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Family Agriculture, Sustainable Development and Ethnographic Linear Programming - A Review

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Abstract— *Family agriculture (FA) is a diversified and multifunctional group both in ecological and socio-economic terms, representing around 90% of the farms, 53% of the agricultural land worldwide and accounting for 50% of the global agricultural production. However, FA faces some problems such as difficult subsistence, poor access to markets, rising production costs and climate change effects. These require urgent sustainable solutions, given the importance of FA as a source of livelihood and income to many poor families and its high contribution to the economic growth, the world food production and security. Fulfilling sustainable development goals (SDGs) and reducing poverty implies supporting FA in the improvement of its productivity, income, well-being of the households and resource maintenance. The challenge is to find ways to allocate the limited and often degraded resources available to different production activities, so to improve the farms' performances, maintain their specificity (productive, reproductive and communitarian functions) and their drive towards sustainability. This article represents a small contribution to overcoming this challenge. It performs an integrative systematic literature review on modeling the functioning of FA households from a sustainability perspective, through ethnographic linear programming (ELP). It also allows for the development of an inexistent body of literature that links FA, sustainability and ELP and allows the uncovering of new ways of thinking about FA (practices, policies, technologies, productive and reproductive activities and community social norms), and its pathways to reach sustainability. Ultimately, this study generates knowledge about the conceptual framework that is to be used and about the agenda for future research. The review methodology that was applied consisted of diverse steps, including the identification of the search terms and the accessed databases, the definition of the criteria for eligibility and exclusion of articles and the bibliometric analysis and review of the final list of the 46 selected studies.*
Keywords— ***ELP, Family Farming, Literature Review, sustainability.***

I. INTRODUCTION

FA is a particular way of organizing work and production within the socio-economic context in which it operates (Schneider, 2016). It is diversified in size, technologies, market integration and ecological and socio-economic characteristics. FA is responsible for 50% of global agricultural production (Graeub et al., 2016; Lowder et al., 2016), 80% of the world food production and it occupies 53% of the agricultural land, including about 90% of the farms (FAO, 2014). Thus, it is an important contributor to economic growth and food security (Möllmann , Buchholz, Kölle & Musshoff , 2020) and it is understood as one of the main resources to solving hunger problems, as it can allow

for an increase in the global level of food self-sufficiency among poorer populations (Paillacho et al., 2021).

FA represents an important way of life and an agricultural work which is carried out by nuclei and family production units (Grisa & Sabourin, 2019). These units are responsible for most of the farms that exist in the rural areas of the planet and thus not only contribute to an important part of food production but also towards increasing sustainability, preserving and restoring biodiversity and ecosystems, while providing traditional and nutritious foods that promote balanced diets and preserve cultural heritage in rural areas (Graeub et al., 2016; Cavalli et al., 2020). Moreover, FA has a fundamental role in establishing populations, maintaining the landscape, structuring the business fabric and social and territorial cohesion in rural areas as well as in strengthening sustainable development (UN, 2011; Graeub et al., 2016; FAO, 2019; Palmioli , et al., 2020). Faced with a scenario of growing urbanization, the effects of climate change and an increasing concern with the future of natural resources (Preiss , Vaasconcellos & Schneider, 2018), there is a growing awareness of the key role played by FA and its needs to be further supported through public policies and projects.

Although FA has acquired a prominent place in research and development agendas, supported by extensive fieldwork experience and a complex network of social actors linked to rural development (Deus, 2019), there are no studies that focus on finding ways to to allocate its limited resources among different production activities, in order to improve the performance of the family productive unit, maintaining its specificity (productive, reproductive and community) and moving towards the achievement of the SDGs. This article attempts to fill the identified research gap and propose a research agenda, by carrying out a systematic review of the literature on FA and sustainable development (SD), from the perspective of the conceptual methodological tool of ethnographic linear programming (ELP).

