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Financial sustainability in agri-food supply chains: A system approach

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Abstract

Historically, both governmental and private sectors have significantly underinvested in the agriculture industry. Increasing agricultural and food system investments is necessary to enhance food security and nutrition, reduce poverty, and adapt to climate change. To achieve long-term benefits, it is crucial to ensure not only that more investments are made, but also that these investments are responsible.

The purpose of this paper is to conduct a literature review of financial sustainability and ethical investing in the agriculture industry. The findings indicate that the academic community has begun to focus on these concerns in recent years. Specifically, issues concerning finance in developing nations and the management of irrigation systems are attracting attention.

This paper's goal is to encourage more financial institutions, financial services managers, policymakers, and universities to participate in sustainable development projects in the financial services sector.

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Introduction

By 2050, the Food and Agriculture Organization (FAO) predicts that the global population will surpass 10 billion people. Against this backdrop, in order to fulfill the rising demand for commodities and assure healthy, safe, and sufficient food, one of the goals of economic policy is to provide financial aid to the agricultural sector (Katan *et al.*, 2018).

The critical role played by the agricultural sector in achieving the United Nations Sustainable Development Goals (SDGs), particularly in terms of poverty reduction, ensuring food security, and improving the ecological situation, underscores the importance of providing financial resources for agricultural production (Katan *et al.*, 2018). In this context, financial sustainability plays a crucial role in a firm's success, and it is becoming increasingly vital to pay attention to environmental, social, and governance (ESG) concerns.

In this regard, voluntary international governance initiatives have begun to emerge that are pushing agribusinesses to reorganize their production processes and make new responsible investments. The aim is to leverage sustainable finance tools as a driver of innovation in the transition to new business models.

The United Nations Environment Program (UNEP) created its Financing Initiative (UNEP FI) in 1992 to provide a broad set of principles regarding sustainable finance (Clapp and Dauvergne, 2011). Furthermore, in 2006, the UNEP FI and the UN Global Compact developed the Principles for Responsible Investment to encourage institutional investors to consider ESG problems in their research and investment choices (Gond and Piani, 2013; Sievanen *et al.*, 2013).

These programs seek to persuade firms and investors to increase socially responsible investments (SRIs) not only because they should behave ethically concerning environmental and social issues, but also because doing so is crucial for their profitability (Carroll and Shabana, 2010; Pimonenko and Lushniak, 2017; Ilchenko-Syuyva and Slyusarchuk, 2019). The Principles for Responsible Investment in Agriculture and Food Systems (CFS-RAI) is defined as the mobilization and deployment of external and internal investment resources and partnerships between governments and businesses to promote the SDGs in rural areas. In May 2018, the European Commission adopted a package of sustainable finance proposals, which included a proposed regulation establishing a framework to encourage sustainable investment (Marx, 2020).

However, there are several challenges associated with financial support for the agricultural sector that mean that it is not accessible to everyone. This has created barriers to accessing funds, including bank loans and governmental financial assistance (Katan *et al.*, 2018).

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This literature review aims to understand how financial sustainability might reduce the environmental effects of current agriculture economic systems and motivate businesses to undertake SRIs. The research question addressed is: What contributions does the literature make to our understanding of financial sustainability in agri-food?

To the best of the authors' knowledge, this is the first literature review of financial sustainability in agribusiness specifically focusing on the political and social elements of potential solutions to agriculture's mounting issues. In addition, it aims to provide a complete evaluation of academic papers to identify important research subjects and aid businesses in building more sustainable business plans.

The paper is structured as follows. Section 1 explains the theoretical background and conceptual framework. Section 2 discusses the materials and techniques utilized. Section 3 summarizes the key findings from the literature review, which are discussed in more detail in Section 4. Finally, the study's shortcomings are discussed and final comments are presented in Section 5.

1. Theoretical background

According to several studies (Darnhofer *et al.*, 2010; Petrillo *et al.*, 2016; Sabău-Popa *et al.*, 2020), a growing number of farmers are selecting SRIs that provide a high financial return and perceptible social and environmental benefits.

Investors' increasing social awareness (Petrillo *et al.*, 2016) could play a significant role in the revitalization of the European economy (Makarenko *et al.*, 2022). This is particularly true in a market such as Italy, where the presence of SRIs is still marginal (Petrillo *et al.*, 2016) owing both to the limited availability of financial products and investors' lack of knowledge of these investment instruments (Eurosif, 2012; Makarenko *et al.*, 2022).

