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KNOWLEDGE CO-PRODUCTION IN BEE STUDIES IN LATIN AMERICAN COFFEE AGROECOSYSTEMS: A META-NARRATIVE REVIEW

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ABSTRACT

Knowledge co-production is key to designing strategies for the use and conservation of pollinators relevant to local contexts. However, the inclusion of diverse actors in research processes does not guarantee a real integration of knowledge. This study analyzes how local knowledge has been incorporated in research on bees in coffee agroecosystems in Latin America. Through a meta-narrative review of studies published between 1993 and 2022, the participation of non-academic actors was evaluated from a transdisciplinary research approach (TDR). The results indicate that, although 63.5% of the studies reviewed in depth involve producers, there is scarce collaborative definition of problems, joint methodological construction, or return of results. Four types of studies were identified according to their objectives: those that describe biotic elements of the coffee-bee system (48.6%), those that analyze beekeeping management practices (31.1%), those that address socioecological connectivity (6.8%), and those that systematize non-academic perceptions of pollinators (13.5%). The review highlights the need to strengthen the processes of knowledge co-production through the explicitness of accessible theoretical and methodological bases, the creation of spaces for horizontal exchange, and the active participation of peasant organizations and other non-academic actors. Overall, the findings offer an overview of the current state of research and underscore the need for more collaborative, inclusive and contextualized approaches to address sustainability challenges in Latin American coffee agroecosystems.

Key words: agroforestry systems, Apoidea, *Coffea arabica*, pollinators, transdisciplinary research.

INTRODUCTION

Coffee plantations are agroecosystems of great ecological and biocultural importance (Méndez *et al.*, 2010; Perfecto and Vandermeer, 2015), where pollination by bees plays a key role in the yield of coffee trees (Ngo *et al.*,

2011; Roubik, 2002), in addition to pollinating other trees and crops. The diversification of coffee plantations ranges from monoculture to plots with more than 74 forest species, which is related to the uses and values given by coffee-growing families to the species with which they carry out their diversification (Cerdán *et al.*, 2012), influencing in turn the diversity of pollinators (Cepeda-Valencia *et al.*, 2014). The management of social bees (*Apis mellifera* and Meliponini) is integrated among productive diversification strategies, due to the benefits of honey extraction and coffee pollination (Vinci *et al.*, 2018). The socio-environmental interactions between coffee plantation management decisions, the benefits these provide to both producing families and the environment, and the importance of bees and other pollinators, have driven the study of the coffee-bee agroecosystem from various perspectives.

Ngo *et al.* (2011) developed a review on the role of different pollinators in coffee fruit setting and yield, highlighting the importance of honeybees (Apini) and stingless bees (Meliponini) in different coffee species. Other reviews focus on the value of biotic pollination in coffee plantations in relation to their structure (Moreaux *et al.*, 2022), and the effects of climate change (Chain-Guadarrama *et al.*, 2019). It is noted that pollinator diversity and frequency of visits are influenced by the landscape matrix, such as distance to nearby forests (González-Chaves *et al.*, 2020; Moreaux *et al.*, 2022), and by agronomic management practices, such as shade and crop intensification (Cepeda-Valencia *et al.*, 2014).

These studies have contributed to the understanding of animal pollination in coffee yield and highlight the need to guide landscape management practices to enhance the resilience of coffee plantations in the face of climate change (Chain-Guadarrama *et al.*, 2019). The objective of this study was to analyze the incorporation of non-academic actors in research on bees in coffee agroecosystems in Latin America, in order to examine their participation in the different phases of the research process and to evaluate if there is an explicit intention to co-produce knowledge relevant to local contexts.

THEORETICAL FRAMEWORK

Despite the growing body of research on pollinators in crops and agroforestry systems (Centeno-Alvarado *et al.*, 2023; Requier *et al.*, 2023), various studies point out that a significant gap still exists between scientific knowledge, local knowledge, and public policies (Gemmill-Herren *et al.*, 2021), and they indicate that there is a need for research that integrates local knowledge on ecosystem services provided by pollinating insects (Rawluk and Saunders, 2019). Studies that are based on local perspectives and traditional and indigenous management practices contribute in this sense, as they document knowledge

and values of pollination (Toledo and Barrera-Bassols, 2017; Hill *et al.*, 2019), related to cultural and symbolic values, which maintain sustainable lifestyles (Hill *et al.*, 2019).

