WORLD CAFE REPORT 2025

APIMONDIA SCANDINAVIA 2025 23-27 SEPTEMBER COPENHAGEN
Funded by the European Union
INSIGNIA-EU
B THE NET
BEE-GUARDS
Better-B FOR RESILIENT BEEKEEPING

Hello Bee World!

Here are the results and summary of the **World Café Session on Resilient Beekeeping** that took place on the **24th of** September of 2025 during the **49th Apimondia International Congress in Copenhagen, Denmark**. It developed around three themes transversal to the four European Projects Apimondia is currently involved. This session aimed to connect with stakeholders, facilitate discussions, and collect feedback on current challenges and opportunities in European beekeeping and beyond. This session built upon the EU Projects Introduction (B-THENET, BEE-GUARDS, Better-B, INSIGNIA-EU).

OVERVIEW

Event: EU Projects Workshop at Apimondia International Congress, Copenhagen 2025
Date: 26th September 2025, 14:30 – 16:30, Hall A3
Duration: 2 hours
Projects: B-THENET, BEE-GUARDS, Insignia-EU, Better-B
Expected Participants: 150-200 (beekeepers, researchers, stakeholders)
Pre-registration: 150 registrants
Methodology: World Café in a Cinema setting to facilitate group dialogue and knowledge sharing and cross-pollinate diverse perspectives.
Objectives: Consult with stakeholders and knowledge exchange through group discussions on defined topics transversal to all four EU Projects
Tools: Poll questions (icebreaker, gather demographics, assess knowledge and expectations), flipcharts, group discussions, post-it notes.

CROSS-PROJECT THEMES:

Theme 1. Technology & Digital Innovation
Theme 2. Sustainability & Resilience Against Stressors
Theme 3. Citizen Science & Stakeholder Engagement

Theme assignment and round discussions: participants assigned a theme at the entrance and were split into three groups of approx. 50 participants (max.); each group engaged in three rounds of discussions, one

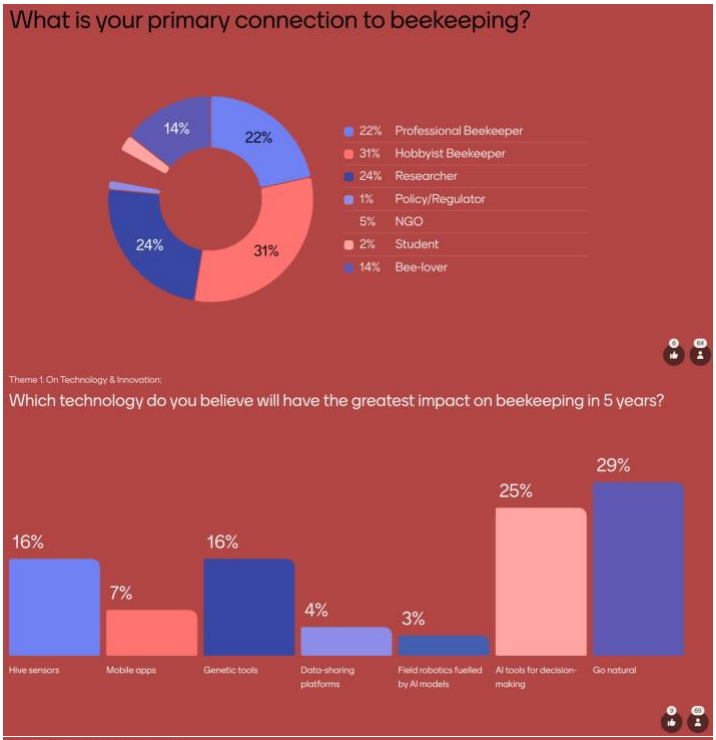
per theme (20 + 5 minutes); attendees expected to represent a range of stakeholders from beekeepers to scientists and policy makers.

