

# Sustainable Development Goal in the beekeeping sector and its cooperative network

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**ABSTRACT:** The Sustainable Development Goals (SDGs) are a global priority in terms of commitment to the responsible development of society. This paper focuses on beekeeping as a strategic sector of the Argentine economy due to its important socio-economic and environmental impacts. The objective of this research is to analyze the practices of beekeeping entities in their alignment with the achievement of the SDGs (with a focus on SDGs 5, 8, 9, 12 and 17), paying special attention to the differential contribution of companies with cooperative formula. It focuses on actions related to work organization, production, innovation and market insertion. To this end, we used variable significance analysis for 2x2 matrices and multivariate factor analysis of multiple correspondences. The results obtained show that there is a positive alignment between the practices of beekeeping sector entities and SDG 5, SDG 12 and SDG 17, with a differential and positive trend for organizations with a cooperative formula. However, the results also show the future challenges faced by the sector, especially with regard to SDGs 8 and 9.

**KEYWORDS:** SDGs, cooperativism, social economy, innovation, honey production.

**ECONLIT DESCRIPTORS:** L10, M140, O13, O32, P13, Q13.

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**RESUMEN:** Los Objetivos de Desarrollo Sostenible (ODS) son una prioridad a nivel mundial en términos de compromiso por un desarrollo responsable de la sociedad. Este trabajo se centra en la apicultura por ser un sector estratégico de la economía argentina por sus importantes impactos socio-económicos y ambientales. El objetivo de esta investigación es analizar las prácticas de las entidades apícolas en su alineación con la consecución de los ODS (con foco en los ODS 5, 8, 9, 12 y 17), prestando especial atención a la contribución diferencial de las empresas con fórmula cooperativa. Se focaliza en las acciones vinculadas con la organización del trabajo, la producción, la innovación y su inserción en los mercados. Para ello, se trabaja con un análisis de significatividad de variables de las matrices 2x2 y con un análisis factorial multivariado de correspondencias múltiples. Los resultados obtenidos ponen de relevancia que existe una alineación positiva entre las prácticas de las entidades del sector apícola y los ODS 5, ODS 12 y ODS 17, con una tendencia también diferencial y positiva para las organizaciones con fórmula cooperativa. No obstante, los resultados dan cuenta también de los desafíos a futuro que enfrenta el sector, especialmente en materia de los ODS 8 y 9.

**PALABRAS CLAVE:** ODS, cooperativismo, economía social, innovación, producción de miel.

# Resumen amplio

## Objetivos de Desarrollo Sostenible en el sector apícola y su red de cooperativas

La Agenda 2030 busca generar compromisos entre las naciones para reducir los impactos que generan las formas hegemónicas de producción sobre los ecosistemas y el crecimiento de las desigualdades sociales y económicas. Dada la centralidad de los ODS como política mundial para alcanzar sociedades más justas, son cada vez más los estudios en distintas partes del mundo, como es el caso de Latinoamérica, que abordan la temática. Entre dichos trabajos, se destacan aquí los que realizan un seguimiento del grado de consecución de los ODS y que analizan escenarios deseables de sistemas de producción y consumo más sostenibles (Laville y García, 2009; Radcliffe, 2015; Villalba-Eguiluz y de-Mendiguren, 2019; Kaul, 2022). En este contexto, el presente trabajo analiza la consecución de los ODS en el sector apícola argentino, el cual posee un papel trascendental en la producción de miel a nivel mundial. Argentina no sólo es el principal productor de América y el cuarto del mundo, después de China, Turquía e Irán; sino que también es uno de los principales países exportadores de miel (FAOSTAT, 2023). A su vez, el protagonismo sectorial del sector apícola aparece también desde un aspecto social, destacando dentro del tejido cooperativo agropecuario argentino (INAES, 2023).

No obstante, dicho protagonismo por el lado de la producción contrasta con los importantes problemas comerciales y ambientales que afronta el mismo desde comienzos del siglo XXI. En términos comerciales, el sector se caracteriza por una estructura productiva muy atomizada y heterogénea, así como por una estructura comercial orientada casi de manera exclusiva al mercado externo, con elevados grados de concentración y con una preferencia hacia el formato de venta a granel con escasa diferenciación (Andrieu et al., 2021). En términos ambientales, el sector enfrenta los desafíos de llevar adelante la producción en entornos cada vez más vulnerables y menos favorables para la misma (De-Groot et al., 2021, Ravinder et al., 2023).

En el contexto anterior, este trabajo de carácter exploratorio trata de dar respuesta a las siguientes preguntas de investigación: (i) ¿con qué grado y en qué sentido el sector apícola argentino impacta en los ODS?, (ii) ¿existen claras diferencias entre las organizaciones cooperativas y el resto en su impacto de los ODS? y (iii) ¿qué variables están teniendo un impacto más favorable en este sentido? Así, el objetivo de nuestra investigación es analizar las prácticas de las entidades apícolas argentinas, evaluando su alineamiento con el logro de los ODS, focalizando el análisis especialmente en los ODS 5, 8, 9, 12 y 17. Al mismo tiempo exploramos la posible contribución diferencial del sector cooperativo, como principal componente de la economía social.

La población objeto de estudio son las personas jurídicas que tributan en la actividad “producción apícola” en Argentina, según Nosis (2020). En total, la población asciende a 228 entidades legalmente registradas. De ellas, casi el 40% son empresas cooperativas (87 entidades).

Como resultado del trabajo de campo se obtuvo que 21 entidades (7 cooperativas y 14 no cooperativas) no tenían actividad. Por tanto, el número final identificado para la población asciende a un total de 207 entidades, de las que 80 son cooperativas. Nos dirigimos a todas ellas, obteniendo la participación de 146 empresas (71 cooperativas y 75 entidades bajo otra figura jurídica no cooperativa), lo que supone un índice de respuesta del 70,53%. Cada una de estas empresas fueron encuestadas telefónicamente entre los meses de enero y abril del año 2022. La encuesta se estructuró en dos apartados con preguntas específicas para el caso de que la entidad asumiera o no la figura jurídica de cooperativa. El primero de los apartados de la encuesta busca caracterizar la relación de la entidad con la innovación en general y con el empleo de las TIC en particular. El segundo apartado está orientado a obtener el detalle de las características de la entidad en cuanto a la gestión, tamaño, así como la orientación productiva y comercial de la misma.