The integration of local, indigenous and peasant knowledge in the study of an agroecosystem can provide a better understanding and thus more effective governance (Hill *et al.*, 2019), involving knowledge aimed at solving problems of unsustainability (Norström *et al.*, 2020; Chambers *et al.*, 2021). Since agroecosystem management practices are strongly influenced by how we understand and relate to nature (Pascual *et al.*, 2023), pollinator conservation (sometimes represented by bee management) is also immersed in a gradient of choices and modes of landscape management. Therefore, the study of bees in agroecosystems allows observing different socio-environmental valuations of pollinators (Galetto *et al.*, 2022). However, moving towards a solution-oriented knowledge co-production requires recognizing the characteristics that a research process should strive for, in order to achieve the integration of local knowledge (Vilsmaier *et al.*, 2017; Reed *et al.*, 2018).

Among the efforts that have sought to recognize local or indigenous knowledge on pollinators, the Assessment on Biodiversity and Ecosystem Services on pollinators (IPBES, 2016) included dialogue workshops with local actors and subsequent spaces for collective reflection with scientists, decision makers and community experts, to re-signify their key messages in specific contexts (Malmer *et al.*, 2019). Particularly, in Latin America, progress has been made in recognizing the cultural and economic value of stingless bees in indigenous communities (Quezada-Euán *et al.*, 2018), and in documenting local knowledge about their management in agroforestry contexts (Reyes-González *et al.*, 2014; Arnold *et al.*, 2018). Likewise, other reviews have addressed coffee-pollinator interactions from ecological, landscape connectivity, and climate change perspectives (Chain-Guadarrama *et al.*, 2019; Moreaux *et al.*, 2022). However, the sustainability of coffee plantations in the region continues to be threatened by land use change and anthropogenic factors (Dicks *et al.*, 2021; Harvey *et al.*, 2021), requiring conservation strategies that recognize peasant knowledge systems as dynamic processes (Toledo and Barrera Bassols, 2008) and which promote not only technical analysis, but also emancipatory processes of territorial management (Aldasoro *et al.*, 2019).

For these strategies aimed at integrating other forms of knowledge, the term knowledge co-production (KCP) is very suitable. KCP encompasses several meanings, terminologies and practices, where Transdisciplinary Research (TDR) is included (Chambers *et al.*, 2021). Transdisciplinary research, for its part, is a reflexive approach to research that seeks to understand complex problems, considering experiential and scientific perceptions, and emphasizing

the co-construction of knowledge as well as transformation-oriented practices (Merçon, 2021).

Although they can be taken as equivalent terms (KCP and TDR), to refer to research approaches conducted by different actors and that are driven by a common purpose or problem (Norström *et al*., 2020; Pohl *et al*., 2021), particular quality criteria have been proposed for each approach (Scholz and Steiner, 2015). In this review, we adopt the notion of knowledge co-production derived from sustainability sciences (Miller and Wyborn, 2020; Norström *et al*., 2020), which for us also includes practices, skills, relationships and values that are equally important for collective co-production processes (Merçon, 2021). The KCP framework has provided methodological tools in research that seek to illustrate transitions towards sustainability (Chambers *et al*., 2021; Schneider *et al*., 2021), and critical positions on asymmetrical power relations with some social groups (Latulippe and Klenk, 2020; Turnhout *et al*., 2020). For its part, TDR has provided quality criteria to evaluate different stages of research processes (Lawrence *et al*., 2022), emphasizing the identification of the problem and the methodological choice. We adopt the term "non-academic actors" to describe social actors from various sectors outside academia, although we recognize that it is a term that reflects a language centered on academia (Vilsmaier *et al*., 2017).