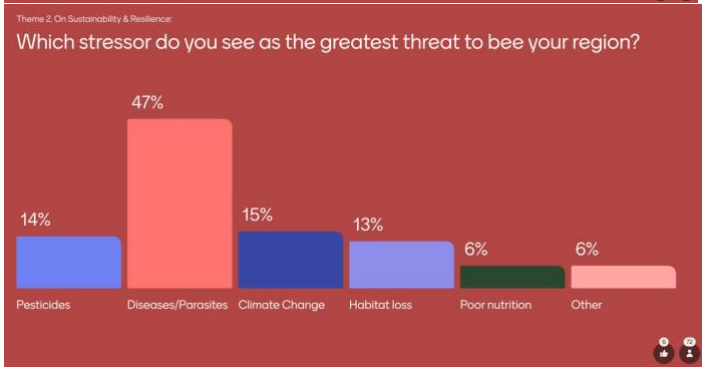
MAIN PROGRAM

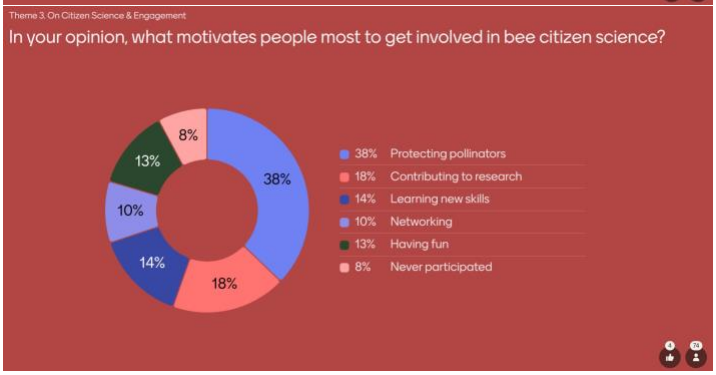
14h30	Part 1	Opening remarks and Welcome	Fani Hatjina and Robert Chlebo
14h35	Part 2	Poll Questions #1 (Icebreaker, Demographics & Expectations)	Raquel de Sousa
14h45	Part 3	Group Discussions (3 themes and groups over 3 rounds)	Moderators & Experts
16h15	Part 4	Poll questions #2 (Icebreaker & Feedback)	Raquel de Sousa
16h20	Part 5	Plenary session: reporting results	Moderators & Experts
16h30	Part 6	Closing remarks and Farewell	Fani Hatjina and Robert Chlebo

Introductions: Our audience demographics and interests

At the start of the session, we asked participants some questions about them to understand their background, assess their broad knowledge on the themes and EU projects, but also to learn what expectations they might have so we could better tailor the session to their needs. We present below in Fig. 1 the poll results:







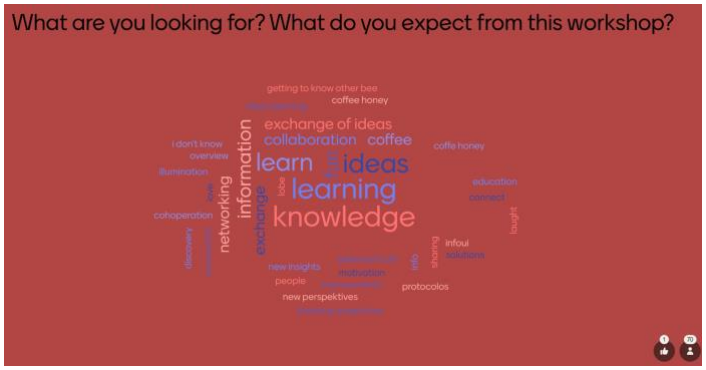


Figure 1. *Introductions Poll Results (Mentimeter online tool).*

Theme 1: Technology and Digital Innovation

The Technology and Digital Innovation session explored how emerging tools and artificial intelligence can support beekeeping practices, improve hive monitoring, and enhance decision-making.

Moderators: Gennaro Di Prisco (BEE-GUARDS), Jesus Yaniz (BEE-GUARDS), Veronica Manara(B-THENET),

Experts: Flemming Vejsnæs (BEE-GUARDS), Marco Pietropaoli (B-THENET/ Better-B), Martin Bencsik (Better-B)

Objectives: Consult with stakeholders and promote knowledge exchange to improve honey bee health through new technologies and digital tools.

