Sustainability indicators in the context of family farming: A systematic and bibliometric approach

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ABSTRACT

Actions that promote the sustainability of small-scale agricultural activities are fundamental to maintaining the supply and diversification of products, generating income, and minimizing their environmental impact. This study aimed to identify the main economic, environmental, and social indicators used in studies focused on food production by family farming. A systematic literature review was performed in the Scopus database, where 22 original articles were identified. The largest number of publications was observed in Italy and the United States of America, followed by Brazil, India, Poland, and the United Kingdom. The main aspect observed in the publications was the interrelationship of the three spheres of sustainability, highlighting the importance of integrated monitoring. Some indicators identified were: in the economic sphere, financial planning, productivity, and profitability; in the environmental sphere, soil use and quality, water, erosion, temperature, and energy; and in the social sphere, food security, job and income generation, and government subsidies. A holistic approach to the use of monitoring indicators as a tool for sustainability is fundamental, but there are few studies that evaluate these three spheres; mainly in the field of agribusiness, due to its greater diversity of activities and aspects to be monitored.

Keywords: Family farm, Food production, Indicators, Sustainability, Triple bottom line

1. Introduction

The main global challenges of today are related to poverty eradication, food security and environmental pressures [1]. In 2015, the 17 Sustainable Development Goals (SDGs) were established so that each Member State of the United Nations (UN) would commit to actions to be followed by the 2030 Agenda for Sustainable Development [2]. This meeting marked the representativeness of family farming relating to the reach of the established SDGs. According to the study presented by Graeub et al. [3], family labor is responsible for at least 53% (fifty-three percent) of the world's food supply and, it is estimated that there are more than 500 million small family farms in the world.

Given the exponential population growth and the growing demand for food, family farming is one of the main suppliers to meet this current need [4, 5]; besides being directly linked to diversification in product supply [5-7]; food and nutrition security [1]; and poverty reduction [8]. This reality points to the need for the development of more productive, profitable and efficient rural prop-

erties in the use and allocation of resources, as well as public policies to assist this activity; and, in parallel with these issues, environmentally conscious with the reflexes of its activities towards the environment [8-11].

Quintero-Angel et al. [12] emphasize that activities carried out in rural areas involve higher anthropogenic intervention in ecosystems, highlighting the importance of developing assessment methodologies appropriate to the particularities of each productive system, making them more efficient while reducing their environmental impact; as well as guiding the decision-making processes of managers to a more sustainable holistic vision.

According to Galdeano-Gómez et al. [10], this field of research aimed at measuring sustainability in agriculture has been growing as a result of the need for balanced actions to face the challenges imposed by modern society and the growing demand for food. To this end, different practices have been developed seeking to preserve ecosystems through measures to restructure agricultural production, with production processes of lower impact, efficient

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use of resources, minimizing the generation of waste, and adequate alternatives for waste disposal and/or valuation [1, 11-14]. Other practices used to boost activities in agribusiness, which respect environmental aspects, are crop-livestock integration [15] and impact monitoring with the use of indicators [16], making farms more competitive and sustainable. In the family farm, there is a need for maximum efficiency in the use of natural resources since it integrates the process of crop rotation and the use of the same land space for livestock, promoting the control of the degradation process through conservationist practices.

In this context, indicators are presented as tools used to monitor certain factors, transmitting information about the achievement or not of an established goal or minimum standard, identifying non-conformities in a system, and contributing a range of information about the organizational picture, supporting the decision-making process [17]. Banu [18] corroborates the importance of identifying and defining key indicators appropriate to the structure to be measured and the intended results, calling them KPIs – Key Performance Indicators.

The objective of the indicators is to make the significance of a phenomenon more apparent and easy to understand, since they unify and quantify information, simplifying it, and enabling it to be easily understood [19]. Therefore, they are important tools for describing the sustainability of systems, providing data capable of assisting in the formulation of public policies, and strategic and business decision-making [20].