METHODOLOGY

This study adopted a meta-narrative review method to document studies on the coffee-bee agroecosystem in Latin America (Wong *et al*., 2013; Snyder, 2019), which allowed integrating different research approaches for this type of agroecosystem and including publications that are not present in academic search engines, such as theses or papers (that is, gray literature).

Studies on the coffee-bee agroecosystem are those that address: (a) the diversity of bees and other pollinators, (b) the diversity of melliferous resources, (c) bee pollination networks (wild and managed), (d) bee management (*Apis mellifera* and Meliponini) and the processing or marketing of bee products from those hives, (e) coffee plantation management practices that seek to promote the diversity of melliferous resources, (f) economic and organizational analyses for the production and sale of hive products, and (g) local knowledge of hive management.

The review consisted of three phases: 1) literature search, 2) selection and 3) analysis (Figure 1).

A detailed description of the review process is available upon request from the authors.

1) Literature search: academic publications and gray literature (1990-2021) were identified in *Web of Science*, *SciELO*, *Redalyc* and *Google Scholar*, using

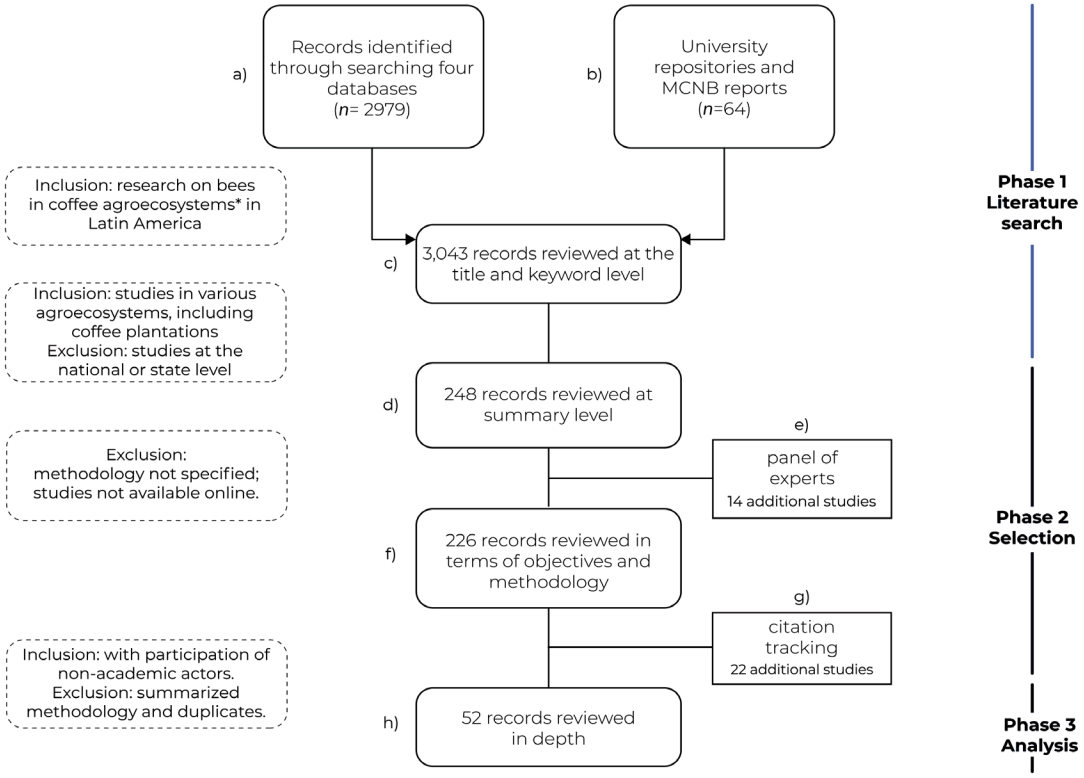

Figure 1. Summary of the semi-systematic review process.

keyword combinations in English and Spanish related to coffee, pollinators, and participatory approaches. University archives and proceedings from the Mesoamerican Congress of Native Bees (2009, 2011, 2013, 2019, 2021) were also included, resulting in 3,043 titles reviewed at the level of title and keyword.