General questions: 1) *Where are you coming from (Country)?; 2) What is your main professional activity?, 3) How much would you be prepared to pay for one monitoring sensor (for one hive)?*

Questions for discussion:

1. ***Which aspect of your beekeeping practice would you like to see supported by new technology? (Flemming/Gennaro)***

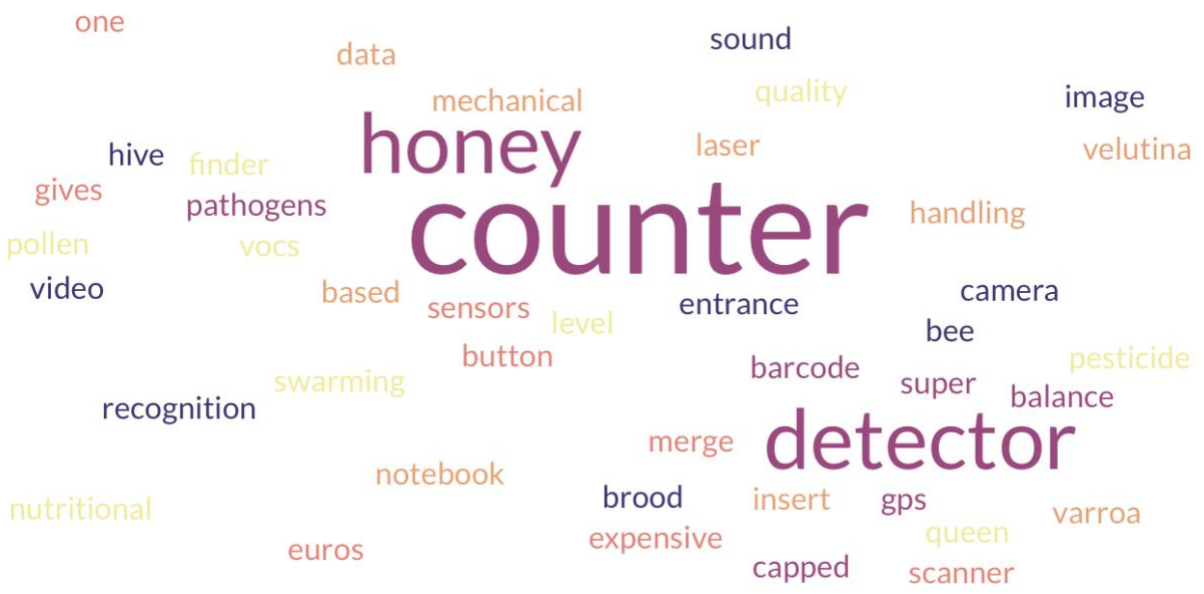


Figure 2. *Word cloud of the range of answers reporting which technological support beekeepers in this group would like to have.*

2. ***Would you rely on AI to learn about beekeeping? (Marco/Veronica)***
   - NO!!!!
   - due wrong answer, no trustable
   - Better training the model and data analysis
   - Common data base to have a good model to predict
   - AI for teaching
3. ***Technology has helped your beekeeping practice, or deteriorated it? Please refer to your worse and best experiences. (Martin/Jesus)***

   Positive experiences:
   - Using pen for notebook
   - Chat GPT voice recognition
   - Social media and network to share tips
   - Find queen with AI

- Light on phone and zoom

- Robbery finding
- Varroa counter

Negative experiences:

- System complex to set
- No WIFI
- Propolis on gloves
- USB smoker based with oil, natural but not work

Results Summary on "Technology & Digital Innovation"

We found that integrating advanced technologies and artificial intelligence (AI) into beekeeping presents both significant opportunities and notable challenges. In this study, we gathered and synthesised qualitative input from practitioners to identify which aspects of apiculture could benefit most from technological enhancement, assess levels of trust in AI systems, and evaluate the overall impact of technology on field operations.