The sustainability indicators are composed of different indicators, such as: environmental (air quality, water quality, energy consumption), social (quality of life, well-being, income distribution), and economic (consumption and production pattern, liquidity), and can act jointly, forming indexes, or separately, in the three spheres that comprise sustainability [21-23]. The combination of these three spheres is also known as the "three pillars" of sustainability or the triple bottom line – TBL. The implementation of TBL indicators includes measuring sustainability in its three spheres of scope and is gaining importance for the provision of information by public and private companies to stakeholders [24, 25].

The main difficulty in developing indicators based on the three pillars of sustainability is due to the fact that there is neither a universally accepted system or package, nor a universally established unit of measurement that can be used to measure the performance of organizations [17, 23, 26]; this fact, according to Sulewski *et al.* [27], corroborates the scarcity of published works covering the three spheres concomitantly.

This study aimed to identify, through a systematic and bibliometric analysis, the main scientific and original publications that address the use of indicators involving the three spheres of TBL. Thus, it is expected to contribute to the discussion on the importance of working on a holistic vision, considering the social, economic, and environmental spheres, through monitoring indicators as a tool for sustainable development objectives in the context of food production by family farming.

2. Methodology

To identify the sustainability indicators focused on the food pro-

duction scenario by family farming, a systematic and bibliometric survey of original publications from the last 5 years (2015 to May 2020) was conducted following a pre-established research protocol described in the PRISMA protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (Fig. 1), and considering the clear and current definition of sustainability indicators as a premise. The results were extracted from the Scopus platform, as it is the database with the greatest diversity of scientific and technical journals of global reach.

As a search index, words contained in the title, abstract, and keywords were used. The search words were used together with the Boolean marker "AND" to restrict the results based on the search focus. The search process was initiated by the "Sustainability" AND "Indicator" terminologies, where 6,858 publications were found, and it was observed that about 99% were not related to the focus of this search, requiring a refinement process. Additional "Small Farm" AND "Food" terminologies were used in the refinement, resulting in a sample of 52 publications. Initially, the abstract of these articles was read to verify if they met the eligibility criteria – with reference to indicators, with reference to food production, and with reference to family farming. It was observed that 19 of the 52 articles did not meet all the established criteria. The 33 remaining papers were fully read to verify if they met the last selection criterion, that of contemplating the application of indicators in the three spheres of sustainability concomitantly. In this process, 11 more papers were excluded; leaving 22 original papers that composed the analysis data of this research.

The bibliometric analysis was carried out contemplating the metric systems available in the Scopus database, which provided the quantity of publications per year, country of origin, journal, and main areas of study. After an analysis and discussion of the results, it was possible to identify the main monitoring indicators in the economic, environmental, and social spheres. The bibliographic

Fig. 1. PRISMA protocol used to select the articles to be analyzed, based on pre-established criteria.

data analysis was conducted using the software VosViewer 1.6.15 from Leiden University. The software identified clusters among the documents collected by the database and selected by the PRISMA protocol.

Since it is not possible to integrate the information from case studies with Vosviewer, which are published in national journals, the documents were searched through Scielo and Google Scholar, with the same time filters and keywords in Portuguese and Spanish. From 1,306 documents found, 32 original articles were selected to read. Further, it was selected the documents related with TBL concept in the family farm and indicators sustainable context.

3. Bibliometric Approach

The field of research aimed at measuring sustainability, once the agroindustrial activities has been growing as a result of the need for balanced actions to face the challenges of modern society and the potential impacts it represents [28]. The 22 articles selected are presented in Table 1 [29-43].

The number of publications related to the use of indicators in the three spheres of TBL in the context of food production by family labor, increased from 9.1% in 2015 and 2016, 22.7% in 2017, 27.3% in 2018, to 31.8% in 2019, demonstrating the trend and commitment of academia to develop studies to measure sustainability in rural areas and ensure the goal of food security.