En relación al método de investigación hemos de indicar que, con la finalidad de confirmar las proposiciones vinculadas con el aporte diferencial de las entidades cooperativas a la consecución de los ODS, se aportan los resultados de significatividad a partir del test Chi-Cuadrado y de intensidad a partir del test de VdeCramer y Phi. Estos cálculos se realizan a partir de la información de la Tabla 1, donde se organizan las variables para cada uno de los 5 ODS bajo estudio y se comparan con la variable dependiente “figura jurídica cooperativa”. Toda la información se analizó empleando el software InfoStat (Di Rienzo et al., 2020). Asimismo, se ha empleado una técnica de análisis multivariado de orden cualitativo, a saber, el Análisis de Correspondencias Múltiples (ACM). A través de ella es posible establecer correspondencias (conexión) entre variables cualitativas a partir de la matriz de desviaciones Chi cuadrado (Fachelli y López-Roldan, 2019: 9). En concordancia con los objetivos planteados, se han utilizado un conjunto de variables que se vinculan con los ODS 5, 8, 9, 12 y 17, con la finalidad de estudiar el alineamiento de las entidades apícolas argentinas con los mismos (Tabla 1).

Respecto del análisis realizado para el ODS 5, fue posible destacar el rol positivo del cooperativismo en la incorporación de mujeres dentro del sector apícola. Dicho aporte significativo se reconoce tanto en la posibilidad de incluir mujeres en la gestión como en las nóminas de integrantes.

También en este trabajo se observa una alineación positiva entre las prácticas de las entidades del sector apícola y los ODS 12 y ODS 17, con una tendencia también diferencial y positiva para el sector cooperativo. Es decir, la presencia de productos ecológicos y de alianzas para la innovación están presentes fundamentalmente en el sector cooperativo apícola. Ahora bien, en términos generales es importante señalar que todas las variables tenidas en cuenta para analizar los ODS 12 y ODS 17 se reflejan en menos del 50% de las entidades estudiadas. Esto da cuenta de las posibilidades de nuevas investigaciones en el futuro. También es importante incorporar otros aspectos al análisis que pueden estar influyendo sobre el nivel de consecución de cada ODS. En el caso del ODS 12 se mencionó la vinculación de los contextos de producción agroalimentarios con el uso de agroquímicos y las posibilidades de certificación ecológica. Para el caso del ODS 17 se destacó la necesidad de mejorar el acceso al financiamiento en general para el sector apícola y específico para el sector cooperativo, así como también sobre

elementos que dificultan un acercamiento más directo al sector del consumo mediante el empleo de certificaciones.

Respecto de la situación del ODS 8 observamos que el sector apícola contribuye de manera mayoritaria a la generación de puestos de trabajo. Sin embargo, vimos también que las condiciones de contratación difieren a las de un empleo a tiempo completo; siendo el sector cooperativo el que en términos relativos menos aporta a la creación de empleos con dichas condiciones. La literatura señala que diversos factores influyen sobre este fenómeno, siendo algunos propios de los espacios agro productivos y otros propios del sector cooperativo.

Sobre la alineación de prácticas con el ODS 9, recuperamos primeramente el hecho de que sólo una de cada cinco entidades manifiesta un acceso a infraestructura apropiada para sostener procesos de integración a lo largo de la cadena. Seguidamente, destacamos la importancia de la innovación en la búsqueda de mercados plurales con vínculos más directos entre los sectores de la producción y el consumo. Por ello, en este trabajo se abre el interrogante respecto a si la diversificación observada responde más a estrategias de supervivencia que a estrategias para el crecimiento; a pesar de que la literatura de referencia vincula positivamente a la diversificación con el ODS 9.

Consideramos oportuno presentar limitaciones en nuestro estudio. En primer lugar, se trabaja a nivel sectorial con aquellas formas de organización de la producción apícola que cuentan con personalidad jurídica. En segundo lugar, no se trabaja aquí con un seguimiento inter-temporal de las variables contempladas y, en tercer y último lugar, no se trabaja tampoco con las asociaciones posibles de ser reconocidas entre aspectos de diferentes ODS. Ahora bien, consideramos también que desde el presente trabajo se brinda un aporte empírico y teórico para discutir e indagar la alineación de las prácticas de las entidades con los ODS en contextos agropecuarios y latinoamericanos. Esta investigación abre también campo de trabajo para futuras investigaciones. Entre ellas podemos destacar las siguientes: a) profundizar en el análisis de indicadores sectoriales que nos permitan medir la contribución del sector apícola Argentino a los ODS y su diferenciación dependiendo de si se tratan de empresas cooperativas; b) extender este análisis a otros sectores agroalimentarios y comparando qué indicadores son diferenciales en cada sector; c) ampliar el análisis sectorial a niveles internacionales y a otros ODS relacionados con el sector agroalimentario en general y apícola en particular.

# 1. Introduction

The 2030 Agenda seeks to generate commitments among nations to reduce the impacts of hegemonic forms of production on ecosystems and to address the rise in social and economic inequalities. For this, in 2015 the Sustainable Development Goals (SDGs) were established, which can be grouped around the following lines of commitment: People (1, 2, 3, 4 and 5), Planet (6, 12, 13, 14 and 15), Prosperity (7, 8, 9, 10 and 11), Peace (16) and Partnerships (17). Different targets and indicators are proposed for each SDG in order to monitor their evolution. Thus, a key objective in this complex integration process is to involve not only governments but also the private sector and citizens in order to achieve the synergies that will make it possible to reach them. In this context, the role of the Social Economy sector is highlighted (UNTFSSSE, 2022; UN, 2023; Mozas-Moral et al., 2023).

Given the centrality of the SDGs as a global policy to achieve fairer societies, there are an increasing number of studies in different parts of the world, such as Latin America, that focus on them. Among all these studies we highlight the ones that monitor the degree of achievement of the SDGs and analyze desirable scenarios of more sustainable production and consumption systems (Laville & García, 2009; Radcliffe, 2015; Kaul, 2022). In this context, this paper analyzes the achievement of the SDGs in the Argentine beekeeping sector, which has a transcendental role in honey production worldwide. Argentina is not only the main producer in the Americas and the fourth in the world; it is also one of the main honey exporting countries (FAOSTAT, 2023). Furthermore, Argentine beekeeping plays an important role in the framework of agri-food systems through pollination (Smith et al., 2019) and in the network of Argentine agricultural cooperatives (INAES, 2023).

