**SUPPLEMENTARY MATERIAL: METHODS AND ANALYSIS**

**Household survey on costs and benefits of beekeeping**

In this study, we conducted household surveys with 25 beekeeper families of ART between August 2018 and August 2019. The survey instrument was an adaptation of a methodology that *Equipo Abejas* (‘Bee Team’) at ECOSUR university had designed and used in focus groups to estimate costs and benefits associated with beekeeping (Vandame, 2008). Through a participatory process, we - members of ART, UVM team, *Equipo Abejas*, and Food 4 Farmers – modified the original instrument to better fit a survey approach and to add sections. For instance, we expanded the list of equipment. We also added sections on nutrition, bee ecology, and social benefits.

After piloting the survey, the members of the local research team visited each of the participating beekeeper families every month for 12 months to collect data. The team members used Kobo Toolbox, a free, open-source software, to document the survey responses on a tablet. To ensure the quality and reliability of the survey, the local team met up once a month or bi-monthly with the UVM/ALC team members to revise and ‘clean’ the survey responses and discuss any concerns or issues.

The survey consisted of seven sections. Sections with questions on the variable costs of production and family labor were repeated every month, while sections with questions related to the apiary and farmer experience, field and processing equipment (i.e., fixed costs), honey sales, bee ecology, nutrition, and social benefits of beekeeping were conducted once. To calculate the fixed costs, we included all equipment and materials, including the ones that beekeepers had received as donations. While this likely resulted in higher costs of production than what occurred in reality, we wanted to include the cost of the donated materials/equipment to communicate the ‘true’ cost of production. The costs of production did not include those associated with the warehouse or operational costs of ART, as they are deducted directly from the amount paid to the beekeepers for their honey (e.g. in 2019, the price per kilogram of honey was 26 Mexican pesos, and 2 pesos were charged by ART to help cover operational costs, leaving the farmer with 24 pesos per kg).

**Table 1**. Items included to calculate the fixed and variable costs

|  |
| --- |
| **FIXED COSTS** |
| **Field equipment** |
| Hive body |
| Shallow supers |
| Beekeeping suit (coverall, veil, gloves) |
| Smoker |
| Hive tool |
| Grafting tool |
| Feeder |
| Cell cup |
| Knife |
| Spur embedder (Pegador de cera) |
| Pollen traps |
| Honey strainer |
| Cappings scratcher |
| Other |
| **Processing equipment** |
| Honey extractor |
| Uncapping tank |
| Honey settling tank (or a bucket) |
| Honey extraction tent |
| **Vehicles** |
| Car |
| Motorcycle |
| *(the cost of car/motorcycle was calculated considering* |
| *the percentage of their use in beekeeping)* |
| **Land rent** |
| Annual rent |
| **VARIABLE COSTS** |
| **Inputs** |
| Sugar |
| Stamped wax |
| Treatment against varroa mites |
| Queen bees |
| Other |
| **Transport** |
| Gas |
| ‘Flete’ (paying someone to give a ride) |
| **Labor** |
| Days of family labor |

**Analysis of the survey**

As the first step, we systematized all data per beekeeper on an Excel spreadsheet. For the variable costs, we calculated a monthly average (for example, for sugar we summed the different price points and then divided the sum by the number of months in which sugar had been bought). For the fixed costs, we took into consideration the asset depreciation by dividing the value of each equipment by the average lifespan (to get the annual ‘cost’). The lifespan was estimated with the help of beekeeping experts from *Equipo Abejas* in ECOSUR. For cars and motorcycles, we asked the beekeepers to estimate how much they use them for beekeeping (%). To calculate ‘yield per hive’, we used the number of colonies in production.

After the data collection and cleaning, we prepared a summary of the results for each beekeeper and used it to validate the data individually with all participants. After this round of validations, we adjusted the data on the spreadsheet (e.g., if families noted differences between the shared data and their own data, we adjusted the data to reflect this), and used the revised version of the data set for the statistical analysis. We used Excel for descriptive statistics, and R software for statistical tests (R Core Team, 2022).

**Note about family labor**

We think it is important to consider the time and effort family members put into beekeeping. Through the survey, we know how many occasions beekeepers and their family members visited the apiary. Yet, we learned that there was a lot of variability in terms of the duration that they spent in their apiaries. Commonly, the visits lasted a few hours, not full days, and were combined with visits to coffee or other plots. Therefore, we did not include family labor in the costs of production in our calculations (as opportunity costs). Instead, we decided to divide the annual net revenue by days of family labor (again ‘day’ does not necessarily imply a full day) to give us an estimate how much each family member would earn per day in beekeeping. This is obviously a narrow way of assessing the value of one’s labor. Additionally, it is important to keep in mind that beekeeping generates many benefits beyond money (nutrition, medicine, mental health benefits).

**Sharing back the results**

Once we had finalized our analysis, we organized sessions with members of ART to share back the results and have discussions on their implications. We also gave all participants a sheet with individualized calculations of their costs of production and earnings, along with management recommendations from a beekeeping expert from *Equipo Abejas*.

**References**

R Core Team. 2022. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. [https://www.R-project.org/](https://www.r-project.org/).

Vandame, R. 2008. Determinación de los costos de producción y de las utilidades de los pequeños apicultores en organizaciones de Guatemala y México. Equipo Abejas, ECOSUR.