ knowledge will be helpful to differentiate among existing bee roles and associate them to a category.

*Table 13. p-values for the post-hoc analysis on AQKnowledge. Values in bold stand for being below the threshold of 0.05.*

| Dimension | Value | Low | Average | High |
|---|---|---|---|---|
| Queen | p values | **0.044** | 0.318 | **0.000** |
| Worker | p values | 0.639 | 1.000 | 0.055 |
| Drone | p values | 0.253 | 1.000 | 1.000 |
| Larvae | p values | **0.000** | 1.000 | **0.001** |

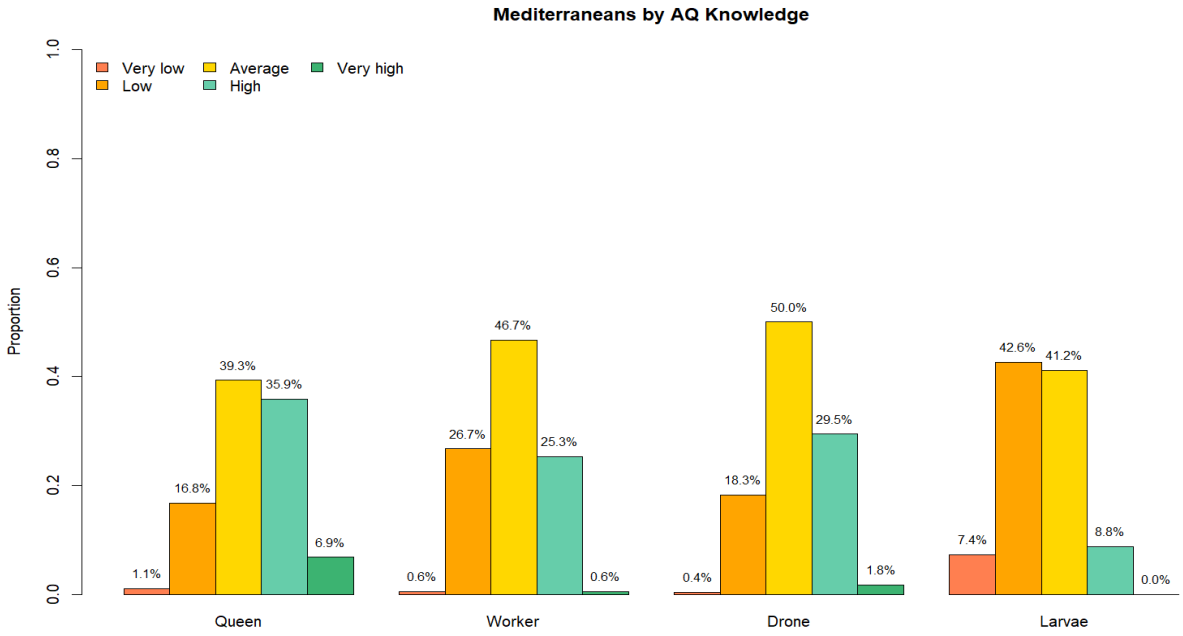



*Figure 8. Distribution of the answers to AQKnowledge by bee role*

## 4.3 Barriers to participation

Identifying and understanding the barriers that hinder citizen participation is fundamental in shaping successful engagement initiatives. In assessing the SOCIO-BEE project's feasibility and recognising potential hurdles, respondents were asked to rank the importance of several barriers on a scale from 1 to 5, marking each one as non-important at all to very important. The barriers encompassed various dimensions (see Table 14), including constraints related to time (Barrier 1), financial limitations (Barrier 2), and the absence of necessary skills or capacities (Barrier 3). Moreover, respondents evaluated concerns regarding the expected impact on the local communities (Barrier 4), the envisioned complexities associated with their enrolment and involvement to the project (Barrier 5), and potential biases toward commercial or political benefits, hindering the achievement of social and environmental goals (Barrier 6). Furthermore, the survey presented also as potential barriers the hierarchical decision-making structure of SOCIO-BEE and the lack of transparency in the outcomes (Barrier 7), the limitations and inflexibility in participation levels and required commitment (Barrier 8), and finally the absence of mechanisms to assess

social and environmental values (Barrier 9). Those barriers were selected as they were previously identified in the inductive approach. Some of them are more generic, while the latter three are very related to participation in SOCIO-BEE.

*Table 14. List of barriers as included in the distributed questionnaire.*

| | ID | Barrier |
|---|---|---|
| **Barrier 1** | B1 | I do not have time |
| **Barrier 2** | B2 | I do not have the financial resources |
| **Barrier 3** | B3 | I do not have the necessary skills or capacities |
| **Barrier 4** | B4 | It will not have any impact on my district / city. |
| **Barrier 5** | B5 | It seems too complex to get involved and to participate. |
| **Barrier 6** | B6 | It is focused on direct commercial or political benefit preventing the social and environmental aims. |
| **Barrier 7** | B7 | It has an excessive hierarchical organization, decision making is concentrated, and there is insufficient transparency of the outcomes. |
| **Barrier 8** | B8 | It doesn't allow different levels of participation and commitment. |
| **Barrier 9** | B9 | It does not provide access to social and environmental value. |

Participants were asked to assess the significance of these barriers concerning their participation in citizen science initiatives. To ensure impartiality and eliminate any potential bias, the presented barriers were intentionally shuffled for each respondent. This strategic randomization aimed to prevent sequence-induced preferences and ensure that each barrier received fair and unbiased consideration from the participants. By randomizing the order in which the barriers were presented, the survey sought to extract genuine perceptions and prioritize barriers based on their inherent significance to the respondents, rather than any order-induced preferences.

### 4.3.1 Most frequent barriers

Assessing the significance of barriers that the individuals believe that they might confront during their participation in SOCIO-BEE project, can elucidate critical factors that could foster or obstruct citizen engagement in scientific initiatives. Understanding the degree to which these barriers are perceived as important can guide the SOCIO-BEE project in developing strategies to mitigate these obstacles and encourage broader participation across diverse communities. The survey respondents were prompted to assess the importance of the various barriers on a scale of 1 to 5, with 4 or 5 indicating high or very high importance and 1, 2 or 3 a bare importance to them. Hight or very high importance was coded with a “1” while barely important barriers were coded with a “0”. For the whole sample we made the sum of those binary values across each barrier resulting on the scores presented below per country and as a whole.