2) Selection: 248 titles were reviewed at the level of abstract, excluding those without full access, without methodological description, or without participation of non-academic actors. To complement this search, a panel of experts on bees and agroecosystems in Latin America was convened, who, through structured interviews on coffee, participatory and transdisciplinary approaches, suggested 14 additional studies, including recent publications (2022) or those in the publishing process. Subsequently, the methodological tools and the degree of participation of non-academic actors in the design and implementation of each study were recorded. Those studies with active participation were analyzed in depth, selecting the record with the most complete methodology and tracking their citations electronically.

3) Analysis: Of the total number of records retrieved, 52 research studies with the participation of non-academic actors were selected for in-depth analysis. Those with summarized methodologies (such as papers and posters) were excluded. The analysis was structured based on the "Design Principles and Guiding Questions" by Lang *et al.* (2012), which synthesize key criteria for transdisciplinary research in sustainability (Table 1). Additionally, methodological elements described by Greenhalgh (2004) were adapted to classify the studies according to the type of objective: from descriptions of non-human elements to proposals for strategies linked to biocultural conservation.

Finally, the research objectives of each study were analyzed, classifying them according to the number of TDR elements mentioned, and according to the applicability of the objectives (from objectives that describe or characterize, to those that problematize or implement the research results).

RESULTS

Of the 52 records reviewed in depth, 59.6% were theses, 28.8% articles, 9.6% reports and other materials, and 1.9% book chapters. Mexico and Colombia stand out with 28.8% and 19.2% of the studies, respectively, which involved the participation of various actors (Figure 2). There has been a sustained increase in the production of research with the participation of non-academic actors, with a notable increase since 2011.

Table 1. Design principles for transdisciplinary research in sustainability science and related guiding questions (Lang *et al.*, 2012).

Phase A	Does it include diverse expertise to address the sustainability issue? Does framing of the research problem and objectives take place collectively? Is there a common understanding of the sustainability problem? Is there a collaborative design of the methodology and does it take into account both the scientific and practical fields?
Phase B	Are the tasks and roles of the actors involved in the research process clearly defined? Does it employ and adjust appropriate methods to generate and integrate knowledge?
Phase C	Are the project results implemented to resolve or mitigate the problem addressed? Are the results integrated into the existing scientific body of knowledge for transfer and scaling-up efforts? Does the research team provide actors with products, publications, services, etc., in an appropriate manner and language? What additional (unanticipated) positive effects are being accomplished?
General	Is a formative evaluation being conducted which involves relevant experts related to the thematic field and transdisciplinary research (throughout the project)? Do the researchers prepare for potential conflicts at the outset, and adopt processes to manage conflict when it arises? Is adequate attention being given to the skills (material and intellectual) required for effective and sustained participation in the project over time?

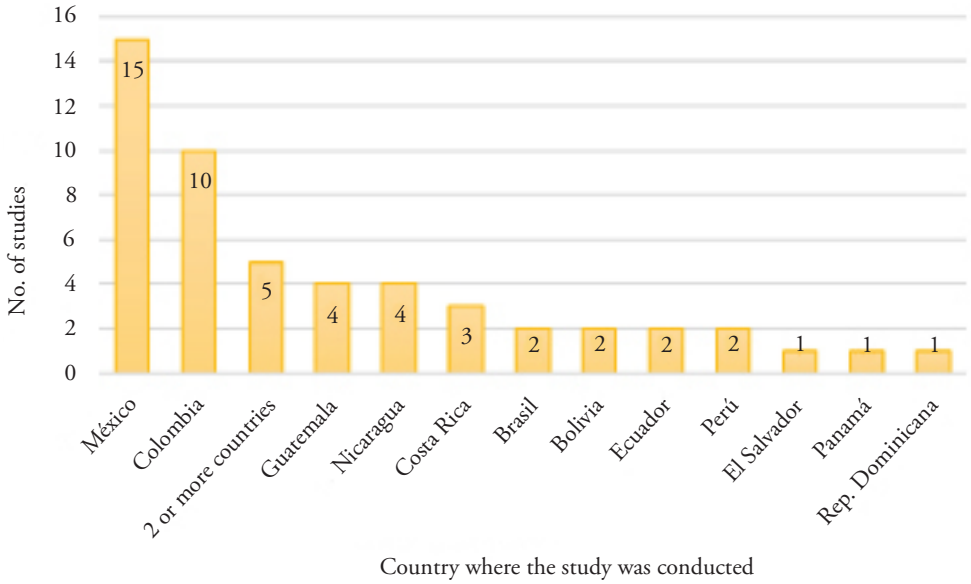

Figure 2. Research production by country with the participation of non-academic actors.