II. SUSTAINABILITY IN FAMILY AGRICULTURE

The application of the concept of sustainability in FA implies creating and improving efficient production models which promote social well-being and are not harmful to the environment (Silva et al., 2020; Silva & Torres, 2020). The author also refers the need for sustainability to consider structural and conjunctural aspects, without neglecting economic viability. To this end, Belmudes et al. (2021) defends the urge to combat the migration of young rural people (who are motivated by the lack of employment) and educate on behalf of responsible food choices with a positive effect on the systems and landscapes of family farming and the well-being of rural communities. This position simultaneously considers the three pillars of sustainability (Melo & Bellen, 2021; Moura et al., 2021).

On the other hand, the vulnerable situation of FA in less developed regions and the lack of infrastructure and basic social and economic conditions, can be exacerbated by climate change (Maia et al., 2018; Torrent et al., 2021; and Tsiouni et al., 2021). Public and private policies are used in an attempt to mitigate this situation, these include, initiatives for granting credit, technical assistance, training human resources and strengthening social relations, market access and development of the value chain for local agricultural products, which can create employment opportunities (Carbonera , 2021; Chen et al., 2021; and Vieira et al., 2021).

Some of the means of transitioning to SD regard the creation of new mentalities and the adoption of consequent practices. These include agroecology and its certification (Pinto et al., 2017), whether it is associated with fair trade or not, the ecological footprint and the ecological, experiential and cultural tourism, which promotes circular economy business models (Fabron & Castro, 2019; Deus, 2019; Silva et al., 2020; Silva & Torres, 2020; Sow et al., 2021; Tamagno et al., 2018; Torres-Solis et al., 2020; and Yamanguchi , 2020).

III. METHODOLOGICAL PROCEDURE

The methodology used followed two main steps (Kahiya, 2018). The first step consisted of identifying the SCOPUS database due to its scope and wide use in similar reviews (Bisht, 2020; Belmudes et al., 2021; Amaral et al., 2021; Fabron & Castro, 2019; Carbonera et al., 2021; Chen et al., 2021; Costa, 2021; Deus et al., 2021; Melo & Bellen, 2021; Moura et al., 2021; Giagnocavo, 2018; Glazebrook & Opoku, 2021) and it also included the selection of the following search terms - "*Family farming", "Ethnographic Linear Programming", "Sustainable development", "Productive, Reproductive, Community Activities*". The second step was organized in two distinct phases and consisted of defining the criteria for eligibility and exclusion of articles. In phase I, both the language criteria (english, spanish and portuguese) and the time limit criteria (2017 to 2021) were used to uncover recent articles on the topic, following the recommendations of several authors (Amaral et al., 2021; Belmudes et al., 2021; Bisht et al., 2020; Carbonera et al., 2021; Fabron & Castro, 2019; Giagnocavo et al., 2018; and Krishnamurthy et al., 2017). This led to a sample of 127 articles. In phase II, according to Paul and Criado (2020), the titles, keywords, abstracts and full texts of each selected article were read. This

procedure allowed for an exclusion of 81 articles which were not considered relevant. Thus, a final sample of 46 articles was attained, of which 34 articles focused on FA, 8 on FA and SD and 4 which were dedicated to the landscape environment, rural settlements, climate and production. This sample met the robustness criterion of literature review defended by Paul and Criado (2020), which should comprise 40 to 50 articles.

For the bibliometric analysis of the articles, the software NVivo 12, *Publish or perish* (Harzing,7) and *VOSviewer* was used.

IV. RESULTS

The organization and analysis of all 46 articles allowed for a set of results that are presented and discussed below .
The search for word frequency bestowed a list of 100 words which were most frequent in the set of selected texts (figure 1). Of these, 10 words were identified as having the highest frequency according to the relevance of the topic . These were: (i) “farms” (farm, farm', farm", farmed, farming, farming', farms, farms', farms"), appearing 2749 times (70%); (ii) “familiar” (familiar, familiar , familiarity), appearing 1687 times (43%); (iii) “agriculture” (agricultural, agriculture, agriculture', agriculture"), appearing 1541 times (39%); (iv) “rurality” (rural, rurale, rurales, rurality), appearing 1415 times (36%); (v) “foods” (food, foods) appearing 1286 times (33%); (vi) “products” (product, product', production, productions, productive, productively, productivity, productivity, products, products') appearing 1226 times (31%); (vii) “socially” (social, sociale, sociales, socially), appearing 1159 times (30%); (viii) “develops” (develop, developed, developer, developing, development, development', developments, develops), appearing 937 times (24%); (ix) “systems” (system, systemic, systems, systems'), appearing 768 times (20%); (x) “economics” (economic, economical, economically, economics, economics), appearing 645 times (16%).