This growing trend in publications on monitoring indicators is perceived by Scherer et al. [7] as the result of increased global demand for food, and due to family labor being the main factor in product supply and diversification. This aspect was highlighted in two selected publications of 2015, which analyze the sustainability of family agriculture based on TBL monitoring indicators; the first aimed to present indicators to provide small rural producers with an immediate assessment of the performance level of their activity [43]; and the second carried out an assessment of different scenarios, considering environmental, economic, and social aspects in agricultural and rural development [42].

In related publications in 2016, the importance of family farming for sustainability is emphasized, highlighting contributions related to the use of short supply chains [41] and the need to maintain family farming activity in the long term [40].

In 2017, the indicator approaches focused on food security as-

pects [39], family succession [28], new technologies [38], agroecological practices [21], and the impact of economic and social pressures on environmental aspects [10].

The year 2018 is also marked by the use of agroecological practices such as sustainable development alternatives [37], organic production [36], efficiency in the use of economic and environmental resources [35], collaboration among members of the same chain [34], and the relationship between the dimensions of TBL [27].

The implementation of TBL indicators has gained importance in organizations and can be a powerful tool for evaluation in family farming units, reflecting the quality of the environment in which it is inserted, in terms of profitability, social, human, and environmental capital [44]. Dočekalová et al. [17], Hák et al. [45] and Huguet Ferran et al. [26] emphasize that the assessment of sustainability and the aggregation of a set of individual indicators depends on how researchers will make use of the measurement tools, in order to arrive at the final result, which can be applied to different organizational conditions and with a holistic approach. In view of this, there is no impediment or limitation to the valorization of family farming with a sustainable organizational approach, both regarding the indicators and the ways in which certain aspects will be measured, leaving the task of the researcher to explore the variables based on the literature, examining the successes already achieved with measuring tools previously applied, and looking at the three pillars of the TBL.

Finally, the year 2019 is marked by studies on the impacts of agricultural intensification [32], the relationship between geographical requirements, ecological practices, economic and welfare aspects [31], certifications [30], agroecological practices [23], the relationship between TBL dimensions and aspects affecting them [5, 29], and short supply chains [22].

In general, the selected publications consider the main themes addressed to promote sustainability in family agricultural production, demonstrating the use of agroecological practices, the use of short chains and cooperation among members of the same chain, and, especially, the feedbacks resulting from interactions between the spheres of TBL, emphasizing the importance of understanding the environment in a systemic way. It also became evident that, in the last 5 years, the search for measures to promote sustainability within the context of food production by family farming has gained representativeness.

Fig. 2. Number of publications and country of origin with the highest occurrence of original documents (a) and by main themes (b), in the period from 2015 to 2020, related to sustainability indicators for the food sector of family farming.

Table 1. The 22 Original Articles Selected, Published in the Period from 2015 to 2020, Relating to Sustainability Indicators for the Food Sector of Family Farming

