

AI-Driven Climate-Smart Beekeeping for Women (AID-CSB): Environmental Health For Human Rights

2022 Final Technical Report



A beekeeper in Ethiopia shows her apiary, explaining how her honey bees pollinate her apple and avocado trees, which in turn provide forage for her bees.
Photo Credit: Laura Becker, ICARDA

The AID-CSB project works to narrow the gender digital divide and support rural women’s livelihoods and biodiversity.

The world is in need of income-generating activities that do not come at the cost of the environment. Low-income countries in dry climates are of particular risk and vulnerability, and in need of profitable activities that not only avoid further degradation of natural environments, but also ideally support and sustain a biodiverse ecosystem. Beekeeping presents such an opportunity and is also unique in its ability to be leveraged by women, particularly in contexts where they may not own land and other productive assets or may be expected to stay at home.

Beekeeping requires strong baseline knowledge of management practices for bees, regular support from local experts in the face of new challenges, and strong monitoring, documentation, and planning by the beekeeper. This is where the opportunity for the Beekeeper’s Companion application came in, as a digital colony management tool.

In light of the above, this project was conceived to support biodiversity and enable improved honeybee colony management among women by leveraging traditional knowledge and technical assistance to become more productive beekeepers.

First, the project leveraged a participatory design and user-research process with women beekeepers to localize a honeybee colony management app.

Then, the project worked to facilitate adoption and use of the app and expand app features and project activities to generate data and awareness on linkages between bee and environmental health, and beekeeper activities.

In 2022, the AID-CSB project piloted a localized hive management app in new regions, raised awareness on the linkages between beekeeper activities and environmental health, and tested new features based on user feedback; narrowing the gender digital divide and supporting rural women’s livelihoods and biodiversity.

Key achievements of the AID-CSB project in 2022 at the country level include:

ETHIOPIA



87 users

14 app & digital literacy training videos

6 app training workshops

5 symptom check prototype tests

4 smartphone and digital literacy workshops

UZBEKISTAN



182 users

9 app training videos

7 app training workshops

3 symptom check prototype tests

7 agricultural pesticide interviews

By empowering women beekeepers and supporting their livelihoods, the protection of environmental health supports human rights.

Four key findings this year included:

1. **New digital skills among women beekeepers:**
In 2021, 15 women beekeepers in Ethiopia with little to no smartphone experience received digital literacy training. During follow-ups in person and on Telegram in 2022, it was witnessed that these women had increased knowledge and confidence in many key skills¹, particularly sharing screenshots and photos of their beekeeping activities, which is of high importance for beekeepers for their own historical records, exchanging ideas and advice with other beekeepers, and seeking help from beekeeping experts.
2. **Young women’s leadership in workshops:**
In the 2021 final report² we noted that in the beekeeper workshops in Uzbekistan (which are majority women but contain a few men beekeepers), men dominated the group discussion/question sessions and few women spoke up. This year we witnessed a positive change in the workshop, where young women took the lead to present feedback and men beekeepers were conscientious not to interrupt or speak on behalf of women.
3. **Lack of transparency on pesticide use and policy:**
To better understand the key stakeholders in the regulation and handling of pesticides in Uzbekistan and raise awareness on the linkages between bee and environmental health, and beekeeper activities, several key stakeholder interviews were conducted in Uzbekistan, but with notable hesitancy to meet in-person and have conversations recorded or take photos, and deferral to managers to answer questions.
4. **The symptom checker provides helpful guidance:**
A new ‘symptom checker’ feature was prototyped based on beekeeper feedback and tested, yielding positive feedback from beekeepers and specific suggestions on how to improve the feature for the local contexts.

Way forward:

Beekeepers see the value and potential of the app together with the support of local and international partners; not only in the service provided to the individual beekeeper in hive colony management support, but also how the data can work to increase beekeepers’ opportunities in three ways:

1. Market access, honey authenticity, product differentiation, and strengthened livelihoods
2. Additional income through biodiversity credits and eco-payments
3. Access to microloans and financial inclusion

1 Field Visit to Amhara Beekeepers: Expanded Digital Literacy & App Training
<https://mel.cgiar.org/projects/aid-csb/538/field-visit-to-amhara-beekeepers-expanded-digital-literacy--app-training>

2 AI-Driven Climate-Smart Beekeeping for Women in Ethiopia and Uzbekistan | Final Project Report 2021 <https://repo.mel.cgiar.org/handle/20.500.11766/67516>