*Table 15. Distribution of answers related to the significant barriers as collected from participants from 3 Mediterranean countries.*

| Country | Barriers | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | SUM of answers in total scoring 4 or 5 per country |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Spain | Number of answers scoring 4 or 5 | 234 | 174 | 139 | 96 | 109 | 62 | 84 | 78 | 53 | 1029 |
| | (% of collected answers per country) | 22.7 | 16.9 | 13.5 | 9.3 | 10.6 | 6.0 | 8.2 | 7.6 | 5.2 | |
| Italy | Number of answers scoring 4 or 5 | 282 | 254 | 199 | 114 | 118 | 85 | 88 | 103 | 61 | 1304 |
| | (% of collected answers per country) | 21.6 | 19.5 | 15.3 | 8.7 | 9.0 | 6.5 | 6.7 | 7.9 | 4.7 | |
| Greece | Number of answers scoring 4 or 5 | 100 | 105 | 48 | 40 | 32 | 26 | 27 | 40 | 21 | 439 |
| | (% of collected answers per country) | 22.8 | 23.9 | 10.9 | 9.1 | 7.3 | 5.9 | 6.2 | 9.1 | 4.8 | |

As can be seen in the table above, which outline the frequency of barriers identified as important or very important, across all Mediterranean countries three barriers stood out as consistently important, i.e., the **Lack of Time (B1)**, the **Financial Resources (B2)**, and the **Necessary Skills or Capacities (B3)**.

In more detail, Mediterranean countries consistently marked time constraints as a major obstacle with percentages ranging between 21% to 23%, suggesting that this consists of a universal challenge transcending geographical boundaries and any cultural background. This shared perception underscores the fact that in modern societies across Europe 1 out of 4 or 5 people experience fundamental limitations in free time and in allocating it to such activities. Following closely in terms of importance, the respondents highlighted the financial constraints, and the insufficient skills as the major barriers hindering engagement in the SOCIO-BEE project. However, the emphasis on financial constraints and insufficient skills varied across regions under study. While financial resources were highlighted as a significant barrier in some countries, it might not hold the same importance universally. Interestingly, given that SOCIO-BEE offers its solution free of charge, the significance of financial resources as a barrier may indicate perceptions and concerns rather than actual difficulties. Similarly, the varying emphasis on skills and capacities could reflect the existing disparities in educational or training backgrounds among respondents. This discrepancy might signify differing levels of confidence in engaging with scientific initiatives like SOCIO-BEE, influenced by varying educational systems or opportunities across different countries.

On the other hand, the barrier related to direct commercial or political benefits (B6) was least emphasized across countries. This minimal significance of B6 aligns with the principal pro-environmental goals of SOCIO-BEE, suggesting that the initiative has effectively conveyed its aims and garnered support for its environmental objectives among participants.

### 4.3.2 Role-based analysis of barriers

In this section, the analysis of the barriers perceived by the participants in relation to their bee role in the project will be presented and discussed. The focus is to shed light on how different bee roles, i.e., Queen Bees, Worker Bees, Drone Bees and Larvae Bees, envision and interpret barriers resulting from their engagement in the project. In that view, Table 16 provides a comprehensive summary of these findings, clarifying the unique challenges faced by each role.

*Table 16. Distribution of participants answers related to the significant barriers as identified per bee role.*

| Bee Role | Barriers | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | SUM of answers in total scoring 4 or 5 per country |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Queen Bee | Number of answers scoring 4 or 5 | **116** | **123** | **67** | 50 | 51 | 52 | 51 | 47 | 40 | 597 |
| | (% of collected answers per country) | 19.4 | 20.6 | 11.2 | 8.4 | 8.5 | 8.7 | 8.5 | 7.9 | 6.7 | |
| Worker Bee | Number of answers scoring 4 or 5 | **304** | **253** | **209** | 116 | 120 | 66 | 84 | 96 | 52 | 1300 |
| | (% of collected answers per country) | 23.4 | 19.5 | 16.1 | 8.9 | 9.2 | 5.1 | 6.5 | 7.4 | 4.0 | |
| Drone Bee | Number of answers scoring 4 or 5 | **145** | **121** | **82** | 53 | 50 | 38 | 44 | 50 | 32 | 615 |
| | (% of collected answers per country) | 23.6 | 19.7 | 13.3 | 8.6 | 8.1 | 6.2 | 7.2 | 8.1 | 5.2 | |
| Larvae Bee | Number of answers scoring 4 or 5 | **51** | **36** | 28 | 31 | **38** | 17 | 20 | 28 | 11 | 260 |
| | (% of collected answers per country) | 19.6 | 13.8 | 10.8 | 11.9 | 14.6 | 6.5 | 7.7 | 10.8 | 4.2 | |

Table 16 illustrates the distribution of perceived barriers across different roles within the SOCIO-BEE project: Queen Bees, Worker Bees, Drones, and Larvae Bees. Each role exhibits varying degrees of significance attributed to distinct barriers, shedding light on the perceived challenges envisioned to be faced by participants during their engagement with the project. As can be easily seen, across the roles of Queen Bees, Worker Bees, and Drone Bees, the barriers related to Lack of Time (B1), Financial Resources (B2), and Necessary Skills or Capacities (B3) emerge as primary obstacles. These barriers accumulate more than 50% of the collected answers with the rest of them having less than 9% each. So, this suggests that if the consortium tackles only three out of the nine assumed challenges by targeted interventions and tailored communication strategies, it could succeed easily in enrolling 50% more volunteers than before.

However, the distribution of larvae' answers related to the significant barriers is not as pronounced as in the other roles. The pattern of perceived barriers extends beyond the three commonly received answers of barriers (B1, B2 and B3), indicating a relatively even distribution of importance across multiple barriers. Six out of nine identified barriers accumulated between 10-20% of the collected answers, suggesting a broader spectrum of concerns compared to the other roles. This broader concern could signify a potential lack of awareness or familiarity among Larvae Bees, not only regarding citizen science initiatives but also in pro-environmental actions. Consequently, the recruitment and engagement of Larvae Bees might necessitate more intensive efforts and personalized approaches, in outreach, education, and targeted communication strategies highlighting the importance of accommodating varying levels of awareness and preparedness among the participants and the participants' roles.