Year	Country	Author(s)	Title
1 2019	Brazil and Poland	Lewandowska-Czamecka et al. [29]	Energy and energy analysis for assessing changes in Polish agriculture since the accession to the European Union.
2 2019	United Kingdom, Italy, Poland, Norway, Hungary, France and Vietnam	Malak-Rawlikowska et al. [22]	Measuring the economic, environmental, and social sustainability of short food supply chains.
3 2019	United States, Netherlands and Italy	Ditzler et al. [5]	A model to examine farm household trade-offs and synergies with an application to smallholders in Vietnam.
4 2019	France	Trabelsi et al. [23]	ESSIMAGE: a tool for the assessment of the agroecological performance of agricultural production systems.
5 2019	Switzerland and Austria	Ssebunya et al. [30]	Sustainability Performance of Certified and Non-certified Smallholder Coffee Farms in Uganda.
6 2019	United States, China and India	Shakya et al. [31]	Visualizing sustainability of selective mountain farming systems from Far-eastern Himalayas to support decision-making.
7 2019	China	Liu et al. [32]	Toward sustainable crop production in China: An energy-based evaluation.
8 2018	Poland	Sulewski et al. [27]	Relations between agri-environmental, economic and social dimensions of farms' sustainability.
9 2018	United Kingdom	Mahon et al. [33]	Towards a broad-based and holistic framework of Sustainable Intensification indicators.
10 2018	Brazil and Portugal	Azevedo et al. [34]	The influence of collaboration initiatives on the sustainability of the cashew supply chain.
11 2018	Brazil	Valenti et al. [35]	Indicators of sustainability to assess aquaculture systems.
12 2018	Italy	Al Shamsi et al. [36]	A sustainable organic production model for "food sovereignty" in the United Arab Emirates and Sicily-Italy.
13 2018	Cuba	Rodríguez et al. [37]	How to make prosperous and sustainable family farming in Cuba a reality.
14 2017	Spain	Galdeano-Gómez et al. [10]	Exploring Synergies Among Agricultural Sustainability Dimensions: An Empirical Study on Farming System in Almería (Southeast Spain).
15 2017	United States and India	Goswami et al. [21]	Sustainability assessment of smallholder farms in developing countries.
16 2017	United States	Clarke et al. [38]	Evaluation of new farming technologies in Ethiopia using the Integrated Decision Support System (IDSS).
17 2017	Spain	Galdeano-Gómez et al. [28]	Family farm's features influencing socio-economic sustainability: An analysis of the agri-food sector in southeast Spain.
18 2017	United Kingdom	Tsolakis et al. [39]	A System Dynamics approach to food security through smallholder farming in the UK.
19 2016	India	Sajjad et al. [40]	Assessing farm-level agricultural sustainability using site-specific indicators and sustainable livelihood security index: Evidence from Vaishali district, India.
20 2016	Canada	Mundler et al. [41]	The contributions of short food supply chains to territorial development: A study of three Quebec territories.
21 2015	Netherlands	Reidsma et al. [42]	Sustainable agricultural development in a rural area in the Netherlands? Assessing impacts of climate and socio-economic change at farm and landscape level.
22 2015	Italy	Paracchini et al. [43]	A diagnostic system to assess sustainability at a farm level: The SOSTARE model.

Table 2. Environmental Indicators Selected by Category

Category	Indicator	Definition	How to measure	References
Water	Consumed in Production Volume	Volume monthly consumed ($\text{m}^3 \text{ kg}^{-1}$)	Record: m^3 of water and productivity in kg^{-1} per month	Dočekalová et al. [17] Prasara-A et al. [46] Carrasquer et al. [16] Galdeano-Gómez et al. [10] Nishitani et al. [47] Lucato et al. [44] Haffar et al. [48] Moghaddam et al. [49]
	Water quality	Potable water standards for human consumption according to current legislation.	Physico-chemical and biological analysis	Meneses-Jácome et al. [50] Carrasquer et al. [16] Galdeano-Gómez et al. [10] Gonzalez-Garcia et al. [51] Haffar et al. [48] Moghaddam et al. [49]
	Sewage and Effluent Treatment	Measures the percentage of water treatment after consumption and before disposal in the receiving body.	Water treated month (m^3) / Water consumed month (m^3) $\times$ 100	Dočekalová et al. [17] Haffar et al. [48]
	Reuse of rainwater	Rainwater collected and stored by the organization	Rainwater used month (m^3) / Rainwater collected month (m^3) $\times$ 100	GRI [52]
	Greenhouse gas emissions	Measures the relationship between the amount of CO_2 emissions and the size of the property in a given pre-established period.	CO_2 emission in the period / property size (ha)	Prasara-A et al. [46] Carrasquer et al. [16] Nishitani et al. [47] Nunes et al. [53] Rasmussen et al. [54] Chaudhary et al. [55] Gonzalez-Garcia et al. [51] Haffar et al. [48] Liu et al. [56] Moghaddam et al. [49]
Air	Air quality	Verification of particulate matter quantities and air humidity	Suspended particulate matter and Relative air humidity	Haffar et al. [48]
	Climate change	Monitoring of temperature and rainfall variations.	Weather data historical	Prasara-A et al. [46] Nishitani et al. [47] Gonzalez-Garcia et al. [51] Liu et al. [56]
	Odor	It aims to monitor the impact of odor emission on the surrounding area.	Number of monthly complaints.	Jackson et al. [57] Balkema et al. [58]
	Noise	Exposure time to noise above 85 dB (A),	decibel meter monitoring	Jackson et al. [57] Balkema et al. [58]