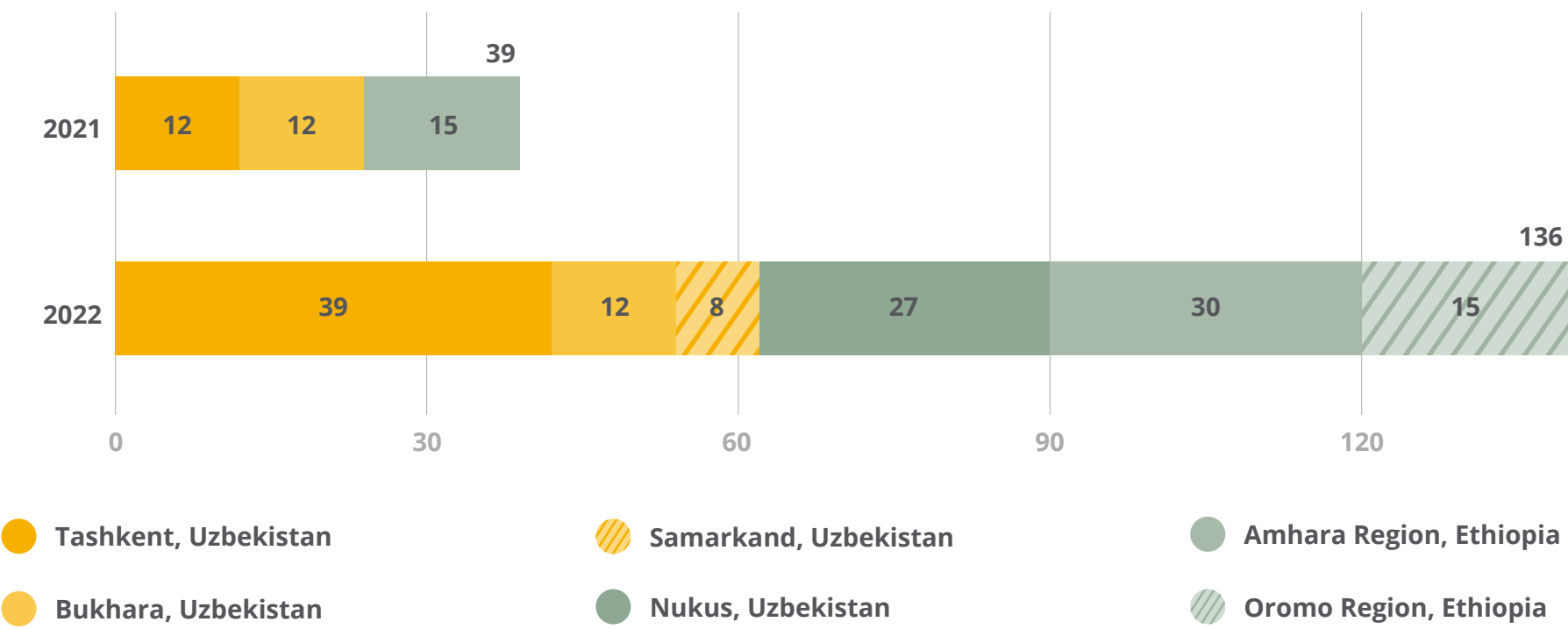
Project Participants and Staff

The project’s public-private partnership enables piloting global solutions at a local scale, nearly a 600 % increase in app users due to training workshops in new regions and app interest among other beekeepers.

This year the AID-CSB project not only continued working with 24 beekeepers in Tashkent and Bukhara, Uzbekistan and 15 in Amhara Region, Ethiopia, but expanded the scope to new geographic regions with different ecologies and cultures. These direct project participants are majority women (~85%), however the app is available for use by beekeepers of all genders.

Despite only 136 beekeepers directly receiving accounts and in-person training, there are a total of 269 app users in Uzbekistan and Ethiopia. This indicates that beekeepers outside of the official project workshops and trainings have requested accounts, indicating a broader demand for the app.

Total number of beekeepers receiving training and accounts with the app



The diversity of project partners brings together decades of experience operating in the project sites, with innovative technologies and approaches:



ICARDA
Science for resilient livelihoods in dry areas

ICARDA MEL (The International Center for Agricultural Research in the Dry Areas Monitoring, Evaluation, and Learning Team) leads project coordination globally and operations in Uzbekistan from the [ICARDA Tashkent Office](#), in addition to enabling knowledge sharing through trainings in both countries on digital literacy and/or the app.



HiveTracks
know your bees!

HiveTracks is the technology partner in the project, leading the technical design and functionality of the Beekeeper's Companion app.



icipe

icipe (The International Center for Insect Physiology and Ecology) leads engagement with beekeepers in the Amhara region through their MOYESH project infrastructure and relationships, and provides technical expertise on beekeeping in the region.



IQQO
Oromia Agricultural Research Institute

[Holeta Bee Research Center](#) leads engagement with beekeepers in the Oromia region and provides technical expertise on beekeeping in Ethiopia.

Building Awareness Among Stakeholders

To raise awareness on the relationship between bee and environmental health, the project facilitated a multi-stakeholder dialogue and conducted pesticide stakeholder research.



Ethiopia workshop participants discuss challenges, opportunities, and project ideas for the beekeeping sector with a focus on digital technologies (right), and gender (center). Photo Credit: Laura Becker, ICARDA

In July, the project held a webinar on **Inclusive Digital Co-Creation in Agri-Food Systems**. Attended by Germany’s Special Envoy for Human Rights and Humanitarian Aid, development partners, donors, and researchers, the event had three goals, to:

- 1. Reflect on the role of women and marginalized groups in technology co-design, in light of the current development of Germany’s Feminist Foreign Policy
- 2. Generate awareness of the linkages between the design and use of technology in agriculture, human rights and climate change adaptation measures
- 3. Share lessons learned from the project and recommendations

Based on project implementation experience and key takeaways from the webinar, in August the project contributed to Germany’s Feminist Foreign Policy³, focusing on closing the gender data gap and tackling the gender digital divide.

Working at the national level, in Uzbekistan key stakeholder interviews were conducted to better understand key stakeholders in the pesticide space, their roles, and perceived relationship of their activities with pollinators and honey bees, with the overarching objective to raise awareness on the linkages between bee and environmental health, and beekeeper activities. This one-on-one format was selected given the sensitive nature of the topic (potential conflicts between pesticide users/ regulators and beekeepers); however, several stakeholders still were not comfortable to have their interviews recorded or photos taken, or deferred questions to upper management.

The key finding of this research is that farmers rarely interact with beekeepers, and thus typically do not give advance warning of pesticide usage. There is currently little systematic work or regulation at the government level aside from a brief regulation passed in 2017, yet interviews revealed there is willingness to act among government stakeholders, but a need for clear policy suggestions and implementation resources.

In Ethiopia, we held a multi-stakeholder workshop in October attended by regional government stakeholders, NGOs, donors, and scientists. The workshop not only raised awareness on this topic and the project, but also brainstormed with participants about key challenges and opportunities for the beekeeping sector across five areas: knowledge and skills, digital technologies, markets, biodiversity, and gender.

Participants were highly active and validated the need not only for scaling existing AID-CSB project activities that leverage digital technologies to overcome gender barriers and support biodiverse ecosystems, but also new concepts like microfinancing schemes and payment for pollination services. Participants also followed up after the workshop to request the ability to pilot the app in some of their projects focusing on sustainable livelihoods and youth entrepreneurship and expressed interest in accessing the data collected by the app given its indication of environmental health and that beekeeping data is not readily available in Ethiopia.

3 Becker, Rünzel. 2023. Closing the gender data gap and tackling the gender digital divide within the Feminist Foreign Policy Framework - Policy Brief. <https://www.auswaertiges-amt.de/blob/2586944/8307bf9b5b639ff9fc759661295c69f1/becker-ruenzel-data.pdf>

Improving Digital Literacy and Inclusion

30 new women participants received smartphones and digital literacy training, and improvements in women’s digital literacy and status among mixed-gender project groups were witnessed

Digital Literacy & Smartphone Trainings in Ethiopia

While Uzbekistan has relatively high smartphone usage and a high level of digital literacy, the situation is different in Ethiopia, where roughly 40% of the population owns a mobile phone⁴ and women are 25% less likely to own mobile phones than men.⁵ Thus the AID-CSB project has a unique focus in Ethiopia to build rural women’s digital literacy to enable them to access information and livelihood-supporting technologies like the app.