Furthermore, the answers of the Queen Bees in comparison to Worker Bees and Drone Bees indicate relatively lower importance for the Barrier 1: Lack of time compared to the other roles. This might reflect the fact that the Queen Bees perception in terms of time required differ, potentially due to their difference responsibilities within the project. Finally, the roles of worker bees and drone bees exhibit similar perception, while their responses were aligned almost across all potential barriers, which requires further exploration.

In summary, the role-based analysis of barriers within the SOCIO-BEE project highlights the primary challenges of Lack of Time (B1), Financial Resources (B2), and Necessary Skills or Capacities (B3) across

most participant roles. These shared barriers stand out as pivotal focal points for targeted interventions and communication strategies in recruitment efforts. Larvae Bees, however, on top of these 3 barriers present additional diverse concerns, indicating potential awareness gaps and lack of familiarity with similar actions, being more reluctant in participating. This requires probably personalized approaches and more effort in the recruitment and engagement phase in comparison to the other roles. Nevertheless, understanding how these role-specific perceptions of barriers, the SOCIO-BEE consortium has the capacity, knowledge, and insight to devise tailored strategies to enhance engagement and address the diverse needs of participants across different roles.

A deeper analysis of the data, concerning the top three barriers, was conducted and the key findings will be reported in the next paragraph, to assess the potential association between distinct bee roles and their responses to these barriers. After thorough examination, statistical associations between barriers 1 and 3 regarding the bee roles' responses were identified. However, it's important to note that no statistically significant association was found between the types of roles and the B2 barrier, and therefore, this part of the results will be omitted.

#### 4.3.2.1 Barrier 1 - lack of time

**Queen bees** present a very strong association between their role and the Barrier #1 because they scored in general very low to this barrier in comparison to what it was expected and very high from the expected distribution (Non-important vs Important). The opposite sense of the residuals in comparison with other roles in the post-hoc test shown below denote that this barrier affects the queen bees in a lower extent than other roles (while still it is an important barrier for them).

| Dimension | Value | Non-important | Important |
|---|---|---|---|
| Queen | Residuals | 5.255 | -5.255 |
| Queen | p values | 0.000 | 0.000 |
| Worker | Residuals | -1.279 | 1.279 |
| Worker | p values | 1.000 | 1.000 |
| Drone | Residuals | -2.243 | 2.243 |
| Drone | p values | 0.199 | 0.199 |
| Larvae | Residuals | -2.909 | 2.909 |
| Larvae | p values | 0.029 | 0.029 |

*Figure 9. Residuals and p-value of the post-hoc analysis to understand the direction of the difference among existing bee roles. The comparison is between the categories Important vs. Non-important for barrier #1*

**Larvae people,** on the contrary to the Queen bees, show a high distribution of the responses to this barrier and therefore, we can understand that it is the major hurdle for this kind of role. In the case of larvae, the impact of this barrier on their involvement in this type of initiative is highly significant. They have a significantly higher distribution of high or very high responses than in the case of the other roles. If we add to this their lack of interest/intention and knowledge, we can identify this role as the one that presents the most problems for their participation in the campaigns.

#### 4.3.2.2 Barrier 3 – lack of necessary skills or capacities

**Queen bees** present a very strong association between their role and Barrier #3 because they scored in general very low to this barrier in comparison to what was expected from the sample and very high from the expected distribution. Again, the opposite sense of the residuals in comparison with other roles in the post-hoc test and the graphs below denote that this barrier affects the queen bees to a lower extent than other roles (while it is an important barrier for them, though).

**Worker bees,** contrary to the Queen bees, they show a high distribution of the responses to this barrier and therefore, we can understand that it is the major hurdle for this kind of role in comparison to the other's answers to barriers.

| Dimension | Value | Non-important | Important |
|---|---|---|---|
| Queen | Residuals | 4.217 | -4.217 |
| Queen | p values | 0.000 | 0.000 |
| Worker | Residuals | -3.187 | 3.187 |
| Worker | p values | 0.012 | 0.012 |
| Drone | Residuals | -0.055 | 0.055 |
| Drone | p values | 1.000 | 1.000 |
| Larvae | Residuals | -0.837 | 0.837 |
| Larvae | p values | 1.000 | 1.000 |

*Figure 10. Residuals and p-value of the post-hoc analysis to understand the direction of the different among existing bee roles. The comparison is between the categories Important vs. Non important for barrier #3*

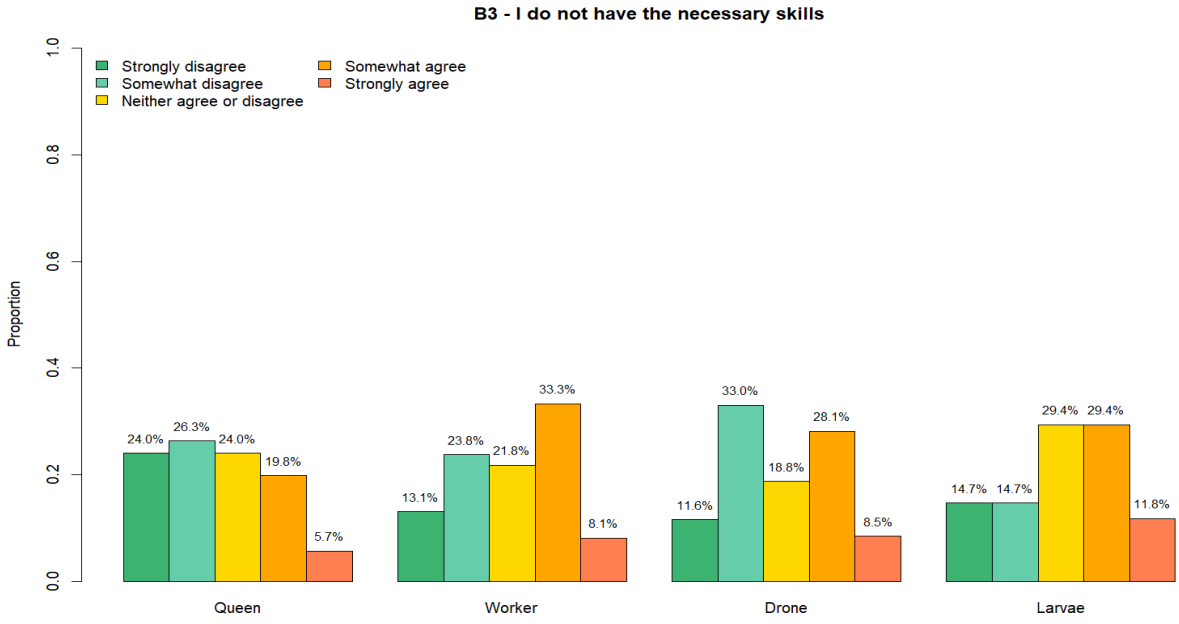



*Figure 11. Distribution of the barrier #3 across the bee roles.*

## 4.4 Drivers of citizen participation

In this subsection, we delve into the top five drivers, among the thirty-two provided, that were identified by respondents across different countries and bee roles as upmost priority for them. With this endeavour,

we can shed light on the key considerations that influence individuals' decisions to engage in Citizen Science-led campaigns related to air quality.