Table 2. Continued

Category	Indicator	Definition	How to measure	References
Soil	Soil Erosion and Fertility	Control Aims to monitor soil fertility levels and biodiversity	Physico-chemical and biological analysis	Galdeano-Gómez et al. [10] Rasmussen et al. [54] Gonzalez-Garcia et al. [51]
	Total consumed energy (KWh)	Consumed energy in KWh	KWh month	Dočekalová et al. [17] Carrasquer et al. [16] Nishitani et al. [47] Lucato et al. [44] Nunes et al. [53] Gonzalez-Garcia et al. [51] Haffar et al. [48] Liu et al. [56]
Energy	Renewable energy consumed	Energy from renewable source consumed in KWh per month	KWh month	Dočekalová et al. [17] Haffar et al. [48] Liu et al. [56]
	Initiatives to energy consumption reduction	Develop a planning and execution to energy consumption reduction	Actions per month	Nishitani et al. [47] Nunes et al. [53] Liu et al. [56]
Waste reuse	Waste reuse	Measures the amount of raw materials reused in the process in relation to the total materials used.	Total reused materials per month (kg) / Total used materials per month (kg) $\times 100$	Dočekalová et al. [17] Carrasquer et al. [16] Galdeano-Gómez et al. [10] Nishitani et al. [47] Nunes et al. [53] Gonzalez-Garcia et al. [51] Haffar et al. [48] Liu et al. [56]
Valorization	Value	More economically attractive possibilities for waste disposal	Comparisons of final retanability	Liu et al. [56]
	Alternative renewable energy	Quantities of renewable alternative energy generated per month in KWh	KWh month	Naqvi et al. [59] Gonzalez-Garcia et al. [51] Haffar et al. [48] Liu et al. [56]
	Packing destination	Reuse or adding value to packaging	Reuse per month	Gonzalez-Garcia et al. [51]

Fig. 3. Developed themes associated to sustainability indicators for the food sector of family farming from 2015-2020.

Taking into consideration the country of origin, it was possible to observe that Italy and the United States lead the ranking with 4 publications each; followed by Brazil, India, Poland, and the United Kingdom with 3 publications; China, France, the Netherlands, Spain, and Switzerland with 2; and the other countries with only one publication, as can be seen in Fig. 2. Cooperation among countries with more publications is also a positive trend that can be verified in the works developed, mainly by India and the USA. These countries have developed research in a cooperative way, sharing experiences, and enabling knowledge enrichment.

Brazil presented 3 publications, the most recent published in 2019 in cooperation with Poland, in which aspects related to energy efficiency and environmental sustainability are discussed after Poland's accession to the European Union (EU). The other two publications date from 2018; one, in partnership with Portugal, highlighting the environmental, economic, and social aspects of cooperation in the cashew supply chain; and, published singularly, a work describing sustainability indicators in aquaculture practice.

The main themes addressed by the highlighted countries, Italy and the United States are focused on the maintenance of agricultural activity in a sustainable way, seeking to guarantee income and subsistence for families, production and diversification of food, social welfare, and zeal for environmental aspects, especially soil fertility. Regarding the main study areas, it was observed that Environmental (29.2%), Social (20.8%), Agricultural (16.7%), and Energy (14.6%) aspects are the most relevant in the selected studies, as can be seen in Fig. 3 based on the key word citations and Table 2 [46-59] shows the main environmental indicators for measuring sustainability found in documents of the last 5 years and some indicators found only before 2015 (odors, reuse of rainwater, and noise).