Improved digital skills among beekeepers trained in 2021:

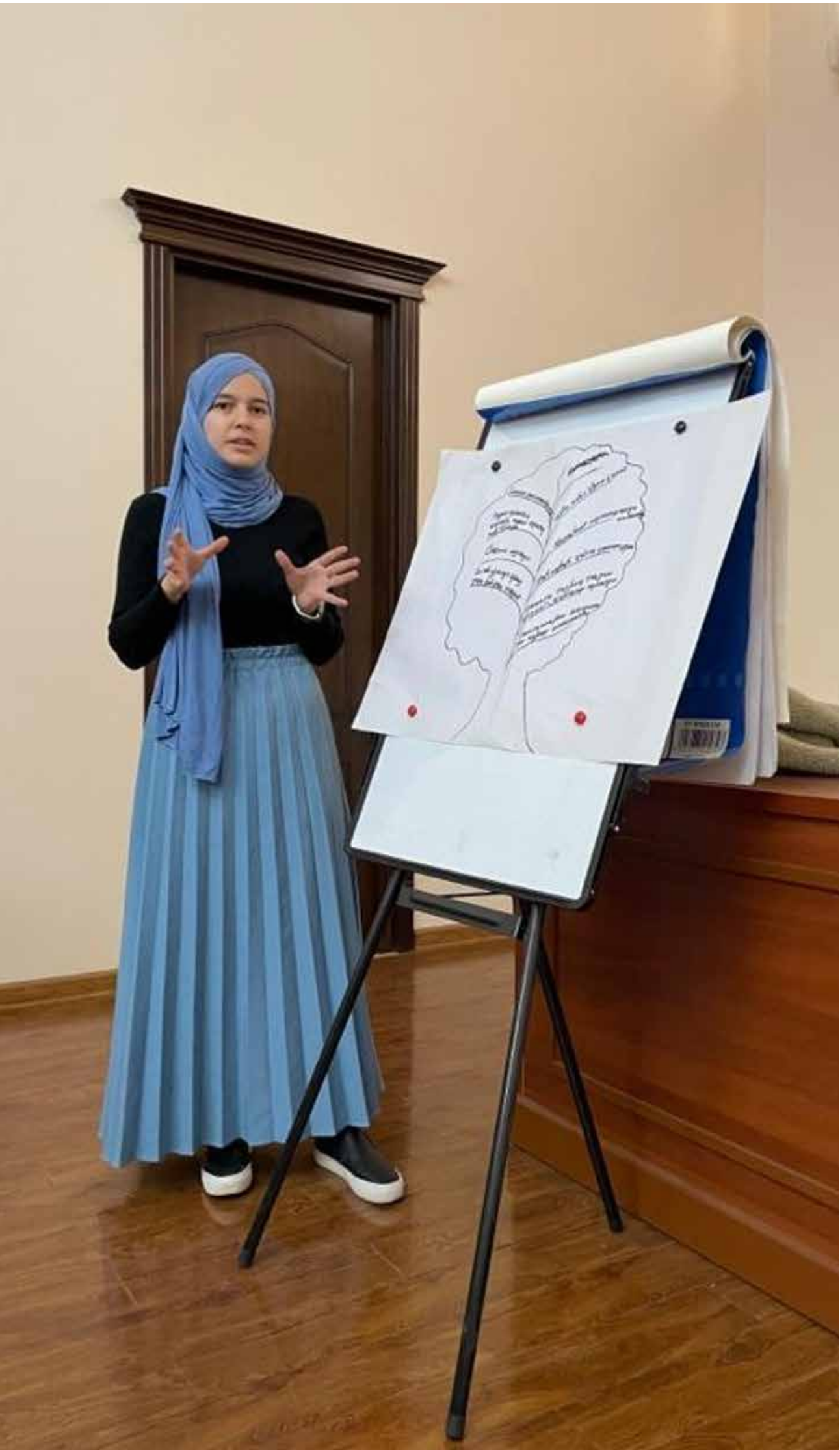
In 2021, 15 women received digital literacy training, and during follow-ups in person and on Telegram this year, it was witnessed that they had become confident in many key skills,⁶ particularly sharing screenshots and photos of their beekeeping activities, which is of high importance for beekeepers for their own historical records, exchanging ideas and advice with other beekeepers, and seeking help from beekeeping experts.

Training with new beekeepers in 2022:

Digital literacy and smartphone training were also provided in Ethiopia to a new group of 15 beekeepers in Amhara region and 15 beekeepers in the Holeta region. Using best practices from last year, the trainings featured hands-on peer-to-peer learning, and enabled participants to bring family members if desired, increasing the comfort and support for beekeepers with zero smartphone experience. This year an additional component was added to the training on smartphone safety, providing basic tips for women to protect their identity and personal data on the internet and avoid scams.

4 Data Reportal Digital 2021 Report: Ethiopia https://www.connectingafrica.com/author.asp?section_id=761&doc_id=768066
5 Does women’s mobile phone ownership matter for health? <https://gh.bmj.com/content/5/5/e002524>
6 Field Visit to Amhara Beekeepers: Expanded Digital Literacy & App Training <https://mel.cgiar.org/projects/aid-csb/538/field-visit-to-amhara-beekeepers-expanded-digital-literacy--app-training>

A young woman beekeeper presents feedback from her small group on the Beekeeper’s Companion app in Tashkent, Uzbekistan. Photo Credit: Laura Becker, ICARDA





A new group of women receive smartphones and digital literacy training in Amhara Region, Ethiopia. Photo Credit: Nahom Lulseged, ICARDA

This is the first time something like this has been done in Uzbekistan – never before have women beekeepers been involved in developing an app