### 4.4.1 Identifying key drivers

Thirty-two questions from the questionnaire in the Annex assessed what would promote and foster the participation of citizens in Citizen Science-led campaigns related to air quality. The table below shows the five top drivers in bold from our respondents. The numbers reflect the count of responses for each driver in each country after coding them in two categories in the same way as is was done with barriers (Important vs barely important). We can see that all the countries' respondents agree on the top 5 drivers as follows:

| | Spain | Italy | Greece |
|---|---|---|---|
| D1 | 103 | 112 | 43 |
| D2 | 88 | 116 | 47 |
| D3 | 136 | 166 | 79 |
| D4 | 204 | 298 | 121 |
| D5 | 97 | 114 | 28 |
| D6 | 213 | 287 | 102 |
| D7 | 171 | 235 | 96 |
| D8 | **276** | **396** | **138** |
| D9 | 216 | 300 | 122 |
| D10 | 257 | 329 | 132 |
| D11 | **274** | **401** | **157** |
| D12 | 173 | 245 | 71 |
| D13 | 219 | 316 | 118 |
| D14 | 258 | 361 | 132 |
| D15 | **285** | **374** | **153** |
| D16 | **308** | **374** | **155** |
| D17 | **335** | **448** | **161** |
| D18 | 170 | 228 | 102 |
| D19 | 197 | 258 | 101 |
| D20 | 174 | 226 | 81 |
| D21 | 190 | 242 | 95 |
| D22 | 87 | 73 | 51 |
| D23 | 100 | 103 | 47 |
| D24 | 78 | 102 | 50 |
| D25 | 124 | 133 | 57 |
| D26 | 176 | 318 | 119 |
| D27 | 154 | 201 | 114 |
| D28 | 74 | 62 | 38 |
| D29 | 49 | 56 | 24 |
| D30 | 80 | 100 | 46 |
| D31 | 53 | 46 | 25 |
| D32 | 251 | 365 | 123 |

**I only make decisions to volunteer to CS campaigns if…**

- **Driver 8:** I trust all the parties involved (e.g., public administration, neighbours) and the technology.
- **Driver 11:** I have enough knowledge of the subject matter, in this case about AQ and scientific methods.
- **Driver 16:** I feel personally committed to the action and the expected outcome
- **Driver 15:** I feel satisfied with the action and the expected outcome.
- **Driver 17:** I feel I can sustain it.

*Figure 12. The resulting top-5 drivers among the three Mediterranean countries.*

The consistency across all countries is remarkable, indicating a significant level of agreement on the top drivers. Notably, participants across these nations prioritize drivers that emphasize sustained participation, personal involvement, satisfaction, knowledge, and confidence in the campaign's processes and technology. In a more detailed way, we can see how these drivers relate to the autonomy of the respondents (Driver 16, 15 and 17), the competence (Driver 11) or Security (Driver 8).

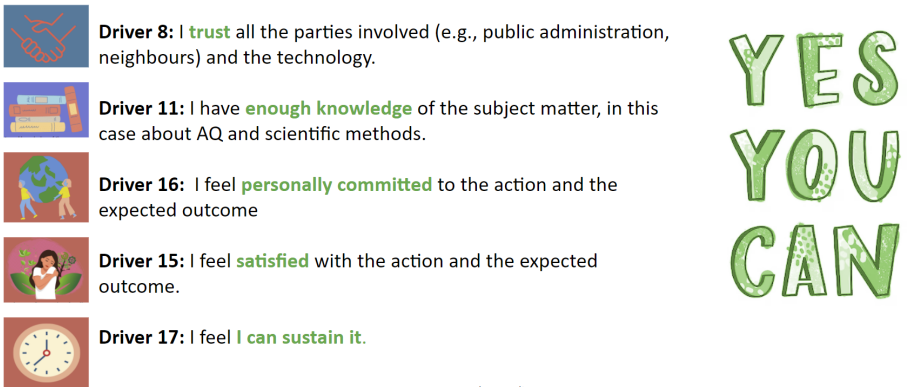



*Figure 13. Relation of the top-5 drivers with their category from the socio-psychological needs.*

### 4.4.2 Role-based analysis of drivers

Analysing the responses by bee role instead of by country provides insights into role-specific considerations (see Table 17). Queen Bees, Worker Bees, and Drone Bees generally exhibit similar patterns in their prioritization of drivers (as it was the case with barriers), aligning with the overall trends observed in the country-wise analysis. However, Larvae Bees, as the exception, show a slight impact from Driver 32- *I only decide if the action has a personal, inner meaning for me* (apparently not significant enough).