4. Indicators of Sustainability and Family Farming

Thus, indicators can reflect complexity presenting results that are easy to understand, guiding decision-making regarding the environmental policy to be adopted by managers [60]. When grouped into categories, indicators can improve aspects related to air, soil, water, biodiversity, energy, and others [48]. The grouping of environmental indicators is proposed for the preparation of Global Reporting Initiative (GRI) reports considering materials, energy, water, biodiversity, emissions, effluent, and conformity. Also, according to Haffar et al. [48], to obtain eco-efficiency, indicators can be established based on an analysis of the performance areas of organizational activities.

Monitoring indicators are versatile tools and should be selected and adjusted according to the proposed objectives and the organization's internal capacity to obtain the necessary data for the total analysis. In this way, there is no universal standard for indicators, they are designed for each reality to be analyzed [18]. After reading the selected articles, it was possible to observe that each study considers a particular feature in the use of indicators, based on the needs of the objectives of each research. Therefore, with respect to measurement by indicators, different goals and environmental scenarios require different indicators [61] and, when defining a group of personalized indicators, new monitoring standards can be established, with predicted indices or trends to be observed, establishing a standard to be adopted by the organization [17].

In the current context, consideration should be given to the choice of indicators, striving for a simplified selection, so that the results can be useful to the management process. These tools can be used to demonstrate the results to stakeholders as well as being an excellent internal monitoring tool, for example, to control the amount of raw material used in the production process and the amount of waste generated from each activity.

Table 3. Sustainability Indicators for the Food Sector of Family Farming Used in the Analyzed Articles

Economic Indicators	Environmental Indicators	Social Indicators
Financial planning	Renewable energy	Age
Third party equity participation	Non-renewable energy	Gender
Productivity	Non-renewable resources	Race
Hours worked	Soil fertility	Schooling
Control of materials used	Erosion	Employment
Sales	Siltation	Labor rights
Profitability	Water quality	Company image
Profit on sales	Water use	Social responsibility in the acquisition of supplies
Net profit	Land use	Negotiating power
Internal rate of return	Re-use of water	Quality of life
Payback	Use of rainwater	Nutrition
Net present value	Waste water treatment	Food safety
Added value	Air quality	Animal welfare
Product diversification	Biodiversity	Social involvement
Quality of the final product	Environmental load	Intensity (working hours) and manual work
Packaging	Greenhouse Gases – GHGs	Government subsidies
Investments	Nitrogen (N)	Community initiatives
Arable area	Temperature	Local governance
Machinery used	Eutrophication	Rural exodus
Marketing channels and cooperation networks	Solar lighting	Family succession
Price oscillation in the market	Food miles	Gross Domestic Product – GDP
Channels of purchase	Agro-ecological practices	Income distribution
Relationship with suppliers	Fertilizers	Basic sanitation
	Natural area	Farm size
		Inclusive growth
		Participation in cooperatives
		Income dependent on agriculture
		Training courses
		Local tourist exploitation
		Odor (surrounding)

The monitoring indicators identified were compiled in order to highlight the current overview of the use of indicators in the context of food production by family farming, in the three spheres that make up sustainability, concomitantly. These results are presented in Table 3. According to Simas *et al.* [62], a good indicator warns of a potential problem, before it becomes established, favoring early decision-making. In communities in crisis (whether social, economic, or environmental), indicators help to point out factors that deserve more attention and identify alternative solutions to these problems, in order to contribute to proactive decision making, minimizing the possibility of future negative impacts.

It was possible to identify greater uniformity in the use of indicators from the economic and environmental spheres, the same sequence of indicators being chosen when the research objectives

were similar. However, when observed from the perspective of the social sphere, it was identified that there is still no consensus among the authors, a fact demonstrated by the wide variety of social indicators used. This fact can be observed in the works of Paracchini *et al.* [43], Clarke *et al.* [38], Galdeano-Gómez *et al.* [10], Mahon *et al.* [33], Sulewski *et al.* [27], Valenti *et al.* [35], Shakya *et al.* [31], Ssebunya *et al.* [30] and Trabelsi *et al.* [23], in which the authors used similar indicators in the economic and environmental spheres to achieve their final objectives, with the measurement of financial planning, productivity, water quality, and soil fertility being present. This similarity of indicators was not observed in the social sphere.