~participating beekeeper in Uzbekistan

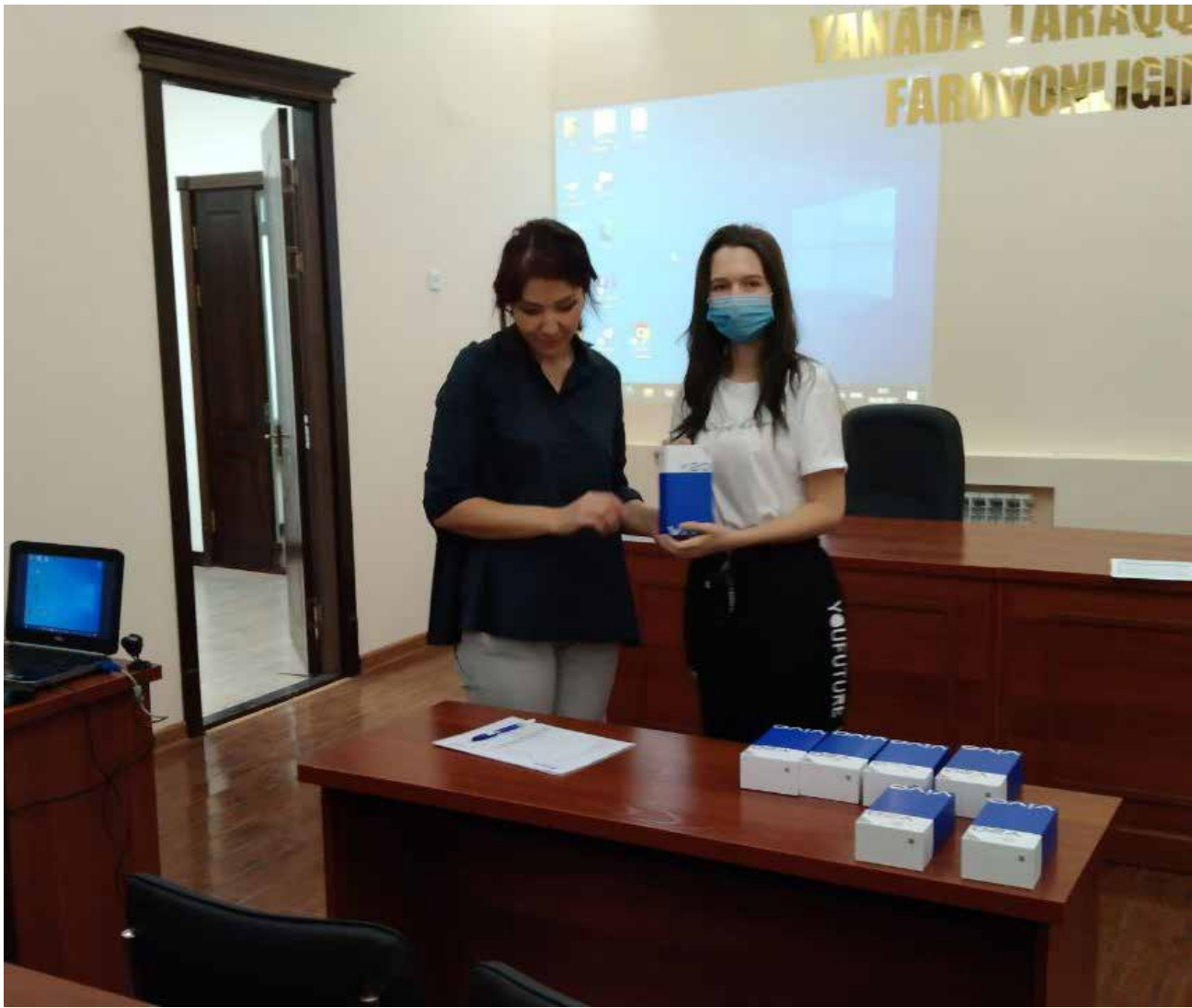
Gender impacts

The AID-CSB project has three impact pathways to women’s empowerment:

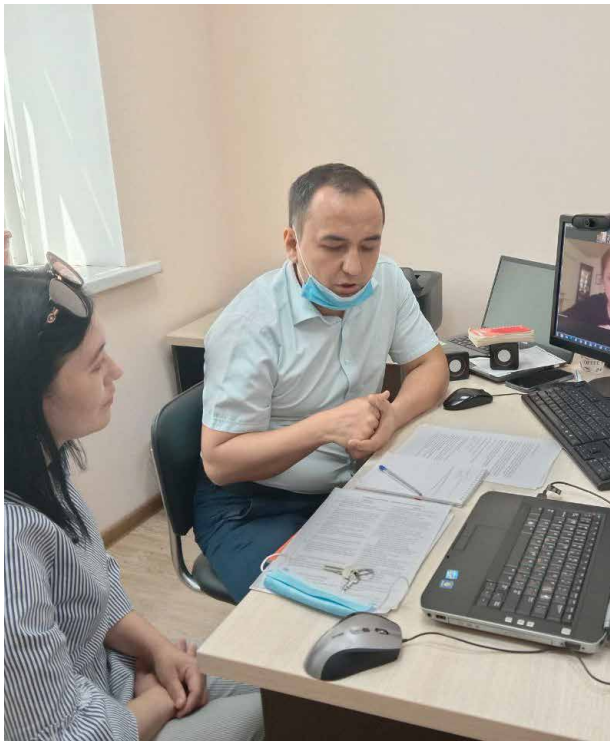
- 1. **Inclusivity & women-led design:** by working with majority women and integrating their feedback at every step of the app localization process, the project not only avoids the common men-design bias of the technology industry but gives women ownership and decision-making power over a solution they can use to increase their livelihoods.
- 2. **Digital access & literacy:** by equipping women with smartphones and providing them with training and ongoing support on how to use them, women are able to confidently access more resources, opportunities, and practice greater autonomy.
- 3. **Awareness building:** women’s use of technology is normalized as family members, men beekeepers, field assistants, and local development partners see the value and impacts of women leveraging technology.

This year we observed an improved enabling environment for women’s participation. During 2021 we noted that in the beekeeper workshops in Uzbekistan (which are majority women but contain a few men beekeepers), men dominated the group discussion/question sessions and few women spoke up.

This year, young women took the lead to present feedback (reference picture above) and men beekeepers were conscientious not to interrupt or speak on behalf of women. In Ethiopia, women who previously did not know how to use smartphones eagerly shared updates on their beekeeping activities and progress in the app over Telegram.



A beekeeper receives a smartphone to pilot the app and be thanked for her participation in the project. Photo Credit: Bakhtiyor Khamidov, ICARDA



A beekeeper participates in app prototype testing in Tashkent, Uzbekistan. Photo Credit: Farida Kuldasheva, ICARDA