Beekeepers in our group discussions identified a broad range of areas where technology could improve monitoring and management. These included environmental and colony-level sensors such as GPS tracking, hive weight monitoring, barcoded honey supers, pathogen detection, capped brood identification, bee traffic counters, and visual and acoustic monitoring using cameras and microphones. Participants also highlighted the potential of VOC analysis, pesticide residue sensors, honey quality and nutritional profiling, queen localisation, pollen load quantification, and automated detection of parasites such as *Varroa destructor* and *Vespa velutina*. In addition, they expressed interest in digitised record-keeping tools, mechanical aids for hive manipulation, and advanced imaging technologies such as 3D scanning. However, many respondents raised concerns about the fragmented and costly nature of current systems, leading us to identify a strong demand for integrated, modular platforms.

Despite rapid advances in AI, beekeepers expressed scepticism about its current use in decision-making, citing inconsistent accuracy and limited contextual understanding. Participants emphasised the need for robust, centralised datasets to improve model training and predictive reliability. While trust in AI remains limited for diagnostic purposes, we observed more positive attitudes towards its use in education and data analysis. Many participants called for AI systems based on empirical data and developed in close collaboration with domain experts.

Participants reported mixed experiences with existing technologies. They highlighted barriers such as technical complexity, poor connectivity in remote apiaries, and impractical tools, including USB oil-based smokers. At the same time, they identified several effective and user-friendly solutions, including digital pens for data entry, voice-enabled assistants, smartphone tools for queen detection, AI-based queen recognition, and systems for detecting hive theft and Varroa infestation. Social media also emerged as an essential platform for knowledge exchange and peer support.

Overall, we conclude that apicultural technologies must be affordable, reliable, and user-centred, with strong emphasis on data interoperability, usability under field conditions, and the integration of beekeeper knowledge into the development process. We highlight interdisciplinary collaboration between technologists, entomologists, and practitioners as essential to ensuring that digital innovations support, rather than complicate, sustainable beekeeping practices.

Key Findings

- High demand for sensors and digital tools for monitoring hive weight, pathogens, bee traffic, acoustics, and parasites.
- Interest in technologies for honey quality, nutrition, and environmental monitoring.
- Concerns regarding high costs and fragmented systems.
- Preference for integrated, multifunctional platforms.
- Limited trust in AI for autonomous decision-making.
- Positive perception of AI for education and data analysis.
- Technical complexity and poor connectivity remain major barriers.

Implications and Key Takeaways

- Need for affordable and modular technologies.
- Improved interoperability between devices.
- Co-design with end users.
- Greater focus on field usability.

Theme 2: Sustainability and Resilience Against Stressors

This session examined how climate change and biological stressors are affecting honeybee health and beekeeping practices worldwide.

Moderators: Giles Budge (BEE-GUARDS), Ellen Danneels (B-THENET / Better-B)

Experts: Annely Brandt (BEE-GUARDS), Raffaele Dall'Olio (BEE-GUARDS), Martin Gabel (BEE-GUARDS), Fani Hatjina (Insignia-EU)

Objectives: to identify and understand the impacts of climate change and biotic stressors on participants' beekeeping practices worldwide, and to gather feedback on the general understanding and perceived relevance of current research projects.

Results Summary on "Sustainability & Resilience Against Stressors"

We had some fascinating discussions with those that attended our session, and we were very grateful to the contributions from all participants. The following attempts to capture the flavour of our discussion.

Attendees were from countries spanning four continents including: Austria, Belgium, Chile, Colombia, Costa Rica, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Northern Ireland, Norway, Perú, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tanzania, Turkey, United Kingdom, United States, and Wales. Most of those attending our session considered beekeeping (29/77) as their primary stakeholder group, but other groups were also represented including: Scientists (18), Beekeeping Associations (10), Bee health / veterinary services (6), Breeders (4), Other (4), Agri-food industry (3), Beekeeping advisors (2), and Suppliers for Beekeeping industry (1). Upon questioning "Other" included musicians who had been working closely with the apicultural industry.