Advocates of responsible investment emphasize the importance of institutional investors in ensuring that investments in agricultural land, for instance, are managed sustainably over the long term (Scott, 2013). In this context, governments aiming to encourage more responsible investment must first improve the enabling environment via national laws prohibiting human rights violations or environmental harm (Bulman *et al.*, 2021). However, the literature has only recently addressed the challenges connected with financial sustainability and SRIs, even though there is growing concern regarding this issue in the agriculture industry. In this context, in addition to a relatively low level of financial sustainability activities on a global scale, Tuyon *et al.* (2022) indicated that the number of scholarly publications on this subject has only recently started to grow. Clapp (2017) studied recent developments in responsible agricultural investment efforts and provided a preliminary evaluation of their likelihood of success in reducing the ecological and

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social costs associated with the expansion of private financial investment in the sector. This author cited inconsistent and difficult-to-implement criteria, a lack of transparency, and a lack of enforcement as potential flaws in projects for voluntary responsible agricultural investment. Dono *et al.* (2022) evaluated the capacity of farms engaged in financial sustainability activities to generate cash flows that could offset the depreciation of the farm production system, as well as whether the diversification of farm efforts contributes to enhanced financial sustainability in agricultural sectors.

Prior studies have identified rural banks, the crops cultivated, farm size, and savings as the main predictors of lending (Akudug, 2012; Dzadze *et al.*, 2012). Those actions that have already been taken and the obstacles that policymakers will need to overcome to promote and achieve financial sustainability have also been highlighted (Marx, 2020). Empirical evidence has also been presented that provides a theoretical explanation for investor demand and preferences (Ng and Zheng, 2018). Other studies have analyzed the socio-demographic factors influencing farmers' access to credit (Hananu *et al.*, 2015; Henning and Jordaan, 2016) and examined perceptions of loan repayments, lending procedures, and asset value (Chauke *et al.*, 2013). Recent research has analyzed the financial sustainability of farm samples to determine whether the final cash surplus provided by Free Cash Flow on Equity (FCFE) is sufficient to balance technology depreciation and provisions for risks or other funds (Dono *et al.*, 2021). In this context, Buttinelli *et al.* (2021) conducted an analysis of the cash generated.

Nonetheless, as highlighted by Makarenko *et al.* (2022), the emergence of scientific studies on agricultural transparency and investment logic in sustainability is one of the most significant reasons for investigating the issues pertaining to financial sustainability.

2. Materials and methods

The searches conducted in this article were performed in the Scopus and Web of Science (WoS) online core collection databases on April 14 2022. The authors adopted the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) method, which is a qualitative approach enabling trends in scientific studies to be the captured (Zarbà *et al.*, 2022). The keywords that were utilized were: "financial sustainability" AND "farm*" OR "agri-food enterpris*" OR "agro-food enterpris*" OR "agri-food busines*" OR "agro-food busines*" OR "agri-food firm*" OR "agro-food firm*" OR "agri-food compan*" OR "agro-food compan*".

While gathering articles from the bibliographic sources, the PRISMA process follows a defined protocol (Dardonville *et al.*, 2021) that is reproducible, scientific, and transparent (Spina *et al.*, 2021).

