Environment, Development and Sustainability
https://doi.org/10.1007/s10668-024-04965-z

A theoretical framework to support green agripreneurship avoiding greenwashing

Jéssica Alves Justo Mendes[1] · Arthur Yassine Oliveira[2] · Lígia Suniga Santos[3] · Mateus Cecílio Gerolamo[1,4] · Vânia Gomes Zuin Zeidler[5]

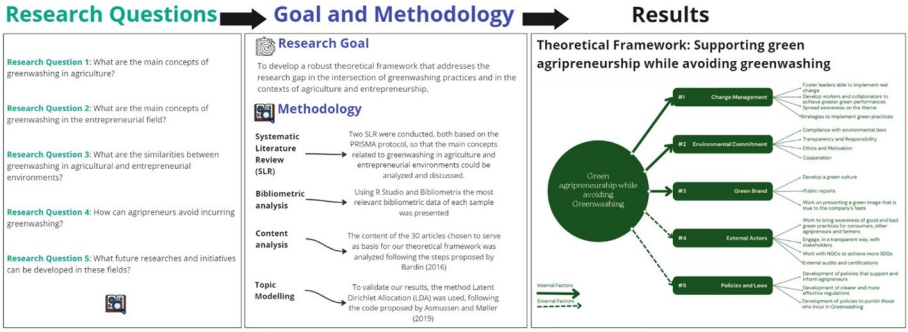
Received: 27 November 2023 / Accepted: 22 April 2024

Abstract
The rising awareness of climate crises has influenced conscious consumer habits towards sustainability, shaping the business landscape towards green principles and ethics. This shift towards sustainability, often referred to as the Green Revolution, emphasizes the importance of green practices in fostering environmental, social, and economic value. However, amidst the push for sustainability, greenwashing appeared. Greenwashing, the deceptive practice of capitalizing on environmental actions without meaningful commitment to sustainability, undermines genuine efforts towards sustainability and erodes consumer trust. Greenwashing is present in various sectors of the economy, with a rise in interest in researches focused on the agricultural sector, where the pursuit of sustainability is essential. In this context, the role of agripreneurs (agricultural entrepreneurs) becomes increasingly significant. Agripreneurs are instrumental in driving agricultural innovation and sustainability, yet the risks of greenwashing in this sector remain largely unexplored. This research aims to fill this gap by developing a theoretical framework tailored to the intersection of greenwashing practices and agripreneurship. To achieve that two systematic literature reviews (SLRs) were performed, one focused on agriculture, the other on entrepreneurship as a whole (seeing as there is virtually no studies focused solely on greenwashing in agripreneurship). Our framework encompasses internal factors, such as change management, environmental commitment, and the cultivation of a green brand, as well as external factors, including stakeholder engagement and policy support. By addressing these factors, agripreneurs can navigate the complexities of sustainability and green branding, ensuring their ventures remain authentic and ethical. Furthermore, we propose a research agenda to explore avenues for validating and enhancing our framework, including case studies to validate our framework, blockchain certifications, and the development of indicators for green practices in agripreneurship. In conclusion, this research contributes with practical and theoretical insights into the intersection of greenwashing practices and agripreneurship. By *providing* a framework for supporting green agripreneurship while avoiding greenwashing, we can begin to offer guidance for agripreneurs seeking to navigate the challenges of sustainability in the agricultural sector.

Extended author information available on the last page of the article

Published online: 23 May 2024

Graphical abstract



Keywords Greenwashing · Agriculture · Agripreneurship · Sustainability · Green Practices

1 Introduction

The availability and widespread dissemination of information about climate crises have led to the emergence of environmentally conscious consumer habits. These individuals, known as Green Consumers, drive businesses to adopt green principles, standards, and ethics (Hameed et al., 2021). With this, it is expected to obtain environmental, social, and economic value, achieving the "triple bottom line" (TBL) benefits and contributing to sustainable development (Govindan et al., 2013). As a part of the larger Green Revolution, these consumers are reshaping ethical standards in the business world (Crutchfield & Lunde, 2012). Thus, the importance of green practices cannot be overstated in today's world, where environmental sustainability has become a pressing global concern.

Green practices refer to adopting environmentally friendly strategies, processes, and policies that seek to minimize environmental negative impacts, promoting sustainability (Hameed et al., 2021; Lee et al., 2016). By implementing these practices, companies can improve their environmental image, gaining a competitive edge in the market. This environmentally friendly image can also contribute to global sustainability rankings, ultimately boosting the company's reputation. Therefore, a green image proves advantageous in an increasingly competitive market (Andersson & James, 2018). However, it is crucial to be aware that some companies that seek to receive the benefits of a green image might resort to deceptive practices, known as greenwashing, which is a way of capitalizing on the green approach by reporting environmental actions without achieving sustainable results or even making meaningful committing to sustainable initiatives (Ruiz-Blanco et al., 2022). Greenwashing can have severe consequences for a company if exposed, including loss of credibility, diminished trust from consumers and stakeholders, and negative impacts on the brand's image and future prospects (Gao et al., 2022).

To establish and uphold a green image, a company must align its corporate purpose with green business ethics. Once this alignment is achieved, a comprehensive approach to managing the TBL and corporate social responsibility (CSR) becomes essential to create genuine economic, environmental, and social value. To demonstrate compliance and the legitimacy of these initiatives and reforms, fostering corporate transparency through clearly defined goals and public reports is crucial. Additionally, maintaining corporate

accountability plays a vital role in reinforcing the company's commitment to its green objectives (Andersson & James, 2018; Stecker, 2016). A final tool to achieve a good green image is to invest in transparent and ethical sustainability reporting, which mitigates consumer concerns about greenwashing, something that is somewhat common in sectors such as the agri-food business (D'Adamo, 2023).

Once a green image is established, it is anticipated that there will be a surge in business investments and external funding from both national agencies and international institutions (Andersson & James, 2018). This can be attributed to the improved management of credit and reputational risks and an increase in the company's resilience, making it an appealing choice for risk-averse institutions. The responsible banking movement is particularly interested in business models aligned with United Nations (UN) Sustainable Development Goals (SDG), actively encouraging adopting more sustainable practices and serving as a catalyst for addressing various challenges. This alignment with sustainable practices not only enhances the company's reputation but also opens doors to a wider array of funding opportunities and collaborations with institutions that prioritize sustainability (Parker & Sheedy-Reinhard, 2022), which is essential for agribusiness growth (Shepherd et al., 2020).

In agribusiness, there is a growing need to find new strategies to increase productivity while bringing less environmental impact (Mendes et al., 2022). According to Condor (2020), a response to these strategies is given by agri-preneurs (entrepreneurs in the field of agriculture), represented largely by farmers willing to change their ways, thus accepting new technologies and models that seek to increase sustainability, entering a new agricultural phase. In a complement to Condor's (2020) work, Thephavanh et al. (2023) and Hosseininia et al. (2023) cite how important universities are for the growth of entrepreneurship in agriculture (agripreneurship), as the students can bring great innovation to farmers. All three articles concur that agripreneurship can be a decisive factor in increasing sustainability in the agricultural field. Similarly, Horne et al. (2020) argue that the presence of start-ups and entrepreneurs is needed to achieve SDGs, citing how in Germany, entrepreneurs are highly engaged in addressing SDG 9 (industry, innovation & infrastructure), SDG 3 (good health and well-being) and SDG 12 (responsible consumption and production), all SDGs that are highly connected to the agricultural field.

Despite the relevance of agripreneurship for agricultural innovation and sustainability and the risks greenwashing poses for developing genuinely sustainable agriculture production, no works analyze (theoretically, conceptually, or in practice) how agripreneurs engage with or act against greenwashing until now. Thus, our research address a research gap in the existing literature, specifically concerning the intersection of greenwashing and agripreneurship. While the broader landscape of green practices and sustainability in business has garnered attention as shown by the works of Vachon and Klassen (2008), Yellowlees et al. (2010) and Raut et al. (2019), there is a noticeable lack of understanding how agripreneurs engage with or counteract greenwashing within the unique context of agricultural entrepreneurship. Despite the acknowledged importance of agripreneurship in driving agricultural innovation and sustainability (Dutia, 2014; Klingenberg et al., 2022), the risks and challenges associated with greenwashing in this sector have been largely overlooked. This gap in empirical, conceptual, and theoretical exploration signals the necessity for more researches that seek to understand the connection between greenwashing practices and agriculture entrepreneurship. Thus, this article, which presents the first theoretical framework tailored to the agripreneurial domain was developed.

We propose to develop a framework that integrates the characteristics of "greenwashing" in both agricultural and entrepreneurial contexts so that agripreneurs can better understand what they should avoid and how they could enact when formulating and

implementing their new venture. We also propose to develop a research agenda, guiding other researchers into possible new avenues of research into greenwashing in two different but interconnected fields. To achieve this, two Systematic Literature Reviews (SLRs) were performed, simultaneously.

The decision to undertake two simultaneous Systematic Literature Reviews (SLRs) is a strategic and justified approach to comprehensively address the research gap identified. Firstly, this approach acknowledges the multifaceted nature of greenwashing (Raut et al., 2019), recognizing that its manifestations and implications may differ significantly in the agricultural and entrepreneurial contexts. By conducting two simultaneously reviews, the study aimed to understand the nuances of greenwashing in both contexts, ensuring a holistic study which was necessary for the creation of a robust theoretical framework. This approach also allowed us to investigate the interconnectedness of agripreneurship with broader entrepreneurial and agricultural concepts related to greenwashing, which served as the basis for our framework. This broader perspective of two different subjects that are inherent to agripreneurship (i.e., agriculture and entrepreneurship) allowed for a more informed synthesis of the challenges faced by agripreneurs. Additionally, this dual SLR strategy is supported up by articles such as Mirna et al. (2014), Martins et al. (2015), Franco et al. (2017), Belle et al. (2021) and Couto et al. (2019).

In summary, our research gap underscores the need for a theoretical understanding of greenwashing within agripreneurship, which is the first step we must undertake in order to help agripreneurs avoid the risks of greenwashing. The employment of two SLRs, conducted simultaneously, is justified by the distinct nature of greenwashing in agricultural and entrepreneurial contexts, ensuring a comprehensive investigation that supports the subsequent development of a robust theoretical framework for Supporting green agripreneurship while avoiding greenwashing. And our research goal is to develop a robust theoretical framework that addresses the research gap in the intersection of greenwashing practices and in the contexts of agriculture and entrepreneurship.