However, the prominence indicated for the Argentine beekeeping sector contrasts with the significant commercial and environmental problems it has been facing since the beginning of the 21st century. In commercial terms, the sector is characterized by a highly atomized and heterogeneous production structure, as well as by a commercial structure oriented almost exclusively towards the foreign market, with high levels of concentration and a preference for bulk sales with little differentiation (Andrieu et al., 2021). In environmental terms, the sector faces the challenges of carrying out production in increasingly vulnerable and less favorable habitats. In other words, the loss of forested areas, the advance of the agricultural frontier and the use of agrochemicals, among other factors, produces negative transformations for the sector under study (De-Groot et al., 2021, Ravinder et al., 2023).

Thus, the objective of our research is to analyze the practices of Argentine beekeeping entities, evaluating their alignment with the achievement of the SDGs, in particular SDGs 5, 8, 9, 12 and 17. At the same time, we explore the possible differential contribution to this process by the cooperative sector, as the main component of the social economy. To this end, the research questions are: (i) to what extent and in what sense does the Argentine beekeeping sector impact the SDGs? (ii) are there clear differences between cooperative organizations and the rest in their impact on the SDGs? and (iii) which variables have a more favorable impact in this regard? To achieve these objectives this paper is structured as follows: after this introduction,

a second section reviews the theoretical literature in order to establish a theoretical link between the SDGs and the practices of these entities in the sector. The third section presents in detail the population under study, the methodology chosen and the variables used. The following sections present the results of the study and their discussion. Finally, the corresponding conclusions are presented.

## 2. Theoretical Framework

### 2.1. The Argentine beekeeping sector and its contribution to the SDGs

Despite Argentina's importance in the world beekeeping market, the sector is facing challenges and difficulties. In the field of primary production, there has been a drop in average yields since the beginning of the 21st century, with an average of 23.5 kg/u for the years 2011-2020, 27.7 kg/u for the years 2001-2010 and 36.9 kg/u for the years 1991-2000 (FAOSTAT, 2023). This decline is influenced by a number of factors that negatively affect hives and beekeeping practices beyond beekeeping management. Among them are the loss of biodiversity, the advance of industrial agriculture over pastures and natural forests, the homogenization of territories and increased exposure to diseases, among others (Rivera and Ortiz-Pech, 2020; De-Groot et al., 2021; Ravinder et al., 2023). This is partially offset by a growth in the number of hives. However, the production structure is presented as atomized and more than 85% of producers have fewer than 500 hives (MAGyP, 2019; MAGyP, 2023).

In terms of labor, it is worth pointing out the significant presence of "submerged" economies in the field of beekeeping production. In fact, in terms of employment the Argentine beekeeping sector is considered the primary sector with the highest level of labor informality (Pitetti et al., 2022). The sector has an estimated 100,000 direct and indirect workplaces (MAGyP, 2023). However, direct employment projections only recognize 7,253 workplaces of which only 65.4% are salaried positions. Also, because only 1,789 positions are "formal salaried positions", the informality rate of salaried employees rises to 62.3%. The rest of the positions created are non-salaried positions. Another characteristic is the limited presence of women in employment records, so that only 5.7% of direct salaried positions are held by women (Pitetti et al., 2022).

In addition to the problems inherent to the production sector there are other problems related to the marketing of bee products, especially honey. These include the significant dependence on external markets and their evolution, the lack of differentiation resulting from preferential bulk sales and the concentration of sales by a few exporting companies to a few markets. Indeed, in 2021 a volume of 60.4 thousand tons of honey was destined to international markets, mainly to the United States, Germany and Japan; this volume represented 85% of domestic production (FAOSTAT, 2023). A contraction of 8% has also been observed with

respect to the average Argentine volume exported between 2011 and 2020 -66.6 thousand tons- (FAOSTAT, 2023). Finally, it should be noted that bulk sales (drums) have an impact on average prices per kilogram exported, causing values for Argentina to be below the world average (FAOSTAT, 2023).

Compared to the supply problems, honey consumption shows a favorable evolution. Thus, world honey exports grew by an average of 5% per year in the last decade (FAOSTAT, 2023). Even within Argentina there has been a growth in apparent honey consumption (Andrieu et al., 2021). On this favorable trend, it is observed that honey has managed to consolidate within the group of natural products related to healthy eating (INTA, 2018; Pippinato et al., 2020). This is mainly associated with its characteristic as a natural sweetener, in addition to other properties that expand its potential use (Urquiza-Jozami et al., 2019). Similarly, it is expected that honey consumption will be favored in the future by the development of policies with an intersectional perspective intended to improve the population's diet. This is from a reduction in the consumption of ultra-processed products and an increase in the consumption of natural products (Aguirre, 2021). In this context, it is important to consolidate the production and distribution systems of such production to make them more sustainable (Sebillotte, 2018; Blacha, 2020).

Furthermore, based on the characteristics that define the Argentine beekeeping sector various authors have studied the contribution to the SDGs by the entities operating in the reference sector. Thus, in relation to the sector's contribution to the achievement of SDG 5 -gender equality-, some studies have highlighted the existence of a "masculinized" sector (De-Arce & Gañán, 2019), although there are other studies that point out the potential of the beekeeping sector to include women (Patel et al., 2021). Meanwhile the importance of beekeeping for sustainable development within the framework of Argentine public policy is shown (PROAPI, 2015); the research of Patel et al. (2021) systematizes global studies that suggest the existence of a positive link between beekeeping and the achievement of SDG 8 - decent work and sustainable growth -; of SDG 9 -resilient infrastructure, sustainable industry and innovation- and SDG 12 -responsible production and consumption. However, Alves et al. (2022) warn of the need to monitor honey quality in certain production environments, where it can be exposed to toxic substances. Finally, a theoretical framework is recognized in which SDG 17 -Partnerships- is positively linked to the possibility of carrying out pollinator monitoring and biodiversity protection activities (Requier et al., 2020) and also to improving the commercial insertion of hive products (Pereira & Schaitza, 2021).

## 2.2. The cooperatives and their contribution to the SDGs

The role that the social and solidarity economy can and does play in achieving the SDGs is being recognized in some regions of the world, including Latin America. Several studies investigate the prioritization of the SDGs in terms of practices that could contribute to the achieve-



ment of the 2030 Agenda from non-governmental sectors (CEADS, 2019; UNTFSSSE, 2022; UN, 2023; Mozas-Moral et al., 2023).