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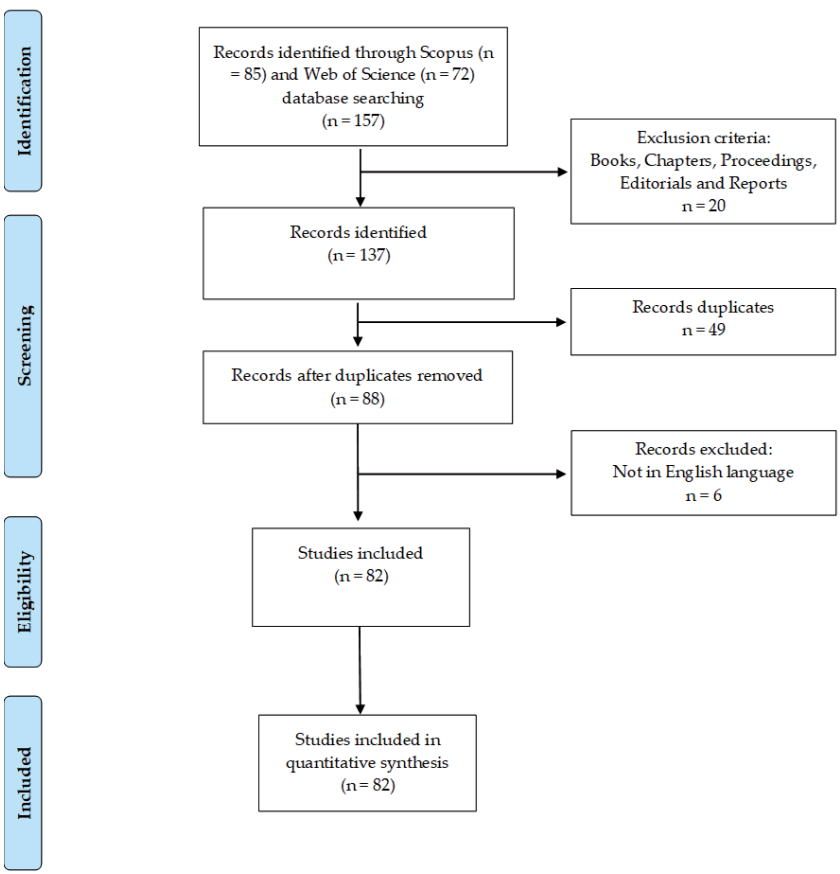
We first adopted a data purification strategy to filter duplicates and include only articles and reviews (written in English) in order to find and evaluate the literature with a high profile in the scientific community (Vindigni *et al.*, 2021). Subsequently, the eligibility step is usually associated with the PRISMA technique (Golbabaei *et al.*, 2020; González-Rubio *et al.*, 2020). However, to avoid potentially reducing the scope of the research, no items were eliminated at this stage since the methodological framework followed for this study incorporated data processing using VOSviewer (Esfahani *et al.*, 2021; Norouzi *et al.*, 2021). A total of 157 papers were extracted, of which 82 were utilized for analysis (Figure 1).

The analysis proceeded using the VOSviewer tool, which is a free Java-based application that produces network-based maps (Van Eck and Waltman,

Figure 1 - Prisma flow diagram



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2018). It was initially created in 2009 by Van Eck and Waltman (2010) of the Centre for Science and Technology Studies (CSTS) at Leiden University in the Netherlands. This application produces network analyses by processing bibliometric maps (Damar *et al.*, 2018) that visually represent diverse network forms of scientific publishing data by integrating many quantitative parameters.

The statistical analysis of the keywords using VOSviewer enabled us to identify the most frequently used phrases and their associations, from which we were able to extract the primary research subjects associated with the area under study. Martinez-Vázquez *et al.* (2021) were previously able to examine existing research trends to anticipate future developments in this way. This was accomplished in the present paper by analyzing the co-occurrence of terms and displaying the associated network map.

The combination of the two methods required importing the data, keywords, article titles, and abstracts (TITLE ABS KEY) obtained following the PRISMA technique into the VOSviewer program (Figure 2). Specifically, VOSviewer generated the so-called co-occurrence network map of the keywords from all the chosen articles from the databases under study, covering all accessible search periods (1998-2021).

The extracted papers were then subjected to descriptive analysis and network analysis using the VOSviewer software, which provides text mining capabilities that enable the construction and visualization of co-occurrence networks among the most frequently used terms in a body of scientific literature.

Figure 2 - VOSviewer technique

Source: Authors' elaboration.

3. Results

The growth in scientific output is shown in Figure 3 for the whole period of activity, namely 1998-2021. The findings indicate that the number of articles is extremely low until 2012, with only three articles per year recorded. However, in the subsequent four years, two to six articles were recorded annually. There is a substantial increase in the quantity of articles between 2016 and 2021. Specifically, 2017 is shown to be the most fruitful year thus far.