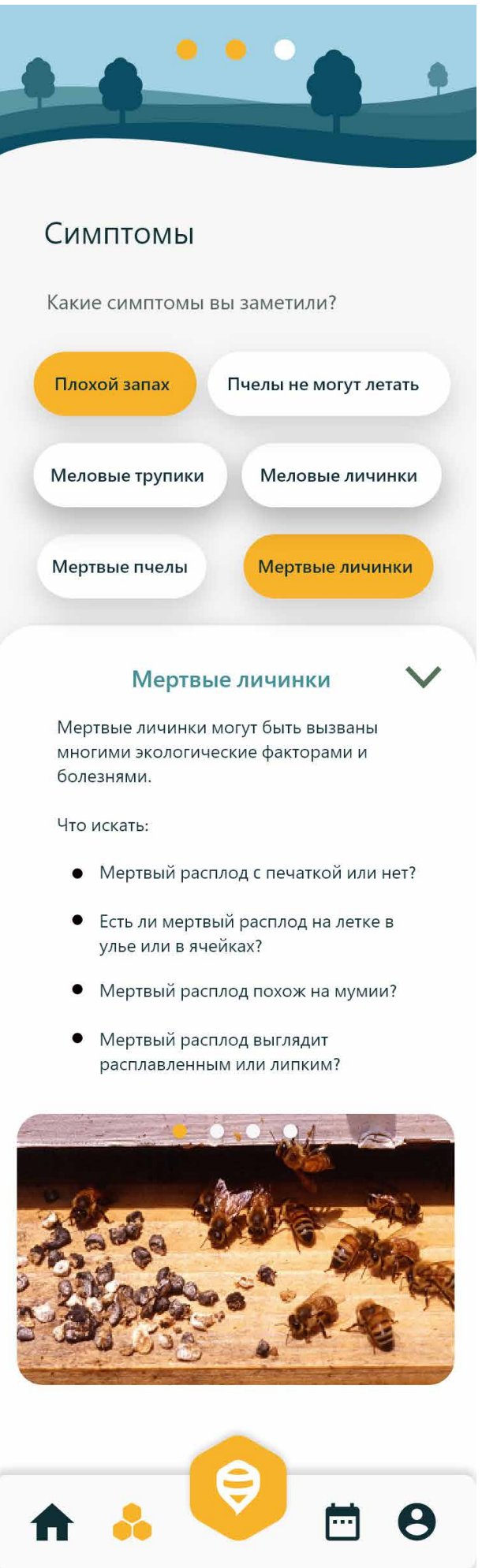
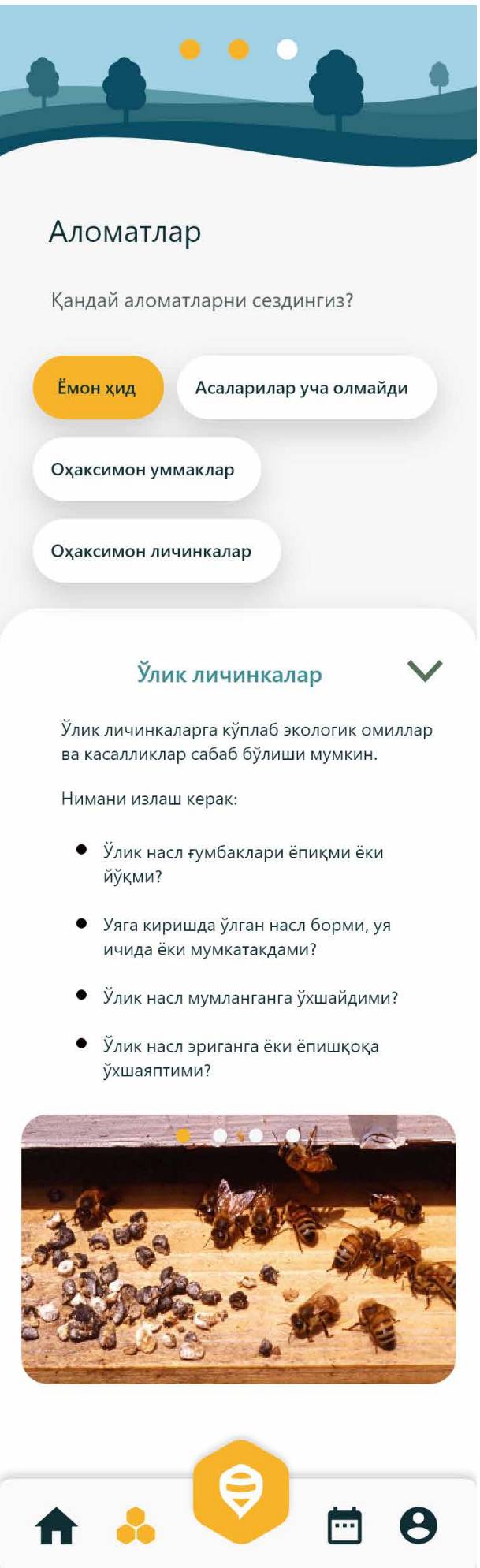
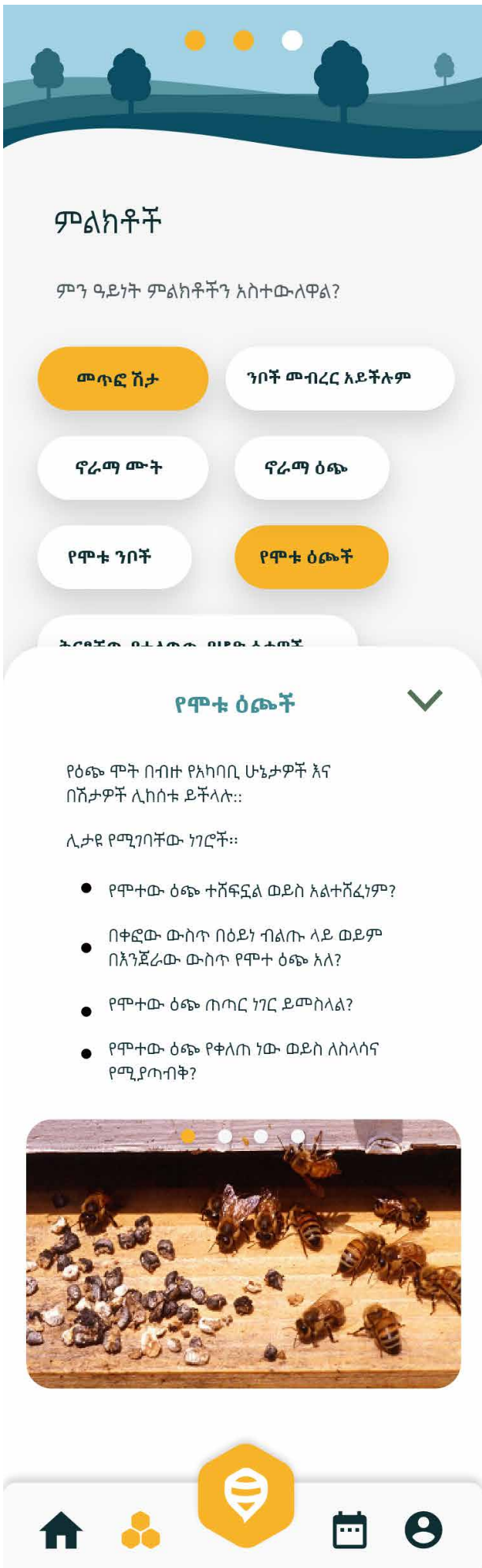
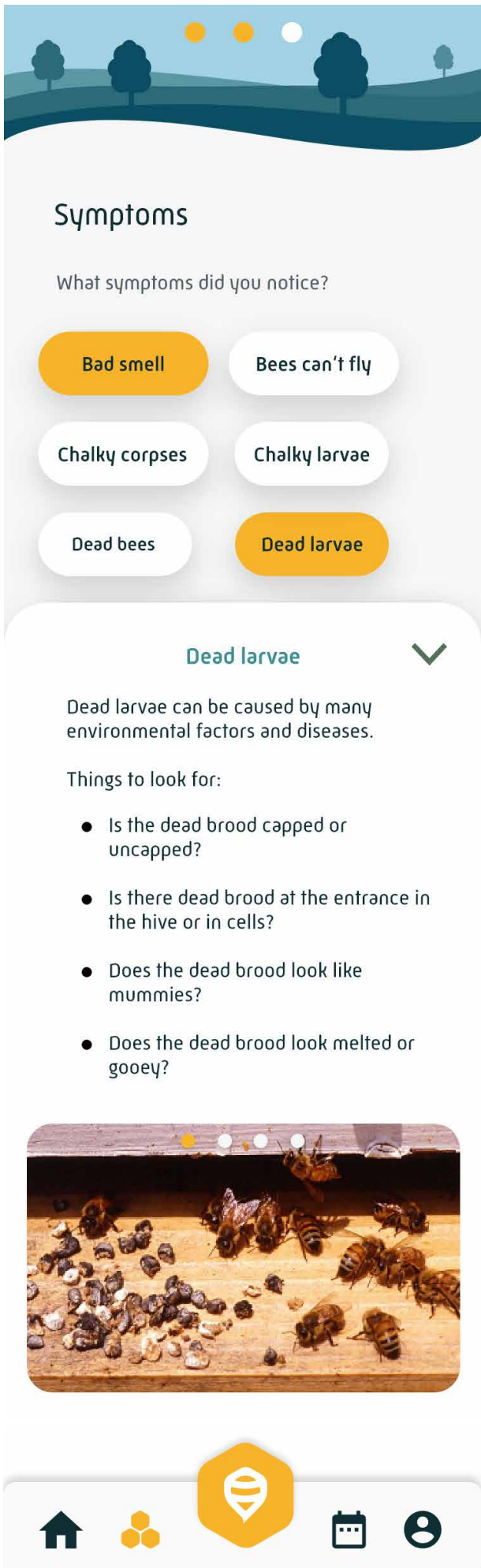
Facilitating Improved Hive Management