In Argentina there are 825 entities categorized as cooperatives linked to the agricultural sector, representing 4% of the cooperative sector (INAES, 2023). There are several aspects that make this sector important (Verbeke, 2021): The first aspect refers to the greater average stability of its entities, being 40 years old as of April 2023, while the average age was 10 years for the rest of the cooperatives (INAES, 2023). The second aspect refers to a recent positive change in the evolution of cooperativism in general, and of agricultural cooperativism in particular, in the last two years, with a 20% growth rate in the agri-food sector (INAES, 2023). The third and last aspect refers to the contribution of the agricultural sector to the generation of work positions within the cooperative sphere. In this sense, agricultural cooperatives represent the second most important block in terms of job creation<sup>1</sup> after public service-oriented cooperatives, excluding worker cooperatives (Vuotto, 2021:36).

The importance of the beekeeping sector within the agricultural cooperative sector should also be noted. As of April 2023, the honey production sector had 66 producer organizations, 73 service providers and 13 worker organizations (INAES, 2023). These numbers mean that beekeeping is positioned as the second agricultural chain with the highest number of registrations in vigor (INAES, 2023). Beekeeping cooperatives in vigor in 2023 have an average age of 15 years and reflect a 25% increase in the number of cooperatives in the last two years (INAES, 2023). These values, in comparison to those of the agricultural cooperative sector as a whole, give us an indication of a younger and, at the same time, more dynamic sector.

Many authors have studied the differential contributions of cooperative enterprises to the SDGs compared to other types of enterprises. It is argued that the same cooperative principles on which SSE entities are based are aligned with the proposals of the 2030 agenda (de-Souza & Pamplona, 2022; Mozas-Moral et al., 2023). It is expected that the achievement of the cooperative principles will contribute significantly to the achievement of the SDGs, since it promotes the active and democratic participation of members, equity and non-discrimination, economic and social development and environmental protection. Also, the work agenda of these entities has a strong commitment to their environment and provides a response to their own constraints/stresses (Lee, 2020), even when the alignment occurs unintentionally (Villalba-Eguiluz et al., 2020).

In this way, it is possible to find studies that show that cooperatives promote equity and non-discrimination in all their activities, which is directly related to SDG 5 -Gender equality (Núñez et al., 2020; Mozas-Moral et al., 2023). In relation to SDG 8 -decent work and sustainable growth- cooperatives can contribute to creating decent jobs and promoting sustainable economic growth (Núñez et al., 2020; UNFTSSE, 2022). There are several cooperative principles that can help create a fair and equitable work environment; providing opportunities in

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1. However, this represents only 0.5% of the total number of salaried workers in cooperatives (Correa-Mautz, 2022:34). It is also mentioned that the cooperatives that appeared in the Argentine Integrated Social Security System (SIPA) declaring at least one dependent employee represented 45% of the cooperative entities -excluding worker cooperatives- with active registration as of 2012 (Llorente & Molina, 2014:8).

vulnerable and local contexts (Mozas-Moral et al., 2023). In relation to SDG 9 - resilient infrastructure, sustainable industry and innovation - cooperatives can contribute to promoting innovation and the development of sustainable infrastructure. It is noted that cooperative principles of active and democratic member participation, as well as transparent and accountable cooperative management, can foster innovation and entrepreneurship within the organization (Salustri, 2019; UNFTSSE, 2022). This can lead to the creation of new innovative products, services and processes that contribute to sustainable economic development. Cooperatives can also promote access to technology and communications in rural or marginalized areas, helping to reduce the digital divide and promote socioeconomic development (UNFTSSE, 2022).

Regarding SDG 12 - responsible production and consumption - cooperatives can also contribute to promoting responsible production and consumption (Hernández-Perlines et al., 2020; UNFTSSE, 2022; Mozas-Moral et al., 2023). Cooperative principles of transparent and democratic management, as well as equity and non-discrimination, can help ensure that the cooperative operates in a responsible and sustainable manner. Through their business model cooperatives can also promote sustainable production and consumption practices, such as fair production and trade, and the promotion of sustainable agricultural and trade practices. Active member participation in decision-making can also foster social and environmental responsibility in the cooperative. Furthermore, this same fundamental principle (Hudon and Huybrechts, 2017) is directly related to SDG 17 -Partnerships. That is, cooperatives that promote participation and transparency can help strengthen governance, accountability and the building of effective partnerships to achieve common goals (Rodríguez-Cotilla, 2022).

In the above context, this exploratory paper seeks to answer the following research questions: (i) to what extent and in what sense does the Argentine beekeeping sector impact the SDGs? (ii) are there clear differences between cooperative organizations and the rest in their impact on the SDGs? and (iii) which variables have a more favorable impact in this regard?

## 3. Methodology

### 3.1. Population

The population of study are the legal entities taxed in the activity “beekeeping production” in Argentina, according to the database of NOSIS (2020). In total, the population amounts to 228 legally registered entities. Of these, almost 40% are cooperative enterprises (87 entities). As a result of the fieldwork, 21 entities (7 cooperatives and 14 non-cooperatives) were found to have no activity. Therefore, the final number identified for the population amounts to a total of 207 entities, of which 80 are cooperatives. We approached all of them, obtaining the participation of 146 companies (71 cooperatives and 75 entities under another non-cooperative legal form), which represents a response rate of 70.53%. Each of these companies were surveyed by telephone between January and April 2022. The survey was structured in two sections with

specific questions for whether or not the entity assumed the legal form of a cooperative. The first section of the survey seeks to characterize the entity's relationship with innovation in general and with the use of ICTs in particular. The second section is aimed at obtaining details of the entity's characteristics in terms of management and size, as well as its productive and commercial orientation.

## 3.2. Methods

In order to confirm the propositions related to the differential contribution of cooperative entities to the achievement of the SDGs, the results of significance, based on the Chi-Square test, and of intensity, based on the VdCramer (VdC) and Phi test, are provided. These calculations are based on the information in Table 1, where the variables for each of the 5 SDGs under study are organized and compared with the dependent variable "cooperative legal form". A qualitative multivariate analysis technique, namely Multiple Correspondence Analysis (MCA), was also used. The multivariate MCA technique, although exploratory, allows the rows and columns of a multidimensional contingency table to be represented graphically in a two-dimensional space, facilitating the interpretation of the associations between variables (Greenacre, 1994). Through it is possible to establish correspondences (connections) between qualitative variables from the Chi-square deviations matrix (López-Roldan & Fachelli, 2016:133-177). All the information was analyzed using InfoStat software (Di Rienzo et al., 2020).