With regard to economic indicators, it was possible to identify the importance of their use for farmers' long-term economic stability.

According to Lewandowska-Czarnecka et al. [29], these indicators are extremely relevant for the agricultural sector, since the production costs and returns obtained directly reflect the economic capacity of farms; however, sustainability indicators monitored should be adapted to the local reality, adopting a holistic view of the system, in order to understand the process as a whole, and the main aspects that may compromise organizational economic stability. Bui et al. [63] corroborate the need for financial management and agricultural practices as factors that impact the increase in productivity and development in rural areas.

This view on the importance of the economic system in relation to the stability of activities in the rural area is due to the capitalist system, where profit is the main aspect. However, more than 20 years ago Tisdell [64], described that agricultural systems have some particularities in the process of monitoring and forecasting financial demand, since some factors are involved that are independent of control, such as the seasonality of production and bad weather, which compromises the predictability of production yields and, consequently, the generation of financial results related to liquidity, requiring greater attention from managers. Considering the documents from 2019/2 (August to December) and 2020/1 (January to August) relating to family farms and sustainability, we found clusters of research as presented in Fig. 4. This figure represents evidence of the current importance of indicators associated to spatial analysis, ecosystems, risks, adaptation, and trade-off, as well as the relevance to food production for the family farm. It is observed that innovation is a way for small farms to survive and, in this last year, using the key words “family farm” and “sustainability”, environmental, social, and economic issues

appeared to be associated with land use, rural exodus, and food production.

In general, with regard to environmental aspects, studies have shown a concern for soil fertility, water quality, erosion, climate change, and the use of energy from renewable sources. According to Cox et al. [65], soil and water quality are determining factors for agricultural productivity. The study demonstrated that sustainability in agriculture depended on adequate water, soil, and crop management practices and that monitoring by indicators was indispensable for managing the farm and for obtaining a history of its evolution based on the decisions made.

In the social sphere, as described, the lack of a pattern in the use of indicators was observed, but some aspects were highlighted such as the importance of minimizing the rural exodus, government subsidies, quality of life and nutrition, and the role of local governance as factors directly related to the permanence of the workforce in rural areas. One factor that contributes to the permanence of small rural farms is related to the well-being of the family workforce in carrying out its activity in rural areas [66].

A survey of social indicators, at the government management level, is also essential to identify the present needs and trends, including for the permanence of families in rural areas, since many of them depend on government subsidies as a form of income supplementation [67].

Another social aspect is highlighted by Sjauw-Koen-Fa et al. [68], who address the need for farmers to group into cooperatives, facilitating the implementation of management processes, such as monitoring by indicators, in addition to enabling participation in certification programs facilitating access to new markets and

Fig. 4. Clusters obtained from research documents in the year(2019/2 to 2020/1).

to socioeconomic benefit programs, since most producers directly market their products to final consumers. Organizing producers into cooperatives is also seen as a strategic alternative with the purpose of strengthening the capacity to supply products, management practices, and price negotiation, ensuring the means necessary for the subsistence and permanence of farmers in the activity [22, 69]. However, Malak-Rawlikowska *et al.* [22] believe that short supply chains are more sustainable compared to mass food delivery systems, and are more economically viable for farmers, as they eliminate the capture of a profit margin attributed to the different intermediaries of a long chain.

In the study presented by Galdeano-Gómez *et al.* [10], a series of environmental, social, and economic indicators is presented based on the Sustainable Agriculture, Food, and Environment (SAFE) Platform, with the purpose of carrying out an analysis of sustainability indicators and their interrelationships in family farming systems in vegetable production. It has been demonstrated that there is an inter-relationship between the spheres due to the increase in economic and social indicators reducing environmental pressures on resource use and, in parallel, social and environmental improvements reveal positive effects on the economic dimension of farmers, these factors being directly linked to the physical structure and activities developed on the farms, such as biological techniques, pest control, and organic production.