*Table 17. Relation of drivers pattern according to the bee roles. Levels of green indicate the top drivers, on the contrary levels or red indicate the least selected drivers. In bold the top 5 per bee role.*

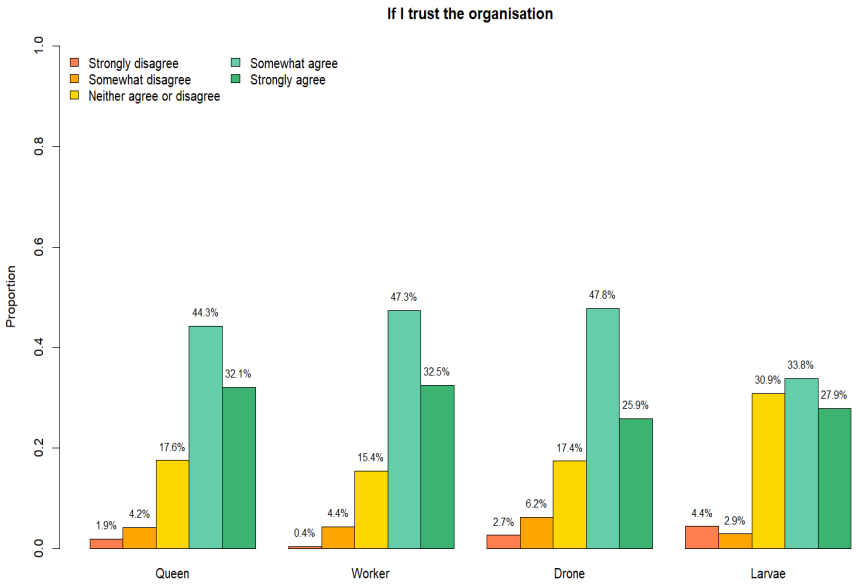
| | Queen | Worker | Drone | Larvae |
|---|---|---|---|---|
| D1 | 62 | 112 | 52 | 32 |
| D2 | 62 | 114 | 56 | 19 |
| D3 | 103 | 179 | 84 | 15 |
| D4 | 151 | 318 | 133 | 21 |
| D5 | 67 | 101 | 53 | 18 |
| D6 | 176 | 278 | 133 | 15 |
| D7 | 145 | 239 | 98 | 20 |
| D8 | **200** | **403** | **165** | 42 |
| D9 | 162 | 294 | 150 | 32 |
| D10 | 171 | 346 | 154 | 47 |
| D11 | **194** | **409** | **175** | **54** |
| D12 | 128 | 221 | 117 | 23 |
| D13 | 166 | 311 | 144 | 32 |
| D14 | 176 | 378 | 164 | 33 |
| D15 | **187** | **401** | **173** | **51** |
| D16 | **207** | **404** | **177** | **49** |
| D17 | **228** | **459** | **195** | **62** |
| D18 | 132 | 223 | 109 | 36 |

| | | | | |
|---|---|---|---|---|
| D19 | 140 | 247 | 136 | 33 |
| D20 | 118 | 212 | 114 | 37 |
| D21 | 137 | 248 | 116 | 26 |
| D22 | 49 | 106 | 45 | 11 |
| D23 | 70 | 121 | 51 | 8 |
| D24 | 62 | 109 | 56 | 3 |
| D25 | 83 | 135 | 82 | 14 |
| D26 | 159 | 307 | 134 | 13 |
| D27 | 108 | 220 | 108 | 33 |
| D28 | 60 | 61 | 47 | 6 |
| D29 | 40 | 49 | 38 | 2 |
| D30 | 65 | 91 | 60 | 10 |
| D31 | 39 | 39 | 40 | 6 |
| D32 | 167 | 366 | 158 | **48** |

#### 4.4.2.1 Driver 8 – trust in the organization

Examining the drivers, we observed that in the top 5, only driver 8 presented a difference between bee roles.

| | Queen | Worker | Drone | Larvae |
|---|---|---|---|---|
| D1 | 62 | 112 | 52 | 32 |
| D2 | 62 | 114 | 56 | 19 |
| D3 | 103 | 179 | 84 | 15 |
| D4 | 151 | 318 | 133 | 21 |
| D5 | 67 | 101 | 53 | 18 |
| D6 | 176 | 278 | 133 | 15 |
| D7 | 145 | 239 | 98 | 20 |
| D8 | 200 | 403 | 165 | 42 |
| D9 | 162 | 294 | 150 | 32 |
| D10 | 171 | 346 | 154 | 47 |
| D11 | 194 | 409 | 175 | 54 |
| D12 | 128 | 221 | 117 | 23 |
| D13 | 166 | 311 | 144 | 32 |
| D14 | 176 | 378 | 164 | 33 |
| D15 | 187 | 401 | 173 | 51 |
| D16 | 207 | 404 | 177 | 49 |
| D17 | 228 | 459 | 195 | 62 |
| D18 | 132 | 223 | 109 | 36 |
| D19 | 140 | 247 | 136 | 33 |
| D20 | 118 | 212 | 114 | 37 |
| D21 | 137 | 248 | 116 | 26 |
| D22 | 49 | 106 | 45 | 11 |
| D23 | 70 | 121 | 51 | 8 |
| D24 | 62 | 109 | 56 | 3 |
| D25 | 83 | 135 | 82 | 14 |
| D26 | 159 | 307 | 134 | 13 |
| D27 | 108 | 220 | 108 | 33 |
| D28 | 60 | 61 | 47 | 6 |
| D29 | 40 | 49 | 38 | 2 |
| D30 | 65 | 91 | 60 | 10 |
| D31 | 39 | 39 | 40 | 6 |
| D32 | 167 | 366 | 158 | 48 |




In a glimpse, for Larvae roles the Driver 8 is not equally important compared to other potential participants. The statistical analysis confirms this observation, with residuals and p-values supporting the notion that Larvae Bees are distinct in their considerations in non-important and important aspects of the driver, aligning with their unique role in the SOCIO-BEE project.

*Table 18. p-values and residuals of the post-hoc analysis to evaluate the role that make the association stronger on driver 8*

| Dimension | Value | Non-important | Important |
|---|---|---|---|
| **Queen** | Residuals | 0.067 | -0.067 |

| | | | |
|---|---|---|---|
| **Queen** | p values | 1 | 1 |
| **Worker** | Residuals | -2.429 | 2.429 |
| **Worker** | p values | 0.121 | 0.121 |
| **Drone** | Residuals | 1.123 | -1.123 |
| **Drone** | p values | 1 | 1 |
| **Larvae** | Residuals | **2.959** | **2.959** |
| **Larvae** | p values | **0.025** | **0.025** |

# 5 Conclusions & Main takeaways for Second Pilot Iteration

To conclude this deliverable, we will provide a retrospective approach comparing the initial results from the inductive process with the second confirmatory approach following a deductive exercise. In a second step, we provide the overall conclusions from the questionnaire results that should inform the preparation of the second iteration of campaigns in SOCIO-BEE for the early months of 2024.