From this objective, the following research questions (RQ) were developed:

- RQ1: What are the main concepts of greenwashing in agriculture?
- RQ2: What are the main concepts of greenwashing in the entrepreneurial field?
- RQ3: What are the similarities between greenwashing in agricultural and entrepreneurial environments?
- RQ4: How can agripreneurs avoid incurring greenwashing?
- RQ5: What future researches and initiatives can be developed in these fields?

Our paper offers valuable contributions to the field of sustainable agriculture entrepreneurship, particularly by addressing the critical issue of greenwashing within the agripreneurial sector. Our research highlights the increasing importance of sustainability in consumer choices, which translates into a corporate shift towards greener practices, as can be validated by the works of Camilleri et al. (2023), Caferra et al. (2023) and the World Economic Forum (2023). By situating our analysis at the intersection of agriculture and entrepreneurship, our paper fills a gap in existing literature, which has largely overlooked the specific challenges and opportunities that agripreneurs face in striving for genuine sustainability amidst greenwashing practices.

Our paper's development of a theoretical framework for understanding and mitigating greenwashing in the context of agripreneurship represents a theoretical advancement in the field. By synthesizing findings from two systematic literature reviews—one focusing on agriculture and the other on entrepreneurship—our study not only delineates the

mechanisms through which greenwashing can occur but also offers strategies for agripreneurs to navigate these challenges effectively. Our framework emphasizes the importance of internal factors such as change management, environmental commitment, and the cultivation of a green brand, as well as external factors including stakeholder engagement and policy support. This comprehensive approach ensures that the ventures of agripreneurs remain authentic and ethical, contributing to the broader goals of environmental sustainability.

Our research also provides insights for agripreneurs, policymakers, and stakeholders in the agricultural sector. By offering a framework that can help guide agripreneurs in the establishment and preservation of trust with consumers, agripreneurs can seek to avoid the pitfalls of greenwashing, and contribute to the sustainable development of the agricultural industry. The emphasis on the development of a green brand and the strategic management of environmental commitments serves as a blueprint for businesses aiming to achieve a competitive edge in the increasingly important sustainable market.

For the academic field, our paper makes an interesting contribution by proposing a research agenda that explores the validation and enhancement of the developed framework. Suggestions for future research, including case studies, blockchain certifications, and the development of indicators for green practices in agripreneurship, demonstrate the paper's commitment to ongoing inquiry and improvement in the field. This research agenda sets the stage for further studies that can test, refine, and expand upon the initial framework, ensuring that the battle against greenwashing in agripreneurship continues to evolve in response to emerging challenges and opportunities.

2 Green practices and greenwashing

The academic relevance of green practices can be seen in the growing number of articles found when searching the main academic databases, such as Scopus and Web of Science (WoS). It is possible to observe a relevant number of works in various fields that analyze the enablers, adoption, advantages, difficulties, and consequences of green practices.

In the manufacturing field, Vachon and Klassen (2008) analyzed North American manufacturers' adoption of green practices, showing that for green practices to be genuinely accepted and applied, there needs to be a collaboration with suppliers and consumers. In the same field, the work of Gupta and Barua (2018) showed that in developed countries, the concern for more sustainable processes and products has grown, translating in greater regulatory pressure for various industries, which has not always been the case in developing countries such as India, making collaboration between manufacturers, suppliers, and consumers challenging.

In the healthcare industry, Yellowlees et al. (2010) argued that there is a lack of green practices adoption and interest in the United States due mainly to ignorance and fears of additional regulations and costs. The authors suggested that implementing green practices such as carbon credit programs could benefit financially and reduce its negative impact on the health of the Earth. In contrast, ten years later, in developing countries, Mousa and Othman (2020) showed increasing pressure from stakeholders in the healthcare industry to adopt environmentally friendly business practices, which emphasizes the need to identify green practices. Their study indicated that green human resource management practices positively impacted sustainable performance.

In the field of agriculture, Raut et al. (2019) postulate that the effective implementation of green management practices increases overall agricultural supply chain performance while, at the same time, providing economic profitability and stability to the related firms in the agricultural supply chain of the related firms. By interviewing 490 people (among them farmers, managers in agrifood industries, professors from rural departments, agricultural institution experts, and agricultural NGOs), the authors have found the following: cooperation is essential for the effective implementation of green practices, the proper usage of materials can not only avoid damage in agricultural produce, but it can also improve environmental performance, and the strategic approaches used to implement green management can maximize economic performance while reducing organizational supply chain effect on the environment.

It is crucial to recognize the potential pitfalls associated toh advertising the so-called "green practices", such as cherry-picking, greenspin, and greenwashing, for they can erode the credibility of a company's sustainability initiatives. Cherry-picking involves selectively emphasizing the most suitable or easily accomplishable targets while disregarding the negative impacts or aspects of a company's operations. This practice, along with green spin, which creates a fake or an illusion of sustainability through not fair marketing tactics, without substantial changes in practices, contributes to the broader phenomenon of greenwash (Andersson & James, 2018; Crutchfield & Lunde, 2012). Greenwashing, the most famous and recurrent practice, occurs when companies engage in deceptive actions, exaggerating or misleadingly promoting their environmental efforts to present a false image of sustainability. This is enabled by unregulated contexts where clear guidelines for green labelling are lacking. Without proper orientation and criteria to frame companies as sustainable, assessing their genuine commitment to environmental practices becomes challenging. This ambiguity raises important questions about how investments and loans are allocated to these companies. The interpretation of sustainability criteria becomes crucial in determining the allocation of financial resources. Establishing clear and universally recognized criteria for evaluating and labelling sustainability can help mitigate greenwash, providing investors and lenders with reliable indicators to make informed decisions about allocating resources to genuinely sustainable companies (Stecker, 2016).

Preventing greenwashing requires systems thinking and multi-faceted approaches that involve rigorous screening of companies and their processes, ensuring compliance with environmental laws, fostering awareness of greenwashing practices, and embracing green business ethics (Andersson & James, 2018; Crutchfield & Lunde, 2012; Parker & Sheedy-Reinhard, 2022). Safeguards are vital in this venture, providing mechanisms to hold companies accountable. These safeguards encompass stakeholders such as private individuals, employee whistle-blowers, media outlets, consumer protection groups, social-impact investment firms, social and environmental organizations, government entities, and competing benefit corporations. Acting as vigilant watch-dogs, these entities inspect the conduct of green corporations and hold them to high transparency and environmental responsibility standards. By encouraging active oversight and creating a culture of accountability, these safeguards contribute to the prevention of greenwashing and promote sustainability efforts within the corporate sector (Stecker, 2016).

It is worth noting that among the highly cited works of Vachon and Klassen (2008), Yellowlees et al. (2010), Gupta and Barua (2018), Raut et al. (2019) and Mousa and Othman (2020), none have discussed "Greenwashing". This appears to indicate that there has been a lack of attention regarding greenwashing in works that analyze the green practices theme, which is validated when searching for "greenwashing" compared to "green practice" in WoS and Scopus. Additionally, from the most cited papers, only one concerns agriculture,

which raises the question of why such an important field that should be deeply connected to the themes of green practices is so underrepresented.

3 Methodology

The Systematic Literature Review (SLR) was used as the main methodology of this research, which involved properly identifying, gathering, evaluating, and synthesizing all relevant literature for a determined topic (Petticrew & Roberts, 2006). From multiple primary studies, it is possible to apply a scientific, replicable, and transparent method to synthesize its results and provide the best evidence to inform academics and practitioners (Tranfield et al., 2003).

The use of SLRs in the sustainability field is well documented, as shown by works such as D'Amato et al. (2017), Franco et al. (2017), Gregorio et al. (2018), Ferraz and Pyka (2023) and Doğan et al. (2023). The studies conducted by D'Amato et al. (2017), Gregorio et al. (2018) and Ferraz and Pyka (2023) were focused on the concepts related to circular economy, while the work of Franco et al. (2017) focused in green supply chain, and the article of Doğan et al. (2023) analyzed the economic complexity, export diversification, and import diversification, related to SDG-9 (industry and innovation) and SDG-13 (climate action).

In the context of our study on greenwashing in agripreneurship, these examples underscore the importance of adopting systematic literature reviews to analyze and synthesize existing knowledge. The SLR ensures a comprehensive examination of the literature, allowing for the identification of gaps, trends, and theoretical contributions, such as our theoretical framework which sought to identify and mitigate greenwashing in agripreneurial contexts. It's worth noting that, just as we propose in our work, the articles of Ferraz and Pika (2023) follows a well-known and structured SLR research protocol such as PRISMA, while the work of Doğan et al. (2023) uses softwares such as Bibliometrix R-tool for their bibliometric analysis.

Thus, our article follows the guidelines of the Preferred Reporting Items for Systematic Literature Reviews and Meta-Analyses (PRISMA), as proposed by Moher et al. (2017) and employed by Ferraz and Pyka (2023). The main goal of the research, as stated in the Introduction section, is to create a framework that interconnects the greenwashing concepts related to the fields of entrepreneurship and agriculture (i.e., agripreneurship). To achieve this, two SLRs were performed, with the PRISMA protocol being followed, simultaneously for each SLR.

The utilization of two SLRs was essential in designing the theoretical framework of our research, and this methodological approach (i.e., use of two SLRs for designing theoretical framework and analyzing broad research questions) is backed up by works in different research fields, such as the ones of Mirna et al. (2014), Martins et al. (2015), Franco et al. (2017), Belle et al. (2021) and Couto et al. (2019). Each work that, like ours, used two SLRs to achieve a more robust theoretical result was described below, so that the need to use this approach could be validated.

Martins et al. (2015) sought to investigate the validation of user interface (UI) models, a multifaceted aspect of software development. Acknowledging the broadness of the research question, they employed two SLRs. The first focused on identifying the models used for UI, while the second honed in on the validation techniques employed

for these models. This dual SLR strategy allowed the authors to handle the complexity of UI model validation comprehensively.

Similarly, Belle et al. (2021) emphasized the significance of employing two SLRs in their research on architectural reconstruction. With a focus on identifying layers within a layered application, the first SLR inventoried architectural-pattern specific criteria, leading to the identification of six criteria embodied in four principles. The second SLR synthesized literature on software architecture reconstruction using these criteria. This approach ensured a thorough exploration of the loosely defined architectural-pattern specific criteria within the layered pattern, providing a nuanced understanding of software architecture reconstruction in the context of layered applications (Belle et al., 2021).