In relation to Phase A of TDR (problem statement and team building), we observed that most of the studies (63.5%) include two groups of actors, the group of academics and the producers with whom they are related (coffee growers or beekeepers). Usually, research that includes non-academic actors does not implement collaborative processes to define the research problem, or to design the methodology (Table 2).

Regarding Phase B (joint creation of knowledge), most (84.6%) of the studies do not define roles and tasks among the participating actors in the research, so the process is mainly carried out by the academic team, and in some cases by technicians or beekeepers who participate in data collection. Only in four studies, there is a joint definition of roles, positioning non-academic actors as protagonists of the process, together with a facilitating team. Four studies mention a collaborative design of the methodology which integrates scientific and practical fields.

Concerning Phase C (reintegration and application of the knowledge created), the studies generally do not mention any collective analysis or formal delivery of the information generated, and only present the results or recommendations for their application. However, 42.3% of the studies mentioned some process of feedback through workshops or materials.

In accordance with the general principles of TDR, it was observed that most of the studies did not apply evaluations (71.2%), nor did they prepare for possible conflicts (94.2%). Fifty-three percent (53%) of the studies considered activities

Table 2. Results in relation to the phases of Transdisciplinary Research.

Phase	Guiding question	No. of studies where it is NOT mentioned	No. of studies where it is mentioned	Examples of what is mentioned
A	Creation of a collaborative research team	33 (2 groups)	19 (3 or more groups)	Groups: academia; coffee growers/ beekeepers, farmers' organizations, civil associations, government
	Collaborative framing of the problem	39	13	Interviews, informational workshops, or description of the research objectives
	Collaborative design of the methodology	28	24	Interviews, participant observation, literature review
B	Definition of tasks and roles	44	8	Technicians or beekeepers involved
	Knowledge generation and integration	24	28	Interviews, informational workshops, or description of the research objectives
C	Implementation of results	10	42	Contributions to solve the problem, management status (beekeeping)
	Provides products, publications, or services to actors	30	22	Workshops, market studies, research notebooks, fact sheets, infographics, and workshops
	Achievement of objectives or additional positive effects	2	50	Some objective achieved, such as productive improvements, learning networks, meetings
General	Application of evaluations	37	15	Post-workshop surveys, self-evaluations
	Preparation for possible conflicts	49	3	Activities to seek participation, trust and confidence
	Attention to capabilities for effective and sustained participation	28	24	Recommendations in the conclusions

Source: prepared by authors based on the phases proposed by Lang *et al.* (2012), we break down the research according to the number of studies mentioned or not, with some examples.

to promote effective participation, highlighting the integration of diverse actors and the attention to cultural and pedagogical perceptions, as well as the importance of recognizing issues of leadership and network learning to sustain collective processes.

Research perspectives of the coffee-bee agroecosystem

With the analysis of the research objectives, four general types of studies with 11 specific lines of research were identified (Figure 3). In total, 74 research objectives described in the 52 studies were analyzed. On the horizontal axis, they were grouped according to the number of TDR elements mentioned. On the vertical axis, they were classified according to the applicability of the objectives. The "economy", "society" and "biosphere" fields illustrate areas of interaction of these objectives.