## 5.1 Inductive vs deductive approaches

During the inductive process several researchers underpinned already existing theoretical frameworks and theories to better understand the potential bee roles that can participate in CS-based activities related to air quality. As a result, the inductive activity not only provided which factors were more relevant to each role, but also, the barriers each bee role encounter and the salient activities each bee role should develop. This information helped dramatically to create the Personas of each bee role. With this information, the researchers were able to devise and develop an instrument with six simple questions to assess in an easy way what roles and responsibilities respondents were more likely to perform in a potential CS-based practice. During the deductive process, the tool was used to categorize the people who participated in completing the survey, but also other variables were also examined to shape the bee roles. These data were linked with the bee roles to find statistical associations. In the following we review the findings. But before, it must be said that the instrument shows some validity to:

1. In each Mediterranean country under study (Greece, Italy and Spain) the recruited people responded uniformly to the self-assignment questionnaire to assess their potential bee role. Thus, we found around 20-25% of queen bees, the same amount can be expected for drone bees. Around 50% of worker bees and 10% or less of larvae. We did not reported the data from other countries, but the results were also consistent with this finding.
2. Differentiate between people difficult to be involved in CS-campaigns (Larvae role) and potential participants in the SOCIO-BEE campaigns. Thus, easily remove or treat differently to 10% of the potential participants.
3. Confirm that Queen Bees hold more knowledge on AQ than the other bee roles, as well as they face a lower number of barriers than other actors to participate in campaigns (overall those of lack of time or lack of skills).

### 5.1.1 Socio-economic and cultural variables conclusions

The exploration of the relationship between bee roles and socioeconomic variables within the SOCIO-BEE project illuminates a compelling narrative of inclusivity and environmental consciousness. The absence of significant associations with earnings, family dynamics, and gender underscores the project's success in fostering a diverse and equitable participation framework. Moreover, the noteworthy connections between bee roles and air quality-related variables emphasize the pivotal role of environmental awareness, intentions, knowledge, and policy preferences in shaping participants' engagement. In this block, it was noteworthy that Larvae scored much lower than the remaining bee roles on almost all the cultural factors (AQAwareness, AQIntentions or AQKnowledge) while only the Queen bees had a salient role when it comes to assess the Knowledge about causes and consequences of Air Pollution.

### 5.1.2 Barrier's conclusions

The survey identified three main barriers in the SOCIO-BEE project: Lack of Time (B1), Financial Resources (B2), and Necessary Skills or Capacities (B3). Time constraints were a universal issue, while financial and skills barriers varied regionally. Financial concerns might be more perceived than real due to SOCIO-BEE's free nature. Addressing these barriers is crucial for wider participation. For B1, flexible time commitment should be communicated. For B2, highlighting the project's free nature is key. For B3, the focus is on easy-to-use tools and comprehensive, multilingual training materials for any single activity or tool users should use. Regarding the roles, different participants in SOCIO-BEE perceived barriers differently. Queen Bees, Worker Bees, and Drone Bees mainly faced B1, B2, and B3, while Larvae Bees had a broader range of concerns. Role-specific strategies are needed, like targeted interventions for Worker Bees' skills needs as they were found to score very high on this barrier in comparison to other bee roles.

In essence, while time is a universal barrier, financial and skills concerns might be less significant due to the project's accessibility, existing digital proficiency among participants, and the forthcoming training resources in multiple languages that SOCIO-BEE is providing.

### 5.1.3 Drivers' conclusions

The analysis underscores a consensus across all bee roles in the top five drivers out of 32 with no other detected differences, emphasizing the significance of sustained participation (D17), personal involvement (D16), satisfaction with actions and outcomes, and the need for adequate knowledge (D11) – which is in line with the previous barriers presented above. These shared priorities highlight fundamental considerations that cut across diverse participant roles. Moreover, trust in all involved parties emerges as a linchpin for participation consistently standing out across all roles. Additionally, the importance of personal commitment (D16) and satisfaction (D15) underscores the emotional and personal dimensions that significantly influence participants' decisions when it comes to join a CS-based campaign related to AQ. While common priorities exist, our analysis reveals subtle differences in how each bee role approaches participation decisions. Larvae Bees exhibit distinctive responses, potentially indicating a unique perspective or a lower level of overall engagement. Larvae Bees show a relatively higher response to Driver D32 - *I only decide if the action has a personal, inner meaning for me* -, suggesting that the intrinsic, personal meaning of the action plays a more pronounced role in their decision-making. While not statistically significant, this insight provides valuable clues for designing targeted approaches to enhance Larvae Bee engagement.

In conclusion, the drivers identified across countries and bee roles underscore the importance of sustained engagement, personal commitment, satisfaction, knowledge, and confidence in fostering citizen participation in SOCIO-BEE campaigns. The nuanced differences observed for Larvae Bees highlight the need for tailored strategies to address their distinct considerations and encourage meaningful involvement.

## 5.2 Limitations:

This study has many limitations. However, the main one we identified is about measuring the bee roles. Addressing the dynamic nature of roles and their measurement across the entire lifecycle of the hive, from its inception and growth to its maturity, is crucial. Relying solely on a single point in time to assess these roles can obscure significant insights, as roles and perspectives within the hive can evolve or change. This evolution is a key indicator of the hive's performance. However, capturing this information at just one moment can lead to inaccuracies in assigning roles, due to the fluidity of the factors and barriers shaping individuals' participation. For instance, a person might occupy varying roles in different hives simultaneously, or transition between roles within the same hive over time. Finally, it is worth mentioning that these tools and questionnaires were only focuses on identifying participating roles to citizens. The bear role characterisation has been already addressed in D2.6 [6].

# References

[1] Socio-Bee Grant Agreement Annex I – "Description of Action" (DoA)

[2] D. Casado Mansilla et al. (2022). Typology of Bees & Bears – Citizen and stakeholder profiling and segmentation for CS activism 1st iteration. SOCIO-BEE project

[3] Vohland, K., Göbel, C., Balázs, B., Butkevičienė, E., Daskolia, M., Duží, B., ... & Schade, S. (2021). Citizen science in Europe. *The science of citizen science*, 35-53.