Franco et al. (2017) conducted two systematic literature reviews to address distinct aspects of Green Supply Chain Management (GSCM). Their study aimed to unravel the pressures leading to the adoption of GSCM practices and to identify articles discussing the performance outcomes of these practices. By conducting separate SLRs, the authors were able to scrutinize each relationship individually, shedding light on the limited existing research in these areas. The two SLRs unveiled key practices, pressures, and performance indicators associated with GSCM, ultimately contributing to the formulation of a conceptual theoretical model.

In a similar vein, Mirna et al. (2014) recognized the importance of human factors in software process improvements, particularly in Small and Medium Enterprises (SMEs). To bridge the gap between formal process descriptions and actual implementations, the authors conducted two systematic reviews. By addressing the characterization and proposing implementation strategies, these dual reviews facilitated a holistic understanding of the challenges faced by SMEs in implementing software process improvements.

Finally, Couto et al. (2019) employed multiple literature reviews, including two SLRs, in the Foundation Phase of their research. The first mapping study explored the evolution of the data lake concept and the architectures related to data lakes. Subsequent SLRs delved into big data profiling and data integration. This strategic combination of MS and SLRs enabled a comprehensive exploration of the research landscape, allowing the authors to address specific facets and challenges within the broader context of their study.

Following the PRISMA protocol, our SLRs were divided into 4 stages, Identification, Screening, Qualification and Reporting. The first stage for our SLRs (Identification), involved the definition of the keywords, which was performed by reading articles related to “greenwashing in agriculture” and greenwashing in entrepreneurship”, in a stage which we saw as exploratory. After defining the keywords, two different databases were used Web of Science and Scopus. Both of these databases are highly valued within academia for their quality and quantity of scientific articles (Shasha et al. 2020). Table one summarizes the keywords used, as well as the number of articles found in each search string.

For both searches, no predefined time was applied. What followed this stage was the exclusion of duplicated records, as well as the definition of exclusion and inclusion criteria (our Screening Stage). The following criteria were applied in both searches:

- Exclusion criteria: All articles that were not freely accessible AND/OR written in languages other than Portuguese, Spanish, English, or German.
- Inclusion criteria: Articles that presented the basic characteristics of greenwashing in either agricultural or entrepreneurial contexts.

To report the results of the Screening Stage of our SLRs, like in the study of Doğan et al. (2023), a quantitative bibliometric analysis, which was aided by the Bibliometrix R-tool, was performed.(see Fig. 1).

For our Qualification Stage, the text were fully read, and any article that failed to provide an answer to our RQs (see Introduction) were excluded. Finally, for our final stage, Reporting, a content analysis, as described by Bardin (2016) was employed. A semantic analysis, where the main aspects of greenwashing in two different contexts were catalogued, was performed, with the categories emerging a posteriori, meaning that we, as researchers, read the texts without predefining which keywords related to greenwashing would be searched. After reading the articles, everything that related to greenwashing (or deceitful green practices) was highlighted, and the most frequent words and sentences were marked and grouped (manually) by their semantic context (Bardin, 2016). One more article was added through snowballing (Wohling, 2014). Additionally, to validate our main framework, we used the Latent Dirichlet Allocation (LDA) model. This probabilistic topic model technique seeks to find themes and topics in texts (Asmussen & Møller, 2019). The code for the LDA was applied in the software RStudio and can be found in the article of Asmussen and Møller (2019). In Fig. 1, we summarize the steps taken to perform these SLRs.

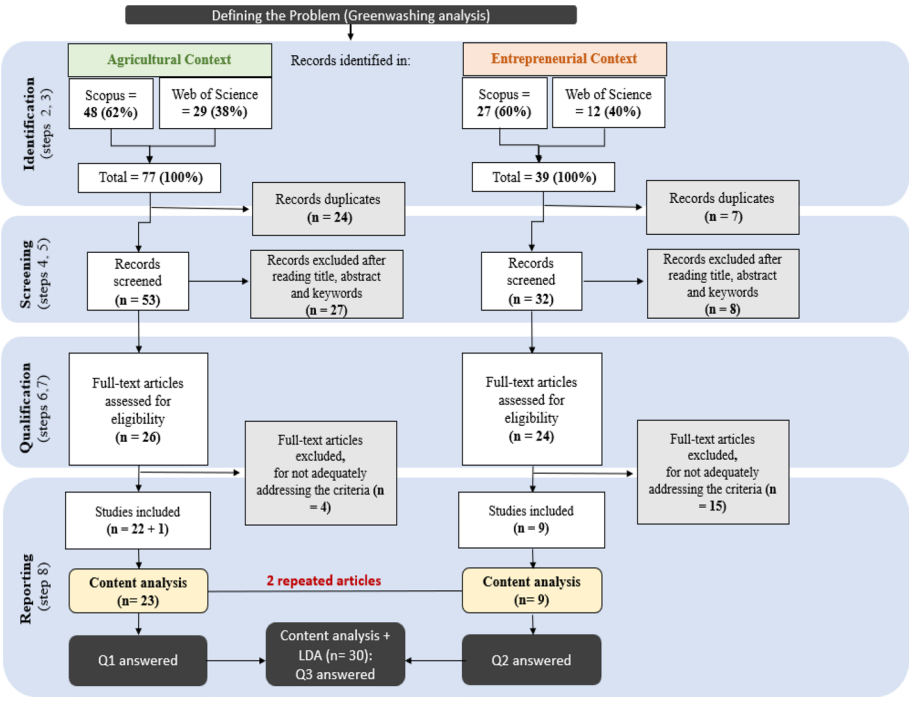


Fig. 1 Steps used in performing the SLR (*Source*: The Authors)

4 Results

The results of our quantitative analysis, which summarizes the bibliometric data of the Screening stage of our SLRs, was presented in the Sect. 4.1. After that, the results of our content analysis is shown, revealing the main findings of the literature about greenwashing in agricultural and entrepreneurial contexts, enabling the construction of a greenwashing framework for agripreneurs. The main aspects of each article used in both SLRs are presented in Appendix A. The results of our content analysis were described in three subtopics: Greenwashing in agricultural contexts (which answers RQ1), Greenwashing in entrepreneurial contexts (answering RQ2), and finally, Greenwashing framework for agripreneurs (which answers RQ3 and RQ4).

4.1 Quantitative analysis

A quantitative study on the themes of greenwashing in agriculture and greenwashing in entrepreneurial environments was performed using the application RStudio Cloud, as shown in the work of Doğan et al. (2023). After presenting the main bibliometric features of each, a comparison between both themes was performed. Before exploring in depth each the bibliometric aspects of the two different academic communities we will be analyzing (i.e., agriculture and entrepreneurial environments), we show in Fig. 2 the correlations between both communities. Figure 2 was created combining the metadata of our research regarding "greenwashing in agricultural contexts" and the metadata of our research on "greenwashing in entrepreneurial environments" (see Table 1 and Fig. 1 for more details).

Analyzing Fig. 2 we see two main clusters, the first formed by the keyword's "sustainability" and "greenwashing" and the second formed by the keyword's "sustainable development", "agriculture" and "human". In the context of sustainability, greenwashing emerges as a critical concern. Greenwashing refers to the practice of corporations marketing themselves or their products as environmentally friendly, often superficially, to gain competitive advantage, without genuinely committing to environmental stewardship (Rodrigues et al., 2021). This is evident in various sectors, from urban environmental policymaking to the

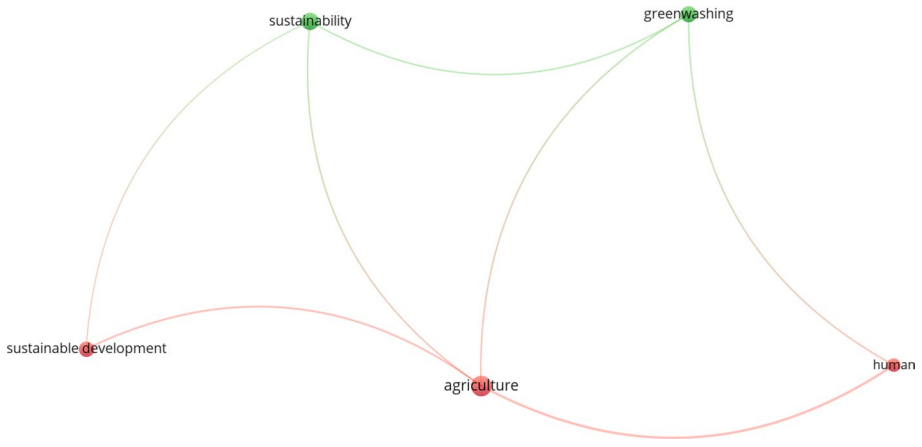


Fig. 2 Connection between Greenwashing in Agriculture and Entrepreneurial Contexts (*Source*: The Authors)

Table 1 Search strings for the exploratory literature review

Database	Search strings 1	Number of articles
Web of Science	("greenwashing" OR "greenwash" OR “green-wash” OR “green-washing” OR “green wash” OR “green washing” OR "grainwash" OR "grainwashing" OR “grain wash” OR “grain-wash” OR “grain-washing”) AND ("agriculture" OR "agribusiness" OR "agricultural" OR “farm” OR “rural”)	29
Scopus	("greenwashing" OR "greenwash" OR “green-wash” OR “green-washing” OR “green wash” OR “green washing” OR "grainwash" OR "grainwashing" OR “grain wash” OR “grain-wash” OR “grain-washing”) AND ("agriculture" OR "agribusiness" OR "agricultural" OR “farm” OR “rural”)	48
Database	Search strings 2	Number of articles
Web of Science	("greenwashing" OR "greenwash" OR “green-wash” OR “green-washing” OR “green wash” OR “green washing” OR "grainwash" OR "grainwashing" OR “grain wash” OR “grain-wash” OR “grain-washing”) AND ("startup" OR "start-up" OR "start up" OR "startups" OR "start-ups" OR "start ups" OR "entrepreneur" OR "entrepreneurship" OR "entrepreneurial" OR "agripreneur" OR "agripreneurship" OR "small business" OR "small enterprise" OR "small industry" OR "small industries" OR "SME")	12
Scopus	("greenwashing" OR "greenwash" OR “green-wash” OR “green-washing” OR “green wash” OR “green washing” OR "grainwash" OR "grainwashing" OR “grain wash” OR “grain-wash” OR “grain-washing”) AND ("startup" OR "start-up" OR "start up" OR "startups" OR "start-ups" OR "start ups" OR "entrepreneur" OR "entrepreneurship" OR "entrepreneurial" OR "agripreneur" OR "agripreneurship" OR "small business" OR "small enterprise" OR "small industry" OR "small industries" OR "SME")	27

cosmetics and financial industries and startups, as highlighted in the works of Andersson and James (2018), Stecker (2016), Rodrigues et al. (2021), Cremasco and Boni (2022), and Geerts (2014). These studies illustrate the delicate balance between true environmental efforts and the exploitation of green credentials for marketing, especially in entrepreneurial environments, where entrepreneurs can lack the necessary maturity to deeply understand sustainability issues, which can lead to greenwashing. Thus, the challenge lies in ensuring that sustainability efforts are authentic and not merely a tool for CSR facade, as discussed in the works of Dragomir (2020), Yang et al., (2021a, 2021b), and Toscano et al. (2022).