App usage analysis reveals a higher total number of users than anticipated, yet a lower level of frequent app engagement than hoped.

Beekeepers and partners see the value of the app and data but want bugs to be fixed and features to be further localized before they invest more time to use it.

The symptom checker guides users to select symptoms and provides a possible diagnosis, here shown for American Foulbrood. Image credit: HiveTracks

Symptom checker

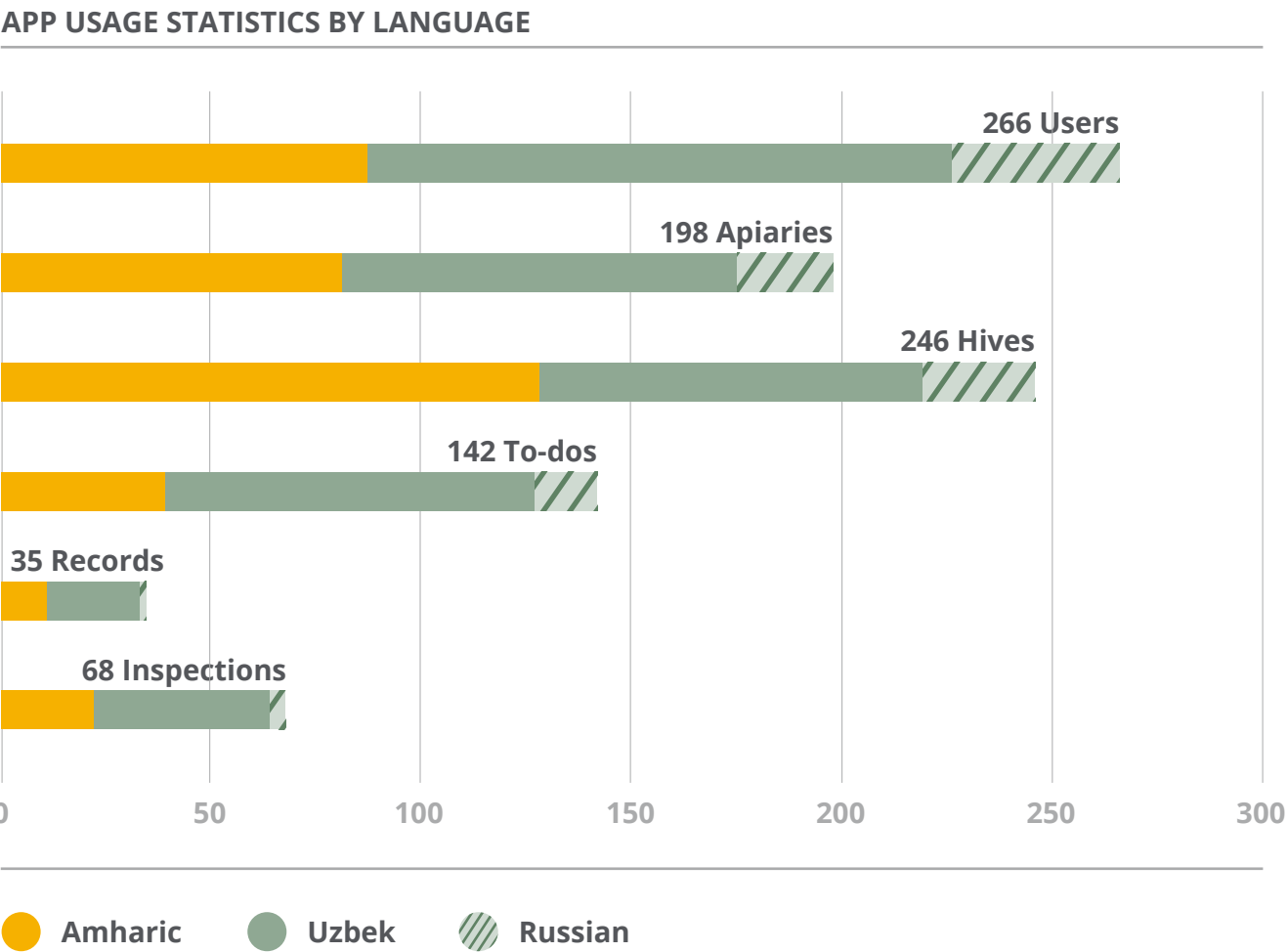


During 2021 user interviews, many beekeepers expressed the need for more guidance and information to understand how to diagnose and treat bee diseases. At the same time, there is a deficit of data on honey bee health symptoms, which are not only relevant to the beekeeping community, but to the wider ecosystem and pollinator-dependent agricultural crops.

Furthermore, national experts and scientists are left without the underlying data to better understand why honey bees are thriving or dying in certain areas. Based on this demand for both diagnostic support to beekeepers and data for researchers, the HiveTracks team developed a prototype to guide beekeepers through this process of assessing honey bee symptoms to reach a possible diagnosis and action:

- 1. **Symptom List:** The beekeeper scrolls through a list of possible honey bee symptoms.
- 2. **Symptom Information:** When they click a symptom, a brief description and photo pops up so they can learn more before confirming the presence of this symptom.
- 3. **Possible diagnosis:** After the beekeeper selects all symptoms their bees are experiencing, they receive a possible diagnosis with a brief description and photo.
- 4. **Hive record:** If the beekeeper agrees with the diagnosis, the bee health issue will be saved in their hive records.
- 5. **Recommended action:** the beekeeper will also receive a recommendation based on the nature of the bee disease—such as performing a mite inspection or contacting a local expert.