Our first discussion was centered around the question "How has climate change impacted apiculture in your region?". The points raised varied by region, but it was clear that all participants (except one) felt that climate had impacted apiculture in their region in some way. Many participants highlighted how the seasons have changed, with some reporting longer summers, that were less stable between years. Many reported the impacts of extreme weather events, like flooding which had washed colonies away, or long periods of drought, even in countries like Ireland which traditionally have high rainfall. Some reported colonies being damaged by wildfires, that had been exacerbated by drought. Many participants spoke about how the timing of floral resources had changed, with some plants flowering earlier in the season, before the bees were ready to visit them. Others highlighted that climate change had influenced the crops farmers were planting, with and knock-on effect on the availability of forage. Several participants suggested seasonal changes were making it more difficult for the bees (and beekeepers) to prepare colonies for winter.

Seasonal changes had two notable knock-on consequences on honey bee biology. First, many participants highlighted climate change had extended the brood rearing season, especially into the winter months. Second, intermittent poor weather, especially rain, was impacting the ability of honey bees to find forage, even when suitable foraging weather returns. In discussion, we wondered of the sporadic bouts of foraging could be preventing honey bees from exploiting their recruitment behaviours.

We then moved our discussion to consider "What pests and diseases are you most worried about in the future?". This was a fascinating discussion, because the responses touched on climate change. Most participants felt that *Varroa* represented the number one future threat and highlighted how longer brood rearing was making *Varroa* management more challenging (Figure 3). In addition, some participants highlighted that climate change was impacting the efficacy of some control methods. For example, thymol efficacy is treatment sensitive, and oxalic acid treatments are not efficacious against *Varroa* beneath capped cells. The next most common future concern was *Tropilaelaps* mites. These ectoparasitic mites are a concern because they are spreading from the East and can severely impact colony health. It was heartening to see high awareness for *Tropilaelaps*, but it is also clear there is much to do to improve our preparedness if we are to minimise losses as this mite continues to spread. There was also concern over *Vespa* spp., and upon questioning, participants were most concerned about *Vespa mandarinia* (Giant Asian Hornet) and *Vespa velutina* (yellow-legged hornet) but seemed less concerned about *Vespa orientalis* (Oriental Hornet). It was clear that concern was higher for pests than diseases, but the disease of most concern was *Nosema*. We did not have time to explore which *Nosema* species was of concern, but a geographical focus around The Netherlands, Sweden and Denmark was clear from the responses.

Figure 3. *Word cloud showing the responses to the question "What pests and diseases are you most worried about in the future?". Varroa mites were the main concern, followed by Tropilaelaps mites. Vespa was not an option for the first group, and so could be underrepresented.*

If we moved on to the question on how we can train young beekeepers to cope with all these different stressors, the common ground was to inform them early on, but gradually and with a lot of practical guidance. Beginner beekeepers already have a passion for bees and this needs to be maintained. On the other hand, it is important not to wait too long with lessons on all the different honey bee pests and diseases. Hands on teaching should be in an apiary before they get their own hives.

To wrap up this session on sustainability and resilience against stressors, we asked if researchers are working on the correct stressors. This related also to the content of the lectures on Apimondia and the different EU projects that were presented. Several beekeepers wanted to see more research done on the thermoregulation of the inside of the hive, next to all the research being done on the effect of climate change on the outside of the hive. Since more beekeepers are working with plastic boxes to keep their bees, one participant wondered if there are negative effects of this plastic being so commonly used, relating to the INSIGNIA-EU study that noted a lot of microplastics detected inside the bee colonies. Several participants mentioned that there was discussed a lot on stopping treatments against varroa, but they missed hands-on protocols on how to tackle

this issue. They agreed that there should be a decline on the chemicals used in the colonies but are left with so many questions on how to reach these varroa resistant populations. Multiple talks and posters are showing mass data collected by beekeepers and innovative tools, together with the use of Artificial Intelligence, but they would like to see this translated into practical tools or knowledge for the beekeepers to use. The lack of practical advice towards the beekeepers after a specific project was finished, was mentioned by several participants. There should be more coordination between the scientists and beekeepers, and they should decide together which problems should be focused on. Someone also acknowledged that there is always a time lag between research and innovations entering practice. Overall, most participants acknowledged that the EU projects are focusing on the correct problems our bees are facing.