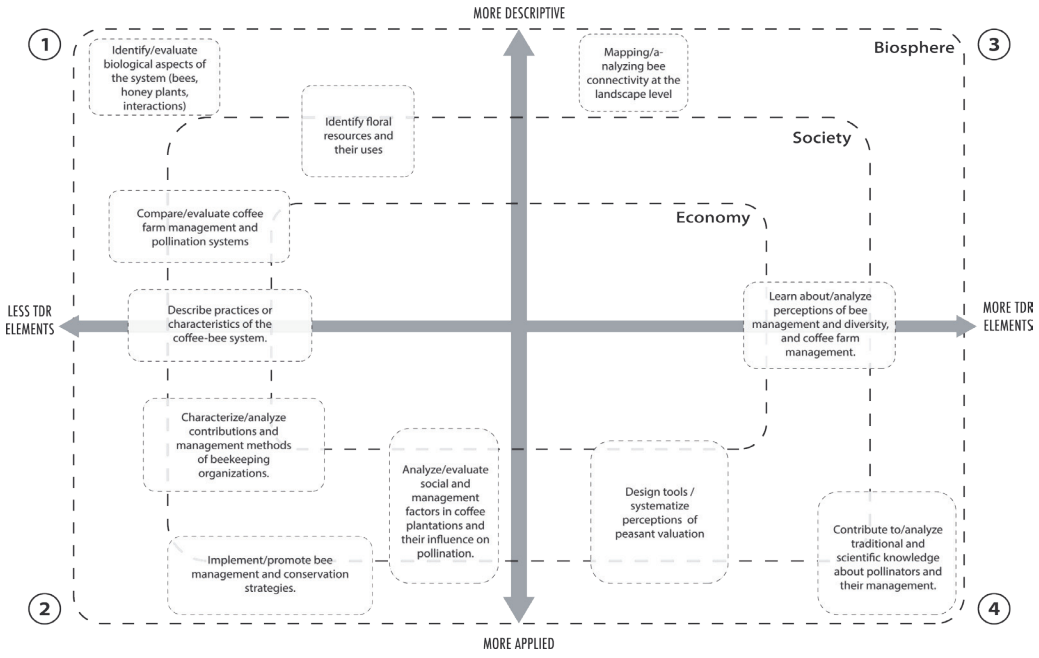

Figure 3. Classification of research objectives of the coffee-bee agroecosystem with non-academic actors.

The largest number of research objectives are found in quadrant 1 (more descriptive and with fewer TDR elements) and quadrant 2 (more applied, but with few TDR elements), n=36 and n=23, respectively. In these two types of studies, objectives aimed at describing and analyzing biotic and management elements stand out (Cepeda-Valencia *et al.*, 2014), as well as studies examining both peasant practices and the management of beekeeping organizations (Bathfield *et al.*, 2013). Additionally, there are studies focused on implementing strategies for the management or conservation of bees (Martínez, 2020).

The third quadrant (descriptive, but with TDR elements) included eight objectives aimed at understanding and mapping biological aspects (such as bee connectivity and landscape), and management perceptions (Martínez-Fortún, 2015; Luiza, 2020) (n=5). Unlike quadrants 1 and 2, these studies emphasize the importance of functional connectivity and integrate non-academic actors into the research at various stages. Finally, quadrant 4 (more applied and with more TDR elements) includes the studies (n=10) that integrate a large number of non-academic actors, systematize perceptions, analyze peasant valuations of the coffee-bee agroecosystem, and integrate a Participatory Action Research (PAR) approach (Anderzén *et al.*, 2020; Luna *et al.*, 2022).

Findings and recommendations from the studies with more TDR elements

Some elements of the 15 studies with the highest number of TDR indicators were analyzed. These studies highlight the importance of integrating different group interests, and making the theoretical and methodological bases explicit, as well as the ethical and political aspects present in the narratives of participants (Restrepo, 2020). Furthermore, the importance of spaces for exchange or Peasant School models (López, 2019) that promote dialogue among participants is emphasized. In the cases where work was conducted with beekeepers' organizations, the importance of visualizing the organization as a whole (not only beekeepers but also peasants) was highlighted, as well as making explicit the asymmetric power relations in the collection and commercialization links (Delfin, 2011; López, 2019).