The management of productive activities in the different economic sectors has been developed from the need for planning, both of the resources used, as well as the dimensioning of the capacity and of the major productive efficiency, in order to obtain competitive advantage, greater market gain, and greater profit. Economic indicators are the main tool used to monitor the performance of strategic management in order to maintain financial stability, assisting managers in the decision-making process and in the long-term economic viability of the activity [70]; since, maintaining organizational liquidity has become an even greater challenge due to the expansion of global trading boundaries [44].

Agricultural systems have some peculiarities in the process of monitoring and forecasting financial demand, since they involve factors independent of control, such as seasonality of production and inclement weather. These factors may compromise the production forecasting process and the generation of financial results related to liquidity and the availability of resources. Since, in rural areas, economic productivity is affected by non-economic factors, monitoring tools must be adapted to this reality, adopting a holistic view of the system, in order to understand the process as a whole and its inference zones.

In the case studies, it was highlighted the economic and social issues and the environmental concern was less worked. Moreover, family farms had some peculiarities in the selection of indicators such as the seasonality of production and bad weather, which undermines the predictability of production yields and hence the generation of financial resources [71-77].

Indicators obtained according to TBL concept allowed to propose sustainability actions beyond the financial control and new marketing channels of the family farm. Some of the sustainability actions were composting organic waste and adoption of other management techniques and soil conservation; construction of cisterns and protection of sources and other water resources; collection of solid

waste; cultivation of seedlings and use of creole seeds [78, 79].

The creation of an environmental policy to guide actions on family farms was also suggested. There is a need to assess organic or not organic agrosystems and to establish critical points in the management system, maintenance of biodiversity, crop diversification, soil conservation, recycling of nutrients, weed control, pest and disease control and increased productivity [80, 81].

5. Conclusions

Promoting sustainable agriculture is a global trend, so this objective must be pursued, measured, and accompanied with viable planning and strategies. Bibliometric analysis has shown an increasing number of publications focused on the use of indicators in the three spheres of TBL. It was observed that most of these studies originate in Italy and the USA and that environmental indicators are the aspects most addressed in the publications. Although 6,858 papers related to sustainability and indicators were identified, only 22 are related to the objectives of the research, showing that the use of monitoring indicators, used in the three spheres of sustainability, is still a challenge to be explored in the context of family farming.

It was observed that the economic and environmental spheres present a certain "consensus" among the authors, demonstrating a similarity in the use of indicators from these spheres; however, this is not perceived in the social sphere, which resulted in a greater diversity of indicators. In the economic sphere, the main indicators are related to financial aspects, productivity, quality of the final product, commercialization channels, and possibilities of cooperation. In the environmental aspects, the greatest concern is focused on soil fertility and water quality and availability. The studies also presented a concern about climate change, the use of agricultural fertilizers, and greenhouse gas emissions. Despite the diversity of indicators listed in the social sphere, food security, rural exodus, and government subsidies were the main aspects identified for the viability of farmers' livelihoods in rural areas, aiming to ensure the development of the activity and diversification in the supply of agricultural products.

In these aspects, it is also clear that family agriculture needs to be understood as an important sector of the economy to be analyzed within the context of the SDGs and the 2030 Agenda for Sustainable Development in all countries, in the search for sustainability based on the economic, social, and environmental pillars. The study reached the proposed objective by identifying the relationship of monitoring indicators in the three spheres of sustainability used in original and current studies, in the context of food production by family labor. Effective proof of the efficiency of the monitoring indicators along with the activities developed by family farming is a factor to be explored in future works.

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Author Contributions

J.W. (Ph. D. student) wrote the manuscript. M.H. (Professor) wrote and revised the manuscript. R.C.S.S. (Professor) revised the manuscript.

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