Key Findings

- Widespread impacts of climate change on flowering patterns and forage availability.
- Increased frequency of droughts, floods, and wildfires.
- Longer and less predictable seasons.
- Extended brood rearing periods.
- Disrupted foraging behaviour.

- Varroa destructor identified as the primary threat.
- Growing concern over *Tropilaelaps* mites and *Vespa* species.
- Reduced effectiveness of some control treatments.

Training and Research Needs

- Early and progressive practical training for new beekeepers.
- Apiary-based learning approaches.
- Research on hive thermoregulation.
- Assessment of impacts of plastic hive materials.
- Development of practical varroa management protocols.
- Improved translation of research results into practice.

Theme 3: Citizen Science

The Citizen Science session focused on collaboration between beekeepers and researchers through participatory research approaches.

Moderators: Robert Brodschneider (BEE-GUARDS / B-THENET / Insignia-EU), Lauriane Mariamè (B-THENET)

Experts: Gherardo Bogo (BEE-GUARDS), Cecilia Costa (BEE-GUARDS), Noa Simon(B-THENET), James Williams (Better-B)

Objectives: to estimate the level of engagement, motivations and challenges of citizen science. Also, to understand how researcher can improve methodologies and output delivery.

Results Summary on "Citizen Science"

In the 3 groups of participants, we had the opportunity to facilitate, there were both beekeepers and people from the academic sector in a ratio of roughly 40%/60% (or the reverse) in each group. In all 3 cases, at least 20% of the participants—and often more—already had experience participating in citizen science initiatives in different formats. In all 3 groups, there was clear interest and expectations from beekeepers regarding how academia could use and implement these approaches.

After the moderators and experts provided definitions and shared their own experiences implementing these approaches in their research projects, the exchange with participants enabled us to draw the following conclusions:

From the beekeepers' perspective: There is a willingness to participate in these approaches, driven by a spectrum of motivations ranging from the most altruistic and insight-driven to the most practical and outcome-oriented. Insight-driven motivations included a desire to deepen both practical and scientific knowledge about bees and beekeeping, contributing to educational efforts in the sector (both as learners and educators), and supporting broader scientific progress to ensure the resilience of beekeeping. The more outcome-oriented motivations included: obtaining data and analytical results about their own bees, building networks across academic, beekeeping sectors as well as with policy makers, influencing and helping to define research objectives to better reflect beekeeping sector needs, and receiving very practical, immediate, and user-friendly outputs similar to what the "Plantnet" app provides for plant identification.

Challenges and frustrations: While many citizen science initiatives have been successful and well-received, it emerged that several areas still require improvement. Despite strong motivations, poor implementation of citizen science approaches has led to frustration and eventual disengagement of participants before project completion. **Key issues identified:** lack of clarity in communicating research plans, leading to misunderstandings of research goals by beekeepers; unclear methodology guidance for data collection; extensive time needed to analyse data; unclear communication of results; and sometimes a complete lack of feedback. The use of complicated scientific language often adds an additional layer of difficulty and misunderstanding. Many former participants in citizen science initiatives felt that their time and effort in delivering the requested contributions were not adequately acknowledged or rewarded, and their involvement often ended abruptly at project completion.

Key Findings

- Balanced participation between beekeepers and academics.
- High willingness to engage in citizen science.
- Motivation driven by learning and practical benefits.
- Desire for personalised feedback and usable outputs.
- Interest in influencing research priorities.

Challenges

- Unclear project objectives.
- Insufficient methodological guidance.
- Complex scientific language.
- Delayed or absent feedback.
- Limited recognition of contributions.
- Abrupt project termination.

Take-home messages and Best Practices: As an output of the Citizen Science theme, we think we could define take-home messages as a 3-point action plan for citizen science projects, which Apimondia could possibly endorse. We have suggested the following, but this is open for discussion.

- **Clear and inclusive communication**: Use accessible language and clearly explain project goals, methods, and expected outcomes, whilst providing regular updates and feedback throughout the project to maintain transparency and trust.
- **User-friendly data collection tools**: Ensure practical guidance and tools for user-friendly data collection and interpretation, with outputs that are relevant and usable for beekeepers.