Regarding the contributions of non-academic actors to the understanding of problems in the coffee-bee agroecosystem, some pointed out deforestation and use of pesticides as the main causes for the decline of bees (Marques *et al.*, 2017). On the other hand, it is recognized that the diversity of trees –and bees– in the coffee plantation is associated with the priorities of coffee-growing families, particularly women, thus highlighting the importance of adopting gender and also intergenerational perspectives (Ramos, 2019; Martínez, 2021). Some studies with meliponiculturists (Martínez-Fortún, 2015; Luna *et al.*, 2022) emphasize that working with native bees promotes sensitivity to the agricultural context and environmental vulnerability, which motivates the reorganization of the territory in terms of the conservation of native bees and the invitation to consider them as agroecological indicators.

Among the recommendations for future research, emphasis is placed on designing projects aligned with local dynamics and worldviews (López, 2019), integrating indigenous pedagogical aspects and didactic resources for diverse actors (Delfin, 2011). Likewise, some authors (Luiza, 2020; Martínez, 2021) recommend investigating historical and territorial processes, to help in understanding the problems and possible tensions between the various actors involved. Although the incorporation of different levels of the government sector is recommended, it is important to have agreements for resource management and decision making, as well as to differentiate the management programs for *Apis mellifera* and stingless bees (Lara, 2021; Luna *et al.*, 2022).

DISCUSSION

The classification of the studies reviewed in depth according to their research objectives enabled the identification of the main approaches used to study the coffee-bee agroecosystem. Quadrants 1 and 2 (with fewer TDR

elements) showed that the participation of non-academic actors is focused on understanding the different contributions of bees and coffee plantations to humans. Other studies under these approaches expect that their data can be used to promote strategies and practices for pollinator conservation (Moreaux *et al.*, 2022). However, pollination services to crops or payments for environmental services are insufficient to achieve the conservation of pollinators or coffee plantations (2015; Serafin-Castro *et al.*, 2021). In addition, the economic valuation of pollination presents inconsistencies that can lead to scenarios where the benefits of pollination of a forest are fewer than the conversion to coffee cultivation in the same area (Magrach *et al.*, 2019). In fact, when studying the relationship between agroecological practices and ecosystem services, this valuation points out that the application of practices such as the adoption of complex landscapes, field margins, or the application of covering on crops can decrease crop yields when compared to conventional practices (Palomo-Campesino *et al.*, 2018). The above helps to observe that the framework of ecosystem services runs the risk of omitting other values and biocultural frameworks in its evaluations, which are important in the adoption and maintenance of sustainable practices. Among the efforts to integrate various methods of valuing nature, the Intergovernmental Platform on Biodiversity and Ecosystem Services proposes value-centered approaches that can guide transformative changes that foster fairer and more sustainable relationships (Pascual *et al.*, 2023).

Studies such as Cerdán (2012), Bathfield *et al.* (2013), and Anderzén *et al.* (2020) analyze the coffee plantation as part of the peasant agri-food system, where management decisions are associated with a broad socio-political context. In this sense, it is recognized that, although knowledge about pollinators can support the adoption of practices for their conservation (Osterman *et al.*, 2021), it is important to adopt management approaches, such as agroecology, that promote integrated agroforestry systems and bee management (Galetto *et al.*, 2022).

The analysis with the TDR guiding questions showed that, even in theses, there is little emphasis on methodological aspects of participation, such as role definition, formative evaluation, and conflict prevention. The importance of making explicit the positioning of research teams has been pointed out, both in the choice of the theoretical-methodological framework and in the generation of the research objectives (Chambers *et al.*, 2022), since decisions in their design and development are immersed in power relations, legitimacy dilemmas or conflicts of interest, with epistemological implications that must be recognized and addressed (Caniglia *et al.*, 2023). On the other hand, few studies have been found that integrate information related to collaborative

framing and the adaptation of methodology with the various actors. This points out an important distinction of research approaches such as PAR and TDR, where such a phase is considered key to foster knowledge co-production relevant to local contexts (Scholz and Steiner, 2015).