In the realm of sustainable development, agriculture holds a central position, intertwining environmental conservation with human welfare. Sustainable agricultural practices are crucial for ecological benefits and supporting human societies, as emphasized by Francis (2004) and Schermer (2008). This approach extends beyond mere compliance to certification standards and delves into authentic practices that benefit both the environment and humanity. The ethical and communicative aspects of sustainability in agriculture are highlighted by Cosby et al. (2022) and Munasinghe et al. (2021), who emphasized the importance of transparent and ethical practices to combat greenwashing in the sector. Additionally, the works of Bager and Lambin (2020) and Buseth (2017) emphasize the need for

sustainable development in agriculture to mitigate climate change impacts and foster environmental conservation.

These two clusters main connection comes from the concerns regarding sustainability, agriculture, human aspects and greenwashing, and this connection reveals a broader narrative of sustainable development in which greenwashing poses a significant threat. The intersection of sustainable practices in agriculture and the dangers of greenwashing underscores the importance of genuine, transparent, and ethically sound initiatives. The works of Andersson and James (2018), Stecker (2016) in the context of sustainability, along with those of Francis (2004), Schermer (2008), Bager and Lambin (2020) and Toscano et al. (2022) in sustainable agriculture, demonstrate a clear relationship between these domains. Both realms highlight the need for stringent certification processes, transparent communication, and real environmental initiatives, moving beyond superficial sustainability claims to ensure that the efforts in agriculture and various entrepreneurial sectors are genuinely contributing to societal and environmental well-being.

4.1.1 Greenwashing in agricultural contexts: a bibliometric analysis

Figure 3 presents the main features found by analyzing the 53 articles compounding the Web of Science and Scopus databases.

We found that the first time that a keyword related to "Greenwashing" appeared in the context of agriculture was in 1993, in the paper "Early detection of fungi in stored grain", by Magan (1993). However, when reading the article, it became clear that the term "grainwash" was used simply to signify the washing of grain, having no relation to the meaning of "greenwashing", as stated in Scalan (2013) and as previously defined in this paper. Thus, the first academic paper (indexed in either Scopus or Web of Science) to use greenwashing as we came to understand it, was the paper "Greening of Agriculture for Long-Term Sustainability", written by Francis (2004). In his paper the economic, social and environmental challenges and solutions faced by the agricultural sector were discussed, and a critique regarding the use of misleading marketing techniques, which are geared towards making the agroindustry appear greener than it is, was made. It's worth highlighting that the period between 2019 and 2023 is the one that presented the highest growth.

In Fig. 4 the detailed growth of the theme "Greenwashing in agriculture" is presented.

As shown in Fig. 4 the growth of the theme is accentuated from 2017 onwards, with highlights to the years 2021, 2022 and 2023. To make a more comprehensive analysis, we

Fig. 3 Statistics about our sample (Agriculture) (*Source*: The Authors)

will separate the studies in three periods, Beginning (from 1993 to 2016), Growth (from 2017 to 2020) and Accentuated Growth (from 2021 to 2023). When analyzing the Beginning period, we see that the discourse surrounding sustainability within the agricultural sector was marked by a growing understanding of the concerns surrounding the authenticity of environmental practices, with the issue of greenwashing starting to be addressed. This dialogue was noticeable in the contributions of Francis (2004) and Crutchfield et al. (2012), alongside the insights of Scanlan (2013) and Schermer (2008), forming a narrative that emphasized the pressing need for genuine sustainability practices in agriculture. These works collectively advocate for a shift beyond superficial green marketing tactics towards substantial, meaningful environmental and social practices.

Francis (2004) offered a systemic critique of the agricultural industry, highlighting the often superficial corporate commitments to sustainability. His work called for a more authentic approach that transcends mere image enhancement, advocating for sustainability practices that are truly beneficial to the environment and society. Complementing this, Crutchfield et al. (2012) introduced a practical framework aimed at avoiding greenwashing through design and ethical decision-making. This framework emphasized the reconciliation of economic incentives with genuine environmental responsibilities, showcasing the critical need for holistic sustainability approaches in design and construction.

The analysis is further deepened by Scanlan (2013) and Schermer (2008), with Scanlan's work critically exploring the phenomenon of "grainwashing" within the agribusiness sector, where corporations like Archer Daniels Midland, Cargill, and Monsanto claim to contribute towards sustainability and alleviating global hunger through their CSR narratives. By juxtaposing these claims against their actual practices, Scanlan (2013) revealed a significant gap between the companies' publicized commitments to sustainability and the reality of their contributions to environmental degradation and food insecurity. His article delved into the structural challenges of the world food system, emphasizing the conflict, power dynamics, and inequalities that underpin global hunger issues. Through a detailed analysis of agribusiness advertising and public statements, Scanlan (2013) critiqued the efficacy and intentions behind agribusiness's CSR efforts, suggesting they serve more to enhance corporate image and profit rather than genuinely addressing the root causes of hunger and environmental harm, thereby contributing to an ongoing debate within the sociology of agriculture and food.

Nº Articles	Year
1	1993
1	2004
1	2007
1	2008
1	2009
2	2010
2	2012
2	2013
2	2014
1	2015
1	2016
6	2017
2	2018
2	2019
1	2020
6	2021
14	2022
7	2023

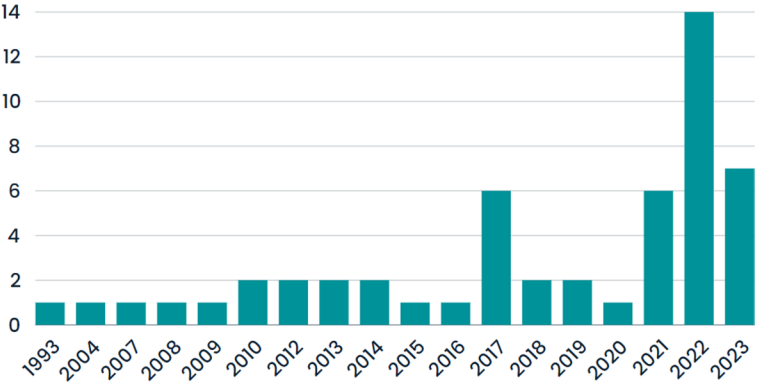


Fig. 4 Greenwashing in Agriculture—An Analysis Through the Years (*Source*: The Authors)

Schermer (2008) critically examined the impact of the organic farming sector's expansion in Austria, exploring whether it leads to a genuine integration of sustainable practices into broader agricultural policy ('greening') or if it merely enables superficial environmental claims ('greenwashing'). Situated within the framework of ecological modernisation, his paper investigated Austria's role as a leader in organic farming within the EU, analyzing the interplay between governmental policies, market responses, and the evolving public image of organic agriculture. Schermer(2008) highlighted the dual phenomena of 'greening', where organic principles potentially reshape agricultural practices and policies, and 'greenwashing', where the eco-friendly image of organic farming is used to bolster conventional agriculture without significant changes. Through an in-depth exploration of Austria's institutional environment for organic farming, policy support measures, and the contentious issue of GMOs, the article calls for clearer distinctions between organic and conventional practices to preserve the integrity of organic farming's ecological and ethical principles.

The Growth Period (2017–2020) is defined by a unified concern regarding better regulations and certifications in order to mitigate greenwashing, as evidenced by the articles of DeFries et al. (2017) and Alons (2017), which delved into the intricacies of certification programs and policy integration, respectively, to scrutinize their genuine impact on environmental and social outcomes. DeFries et al. (2017) presented a comprehensive review to assess the efficacy of voluntary certifications in improving the livelihoods of small-scale producers in tropical regions, comparing environmental, economic, and social benefits against the backdrop of sustainability goals. Concurrently, Alons (2017) critically examined the European Union's Common Agricultural Policy (CAP) reforms, specifically the greening measures, questioning whether they represent substantial environmental progress or merely serve as greenwashing tactics. Both studies converge on a critical analysis of purported sustainability efforts, evaluating their authenticity and effectiveness in contributing to genuine environmental and social improvements.

Despite their shared concerns over the authenticity of sustainability claims, DeFries et al. (2017) and Alons (2017) diverge in their focal points and methodological approaches. DeFries et al. concentrate on the micro-level impacts of certification schemes on small-scale producers across various tropical commodities, employing a systematic review of existing literature to gauge the broad spectrum of certification outcomes. Alons (2017), on the other hand, adopted a more macro-oriented lens, analyzing policy documents and the structural integration of environmental policies within the CAP, with a keen focus on the EU's agricultural sector. This comparison highlights a nuanced discourse on sustainability, underscoring the importance of distinguishing between genuine efforts and greenwashing. Both articles ultimately advocate for more rigorous and targeted evaluations of sustainability claims, whether they arise from certification programs or policy reforms, to ensure that such initiatives yield substantive environmental and social benefits rather than superficial appearances of sustainability.

Similarly to DeFries (2017) and Alons (2017), Partzsch et al. (2019) analyzed the effectiveness of voluntary certification schemes in the agricultural sector, especially in sub-Saharan Africa (SSA). Their analysis indicates that while these schemes aim to address sustainability concerns, their efficacy in genuinely mitigating environmental pollution and enhancing sustainability practices is questionable. The article argues that some certification schemes may, in fact, dilute existing public standards, such as the EU Organic Regulation. This dilution is primarily due to the lack of stringent measures within these private schemes to combat pollution from agricultural inputs. The authors suggest that instead of

investing resources in multi-stakeholder initiatives, which often fall short of public regulation standards, NGOs should focus on promoting and strengthening public standards.