## 3.3. Variables

In accordance with the stated objectives, a set of variables that are linked to SDGs 5, 8, 9, 12 and 17 were used to study the alignment of Argentine beekeeping entities with them (Table 1). The variables were selected to fit both the theoretical purpose and the requirements of the factor analysis technique itself (data type/variance/minimum frequency) (Hernandez-Sampieri et al., 2017, p. 548). Table 1 presents in detail the variables associated with each SDG and the analysis factor, as well as the categories considered for each of them and a brief description of the content.

It should be noted that during the fieldwork access to financing and investment in ICTs was investigated, showing that investments in ICTs were uncommon and that when they did appear, the funds were mostly their own. Therefore, in SDG9 the link with credit markets is recovered in general terms based on their "scoring" (Gayoso, 2021).

**Table 1.** Description of variables

SDG	Details	Type	Value	Framework
n/a	Legal Entity	(D)	Entities with or without the legal form of a cooperative.	-----
SDG5	Woman.Member	(C)*	Proportion of women members. Entities without formal women members (No.W.Mem), entities whether the proportion tended to be balanced (Equ.W.Mem when women represent more than 40%) or not (Inequ.W.Mem when women represent less than 40%).	Variables like proportion of women in management, in constituent payrolls and, among others, in employment payrolls (Mozas-Moral, 2019; Parrilla-Gonzalez & Ortega-Alonso, 2022)
	Woman. Employ	(C)*	Proportion of women employed. Entities without formal women workers (No.W.Employ), entities whether the ratio tended to be balanced (Equ.W.Employ when women represent more than 40%) or not (Inequ.W.Employ when women represent less than 40%).	
	Woman.Manage	(D)	Presence of women in management positions (at least one)	
SDG8	Qemploy	(C)*	Number of direct jobs per entity according to the person in charge; without considering the contribution of the latter in the count.	Variables related to production levels (Mozas-Moral, 2019; Abudu et al., 2023) and employment generated (Hernández-Perlines et al., 2020; Abudu et al., 2023).
	FullTimeEmploy	(D)	Entities with full-time workers.	
	Qhives/ Member	(C)*	Range of average number of hives per member for each entity.	
	Average PRD	(D)	Entities with members whose average number of hives is higher than the average for the group analyzed.	

SDG	Details	Type	Value	Framework
SDG 9	Diversification	(C)*	Presence of production diversification actions (related and unrelated).	Variables about diversification, internationalization, level of ICT use (Kynclová et al., 2020; Fuster-Morell et al., 2020; Patel et al., 2021), integration in the value chain and access to financing (United Nations, 2023). It is part of SDG 9 and not of SDG 17, because here ICTs are recognized as facilitators of direct links with the market (Fuster-Morrel et al., 2020; Mozas-Moral et al., 2023).
	ExternalMarket	(C)	Presence of links with foreign markets, differentiating here between indirect and direct links.	
	Integ. Supply Chain	(C)	Gradient of integration for the group of entities in terms of their links with the honey production and marketing chain (from less to more integrated).	
	ICT.Use	(C)*	Use of ICT tools according to implementation by each entity. Ranked according to entities that do not use any tool, entities that implement only one type of tool and entities that vary the use of more than one type of tool.	
	Found Acces	(C)*	Credit score reflecting the greater or lesser financial suitability for accessing private credit (from least to greatest creditworthiness)	
SDG 12	Labeling	(D)	Entities with end-product certifications.	Variables related to the presence of certifications were used, especially those of an "ecological" nature (Biggeri et al., 2021; Rótolo, 2022; Del-Águila-Arcenales et al., 2022; Mozas-Moral et al., 2023).
	Ecological	(D)	Entities stating the possibility of certifying their production as ecological (whether or not certification takes place)	
SGD17	PartnerInnovation	(D)	Entities with the presence of agreements to carry out innovations.	Variables related to the presence of partners for innovation and/or partners for commercialization were used (Rodríguez Cotilla, 2022)
	PartnerCommerce	(D)	Entities with agreements for the commercialization of production.	

Source: Compiled by the authors.

## 4. Results and Discussion

The results obtained suggest that there is a positive alignment between the beekeeping activity and the achievement of SDG 5, SDG 12 and SDG 17. In the case of SDG 8 and SDG 9, it is observed that the practices do not always present a positive alignment and even when they do, the frequency of occurrence is low. In turn, the activity of companies under the cooperative legal form is positively aligned with the achievement of four of the five SDGs analyzed. This is the case for SDG 5, SDG 12, SDG 17 and, partially, in SDG 8, with SDG 9 being the only goal in which a negative relationship is reflected for the cooperative sector.

**Table 2.** Correlation matrix of the variables related to SDGs, discriminating by cooperative

SDG	DETAILS	CATEGORY	Frec. LABEL/ TOTAL CASES (*)	Frec. COOP/ TOTAL LABEL (**)	Chi-C	VdC/Phi
1	[Legal.Entity]	No.Cooperative	48.6%	—	—	—
		Cooperative	51.4%	—		
5	Proportion of women members [Woman.Member]	No.W.Mem	47.5%	25%	58.61 (0.000)	0.640 (A)
		Inequ.W.Mem	37.8%	91%		
		Equ.W.Mem	14.7%	24%		
	Proportion of women employed [Woman.Employ]	No.WEmploy	69.4%	49.0%	—	—
		Inequ.W.Employ	15.3%	45.5%		
		Equ.W.Employ	15.3%	54.5%		
Presence of women in management positions [Woman.Manage]	No.W.Manag	76.7%	36.6%	27.8 (0.000)	0.437 (B)	
	Yes.W.Manag	23.3%	88.2%			