The research contributes to point out that the complexity and vulnerability of coffee agroecosystems in Latin America demand studies that dialogue around conceptualizations, languages, and applications with local knowledge (Hill *et al.*, 2019). Identifying the characteristics of the different studies and the underlying frameworks allows us to understand how the involvement of non-academic participants is conceived, and how to address the asymmetries of power inherent in any collaborative process (Turnhout *et al.*, 2020). This, in turn, can support a scientific paradigm shift (Wong *et al.*, 2013), focused on more meaningful ways of generating and sharing knowledge and understanding (Delgado and Rist, 2016).

Although the importance of KCP in strategies for pollinator conservation has been recognized (Galbraith *et al.*, 2017; Maderson, 2023), this analysis emphasizes the need for theoretical-methodological frameworks that promote a fundamental shift in research processes: from studies that integrate non-academic actors as informants to research that strengthens the tools and capacities of local collaborators, who are considered researchers and "owners" of the process (Chambers *et al.*, 2021). The success of science-policy interfaces for pollinator conservation depends on their credibility, pertinence and relevance in specific contexts (Malmer *et al.*, 2019), and on the coordination of mechanisms to promote transdisciplinary research (Bartomeus and Dicks, 2019).

CONCLUSIONS

The analysis of research with non-academic actors in the study of bees in coffee agroecosystems in Latin America allowed us to observe several levels of participation of non-academic actors in their design and execution. It was identified that most of the studies that incorporated non-academic actors did so mainly as informants or data sources, without them being actively involved in the formulation of problems or in methodological design. However, a small group of studies showed a deeper integration of local knowledge. These studies stood out because they included the interests of diverse social groups, recognizing the multiple perspectives and priorities of the parties involved, and making explicit the theoretical and methodological foundations of the research process. They also consciously addressed ethical and political aspects, particularly power imbalances, and they promoted spaces for dialogue and equitable exchange between academic and non-academic actors,

such as those observed in the experiences with peasant schools. Regarding the review process, integrating various relationships between bees and coffee plantations in the search criteria allowed for a broader assessment of bees and hive management; not only as an ecosystem service for coffee pollination or as a productive activity, but also as part of the livelihoods of the families who inhabit and manage the coffee plantations.

Although the studies analyzed contribute to the KCP on bees in coffee plantations, it was considered that, given the growing socioecological crises of these agroecosystems, it is important for more studies to seek their articulation and relevance in local contexts, and to establish KCP processes directed at generating solutions. In this sense, it is recommended to integrate non-academic actors in future studies that: a) consider the diverse knowledge, life histories and management practices in the methodological design of the research; b) recognize that starting from pre-established objectives is different from reconciling research concerns with those of the groups, based on the reflections of the people who problematize or express their needs; this way, studies can become more relevant; c) design the techniques or tools to generate qualitative information, based on the system of study and local particularities; participatory mapping and interviews can be used to explore interests from which joint objectives are set; d) take care of time, resources and logistics, to generate participation; seek financing; e) establish relationships beyond the academic sphere and take care of emotional and affective bonds; f) reward the attention of the people involved by conducting workshops that address potential knowledge gaps and observed needs; g) promote and ensure communication; h) propose evaluations of the research process from the start; i) encourage co-creation from the beginning, avoiding fragmented compilation; j) formulate long-term participatory research to understand the sociocultural dimensions and effects of climate change on bee management; k) seek to communicate the results in relevant ways to participants, acknowledging their authorship.

Among the main limitations of the review, the geographical bias derived from the place of origin of the authors stands out, as well as the low participation of the panel of international experts and the exclusion of searches in Portuguese. In addition, the selection of key terms limited the inclusion of anthropological or historical approaches. Despite efforts to integrate gray literature, an underrepresentation of reports from civil and governmental organizations was identified, possibly due to publication barriers and different priorities (Lokot and Wake, 2023). Finally, applying TDR evaluation criteria to studies not designed with this approach could introduce biases; it was useful to understand how non-academic actors are being integrated at different stages of the research and whether or not there is an intention to co-produce knowledge. Building

links between academic and non-academic actors requires methodologies, resources and funding schemes that recognize epistemic diversity and of practices. This review highlights the need for transdisciplinary approaches in the study of pollinators and underlines the importance of promoting spaces for intercultural dialogue that legitimize and articulate local and scientific knowledge through relevant and accessible languages.

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