Finally, Parker et al. (2021) focused on the potential of food labeling to drive transformative changes in the food system, particularly in the context of meat consumption and its implications for human and planetary health. They critique the reliance on labeling as a solitary strategy for informing consumer choices and promoting sustainable practices, arguing that labeling often falls short of sparking significant food system transformations due to issues like greenwashing, reductionism, and market segmentation. The paper posits that labeling, while valuable as an educational tool, is vulnerable to being co-opted for greenwashing purposes, where superficial or misleading sustainability claims do not translate into substantial environmental or health benefits. It calls for an integrated approach that combines labeling with a broader suite of regulatory and policy measures to genuinely shift production and consumption patterns.

In the Accentuated Growth Period (2021–2023) a critic to certification process is presented by the work of Munasinghe et al. (2021), where the exacerbated use of certifications is pointed out as a contributor to greenwashing. Despite ongoing concerns regarding greenwashing, the certification process through marketization mechanisms has been shown to have positive impacts on social and ecological outcomes, challenging the narrative that certifications serve merely as tools for greenwashing. The study contributes to the discourse on accounting for sustainable development by highlighting the nuanced ways in which sustainability certifications can influence industry practices (both positive and negative) and encourage a move towards genuine sustainability efforts.

Gittelson et al. (2022) highlighted the lack of oversight, regulation, and transparency as factors that allow greenwashing as well as the continued expansion of industrial agriculture at the expense of rural communities and environmental justice. They argue that while manure-to-energy projects could potentially benefit small farms, their implementation on factory farms results in negative environmental impacts, including CO2 emissions, hazardous air pollutants, and methane leaks. The study concludes that these projects are unsustainable solutions to the issues posed by CAFOs and calls for governmental action to halt the promotion and incentivization of CAFO manure-to-energy projects that compromise environmental health and rural community welfare.

For Cosby et al. (2022) there is a need for increased personal and financial capacities for farmers, market incentives for conservation behaviors, and the improvement of biodiversity protection laws through collaborative governance in Australia's dairy sector. The authors pointed out the challenges of traditional regulation and the opportunities for addressing sustainability issues, including biodiversity loss, by strengthening the integrity mechanisms around farmers' self-reporting to credibly refute claims of greenwashing. Thus, we see a critic on self-reporting, as it can lead to greenwashing.

Gordon et al. (2023) analyzed and critiqued regenerative agriculture (RA), presenting it as a unified discourse coalition comprising various perspectives ranging from profit-oriented restoration to deeply holistic environmental stewardship. The article critically examines RA's potential vulnerability to co-optation and greenwashing, particularly highlighting the risk that its transformative narrative could be diluted by entities prioritizing profit over genuine ecological and social restoration. Their analysis showed the importance of maintaining the integrity and transformative potential of RA amidst its growing popularity, ensuring that it remains a credible and effective approach to addressing the ecological degradation wrought by conventional agricultural practices. Through identifying the diverse discourses contributing to RA, the study brings to light the essential tension

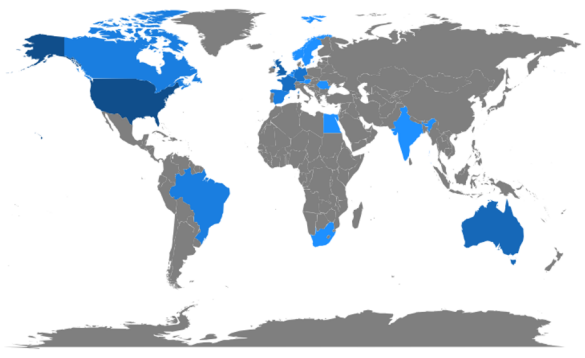
between maintaining RA's comprehensive ecological goals and the possibility of its principles being superficially adopted for greenwashing purposes.

Finally, Christiansen et al. (2023) critically explored corporate net-zero emission commitments through the lens of the Swedish fast food chain MAX Burgers AB, revealing how such pledges can veer into greenwashing territory when they overly rely on carbon offsetting rather than direct emission reductions. The study illustrates how MAX Burgers' claim of producing "climate-positive" burgers, offset by tree planting in Uganda, exemplifies a strategy that, while enhancing the company's green image, potentially obscures the urgent need for substantial changes in production and consumption patterns. Highlighting the risks of legitimizing business-as-usual practices and outsourcing environmental responsibility, the article calls for stricter regulatory frameworks to differentiate genuine environmental efforts from greenwashing, emphasizing the importance of absolute emission reductions over relative or compensatory measures. This examination underscores the complexities surrounding corporate climate commitments and the potential for such strategies to undermine rather than advance genuine sustainability goals.

Through an analysis of the most relevant works of the Accentuated Growth Period (2021 to 2023) we can see a more robust critic of various process and aspects related to the efforts to achieve sustainability in the agricultural field. Despite the distinct focal points of these period and their respective works, a shared concern emerges: the prevalence of greenwashing and the need for integrity, transparency, and accountability in environmental claims and practices. These authors collectively call for a reevaluation of the metrics and systems used to measure sustainability, advocating for a paradigm shift towards approaches that ensure long-term environmental and social well-being.

Now, in order to examine the global attention to the theme, publications by country are analyzed. In Fig. 5, the countries that have published on the theme of greenwashing in agriculture are presented.

We can see that the USA is responsible for the majority of the articles published in the theme of "greenwashing" in agriculture. Of all the papers published in the theme of "greenwashing" in agriculture, only five developing countries (Brazil, Egypt, India, Romania and South Africa) have published on this theme, totaling 6 articles. This can either be because developing countries are less aware of the theme or unwilling to deal with it (Kumar & Kumar, 2013). It is notable that there are more publications from the global



Country	Number of Articles Published
USA	15
UK	7
AUSTRALIA	5
FRANCE	4
GERMANY	3
BRAZIL	2
CANADA	2
NETHERLANDS	2
SPAIN	2
AUSTRIA	1
BELGIUM	1
EGYPT	1
INDIA	1
NORWAY	1
ROMANIA	1
SOUTH AFRICA	1
SWEDEN	1

Fig. 5 Publications by country (*Source*: The Authors)

north than from the global south, which may indicate greater attention to the topic. This could be because countries in the global north are much more responsible for CO_2 emissions when compared to those in the global south, or just because there is more funding for research in the richest regions of the globe. Finally, analyzing the countries with more than one publication, we see that only one is an emerging country (all the others are developed countries), that being Brazil. These results are consistent with Brazil's high investments in technological advancement and the growing concern of appearing to become more sustainable (Romani et al., 2020; Carvalho et al., 2021).

Figure 6 illustrates the co-citation cluster designed to uncover the central themes and intellectual foundation of greenwashing in agricultural contexts. This analysis offers a notable advantage by visually revealing the knowledge structure within the research domain (Doğan et al., 2023). By relying on the visual representation derived from numerous keywords cited within the thematic realm of greenwashing in agriculture, we can delineate the scientific framework. This investigation identified five prominent clusters, showcasing the distinctive keywords prevalent in the metadata of the articles. The first main cluster (and the most relevant) is focused on agriculture and the human aspects of agriculture (such as politics, smallholders). The second main cluster included sustainability, biodiversity, communication and ethics. The third cluster was focused on sustainable development. The fourth main cluster focused on climate change and carbon emission. And finally, the fifth main cluster focused on environmental justice, politics, regulation, agribusiness and ecosystem services. The sixth cluster (in Fig. 6 it is the green cluster) was not considered in our analysis due to it having little connection to the other clusters, as well as having the keyword "article" as the main connector, which showed that the cluster is not well defined. This analysis shows the relevance of sustainability for agriculture as a whole.

Analyzing our first and most prominent cluster we see that the intersection of "agriculture" and "human aspects" is significantly highlighted in discussions about sustainability and ethical practices within the sector. Works by Francis (2004) and Schermer (2008) emphasize the need for agriculture to move beyond superficial commitments to sustainability, advocating for practices that genuinely benefit both the environment and human

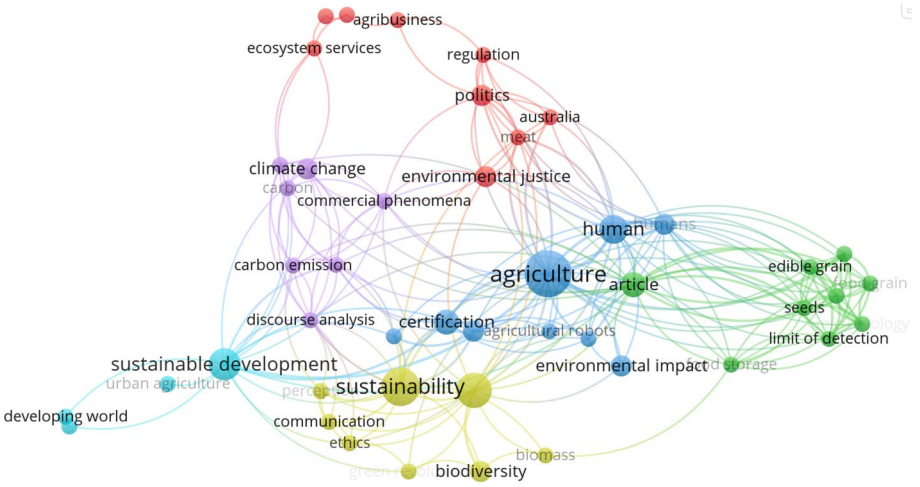


Fig. 6 Co-citation by cluster (Agriculture) (*Source*: The Authors)

societies. The role of "certification" in this context is double-edged; while it aims to ensure the authenticity of sustainable practices, as seen in the critique by Partzsch et al. (2019), it also faces challenges in effectively mitigating greenwashing, highlighting the necessity for stringent and transparent certification processes (Alons, 2017; DeFries, 2017). The "environmental impact" of agriculture is a core concern, with studies like those by Bager and Lambin (2020) and Munasinghe et al. (2021) examining how certifications and sustainable practices can lead to tangible ecological benefits. However, the risk of greenwashing persists when these efforts are not sufficiently substantiated or when they serve merely as marketing strategies rather than genuine environmental stewardship.

Analyzing the second most prominent cluster we see that the cluster is formed mainly by the works of Schermer (2008), Crutchfield et al. (2012), Cosby et al. (2022), and Munasinghe et al. (2021), with the authors contributing to the discourse on "sustainability", "biodiversity", "communication", and "ethics" in agriculture, each emphasizing the necessity of genuine practices to combat greenwashing. Schermer (2008) examined Austria's organic farming policies to highlight the essential role of transparent policies and communication in safeguarding biodiversity and ensuring the authenticity of sustainability efforts. Crutchfield et al. (2012) advocated for an ethical framework in sustainable design to prevent sustainability initiatives from becoming mere greenwashing facades. Cosby et al. (2022) explored collaborative governance in Australia's dairy sector as a means to enhance biodiversity conservation, emphasizing the importance of ethical communication and stakeholder engagement. And Munasinghe et al. (2021) highlighted the role of clear communication, ethical standards, and stringent certification processes in the tea industry as tools to distinguish true sustainability efforts from greenwashing. Collectively, these studies underscore the importance of ethics, transparency, and stakeholder collaboration in promoting sustainability and biodiversity within agriculture, while cautioning against the superficial application of sustainable labels.