SDG	DETAILS	CATEGORY	Frec. LABEL/ TOTAL CASES (*)	Frec. COOP/ TOTAL LABEL (**)	Chi-C	VdC/Phi
8	Number of direct jobs [Qemploy]	No.employ	42.4%	50.8%	-	-
		1.employ	13.2%	42.1%		
		2-3.employ	21.5%	54.8%		
		≥4.employ	22.9%	45.5%		
	Presence of full-time jobs [FullTimeEmploy]	No.FullT.Employ	79,0%	55.3%	7,770 (0,005)	0.232/ -0.232 (B)
		Yes.FullT.Employ	21,0%	26.7%		
	Number of hives per member [Qhives/Member]	0-58h/M	24.6%	47.2%	-	-
		59-200h/M	26.7%	53.8%		
		201-400h/M	24%	57.1%		
		>400h/M	24.6%	36.1%		
Average number of hives per member above the average [AveragePRD]	No.AveragePRD	66.4%	54.6%	4,178 (0,041)	0.169/ -0.169 (B)	
	Yes.AveragePRD	33.6%	36.7%			
9	Production diversification strategies [Diversification]	No.Div	17.8%	19.2%	15,405 (0,000)	0.325 (I)
		Yes.DivRel	62.3%	60.4%		
		Yes. DivRel&noRel	19.8%	37.9%		
	Form of linkage with external markets [External.Markets]	No.X	32.9%	45.8%	-	-
		Indirect.X	59.6%	50.6%		
		Direct.X	7.5%	45.5%		
	Integration within the supply chain [Integ. SupplyChain]	No.IntegSC	11.6%	58.8%	-	-
		low.IntegSC	22.6%	39.4%		
		midl.IntegSC	45.2%	50.0%		
high.IntegSC		20.5%	50.0%			
Number of types of ICT tools implemented [ICT.Tool]	No.ICTuse	54.1%	49.4%	6,272 (0,043)	0.207 (B)	
	1.ICTuse	28.8%	59.5%			
	2-3t ICTuse	17.1%	28.0%			
Ease of access to finance [Found.Access]	low.FoundAcces	34.1%	84.4%	32,714 (0,000)	0.496 (I)	
	midl.FoundAcces	33.3%	38.6%			
	high.FoundAcces	33.3%	27.3%			

SDG	DETAILS	CATEGORY	Frec. LABEL/ TOTAL CASES (*)	Frec. COOP/ TOTAL LABEL (**)	Chi-C	VdC/Phi
12	Presence of end-product certify [Labeling]	No.Label	67.8%	48.5%	-	-
		Yes.Label	32.2%	48.9%		
	Possibility of ecological production [Ecological]	No.Ecological	56.2%	36.6%	10,864 (0.001)	0.273 (B)
		Yes.Ecological	43.8%	64.1%		
17	Collaboration for innovation activities [PartnerInnovation]	No.PartnerInn	67.8%	35.3%	14,484 (0.000)	0.315 (I)
		Yes.PartnerInn	32.2%	67.2%		
	Collaboration for marketing activities [PartnerCommerce]	No.PartnerCom	58.3%	41.4%	-	-
		Yes.PartnerCom	41.7%	63.8%		

(\*) The weight of each category over the total number of cases.

(\*\*) The weight of each category over the entities' cases with the legal form of a cooperativeSource: Compiled by the authors.

Source: Compiled by the authors.

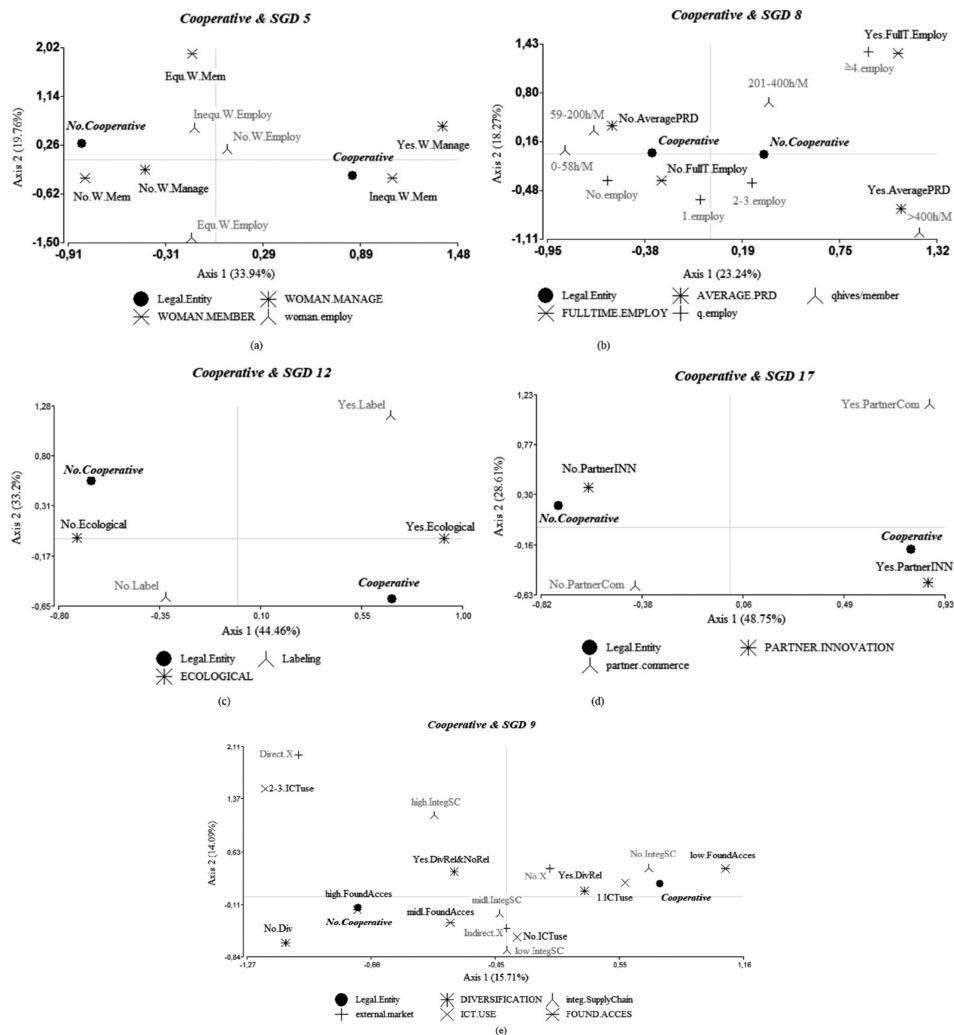
Figure 1 complements the information of Table 2 and presents the biplot graphs from ACM. Those graphs allow us to explore how cooperatives and non-cooperatives are ordered by the variables used to evaluate each SDG studied but also by adding the possibility of visualizing the proximity between each category of the set considered. The first two axes, which accumulate most of the inertia, are presented for each case (López-Roldan & Fachelli, 2016).

Geometrically, the resulting dispersion diagram makes it possible to identify the cases (rows) and the categories of the variables (columns). Thus, a positive correlation is proposed for those row-points and column-points that fall in the same direction with respect to the origin, and a negative correlation for those that fall in opposite directions (Greenacre, 1994).

The results obtained for each of the SDGs – listed in Table 2 and plotted in the different sections of Figure 1 - are detailed below, taking into account the sectoral particularities of beekeeping in general and cooperativism in particular.