Figure 1. Cloud of words.
(Source: Own elaboration with Nvivo program.)

Table 1 shows the distribution of the articles by scientific journals, following the procedure defined by Hao et al. (2021) and Kahiya (2018). This observation reveals that the following scientific journals cover the largest amount of publications in the sample: “ Sustainability ” (Switzerland) (n=12), “Journal of Rural Economics and Sociology” (n=7), “Development and Environment” (n=5), and “Mundo Agrario, Agriculture” (Switzerland) (n=2).

Table 1. Number of published by scientific journal

Scientific Journal	Nr. of articles	Scientific Journal	Nr. of articles
Sustainability (Switzerland)	12	Ensayos Sobre Politica Economica	1
Revista de Economia e Sociologia Rural	7	Semina:Ciencias Agrarias	1
Desenvolvimento e Meio Ambiente	5	Pastoralism	1
Agriculture (Switzerland)	2	European Countryside	1

Mundo Agrario	2	Revista em Agronegocio e Meio Ambiente	1
Sustainability Science	1	Historia Agraria	1
Latin American Research Review	1	Ecological Indicators	1
Mountain Research and Development	1	Economia Agraria y Recursos Naturales	1
International Journal of Climate Change Strategies and Management	1	Sarhad Journal of Agriculture	1
		Iconos	1
Cahiers Agricultures	1	RA'E GA - O Espaco Geografico em Analise	1
Terra Latinoamericana	1	Food Security	1

(Source: Own elaboration with Publish ou Perish software.)

The number of global and partial citations per year for each article is exposed in table 2. About half of the publications in the sample had already been cited, with Bisht et al. (2020), Giagnocavo et al. (2018) and Ortiz et al. (2018) being the most referenced in global terms (n=13). This insight reveals the scientific interest of these articles, being that they are relatively recent. In fact, most of the articles in the sample (29, of which 27 on FA and SD) were published between 2020 and 2021, with only 15 of the remaining 17 being dedicated to the FA and SD topics. Understandably, the less cited articles lie between the years of 2021 and 2020, with the exception of 2017. This study also found that the most influential article, both in terms of overall number of citations (n=13) and citations per year (6.50) was by Bisht et al. (2020). This article was followed by the work of Giagnocavo et al. (2018) and Ortiz et al. (2018), both with an identical number of citations (n=13).

Table 2. Top 5 of citation articles

Order Nr.	Articles	Quotes	Citations / Year
1	Bisht et al. (2020)	13	6.50
1	Giagnocavo et al. (2018)	13	3.25
1	Ortiz et al. (2018)	13	3.25
2	Niederle et al. (2019)	10	3.33
3	Toscani & Sekot (2017)	8	1.60
4	Reyes et al. (2020)	6	3.00
4	Maia et al. (2018)	6	1.50
4	Parodi (2018)	6	1.50
4	Krishnamurthy et al. (2017)	6	1.20
4	Teixeira & Pires (2017)	6	1.20
5	Mutea et al. (2020)	5	2.50

(Source: Own elaboration with Publish or Perish software.)

The geographical contexts of the research following Gilal et al.'s procedures (in press); Kahiya (2018); and Hungara and Nobre (2020), can be seen in Table 3. Most of the studies took place in Brazil (n=18), followed by Argentina and the United Kingdom (n=5), Colombia, Mexico and the United States (n=3), Chile, Greece, Italy, Japan, Portugal and Spain (n=2) and finally China, Germany, Kenya, Ghana, Senegal, Canada, Austria, India, Netherlands, Belgium, Pakistan, Switzerland , Tanzania and East Timor with fewer contributions from studies in the field (n=1).