The discussion on "sustainable development" within the agricultural sector, our third cluster, as illuminated by Buseth (2017) and Toscano et al. (2022), revolves around the urgent need for precise, universally recognized standards and transparent reporting mechanisms to mitigate the risks of greenwashing. Buseth (2017) emphasized the importance of clear definitions and rigorous certifications to ensure authenticity in sustainability claims, while Toscano et al. (2022) highlighted the challenges of implementing and accurately communicating sustainable practices, particularly in the poultry industry. Thus, we can see a clear connection between the first three clusters, as they all have a heavy emphasis on the development of a more sustainable and ethical agriculture, with attention to transparency as a way to mitigate the dangers of greenwashing.

Our fourth cluster is characterized mainly by the works of Christiansen et al. (2023), Alons (2017), Parker and Sheedy-Reinhard (2022), and Marchant et al. (2022), which collectively examined the intricate relationship between climate change mitigation efforts, carbon emission reduction strategies, and the prevalent issue of greenwashing within corporate practices. These studies revealed a critical examination of corporate and regulatory approaches to combating climate change, emphasizing the problematic reliance on carbon offsetting and the potential for such strategies to serve as greenwashing. Christiansen et al. (2023) provided a critique of corporate net-zero claims that prioritize offsetting over direct emission reductions, while Alons (2017) and Parker and Sheedy-Reinhard (2022) highlighted the necessity of stringent regulations and genuine ethical commitments to ensure that carbon emission reduction efforts are substantive rather than symbolic. Marchant et al. (2022) argued for the adoption of technological innovations as a means to achieve real reductions in carbon emissions, cautioning against the overstatement of their environmental

benefits, a practice that could constitute another form of greenwashing. Together, these contributions emphasized the need for transparency, accountability, and real action in the fight against climate change, pointing out that without these elements, initiatives risk being undermined by greenwashing tactics that compromise genuine environmental progress.

Finally, cluster five is formed by the interconnections between "environmental justice", "politics", "regulation", "agribusiness", "ecosystem services", which shows the complex landscape where agricultural practices and policies intersect with sustainability goals. In this cluster, the main works to analyze are those of Scanlan (2013), Mehta et al. (2021) and Gittelson et al. (2022). Scanlan (2013) critically examined the political and regulatory frameworks that enable or combat greenwashing in agribusiness, emphasizing the manipulation of sustainability narratives to serve corporate interests. Mehta et al. (2021) and Gittelson et al. (2022) contributed to this discourse by highlighting the role of certifications and oversight in aligning agribusiness with genuine environmental and social justice objectives, demonstrating how appropriate regulatory and certification mechanisms can mitigate greenwashing and enhance ecosystem services. Collectively, these analyses advocated for stringent, transparent regulations and a true commitment to sustainability from agribusinesses to ensure that agricultural practices not only claim to support environmental justice but also actively contribute to it, thereby fostering a sustainable and equitable agricultural sector that prioritizes ecosystem health and social equity.

4.1.2 Greenwashing in entrepreneurial contexts: a bibliometric analysis

In Fig. 7, a summary of the main bibliometric features of greenwashing in entrepreneurial environments is presented. And, as we can see, it indicates 2011 as the first year where an article united the themes of entrepreneurship and greenwashing. However, when reading the article of Er et al. (2011), it is clear that the focus is on greenwashing in the whole ecotourism environment, without a clear distinction of the specificities and characteristics found in entrepreneurial contexts. Therefore, we argue that the first article to analyze greenwashing in an entrepreneurial context was that of Geerts (2014), which analyzes how managers of SME independent hotels can seek certification programs as a way to improve (as well as prove) their green practices, while learning paths to avoid committing greenwash.

Analyzing the periods (Fig. 8), we see that there are very few articles between when the theme first appeared on the literature (2011) up until 2019. Thus, we defined this period as "Beginning". The second period, from 2020 to 2023 was defined as "Growth" period.

Fig. 7 Statistics about our sample (Entrepreneurship) (*Source*: The Authors)

Due to the reduced number of articles we do not believe that this theme has experienced an accentuated growth. This shows that there are still very few articles that seek to analyze greenwashing in entrepreneurial contexts, which we see as not only a research gap, but also as a research opportunity. With our article seeking to create the first theoretical framework on greenwashing in agripreneurship, we believe new and interesting research avenues may be open.

Analyzing Fig. 8 we see that the "Beginning" period is composed of 9 articles. Of these articles, the works of Geerts (2014), Stecker (2016), and Andersson and James (2018) are highly relevant, as they collectively address the pervasive issue of greenwashing in sustainable development, underlining the critical need to verify the authenticity of sustainability claims across different sectors. These studies reveal a consensus on the dangers of greenwashing, where the actual environmental efforts fall short of claimed commitments, highlighting the difficulty in distinguishing genuine environmental stewardship from misleading claims that aim to bolster organizational (Geerts, 2014; Stecker, 2016) or urban reputations (Andersson & James, 2018). Despite varying in context and approach, from CSR (Geerts, 2014; Stecker, 2016) to urban policy (Andersson & James, 2018), each article brings insights into identifying and countering greenwashing practices through methods such as legal regulation (Geerts, 2014), stakeholder engagement (Stecker, 2016) and strategic collaboration to achieve genuine commitment towards sustainable development (Andersson & James, 2018). Furthermore, they propose solutions like stricter regulations (Andersson & James, 2018; Geerts, 2014; Stecker, 2016) and increased consumer awareness (Geerts, 2014; Stecker, 2016) to combat greenwashing, emphasizing the importance of true sustainability efforts for achieving environmental progress.

The "Growth" period has 23 articles and encompasses the years 2020 to 2023. Some of the most relevant works of this period are described as follows. The articles of Dragomir (2020) and Bager and Lambin (2020) examined the discourse surrounding greenwashing within corporate sustainability efforts. While both articles converge on the imperative of distinguishing between genuine sustainability practices and superficial greenwashing, they diverge in their analytical focus. Dragomir (2020) provided a broader critique of the corporate sector's engagement with sustainability, emphasizing the risks of undermining genuine environmental and social initiatives through misleading sustainability claims. Conversely, Bager and Lambin (2020) delved into the specific challenges and opportunities within the coffee industry, examining how voluntary

Nº Articles	Year
1	2011
0	2012
1	2013
1	2014
0	2015
1	2016
1	2017
2	2018
2	2019
3	2020
8	2021
8	2022
4	2023

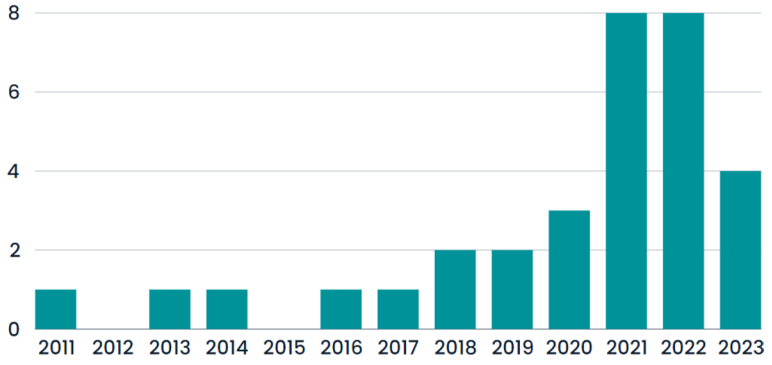
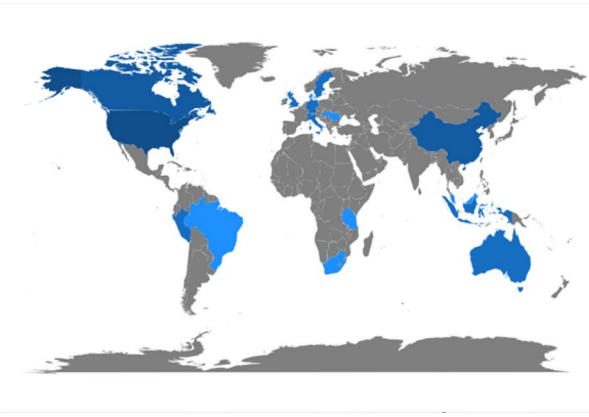


Fig. 8 Greenwashing in entrepreneurial contexts—an analysis through the years (*Source*: The Authors)

sustainability standards and CSR programs shape authentic sustainability efforts and influence market dynamics. Together, these studies underscore the critical importance of transparency, accountability, and stakeholder engagement in advancing true sustainability within corporate practices, while cautioning against the detrimental effects of greenwashing on both environmental conservation and corporate credibility.

Yang et al., (2021a, 2021b) and Neumann (2021) both critically explore the implications of sustainability initiatives on firm performance, delving into the dynamics between genuine environmental strategies and greenwashing. While Yang et al., (2021a, 2021b) focused on sustainable entrepreneurship, examining how green startups navigate sustainability claims and innovate to avoid greenwashing, Neumann (2021) adopted a broader lens, analyzing the impact of greening strategies, both substantive and symbolic, across a spectrum of new firms in various industries. Despite their differing scopes, both studies converge on the critical view that while sustainability efforts can enhance firm legitimacy and stakeholder trust, the thin line between authentic environmental commitment and greenwashing requires vigilant navigation to ensure that such initiatives do not merely serve as superficial marketing tactics but genuinely contribute to environmental and social well-being. Similar to Bager and Lambin (2020) the analysis of Rodrigues et al. (2021) delved into the complexities of greenwashing within the corporate landscape, highlighting its implications for environmental sustainability and CSR. The study defined greenwashing as deceptive practices that exaggerate or fabricate the environmental friendliness of a company's products or policies, misleading stakeholders about the true environmental impact. It underscored the prevalence and detrimental effects of such practices on consumer trust and the integrity of genuine environmental efforts. Through a discussion on various strategies employed by companies to appear eco-conscious, such as vague claims and misleading labels, Rodrigues et al. (2021) emphasized the critical need for enhanced regulatory oversight and increased consumer awareness to combat greenwashing. The authors advocated for stringent transparency and accountability measures to ensure that corporate environmental claims are both credible and substantiated, thereby safeguarding the credibility of CSR initiatives and promoting true environmental stewardship.