[4] D Casado-Mansilla, C. E. Borges, C. Quesada, A. Aguayo-Mendoza, M. Larrea, A. Schibline, and A. Ceglarz. Causal diagram: methodology and results (2022). WHY project. Online: https://www.why-h2020.eu/fileadmin/Inhalte/Dokumente/WHY_Deliverable_D2.2.pdf

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[6] D. Casado Mansilla et al. (2022). D2.6 - SOCIO-BEE methodology for ecosystem and hive creation 2nd release. SOCIO-BEE project

# Appendix 1 – The Survey

Q1 *What is your age range?*

*18-25*

*26-39*

*40-59*

*60 or older*

*I prefer not to answer*

Q2 **What is your gender?**

*Male*

*Female*

*Non-binary*

*Other*

*I prefer not to answer*

Q3 **Where are you located?**

*Spain*

*Italy*

*Greece*

*The Netherlands*

*Germany*

*Belgium*

*Other EU country* _____

Q4 **What is the highest level of education you have completed?**

*Less than secondary school or high school diploma*

*Secondary or high school diploma*

*Vocational training*

*Undergraduate (Bachelor's) degree*

*Master's degree*

*PhD*

*Other* _____

Q5 **Which statement describes best your current employment status?**

*Paid employee (private sector)*

*Paid employee (public sector)*

*Self-employed*

*Not working (unemployed)*

*Not working (other)*

*Retired*

*Student*

*Other* _____

Q6 **How many children do you have?**

*None*

*1*

*2*

*3*

*4*

*More than 4*

*I prefer not to say*

Q7 **What was your total household income AFTER taxes during the past 12 months in euros?**

Less than 20,000 euros per year

20,000 - 49,999 euros per year

50,000 - 100,000 euros per year

More than 100,000 euros per year

I prefer not to say

Q9 **In the following, we would like to know your views on air pollution and Air Quality (AQ) in general. Please indicate how much you agree with the statements below.**

| | Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree |
|---|---|---|---|---|---|
| I am concerned about the levels of air pollution in my city / neighbourhood. | | | | | |
| In my opinion, air pollution in my city/neighbourhood has a negative effect on human well-being. | | | | | |
| I feel that I can take actions that will reduce my individual source of air pollution | | | | | |
| I feel that there is NOTHING I can do to decrease the air pollution I am personally emitting. | | | | | |
| I think that I am able to cut back my individual contribution to air pollution. | | | | | |
| In my opinion, air pollution is NOT a severe matter in my city / neighbourhood. | | | | | |

Q10 **The following statements refer to your current knowledge on air quality. Please indicate how much you think you know about each statement below.**

| | Nothing | A little | Somewhat | A lot | A great deal |
|---|---|---|---|---|---|
| Causes of air pollution. | | | | | |
| Air pollution health effects. | | | | | |
| Air pollution levels in your city/ neighborhood. | | | | | |
| Initiatives to tackle air pollution in your city / neighbourhood. | | | | | |

| | |
|---|---|
| The things you could do to reduce exposure to harmful pollutants. | |
| The things you could do to reduce your contribution to air pollution. | |

Q11 **From which source(s) would you like to receive information about air pollution? Please indicate as many as relevant.**

- ☐ *Academic scientists*
- ☐ *Central government*
- ☐ *Local administration*
- ☐ *Your doctor*
- ☐ *TV / newspaper*
- ☐ *Internet*
- ☐ *Social media*
- ☐ *Work / school*
- ☐ *Environmental groups*
- ☐ *Other* _____

Q12 **Next, we would like to know your opinion on the impact citizens can have on the policies on air pollution or other related environmental topics in your city / neighborhood. Please indicate how much you agree with the statements below.**

| | Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree |
|---|---|---|---|---|---|
| In general, I feel that my concerns are taken into consideration by the local policy makers in my city / neighbourhood. | | | | | |
| As a citizen, I believe my voice is heard when the local policy on air quality or other related environmental topics are being made. | | | | | |
| Right now, I think that policy makers do NOT care about the opinion of the citizens on air quality or other related environmental topics. | | | | | |

Q13 *SOCIO-BEE (https://socio-bee.eu/) is a citizen science project on air quality. Citizen science means that the public (i.e., ordinary people) voluntarily helps professional scientists to conduct scientific research. For example, by collecting and/or analyzing data, attending public gatherings in your neighbourhood or city, participating in a workshop, spreading word-of-mouth on social media, recruiting others, etc*.

**Based on this definition, do you have experience with citizen science?**

*Yes*

*No*

*Not sure*

In the following, we would like to better understand your motivations and attitudes toward climate change and environmental action campaigns. Please read the scenario on the next page and answer the questions honestly always taking into consideration the scenario. Remember, there are no right or wrong answers, it is your opinion that matters.

Q31 *The local administration of your city has made a commitment to improve air quality and they would like to involve residents, businesses, non-profit, and academic organizations to achieve this. As a first step, they organize a campaign to know which areas and routes are the most polluted. One day, you come home, and you find a leaflet in your mailbox informing you of this campaign asking you to get involved. The leaflet informs you that the local administration has set up a website, developed a mobile application, and acquired sensors that measure the quality of air. A picture of the sensor shows a small device that can be attached to a backpack or a bike and take measurements as you carry it with you. You decide to take a look at the website and the mobile app. You see a map of the city with spots where air quality has already been measured and where it has not. The current level of air pollution is shown and gets updated as more and more air quality data is collected by citizens. There are videos on air quality, social media posts, academic resources, instructions on how to use the sensor, testimonials, and opportunities to join the online community. It is also possible for anyone to download the collected data to their computer and analyze it. You scroll on the map to your neighbourhood and see that no air quality data is available yet.*

Q33 **I would be willing to participate in collecting air pollution data while walking or roaming the city and no more (e.g., one or two hours of commitment per week to go to specific points close to the area where you usually roam).**

*Strongly disagree*

*Somewhat disagree*

*Neither agree nor disagree*

*Somewhat agree*

*Strongly agree*

Q34 **I would be willing to study the outcomes of the air pollution campaigns and learn how to interpret the results (e.g., two to three hours of commitment per week to join other peers to collectively understand the data and information that is collected in order to make sense of it).**

*Strongly disagree*

*Somewhat disagree*

*Neither agree nor disagree*

*Somewhat agree*

*Strongly agree*

Q29 **I would be willing to approach people I know to collaborate with me to gather more and better air pollution data (e.g., one day of commitment per week to think about ways and strategies to involve more people in the pro-environmental campaigns. This includes recruiting skills but also communication competences to easily make others understand your goals).**