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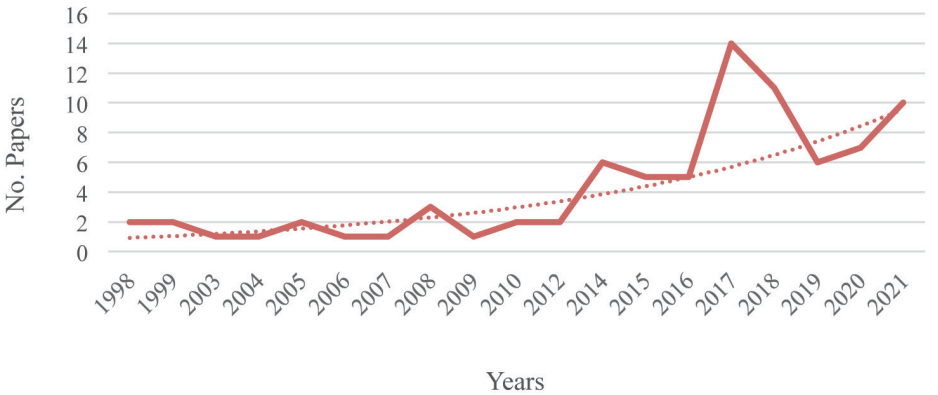
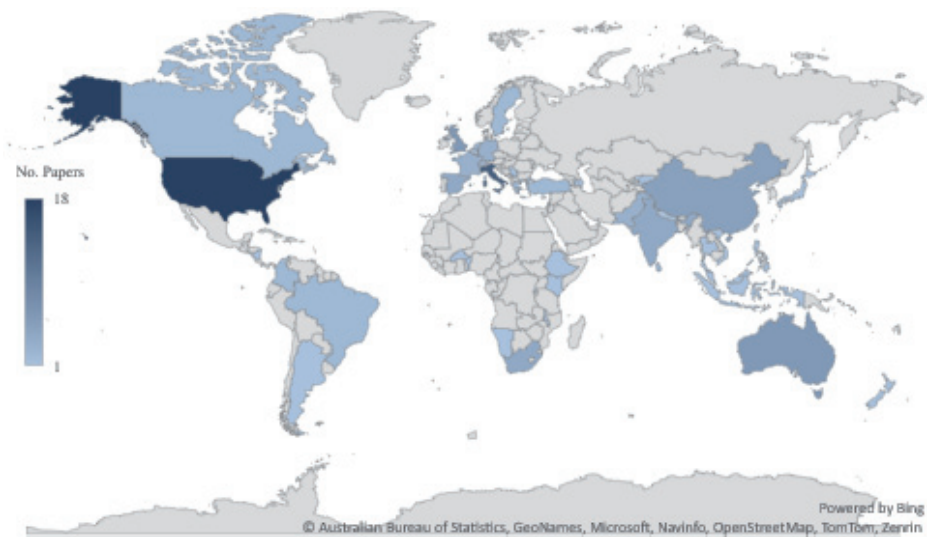
Figure 3 - Number of papers per year



Source: Authors' elaboration.

Figure 4 depicts, on a globe map, the distribution of author connections from various nations for the 82 scientific articles chosen. The colors represent the quantity of research produced in each nation. Specifically, the lighter the color, the smaller the number of studies, while the darker the color, the greater the number of articles. There are no studies in the gray region. The map demonstrates that author affiliations are not spread spatially uniformly. Given

Figure 4 - Countries in which the selected studies were conducted



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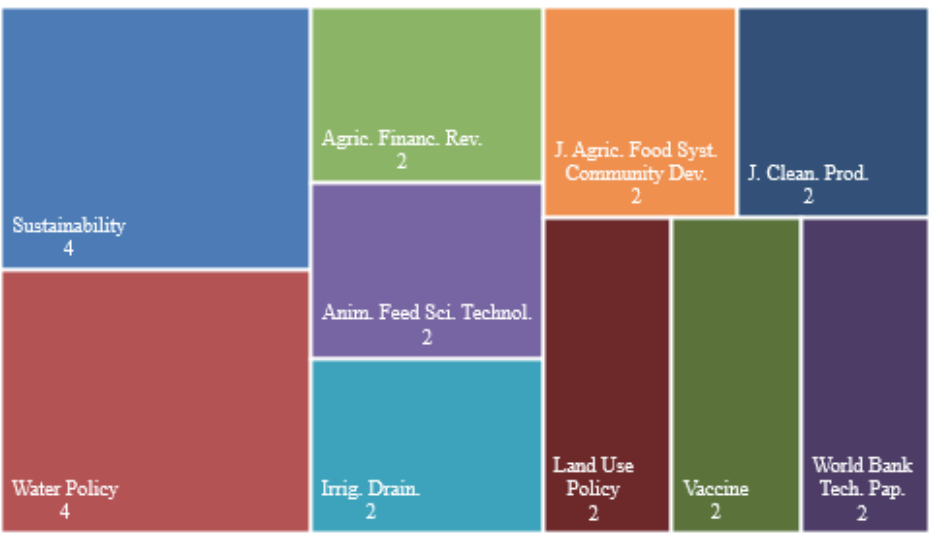
that the United States, Italy, China, Australia, India, South Africa, and the United Kingdom are the most active nations in scientific production related to financial sustainability in the agricultural sector, it can be concluded that the topic of financial sustainability is of scientific interest to several countries.