Finally, Cremasco and Boni (2022) critically examined the European Union (EU) Sustainable Finance Disclosure Regulation (SFDR) and its impact on investment funds, focusing on the regulation's potential to mitigate greenwashing in the financial sector by mandating increased transparency and sustainability declarations. This regulation aims to differentiate financial products based on their sustainability focus, thus addressing the pervasive issue of greenwashing by ensuring that claims of sustainability are substantiated. Conversely, Toscano et al. (2022) explored the perceptions and implementations of sustainable practices within the Italian poultry sector, emphasizing the role of environmental, social and governance (ESG) criteria in shaping business strategies and the potential for greenwashing when such criteria are superficially adopted without genuine integration into business operations. While Cremasco and Boni (2022) investigated into regulatory measures to combat greenwashing in financial products, Toscano et al. (2022) offered insights into the agricultural sector's efforts to navigate sustainability challenges, highlighting the necessity for clear, actionable, and verifiable sustainability standards across sectors to prevent greenwashing and promote authentic sustainability initiatives. Together, these studies underscore the multifaceted approach needed to address greenwashing, spanning regulatory frameworks and sector-specific sustainability efforts to ensure transparency and authenticity in environmental claims.



Country	Number of Articles Published
USA	4
CANADA	3
CHINA	3
AUSTRALIA	2
GERMANY	2
INDONESIA	2
ITALY	2
PERU	2
SWEDEN	2
SWITZERLAND	2
UK	2
BRAZIL	1
DENMARK	1
HUNGARY	1
MALAYSIA	1
ROMANIA	1
SINGAPORE	1
SOUTH AFRICA	1
TANZANIA	1

Fig. 9 Publications by country (Entrepreneurship) (*Source*: The Authors)

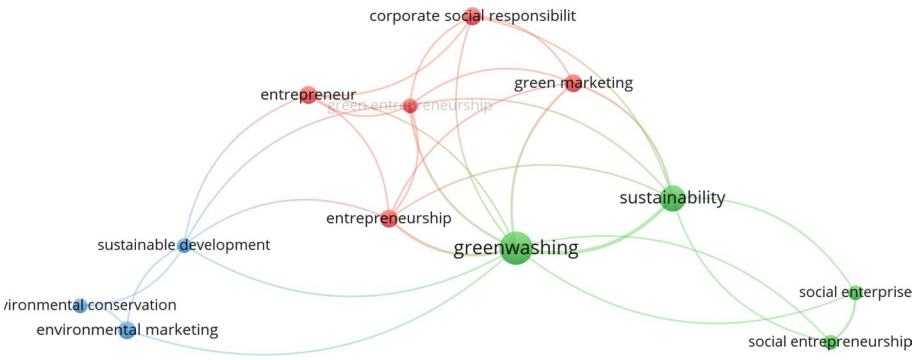


Fig. 10 Co-citation by cluster (Entrepreneurship) (*Source*: The Authors)

To assess the worldwide interest in the topic, an analysis is conducted on publications categorized by country. In Fig. 9 we show a map of the countries that have published articles on greenwashing in entrepreneurial contexts. We can see that the USA is responsible for the majority of the articles, followed closely by Canada and China. This result is consistent with USA and China's investments in entrepreneurship (Kuckertz et al., 2019). It is possible to notice publications from 7 developing countries (Indonesia, Peru, Brazil, Malaysia, Romania, South Africa, and Tanzania), thus emphasizing the importance of entrepreneurship in emerging economies.

In Fig. 10 the co-citation clusters of greenwashing in entrepreneurial contexts is presented. Our study showed three main clusters. The first one (and the most relevant) highlights the themes of greenwashing, sustainability and social aspects of enterprises and entrepreneurship. The second prominent cluster in the analysis included keywords related to entrepreneurship themes (entrepreneur, green entrepreneurship and entrepreneurship) as well as CSR and green marketing. Finally, our third main cluster was based on the keywords sustainable development, environmental conservation and environmental marketing. This shows that in the broader theme of greenwashing

in entrepreneurship, the marketing and social aspects are as prominent as the aspects related to environmental sustainability.

To give a more detailed analysis of the first and main cluster, we see that in the context of "greenwashing", "social enterprise", "social entrepreneurship", and "sustainability", five papers are the ones to offer the most relevant insights and analysis, illustrating varied approaches to these intertwined themes. Andersson and Laura James (2018) delved into the interplay between green place branding and urban environmental policymaking in Växjö, Sweden, providing a critical lens on the motivations, altruistic versus entrepreneurial, behind the adoption of green labels and the potential for "greenwashing". This study underscored the delicate balance between genuine environmental efforts and the marketing of green credentials for competitive advantage. In contrast, Stecker (2016) explored the legal nuances of benefit corporations, a novel form of social enterprise that aims to counteract greenwashing by legally embedding the "triple-bottom line" of sustainability into corporate governance. This legal structure provided a pathway for social entrepreneurs to navigate the often-murky waters of CSR, ensuring their enterprises can genuinely commit to social and environmental impact without succumbing to greenwashing pressures. Rodrigues et al. (2021) focused on the cosmetics industry, examining how companies employ green marketing strategies to differentiate themselves in a market fraught with greenwashing risks. Their analysis highlighted the critical role of transparency and consumer trust in the success of green businesses, pointing to a broader implication for sustainability in the corporate sector. Cremasco and Boni (2022) tackled greenwashing from the perspective of the financial industry, seeking to enhance accountability and deter misleading sustainability claims in financial products. Geerts (2014) addressed the hospitality sector's challenges with green certification, where the pursuit of sustainability often collides with the temptations of greenwashing.

Together, the works of Andersson and James (2018), Stecker (2016), Rodrigues et al. (2021), Cremasco and Boni (2022) and Geerts (2014) constructed a narrative that emphasized the importance of authenticity, legal frameworks, and regulatory mechanisms in fostering sustainable development and mitigating the risks of greenwashing. They collectively argued for a more integrated approach to social entrepreneurship, where enterprises are not only tasked with turning a profit but also contributing meaningfully to societal and environmental well-being. The diversity of sectors and geographical contexts covered by these studies underscores the ubiquity of greenwashing challenges across the global economy, highlighting the need for a concerted effort among policymakers, businesses, and consumers to champion genuine sustainability initiatives over superficial marketing tactics.

The second cluster, formed by the keywords "entrepreneurship" "entrepreneur" "green marketing" "green entrepreneurship" "corporate social responsibility" is best represented by the works of Dragomir (2020), Yang et al., (2021a, 2021b) and Toscano et al. (2022). Dragomir (2020) critiqued the superficial engagement with sustainability practices, advocating for a deeper integration of genuine green marketing strategies that align with the principles of CSR. This call for authenticity is echoed in Yang et al., (2021a, 2021b), where the focus is on green startups and how entrepreneurs navigate the challenges of embedding sustainability into their business models, thereby supporting green entrepreneurship as a vehicle for substantive environmental change. Similarly, Toscano et al. (2022) explored the agricultural sector's engagement with sustainability, highlighting the entrepreneur's role in effectively communicating and implementing sustainable practices amid the challenges posed by greenwashing. Together, these studies not only highlight the entrepreneur's critical role in driving sustainable business practices but also underscore the

interconnectedness of entrepreneurship, green marketing, and CSR in fostering a more sustainable and ethically responsible business landscape.

Our last cluster was focused on the keywords "sustainable development" "environmental conservation" "environmental marketing", and the works that best represent this cluster are the articles of Bager and Lambin (2020), Neumann (2021) and Toscano et al. (2022). Bager and Lambin (2020) highlighted the pivotal role of sustainable development in the coffee industry, illustrating how environmental conservation efforts can both drive and derive from sustainable agricultural practices. This aligns with Neumann (2021), who addresses the pressing need for sustainable development in mitigating climate change impacts, emphasizing the agricultural sector's responsibility and potential for environmental conservation through innovative practices. Toscano et al. (2022) further bridge these themes within the Italian poultry sector, revealing how environmental marketing strategies not only reflect but also influence sustainable development goals and conservation efforts. They discussed the gap between the perception and practice of sustainability in agrifood companies, suggesting that a more standardized reporting system and supportive policies could help align perceived and actual environmental efforts. Together, these studies offered a comprehensive view of how sustainable development, environmental conservation, and environmental marketing are interconnected and pivotal to the future of agriculture and food production, highlighting the need for genuine sustainability efforts beyond superficial greenwashing.

4.2 Greenwashing in agricultural contexts: a content analysis

With the content analysis of 22 papers from the SLR and one paper from snowballing (Appendix B), we formulated a framework with the main Enablers, Consequences, and Prevention of Greenwashing, as shown in Fig. 11.

The concept of sustainability remains ambiguous, lacking consensus on its definition and the required activities for adherence to specific standards (Bager & Lambin, 2020; Francis, 2004; Francis et al., 2007). Third-party certifications are crucial in addressing this issue, but they must be rigorous and transparent otherwise, they can be used to enable greenwashing (Bager & Lambin, 2020). To combat accusations of greenwashing, audits, transparent application, strict enforcement, and publicly assessable goals are essential for substantial changes in sustainability governance (Bager & Lambin, 2020; Cremasco & Boni, 2022). Additionally, some companies prefer direct trade, internal standards, and codes of conduct over existing certifications to tackle sustainability challenges within their value chains. However, this approach may risk greenwashing and hinder effective regulatory action, prioritizing control and market appeal over certification credibility (Bager & Lambin, 2020).

Collaborative programs aligned with SDGs enhance genuine sustainability practices, ensuring global marketplace transparency and accountability (Cosby et al., 2022; Francis et al., 2007; Schermer, 2008). Strengthening mechanisms for farmer performance reporting combats greenwashing and upholds environmental integrity (Cosby et al., 2022). Sustainable agriculture certifications benefit small tropical producers economically, socially, and environmentally. They boost incomes, widen market access, and enhance environmental practices. However, concerns include greenwashing, high costs, limited information, and market concentration still exist. To promote fairness and diversity, certification programs should prioritize poorer farmers and the creation of a sustainable marketplace (Defries et al., 2017; Munasinghe et al., 2021).