*Strongly disagree*

*Somewhat disagree*

*Neither agree nor disagree*

*Somewhat agree*

*Strongly agree*

Q30 **I would be willing to organise data collection campaigns on my neighbourhood / community (e.g., one day of commitment per week to define steps to carry out the pro-environmental campaign. Coordination and organizational skills are a plus to help running the campaigns successfully).**

Strongly disagree

Somewhat disagree

Neither agree nor disagree

Somewhat agree

Strongly agree

Q31 **I can or I would like to reach out to third parties (e.g., policymakers, business actors, scientists, etc.) to promote changes in my neighborhood / city / region based on the results of the collected air pollution data (e.g., one or two hours of commitment per week to spread the word about the results in social media, newspapers, or through other channels such as the citizens' mailbox or other communication means).**

*Strongly disagree*

*Somewhat disagree*

*Neither agree nor disagree*

*Somewhat agree*

*Strongly agree*

Q32 **I can or I would be willing to share outcomes of the campaign with others and alert them on the consequences of air quality on our health and planet (e.g., one or two hours of commitment per week**

**to assembly other peers and citizens to collectively think about ways to make a change in your neighborhood / city / region).**

*Strongly disagree*
*Somewhat disagree*
*Neither agree nor disagree*
*Somewhat agree*
*Strongly agree*

Q20 We would like to know more about the reasons you would or would NOT join an air quality (AQ) campaign, such as the one described above.

**To what extent do you agree with the following statements? I would NOT be willing to participate in this campaign because ....**

| | Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree |
|---|---|---|---|---|---|
| I do not have time. | | | | | |
| I do not have the financial resources. | | | | | |
| I do not have the necessary skills or capacities. | | | | | |
| It will not have any impact on my district / city. | | | | | |
| It seems too complex to get involved and to participate. | | | | | |
| It is focused on direct commercial or political benefit preventing the social and environmental aims. | | | | | |
| It has an excessively hierarchical organization, decision-making is concentrated and there is insufficient transparency of the outcomes. | | | | | |
| It doesn't allow different levels of participation and commitment. | | | | | |
| It does not assess social and environmental value created or destroyed through the campaign. | | | | | |

*Finally, the next four answers are intended to understand your motivations in case you would like to join the Air Quality (AQ) campaign.*

**To what extent do you agree with the following statements related to Air Quality (AQ) campaigns?**

| | Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree |
|---|---|---|---|---|---|
| Profits are what guide my decision-making, I always prefer to earn or save money with every decision I take when participating in an Air Quality campaign. | | | | | |
| Access to funding (my own savings, deductions, exemptions, and/or credits) is the main factor that allows me to make a decision of participating in an AQ campaign. | | | | | |
| The evaluation of the risks of my participation in an AQ campaign is what will always guide my final decision. | | | | | |
| I will only join an AQ campaign if my actions have an impact beyond the monetary gain/losses. | | | | | |
| I am a thrifty person, so I only volunteer in actions that allow me to reduce my cost/impact/expenditures. | | | | | |
| Every decision I take serves to foster the planet's preservation. If my choice might harm the environment, I will always avoid taking this action. | | | | | |
| Having complete certainty that my actions comply with the legal, tax, and administrative regulations is what guide my actions. | | | | | |

| | |
|---|---|
| I only make decisions to volunteer campaigns if I trust all the parties involved (e.g., public administration, neighbors) and the technology needed to accomplish my goal. | |

| | Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree |
|---|---|---|---|---|---|
| I only make decisions related to join AQ campaigns if the outcome of them ensures or improves my safety or the ones of my relatives. | | | | | |
| I always review and assess the pros and cons of my decisions looking for the most cost-effective option. | | | | | |
| I only make decisions if I have enough knowledge of the subject matter, in this case about AQ. | | | | | |
| Feeling that I am competent to make an investment is what guides my decision-making when joining an AQ campaign. | | | | | |
| I carefully check that the technology or equipment fits my lifestyle or the technical requirements before making a decision related to the use of technology for an AQ campaign. | | | | | |
| I always review and assess the pros and cons of my decisions in relation to the environment before making a decision related to joining an AQ campaign. | | | | | |

| | |
|---|---|
| I will only make a decision if I feel satisfied with the action and the expected outcome. | |
| I only make a decision if I feel personally committed to the action and the expected outcome. | |

| | Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree |
|---|---|---|---|---|---|
| I will only make a decision if I feel I can sustain it. | | | | | |
| Self-sufficiency and individual sovereignty are what guide my decisions. I will only make a decision related to joining an AQ campaign if I feel that the time invested will improve my control of all circumstances and potential outcomes. | | | | | |
| I will only make a decision if it improves my well-being or the well-being of my relatives. | | | | | |
| I will only make a decision if it improves my comfort or the comfort of my relatives. | | | | | |
| I firmly believe that we live in a society where we have to adhere to regulations, laws, and community agreements by all means, so my decision to join a campaign has to agree with this vision. | | | | | |
| My decision to join an AQ campaign is influenced by the opinions of others (such as my peers, relatives, or family). | | | | | |

| | |
|---|---|
| I will only make a decision of joining an AQ campaign if it has the approval or support of the community I belong to. | |
| I will only make a decision of joining an AQ campaign if it improves my possibilities to socialise with my peers and relatives. | |

| | Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree |
|---|---|---|---|---|---|
| I will only make a decision of joining an AQ campaign if the people affected by it (for example, my relatives, peers, or the community) agree with the decision cohesively. | | | | | |
| I love to test new ideas and cutting-edge technology, so novelty is what drives my decision to join an AQ campaign. | | | | | |
| Having fun is important to me. Therefore, I will only make a decision if it would be enjoyable and amusing for me. | | | | | |
| I usually make decisions that lead to my increased status and I can show others what I achieved. | | | | | |
| I usually follow the trends when making a decision. In particular, I usually find myself sticking to the ads I see, the recommendations of people I admire, or what I read in magazines or blogs I follow. | | | | | |

| | |
|---|---|
| I only make a decision if it helps me improve my position as an expert on the subject matter. | |
| I only make a decision of joining an AQ campaign if it improves my peers' opinions about me, even if this decision is not always what I would do only for myself.<br><br>I only make a decision if the action has a personal, inner meaning for me. | |

**Is there anything else you would like to share with us that would advance our study?**

_____