Figure 5 shows the journals that published the most articles over the studied period (1998-2021). Sustainability and Water Policy are the journals with the most articles published, with four articles each. The following journals published two articles: Agricultural Finance Review; Animal Feed Science and Technology; Irrigation and Drainage; Journal of Agriculture, Food Systems, and Community Development; Land Use Policy; Vaccine; Journal of Cleaner Production; and World Bank Technical Papers. Overall, the journal papers published on financial sustainability in agriculture cover a variety of subtopics, indicating that the issue is being explored from numerous perspectives.

Figure 5 - Top journals in which the selected studies were published



Source: Authors' elaboration.

Keyword analysis using VOSviewer revealed the most common phrases and their correlations, highlighting important study subjects and potential future developments in relation to the research topic. This was achieved through co-occurrence analysis of the phrases and the network map display. Figure 6 depicts the search that can be used to find the three clusters generated by the 32 keywords (items).

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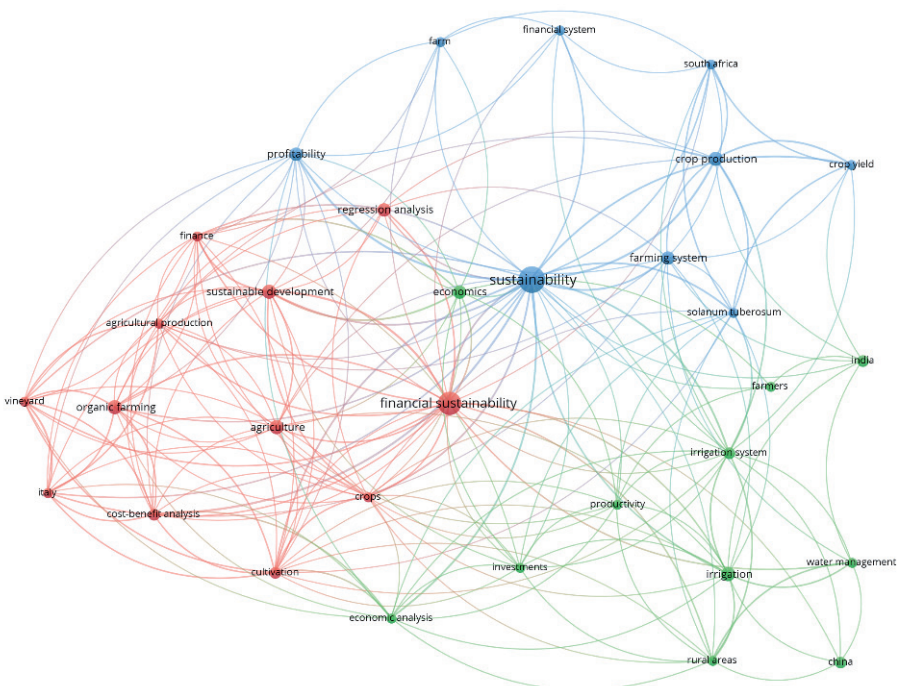
The first cluster (red) comprises studies conducted on financial viability to assess investments in the agricultural industry in general, as well as specifically for viticulture and organic agriculture in Italy. The items demonstrate the use of economic analysis techniques (cost-benefit analysis and regression) to evaluate profitability.

The second cluster (green) encompasses productivity issues in certain rural regions of the globe, including India and China. This cluster's focus is on the management of irrigation systems, which are used for the economic analysis to assess the productivity of the employed variables.