Four symptom checker prototype sessions in Uzbekistan and five in Ethiopia confirmed the general usefulness of the feature and specific symptom-related information and provided valuable feedback that will inform the refining process of the features prior to its launch in 2023.



A new ‘symptom checker’ feature was developed based on beekeeper feedback and tested, yielding positive feedback from beekeepers and specific suggestions on how to improve the feature for the local contexts.

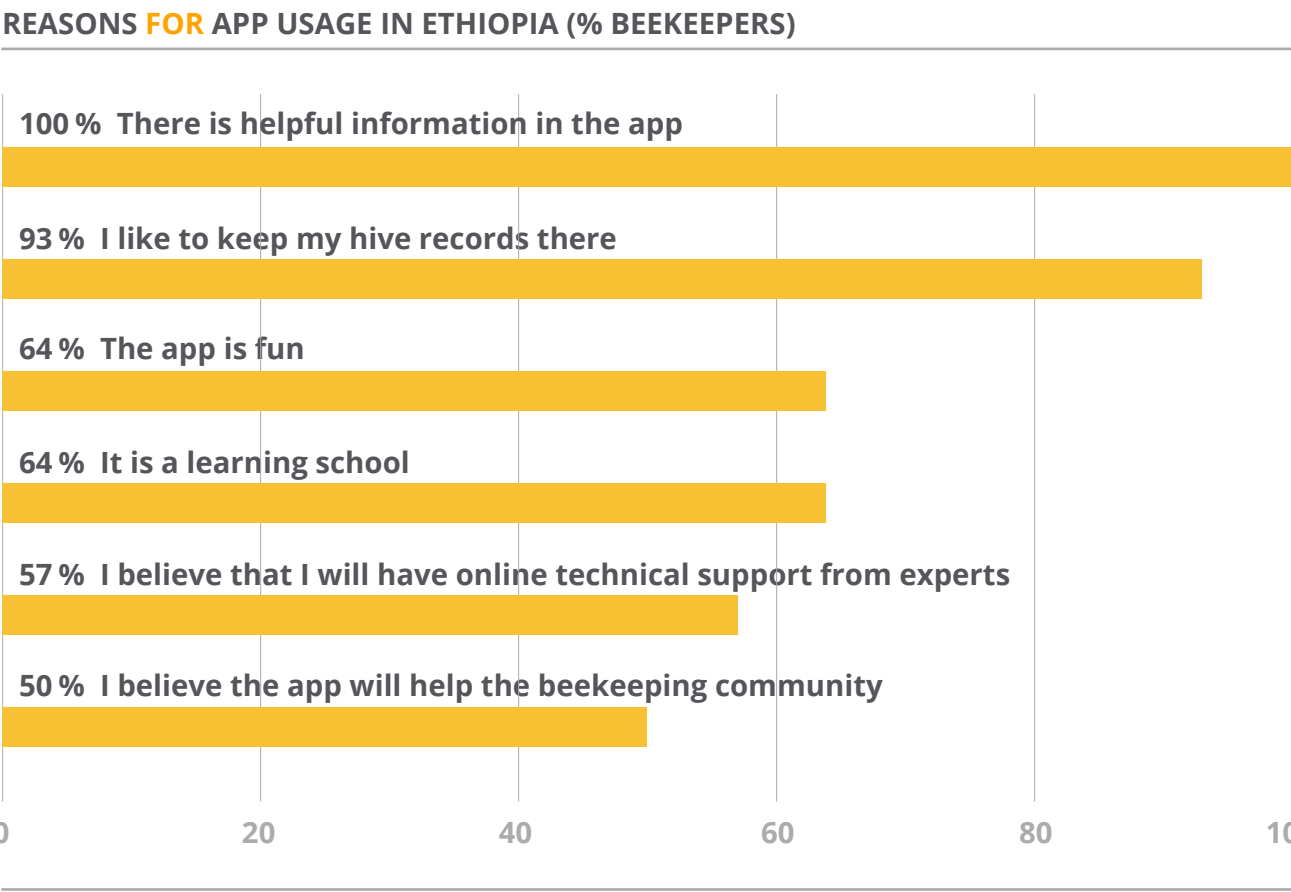
Training workshops

With the 39 beekeepers who already received training on the app last year, the AID-CSB team engaged regularly over Telegram to answer questions and collect feedback on the app. In addition, two training workshops were held with each group of beekeepers to provide further support and encourage beekeepers to continue piloting the app.

Beyond the symptom checker prototype testing with a selected group of beekeepers, a much wider group of beekeepers (N=136) received training on the app. However, an additional 133 beekeepers are also using the app, indicating a broader demand and interest. Despite a high total number of users, the average time and activities each beekeeper does in the app is lower than expected; 118 beekeepers have not created an apiary, which is an essential first step to recording data in the app. One would also anticipate seeing a higher number of inspections (1–4 per month per beekeeper during the beekeeping season, depending on hive type and honey bee health). To better understand why beekeepers were or were not using the app, the AID-CSB team conducted a user survey and held small group feedback discussions.

User feedback: Ethiopia

Out of 15 survey participants, 14 reported that they are using the app. The main reasons they use it include:



Only one beekeeper responded that she was not using the app and explained the reason is that her app isn’t working, but that she would like to use it in the future, especially because she sees the information from the app that her friend receives.

The project staff do think that there may have been some overreporting of app use by beekeepers, as we would have expected more than 22 inspections from the 45 trained users, especially considering that some of the inspections may have been completed for test purposes during workshops. Given the positive response and usage of beekeepers in Telegram, we will continue to use this as a platform for engagement and encouragement for regular hive inspections.

User feedback: Uzbekistan

12 beekeepers participated in the user feedback survey. In contrast with Ethiopia, there are more beekeepers from the original group of 24 beekeepers in 2021 in Uzbekistan that report not using the app. The reasons for this are often technical according to the 6 survey participants who reported not using the app:

- Several beekeepers reported data loss issues or could not access their accounts.
- Requiring and remembering the email and password to log-in is a challenge.

Or there are other underlying reasons:

- App usage is higher in Tashkent than Bukhara, which may be due in part to higher proactivity and engagement of the Tashkent field assistant, but also fatigue among Bukhara participants who expected a smoother technical experience and additional functionality.
- Several beekeepers also noted that they prefer to keep their records in notebooks and suggested that providing data in a table format in the app and allowing usage on tablets would provide the same ease of use as their paper record keeping.