- **Regular updates and feedback and Long-term collaboration frameworks:** Acknowledge beekeepers' efforts through formal recognition or continued collaboration, and endeavour to build long-term relationships and opportunities for ongoing involvement, even after projects end.

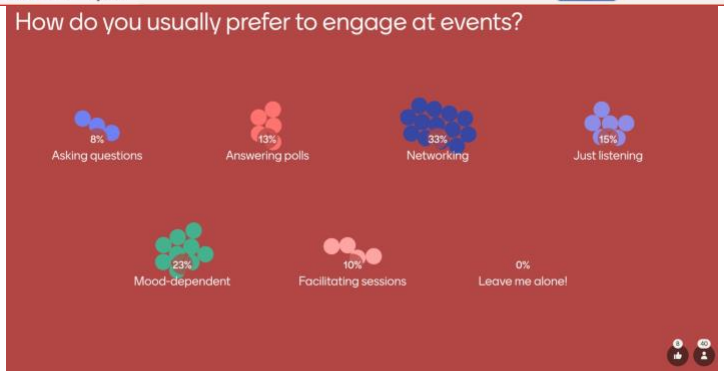
The World Café session on Resilient Beekeeping brought together over 100 beekeeping stakeholders to discuss pressing topics in beekeeping operations, including digitalisation and climate change. We also discussed how research projects can better address beekeeping challenges and engage citizen participation.

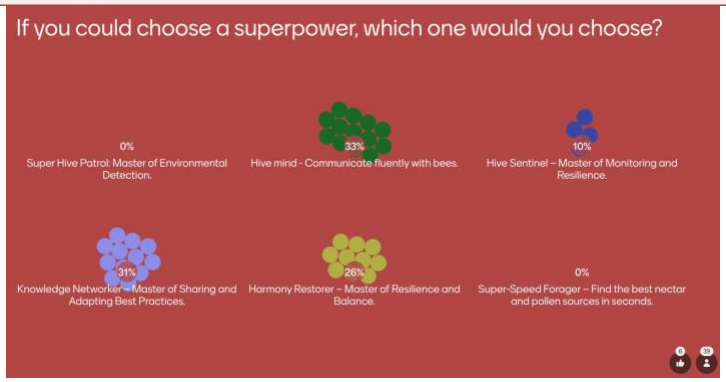
In conclusion:

Cross-Cutting Recommendations

- Beekeepers are highly motivated to adopt innovation when it is practical, affordable, and reliable.
- Climate change and pests remain the dominant threats to colony resilience.
- Digital tools and AI should complement, not replace, beekeeper expertise.
- Citizen science strengthens research relevance when trust and transparency are ensured.
- Closer collaboration between scientists, technologists, and practitioners is essential.
- Future projects should prioritise usability, feedback, and long-term engagement.

We concluded the session with five more poll questions to learn whether participants' expectations have been met and to receive feedback on ways researchers can better reach out and engage with beekeepers (Figure 4).





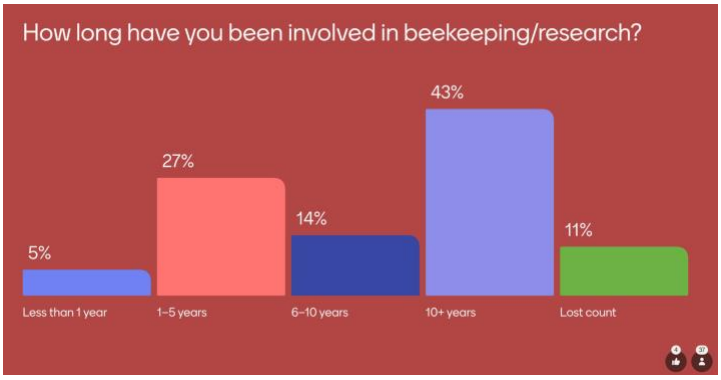


Figure 4. *Feedback Poll Results (Mentimeter online tool).*