The third cluster (blue) focuses on the financial viability of various agricultural methods that determine the profitability of agricultural output in general, as well as potato production in particular.

Figure 6 - Keyword co-occurrence map



Source: Authors' elaboration.

According to their co-occurrence connections, the keywords were grouped into three clusters (Figure 7) (Du *et al.*, 2021).

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Figure 7 - Cluster analysis

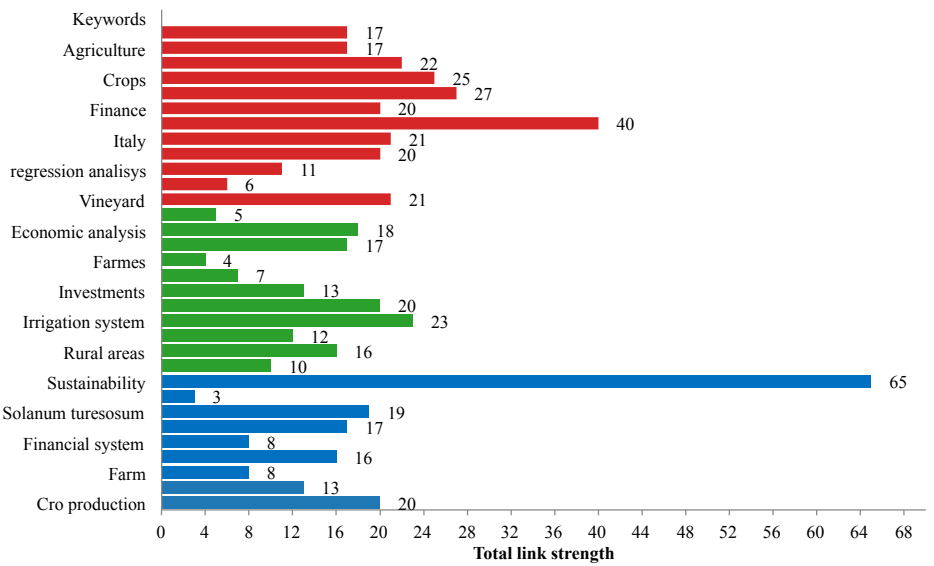
Keywords	Cluster	Color (*)	Occurrences
Financial sustainability	1		12
Irrigation	2		11
Sustainability	3		9

Source: Author's elaboration.

The analysis of the co-occurrence of keywords in the various clusters revealed valuable data (Figure 8), such as the total link strength characteristics, which reflect the overall strength of one item compared to another.

Cluster 1 (red) appears to be the most important, with 12 items, and is based on the following themes: agriculture; crops; finance; Italy; regression analysis; and vineyard. Cluster 2 (green) aggregated 11 keywords, with irrigation system, investment, and economic analysis particularly standing out. Cluster 3 (blue) comprises nine keywords, with sustainability and crop production being the most prominent.

Figure 8 - Total link strength per cluster



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4. Discussion

In recent years, financial risk has emerged as one of the most promising strategies to enhance the environmental and economic sustainability of farms (Pena *et al*., 2022). In this context, international organizations and private investors are promoting programs for the voluntary sustainable financing of responsible agricultural projects (Duong *et al*., 2022). Recent scholarly research has focused on financial sustainability, which is frequently based on short- and long-term financial success variables (Quayes, 2012). For example, Rodriguez Bolvar *et al*. (2016) examined net debt and adjusted income to determine financial sustainability, while Xu *et al*. (2020) highlighted the obstacles that financial constraints present to farm development by adopting a sustainable growth rate.

The analysis of the chosen papers indicates three major clusters identified by the terms "financial sustainability", "irrigation", and "sustainability".

Associated with the first cluster (financial sustainability) are innate concerns relating primarily to the financial sustainability of crops in Western nations, particularly Italy. Specifically, this cluster examines the financial performance disparities between conventional and organic farms (including wine production) in terms of sustainability.