Figure 1. Relationship between the SDGs and cooperativism



## 4.1. Gender Equity - SDG 5

Table 2 provides a first perspective on the situation of gender equity in the beekeeping sector in Argentina. The majority of beekeeping entities in the country include at least one woman on their payrolls. However, the data also suggest the persistence of gender inequalities. These inequalities for women are manifested both when it comes to being members or workers and

when it comes to occupying management positions. Thus, when women access jobs in beekeeping, the conditions of those jobs are worse. That is to say, although the number of women out of the total number of workers rises to 28%, their representation drops to 8% when compared to the total number of full-time workers. These results are in line with others in which the agricultural sector is pointed out as a “masculinized” productive sector (de-Arce & Gañán, 2019).

In turn, among beekeeping enterprises those that have the legal form of cooperatives contribute more than non-cooperative entities to the inclusion of women as associates and as members of management positions. These results are in line with studies that recognize the contribution of the social economy sector in reducing gender inequalities (Núñez et al., 2020; Parrilla-Gonzalez & Alonzo-Ortega, 2022; Mozas-Moral et al., 2023). In Argentina, the latest available data for the cooperative as a whole reveal that only 18.7% of the Boards of Directors had any women, although with preference in the positions of secretaries and auditors (known in Argentina as “síndicos”) rather than in presidency or treasury (Mutuberría-Lazarini, 2022:43). In comparison, representation is greater in the beekeeping sector, since there are 30 cooperatives with women in management positions, meaning 42% of such entities. However, only 2 beekeeping entities have women in the presidency, which means that more women occupy the positions of financial controller and secretary than those of treasurer, as is the case for the cooperative sector as a whole. Similarly, Figure 1.a shows that in terms of gender equity the label that shows equity on payrolls does not show any inclination towards cooperatives or other legal entities. Hence the importance of working to incorporate proposals that tend to reverse the vertical and horizontal segregation processes mentioned above (Mutuberría-Lazarini, 2022).

## 4.2. Decent work and sustainable growth - SDG 8

Within the framework of SDG 8, it is important to observe the form of growth that characterizes the sector under study and the type of work created. In this sense, the information collected allows us to recognize, in agreement with other studies, that the beekeeping sector does indeed contribute to job creation (PROAPI, 2015; Patel et al., 2022). However, the data also show a shortage of full-time jobs (with only 21% of the entities reporting full-time job creation). In turn, the sector under study is made up of micro and small enterprises (SEPyME resolution No. 23/2022). Regarding the monetization of sales and capital proposed in the same resolution, it should be clarified that we cannot go into greater detail, since the questions on these aspects were not answered in a large number of cases.

Regarding the specific contribution of SSE entities to the achievement of SDG 8, we note first of all that, although there is no significant difference between cooperatives and other legal forms in terms of employment generation<sup>2</sup>, the creation of full-time jobs is lower in coopera-

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2. Table 2 shows that the variable “Number of direct jobs” presents balanced percentages for all categories between cooperative and non-cooperative entities.

tives (only 26.7% of cooperatives create full-time jobs). However, it is important to recognize that within cooperative spaces there is an unaccounted contribution of voluntary and solidarity work by members and their families (Fuster-Morell et al., 2020; UNFTSSE, 2022). Secondly, the SSE sector is conscious of the importance of generating growth with equity (UNFTSSE, 2022). In addition, it is necessary to consider the fact that cooperatives are more associated with less capitalized bee producers in terms of number of hives (they include only 34.6% of the entities with 400 or more hives per member). This fact, if not adequately contemplated in the indicators, can be interpreted as a contradiction inherent to SDG 8 (Hickel, 2019). Figure 1.b highlights an aspect that could not be seen in the 2x2 matrices, which refers to a graphic association between the categories of “4 or more employees” and “full-time workers”, regardless of the cooperative legal form and the infrequency with which it occurs sectorally.

### 4.3. Resilient infrastructure, sustainable industry and innovation - SDG 9

The results in Table 2 show that diversification is prevalent in most of the entities in the bee-keeping sector (only 17.8% of the entities do not diversify). However, although diversification is present, direct linkages between the production and consumption sectors are absent in many of the cases studied. In other words, access to infrastructure to support integration in the supply chain is deficient (companies with high levels of supply chain integration are only 20.5%). It is also noted that the levels of innovation in the implementation of ICTs are low (still 54.1% has limited use of ICT tools) and that the relationship with external markets is fundamentally indirect (entities with direct exports account for only 7.5%). In turn, these problems are exacerbated to the extent that there are difficulties in accessing sources of financing (where a satisfactory level of financial solvency is found only in one third of the cases). For these reasons we consider it necessary to review the way in which the internationalization of a sector is evaluated, especially because Argentina is part of the global honey production chain where most of its production is destined for exports, with low added value and offered by few companies (Pitetti et al., 2021; Andrieu et al., 2021).

Regarding the contribution of social economy entities to the achievement of the SDG9, we note that there are three practices in which there are significant differences according to the type of legal form. Specifically, we found that there is a minority of cooperative entities in the ranges: i) without diversification or with related diversification combined with unrelated diversification; ii) with greater use of ICT tools and iii) with better credit scores. In this context, we question how to interpret the alignment of practices with respect to SDG 9. Regarding Figure 1.e, it is again possible to recognize that the appropriate infrastructure to sustain integration is shown to be closer to direct links with the market and with the greater number of ICT tools implemented. At the same time, the existence of an indirect linkage to the external market occurs in both cooperatives and non-cooperatives; a fact that occurs in environments of low integration in the chain and limited use of ICT tools. For all, we ask ourselves whether

the observed pluriactivity (related and unrelated) is the result of a growth strategy or simply reflects a survival strategy. We also question what kind of constraints are introduced by poor access to private financing for the development of resilient and sustainable infrastructure. In this sense, although the literature considers that cooperatives introduce a key and differential contribution in innovation processes the process is not free of contradictions (Salustri, 2019; Hickel, 2019).

## 4.4. Sustainable production and responsible consumption - SDG 12

The information presented provides empirical evidence that the challenges for organic bee production persist (56.2% of entities do not have the possibility of certifying their production as ecological). This is a relevant discussion, not always present, for the analysis of the linkage between honey as a natural product and SDG 12 (Patel et al., 2021). The fact that ecological certification is not present in a large majority of companies calls into question such a relationship and it is important to consider whether the production areas are exposed to pollutants (Alves et al., 2022). Precisely, in Argentina the productive sector that certifies its honey as organic is almost insignificant (it does not exceed 1% of the hives for the year 2021), and when it occurs it happens in peripheral areas for the national beekeeping production (MAGyP, 2023). Therefore, while it is noted that the percentage of entities with the possibility of certifying is higher than if we focus only on organic certification, it is also recognized that there could be limitations to the certification processes themselves. In this sense, in view of the fact that beekeeping appears to be increasingly related to agrifood regions and for that with more possibility of being exposed to agrochemicals, we highlight the interstices for the development of other types of certifications; even on the agricultural landscape (López-García et al., 2021).