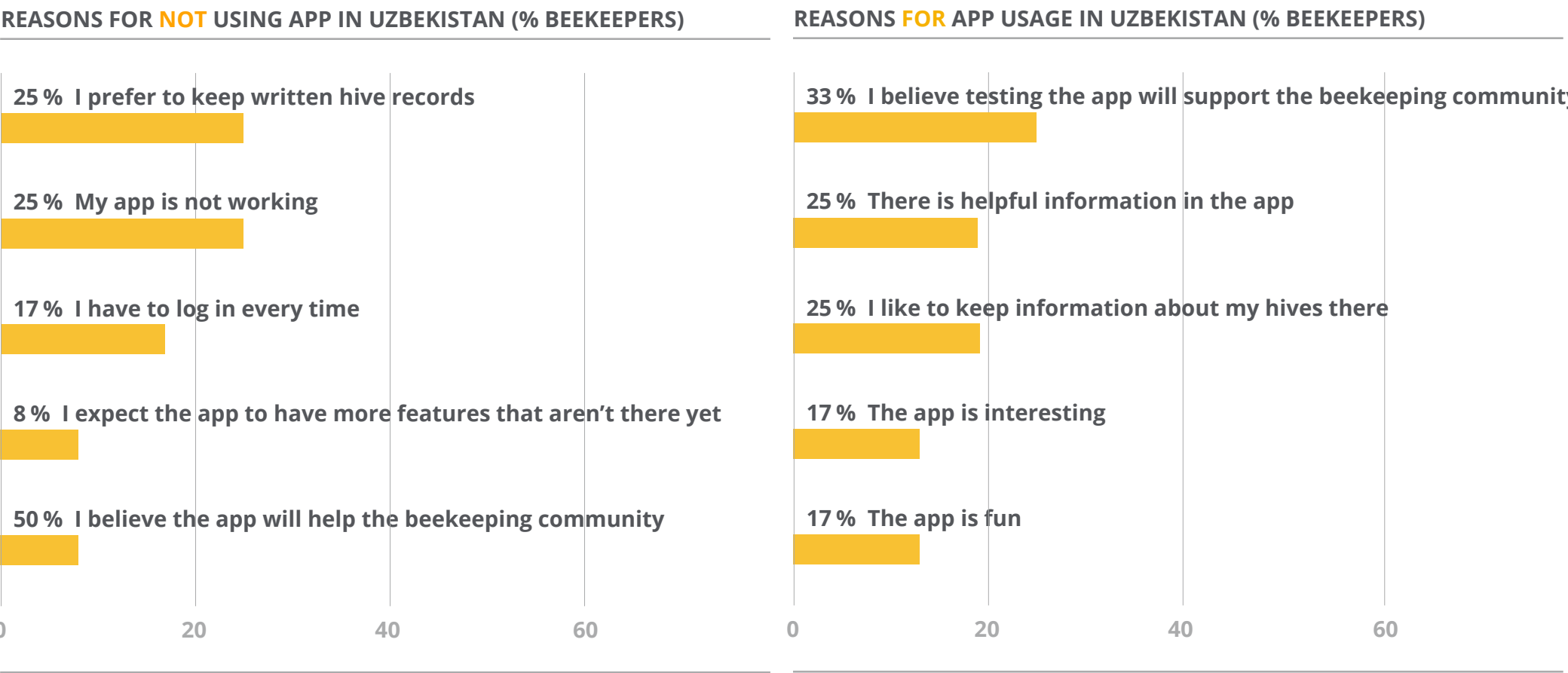
Notably, the majority of non-app users said they did however plan to use it in the future.

The 6 responding active app users in Uzbekistan believe their use of the app will help support the beekeeping community. Furthermore they said the app helped save time and they liked the ability to easily access previous records. They also suggest many features for improvement, such as an ability to see hive locations (or general area to avoid placing too many hives in the same area).

Use of feedback

User feedback is a vital component of providing a great user experience. Hence, in light of the technical issues (i.e., data loss, log-in challenges) experienced by several beekeepers as well as the constructive feedback received and the ambitious roadmap ahead, HiveTracks has decided to launch a new version of the app ahead of the 2023 season.

It is hoped that new features in 2023, including recommendations and notifications, as well as the symptom checker, will provide a greater incentive for regular and frequent app usage, and suggested features by beekeepers (table format, hive location map) should be tested. Hiring a new staff person locally with strong digital and communication skills to champion the app, would also incentivize app use.



The Way Forward

To respond to beekeeper feedback, address technical challenges and prepare for scale, HiveTracks is rebuilding the app, anticipating its release in early 2023 before the start of the beekeeping season in the Northern Hemisphere.



Apiculture students from Tashkent State Agrarian University receive app accounts and training. Photo Credit: ICARDA

In addition to resolving technical challenges, this choice also improves user navigation, improves the foundation for building further integration, and provides opportunity to implement feedback received over the past two years. Together with partners and beekeepers, everyone sees the value and potential of the app; not only in its service to the individual beekeeper in hived colony management support, but also how the data can work to increase beekeepers' opportunities in three ways:

- 1. Market access, product differentiation, and strengthened livelihoods:** data the beekeepers collect such as location, photos of bee forage, and harvest date can be collated in a digital profile for consumers; enabling a marketing opportunity to show of the beekeepers' unique product and quality
- 2. Additional income through biodiversity credits and eco-payments:** a model already leveraged in several countries⁷, beekeepers could get paid for the pollination services their bees provide to agricultural crops or local ecosystems.

The app enables collection of the radius, flying time, hive management practices, and bee population to provide quantitative data on the pollination services bees provide.

- 3. Access to microloans and financial inclusion:** a top challenge for beekeepers in both Uzbekistan and Ethiopia is the cost of beekeeping equipment, preventing them from starting beekeeping or expanding their businesses. However, documented data from the app could serve as a "credit score" and collateral for loan providers, to show the projected quantity of honey produced and profits anticipated to repay the loan.

In both countries, beekeepers will continue to have access to the app, along with all of its feature enhancements. The project works to secure further funding for additional activities in both countries to increase sustainability, equity, and scale of support to beekeepers:

In Uzbekistan, the AID-CSB team is exploring ways to improve the content and equitable access of beekeeping training materials. The app may also be piloted in a new FAO Peacebuilding Project as a means to support income-generating activities.

In Ethiopia, the AID-CSB team developed a predictive model for calculating the costs and repayment period for beekeeper microloans, considering the different types of beekeeping and projected honey production levels. The team is also exploring ways to better connect beekeepers with market opportunities, including a unique profile to support linkages and premium prices with wholesale suppliers.

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⁷ Payments for pollination services – an unexplored opportunity for African beekeepers. 2014. https://www.researchgate.net/publication/274352812_Payments_for_pollination_services_-_an_unexplored_opportunity_for_African_beekeepers