Organic farming is highly valued by many consumers who consider organic products to be of superior quality, particularly due to the absence of chemicals used in the production process or the storage phase. This creates a more sustainable and environmentally friendly supply chain over time (Govindan *et al*., 2014), as well as protecting the entire agricultural agroecosystem and promoting farming practices that make use of natural soil fertility (Mader *et al*., 2002). According to Testa *et al*. (2015), organic farming appears to be more sustainable than conventional farming because of the reduction in process inputs and the resultant drop in total expenses (Acs *et al*., 2007). Considering the higher profitability of organic farming and the use of environmentally friendly inputs that make farms both competitive and ecologically beneficial (Sgroi *et al*., 2015), it is understandable that organic farming has been the subject of research on the challenges of financial sustainability. In addition, as shown in this cluster, the financial and sustainability worlds are intersecting in the wine industry, since both need accurate and verifiable data and transparency to combat climate change and ensure a prosperous future (Sardaro *et al*., 2017). Case studies of wineries (Tenev and Yordanova-Dinova, 2021; Rekova *et al*., 2020) have revealed that the more a winery adopts environmentally friendly practices, the greater its financial success. This cluster also demonstrates that the financial sustainability of wine production is especially important for Italy, which is the third largest nation in Europe by vineyard area and the largest producer

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by volume (FAOSTAT, 2014; Sardaro *et al.*, 2017). It also reveals that cost-benefit analysis is the primary assessment technique (Lanfranchi *et al.*, 2014; Carluccia *et al.*, 2015).

In the second category (irrigation), water supply and management issues are particularly prevalent in developing nations such as India and China. This is not surprising as, in densely populated areas that require substantial agricultural productivity and where water resources play a major role in responsible investment, economic analysis of investment and the management of irrigation systems is essential.

China is the world's largest developing nation (China Water Resources Statistical Yearbook, 2019). In 2018, the agriculture sector used 61.4% of the country's water (Ministry of Water Resources of the People's Republic of China [MWRC], 2019). The low coefficient of effective irrigation water usage on agricultural land is due to inefficient water use in agriculture and the pervasive wastewater issue (MWRC, 2019). Because agriculture is China's largest water consumer, there is a substantial opportunity to reduce water usage (Huang *et al.*, 2020; Zhang and Oki, 2021; Zhang *et al.*, 2023). Consequently, sustainable water management could prevent water shortages (Garcia *et al.*, 2019; Suleiman *et al.*, 2020; Musz-Pomorska *et al.*, 2020).

The third category (sustainability) is related to developing sustainable agricultural systems in poorer nations, such as South Africa, as well as specific crops, such as potatoes. Potatoes are the most significant vegetable crop in South Africa and the fourth most important food crop globally (FAOSTAT, 2016). They are cultivated in several distinct geographic regions with varying temperatures, soils, production seasons, management strategies, and market access. All of these variables influence the amount of resources required to cultivate potatoes, the yield and value of the crop, and, consequently, the efficiency of land, water, nutrient, seed, and energy use. This necessarily influences the ecological and economic sustainability of potato production in this region, which generally has less favorable growing conditions than northern Europe and the United States. Using decision support systems, such as irrigation scheduling tools, improved management practices could considerably boost the economic efficiency of potato production and the production efficiency of the region under study (Steyn *et al.*, 2016).

Conclusion

Both the public and private sectors have failed to invest appropriately in the agriculture sector for many years. It is vital to increase investment in agricultural and food systems to enhance food security and nutrition, alleviate poverty, and adapt to climate change. To obtain long-term

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advantages, it is vital to guarantee not only that more investments are made, but also that more responsible investments are made. This needs to be accomplished through laws and government regulations.

To the best of the authors' knowledge, this is the first literature review of financial sustainability in agribusiness that specifically focuses on the political and social elements of potential solutions to agriculture's mounting issues.

The findings of the literature review reveal problems associated with water management and irrigation systems in densely populated countries and problems associated with sustainable production in developing countries. Our aim is for these findings to be used to encourage more financial institutions, financial services managers, policymakers, and university professors to participate in sustainable development projects in the financial services sector.

Notably, governments could play a crucial role in promoting sustainable development and achieving the SDGs in agricultural and food systems by providing incentives for targeted investments and adopting inclusive and substantive stakeholder participation at all relevant levels. In addition, soft loans should be used to address this issue and boost the availability of financial resources for agribusinesses. This will enable them to modernize production equipment and technologies, decrease production costs, and increase profitability and competitiveness.

This research, however, has some limitations. We particularly emphasize that conclusions should be drawn with care due to the limited sample size. Finally, given its intricacy and unique nature, this topic requires more research, which provides ample opportunities for new lines of inquiry.

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