It is possible to observe, as evidenced by other authors such as Hernández-Perlines et al. (2020) along with international declarations (UNDP 2020, ILO 2021; OECD 2022 in: UNTFSSE, 2022: 67), that the SSE sector studied contributes differentially to the achievement of SDG 12. This happens in particular from the promotion and accompaniment of more sustainable forms of production and consumption (Rambo & Freitas, 2019). However, this alignment between practices and SDGs may be unintentional. An example of this situation could be found if there were a concurrence or association between the location of cooperative entities, beekeeping production areas less exposed to the presence of pollutants and the possibility of certification. Also, Figure 1.c shows that certain aspects of marketing (certifications for consumption) are uncommon (entities without end-product certification represent 67.8% of the cases) and occur regardless of the legal status of the entity. This fact could reinforce the problems with obtaining ecological certification.

## 4.5. Partnerships - SDG17

Agreements on innovation and marketing are key axes linked to the achievement of SDG 17 (Mozas-Moral et al., 2023). In the beekeeping sector studied the existence of collaborative work experiences is evident, both for innovation and marketing activities, although only in a minority of companies. These results are in line with those of other studies (Requier et al., 2020; Pereira and Schaitza, 2021). Regarding section (d) of Figure 1, it is again possible to recognize that the materialization of commercial agreements is infrequent and also occurs regardless of the legal status of the entity.

In the Argentine agricultural cooperative sphere, in 2008 13.7% of these entities reported having carried out Research and Development activities (INAES, 2008: 133). These values are lower than those identified within the cooperative beekeeping sector, where more than half of the cooperatives surveyed claimed to carry out collaborative innovation activities. For this reason, the empirical evidence is considered to be in line with the literature regarding the specific contribution of the SSE sector in terms of innovation (Hudon and Hybrechts, 2017; Rodríguez-Cotilla, 2022; Mozas-Moral et al., 2023). However, this information must be interpreted taking into account the observed sectoral deficits in access to financing.

## 5. Conclusions

The purpose of this article has been twofold: The first is to review the alignment of the practices of Argentine beekeeping entities with the achievement of the SDGs (5, 8, 9, 12 and 17). The second, to inquire about the differential contribution of the cooperative sector within this productive space. The following final reflections are written based on the evidence found in favor of the practices of SSE entities that are significant in the achievement of the SDGs.

Regarding the analysis carried out for SDG 5, it was possible to highlight the positive role of cooperatives in the incorporation of women into the beekeeping sector. This significant contribution is recognized both in the possibility of including women in management and in the membership lists, even when the persistence of vertical and horizontal segregation processes is also identified. That is to say, when the inclusion of women is effective -both in the lists of members and in the lists of workers- it happens mostly in contexts of inequity. Women are also in the minority in management positions such as presidents or managers in the entities. For this reason, it is important to continue investigating the persistence of gender biases in the roles assumed by women in the productive sector under study.

This work also shows a positive alignment between the practices of the entities in the beekeeping sector and SDG 12 and SDG 17, with a differential and positive trend for the cooperative sector. In other words, the presence of ecological products and partnerships for innovation are mainly present in the beekeeping cooperative sector. However, in general terms, it is important to note that all the variables taken into account to analyze SDG 12 and SDG 17 are

reflected in less than 50% of the entities studied. This shows a margin for action on which it is possible to work in the future. It is also important to incorporate other aspects into the analysis that may additionally be influencing the level of achievement of each SDG. In the case of SDG 12, the linkage of agrifood production contexts with the use of agrochemicals and the possibilities of organic certification were mentioned. In the case of SDG 17, the need to improve access to financing in general for the beekeeping sector and specifically for the cooperative sector was highlighted, as well as elements that hinder a more direct approach to the consumer sector through the use of certifications.

Regarding the situation of SDG 8, we observed that the beekeeping sector contributes the most to job creation. However, we also saw that the hiring conditions differ from those of full-time employment, with the cooperative sector being the one that in relative terms contributes the least to the creation of jobs with such conditions. The literature points out that several factors influence this phenomenon, some of which are specific to agro-productive spaces and others to the cooperative sector. In any case, this is presented as a warning regarding the need to incorporate forms of measurement that do not make work invisible and thus to think about the new challenges that lie ahead for the achievement of SDG 8. This idea of equity is not fully contemplated regarding SDG8, and it is necessary to be alert to the possible contradictions that this could lead to.

Concerning the alignment of practices with SDG 9, we note firstly that only one in five entities report having access to adequate infrastructure to support integration processes along the chain. Thus, we highlight the importance of innovation in the search for plural markets with more direct links between the production and consumption sectors. Therefore, this paper raises the question of whether the observed diversification responds more to survival strategies than to growth strategies, despite the fact that the reference literature positively links diversification with SDG 9. Similarly, the observation regarding the sectoral problems of access to financing is also relevant, which is more significant for the group of cooperatives. For this reason, we believe it is also important that in the pursuit of promoting innovation specific financial support should be considered.

We suggest two observations on the scope of the results found in the framework of this research. Firstly, we work at the sectoral level with those forms of beekeeping production organization that have a legal personality. Although this is justified in order to know the situation of the cooperative sector and to be able to compare it with other legal forms, it should be noted that unipersonal and/or informal forms of management (individual or collective) are left out. Secondly, there is no intertemporal monitoring of the variables considered. However, we also consider that this paper provides an empirical and theoretical contribution to discussing and investigating the alignment of the practices of entities with SDGs in agricultural and Latin American contexts. This is done on the basis of a simple and viable methodological proposal to accompany the synergies between actors of society in view of favorable productive processes with sustainable development.

This study also opens up a field of work for future research. Within this we can highlight the following: a) deepen the analysis of sectoral indicators that allow us to measure the con-

tribution of the Argentine beekeeping sector to the SDGs and their differentiation depending on whether they are cooperative enterprises; b) extend this analysis to other agri-food sectors and compare which indicators are differential in each sector; c) extend the sectoral analysis to international levels and to other SDGs related to the agri-food sector in general and beekeeping in particular.

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