Table 3. Geographical context of the research

Order Nr.	Geographical Context	Number of Studies	Order Nr.	Geographical Context	Number of Studies
1	Brazil	18	14	Belgium	1
2	Argentina	5	15	Canada	1
3	United kingdom	5	16	China	1
4	Colombia	3	17	Germany	1
5	Mexico	3	18	Ghana	1
6	United states	3	19	India	1
7	Chile	2	20	Kenya	1
8	Greece	2	21	Netherlands	1
9	Italy	2	22	Pakistan	1
10	Japan	2	23	Senegal	1
11	Portugal	2	24	Switzerland	1
12	Spain	2	25	Tanzania	1
13	Austria	1	26	Timor leste	1

(Source: Own elaboration with VOSviewer software.)

The themes addressed and presented in table 4, include sustainability (n=13), agriculture (n=9) rural sociology (n=7), environment (n =6), agrarian science (n=5), food (n=1), politics economics (n=1), pastoralism (n=1), agribusiness and environment (n=1), ecology (n=1), and geography (n=1).

Table 4. Thematic context of the research

Order Nr.	Context in Search	Nr. of Studies
1	Sustainability	13
2	Agriculture	9
3	Sociology Rural	7
4	Environment	6
5	Agraria sciences	5
6	Food	1
6	Politics economic	1
6	Pastoralism	1
6	Agribusiness and Environment	1
6	Ecology	1
6	Geography	1

(Source: Own elaboration with Publish or Perish software.)

The method review followed the perspective of Paul and Benito (2018), having found works that use case studies (n=18); qualitative methods (n=7); mixed - qualitative, quantitative and ethnographic - methods (n=9); empirical methods (n=2); and regression models (n=1). The data collection tools used in the application of these methodologies were structured interviews and questionnaires composed of open and closed questions as well as participant observation.

In ELP, the construction of models is supported by quantitative and qualitative information collected through the application of a questionnaire to a sample of family

farms and qualitative tools, such as interviews, participatory observation and focus groups. In the study where ELP was used (Deus, 2019) special attention was given to the use of available resources, division of labor among household members and its distribution and breakdown by each of its activities. Although requiring a large volume of information, of a qualitative and quantitative nature, the PLE proved to be an adequate instrument to model, in an integrated and realistic way, the set of productive, reproductive and community activities, taking into account the available resources and the needs of the various activities of agricultural households and pursuing objectives of social, economic and environmental well-being.

V. CONCLUSION

This study set itself with the purpose of filling the research gap and defining a research agenda on the subject of FA and SD. Its literature review, which combined 46 articles published in the last five years, allowed for specific conclusions, particularly for developing countries.

It was found that FA contributed to several dimensions of sustainability, in part due to a large majority of rural agricultural households directly depend on it, but also because it relates to the management of natural resources and environmental preservation, the mitigation of climate change and the fight against poverty and hunger in the world, which are fundamental challenges to SD.

The bibliometric analysis allowed the identification of the main research contexts within the scope of FA and SD, namely scientific journals, countries, topics and methodologies. It is thus concluded that there has been a growing interest in the subject, given the large volume of publications which were made in the last two years. These recent publications were the most cited.

The main geographic contexts were Brazil, probably due to the breadth of the territory and the consequent relevance of FA and SD to its researchers. The most relevant topic was sustainability and the dominant methodologies were case studies. Among the methodologies, the ELP was not the most used, probably due to the complexity of the modeling and the need for a large volume of information, but it seemed to be the one which allowed for an integrated approach to the various components of FA and the different dimensions of sustainability of rural communities. The absent use of this instrument showed that research still has a long way to go in order to overcome the problems and the vulnerability of FA in conjunction with DS.

Given the importance of FA today, attested by international organizations, future studies can explore the role of family farmers as agents of change and of transition to SD. Another line of research can be directed towards identifying FA livelihood strategies that address climate change mitigation, social inclusion and poverty alleviation. The determinants that FA may have in creating sustainable opportunities for producers, territories and rural communities is an emerging topic in current research. FA could be an alternative way to rejuvenate the sector and fight migration and its social problems.

Another line could be the development of a methodological approach adjusted to the context and specificity of FA, which balances objectives that can be contradictory, such as those of social, economic and environmental nature.

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