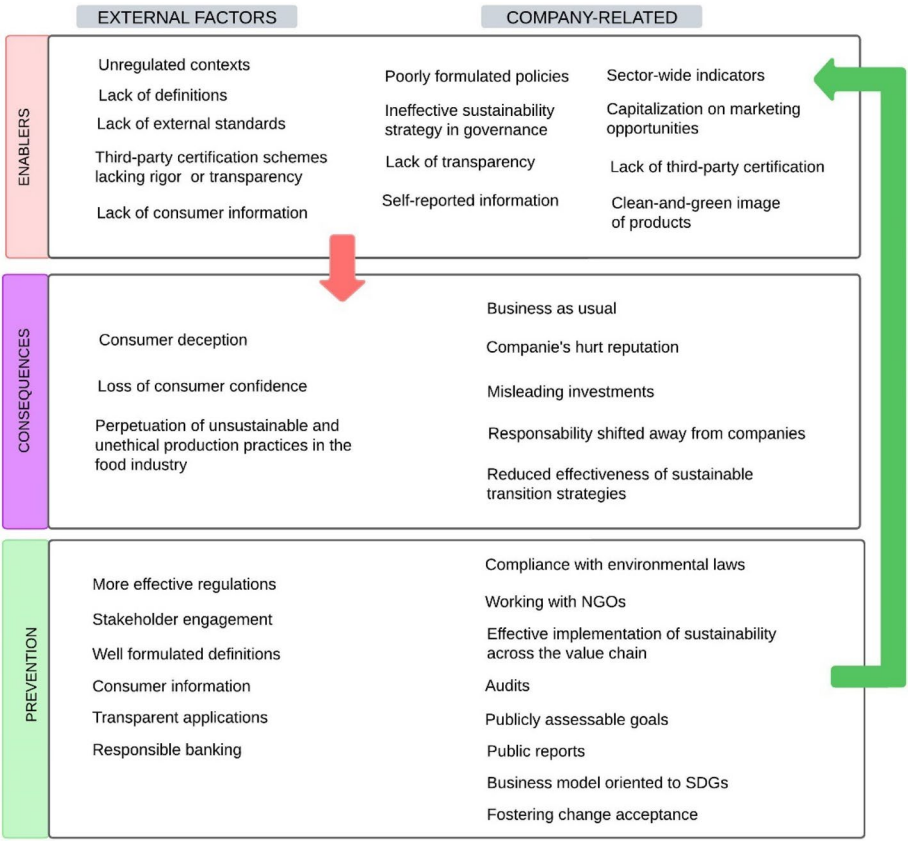


Fig. 11 Framework for greenwashing in agriculture (*Source*: The Authors)

In view of what was discussed, we see that a main enabler of greenwashing is the lack of transparency from companies (Bager & Lambin, 2020; Christiansen et al., 2023; Mehta et al., 2021; Schermer, 2008). One example highlighting the lack of transparency is the confusion between absolute and relative emissions reductions. For example, it is common for companies to report that they have achieved or intend to achieve a percentage reduction in emissions without specifying that this reduction is being measured concerning turnover. In this way, companies can hide absolute increases in their emissions, creating a false impression of sustainable progress (Christiansen et al., 2023). The case of the Swedish fast food chain MAX Burger was analyzed by Christiansen et al. (2023) and revealed that although the company tripled its emissions between 2007 and 2021. The fact that it presents emissions relative to the number of meals sold allows MAX to say that it has decreased its emissions. Furthermore, the company has shifted the responsibility for climate change to its consumers, who are called "climate heroes" by the company if they choose MAX products, and to smallholder farmers in the global south, as the company adopts an intensive policy of carbon offsets (rather than reducing emissions along its value chain), through the purchase of carbon credits from the global south. In this way, MAX justifies its carbon-intensive business model.

Another greenwashing enabler closely related to lack of transparency is self-reported information (Bager & Lambin, 2020), allowing companies to highlight their sustainability efforts selectively while potentially obscuring less favourable practices. The ability and resources devoted to reporting company sustainability endeavours can significantly impact the results. Smaller agricultural companies, constrained by limited resources, may struggle to maintain comprehensive websites or produce detailed annual reports or even certificates, leaving potentially significant sustainability initiatives unreported and overlooked. Moreover, self-reported data may not always accurately reflect a company's actual sustainability impact, raising concerns about greenwashing. However, mandatory reporting requirements can be crucial in increasing transparency and facilitating comparisons of company efforts. When compliance is mandated, it becomes easier to scrutinize and validate claims, ensuring a more accurate representation of a company's sustainability practices and encouraging environmental progress in the agricultural sector (Bager & Lambin, 2020).

Thus, we see that the lack of transparency, coupled with weak regulations and an absence of consumer awareness, enables greenwashing in agriculture. With external pressures for sustainability, the agricultural industry often uses greenwashing as its position as sustainable is very much linked to consumer perception through packaging and labels (Toscano et al., 2022). Yang et al., (2021a, 2021b) state that the market for sustainable products is characterized by asymmetric information, where consumers have limited knowledge and information. Consumers often trust the sustainability certification that the product bears, which can lead to greenwashing (Munasinghe et al., 2021). The analysis of a certificate of sustainability as marketization, justified by the need to shape capitalism's mechanisms for sustainable development, using a case from the Sri Lankan tea production industry, was carried out by Munasinghe et al. (2021). In this context, three aspects are important to constitute this marketization, and, in short, it is necessary to outline what it means for a product to be said to be produced sustainably, to identify what producers can change in their production processes to make it sustainable products, and connecting suppliers of certified products with the demand from consumers ethically determined to make sustainable consumption choices. The article concludes that the sustainability certification process can go beyond mere greenwashing and bring positive social and ecological results.

Similar to the lack of regulation and oversight to attest to the legitimacy of sustainability certificates, there is a lack of regulation and oversight for sustainability reporting and rating (Yang et al., 2021a, 2021b). An analysis of the Italian poultry industry highlighted these issues and also that "the risk of greenwashing in manufacturing companies is even greater when the legislative environment is deregulated, or ESG compliance control systems are poorly adopted" (Toscano et al., 2022, p. 11). The main actors in this industry are large companies that control production, and small and medium-sized companies have contracts with these prominent players. The lack of a universal standard for ESG reporting and the lack of definition of sustainability criteria increase the risk of greenwashing, which occurs when the company does not use sustainable transformations in the core of its business but only uses marketing strategies to increase its perceived value (without actually implementing sustainable changes).

Business as usual is a common criticism for companies that practice greenwashing (Alexander, 2019; Geist, 2021). To exemplify, Geist (2021) analyzed the Tobacco industry and found evidence revealing that tobacco companies engage in deceptive compliance with environmental standards by implementing natural valuation tools and launching green (CSR) campaigns. This strategic approach aims to portray tobacco farming as an environmentally friendly activity while the companies continue their conventional operations behind the scenes. In the work of Alexander (2019), the impact of the Global Alliance

for Climate-Smart Agriculture (CSA) on sustainability is analyzed, and one of the findings was that many large commercial companies use their participation in the CSA as a marketing technique, incurring in greenwashing. Greenwashing can also lead to misleading investments, especially when public policies legalize pollution and defend falsely sustainable solutions, as in the case of investing in the use of biogas. "Biogas is the industry's next attempt at greenwashing another polluting fuel to save their industry" (Gittelson et al., 2022, p. 35). Assessing concentrated animal feed operations (CAFOs), Gittelson et al. (2022) concluded that manure-to-energy projects can be sustainable only on small farms (if the energy is used on the farm itself). If applied to industrial farms, there are higher emissions of methane, CO_2, and hazardous pollutants, and require the installation of infrastructure, such as pipelines, which leak large amounts of methane. Gittelson et al. (2022) criticized government support and investment in manure-to-energy projects in CAFOs, noting that the use of biogas in these industrial farms can even lead to health problems for rural communities close to the facilities.

The use of various "green terms" and the nuances in their definitions can lead to greenwashing. The emphasis on business opportunities sets "sustainable development" apart from the "green economy", with the latter placing greater importance on economic growth as its defining characteristic (Buseth, 2017). Different authors, studyng other sectors of the economy, concluded that the focus of companies is their economic sustainability, with environmental sustainability being used as a tool to obtain better economic performance instead of adopting sustainable transformations in the core of the business as a development strategy. In turn, the social aspect of sustainability goes unnoticed by companies (Buseth, 2017; Toscano et al., 2022; Yang et al., 2021a, 2021b).

Other aspects of greenwashing can be found in the works of Gordon et al. (2023), Partzsch et al. (2019), Parker and Sheedy-Reinhard (2022), and Cosby et al. (2022). Gordon et al. (2023) analyzed different discourses for regenerative agriculture and highlighted that the Restoration for Profit discourse can serve as an entry point for conventional farmers to join the practice but tends to make milder criticisms of industrial agriculture. This can result in a higher risk of co-optation and greenwashing, where the conventional industry can absorb the Restoration for Profit discourse without a fundamental change in behaviour. Thus, accusations of greenwashing in Regenerative Agriculture are often directed at supporters of this approach. The lack of definitions is also problematic and identified as one of the tensions in regenerative agriculture discourses, where the term's ambiguity can facilitate greenwashing.

The work of Partzsch et al. (2019) highlights cautionary considerations for non-governmental organizations (NGOs) when supporting private regulation initiatives in the cotton supply chain to avoid potential greenwashing or false perceptions of environmental sustainability. The argument proposes that instead of backing private initiatives, NGOs should prioritize promoting established public regulations and organic certification programs, which uphold higher environmental standards. While acknowledging that private regulation might be necessary in certain cases, the text emphasizes that it should not be the primary choice for NGOs concerned with environmental sustainability in the cotton supply chain. Furthermore, the study delves into the concept of greenwashing, describing it as a strategy for companies to uphold their legitimacy and reputation amidst environmental pressures while evading the costs and risks associated with genuine sustainability efforts. The ultimate aim of greenwashing is to create an illusion of environmental responsibility and to retain or increase market share. Tactics used in greenwashing involve making misleading claims, utilizing vague or meaningless terms, and relying on third-party certification schemes that lack rigour and transparency. The authors propose that greater transparency, accountability,

and stakeholder engagement, alongside more effective regulation and enforcement, can serve as effective countermeasures against greenwashing practices.

In responsible banking, audits and third-party certifications are essential safeguards against greenwashing, particularly in animal agriculture. The risk lies in banks employing vague animal welfare policies to project a facade of sustainability, diverting attention from pressing challenges like climate change and animal suffering (Alons, 2017; Parker & Sheedy-Reinhard, 2022). To tackle this issue, implementing more comprehensive ESG reporting requirements encompassing animal welfare and environmental impacts becomes vital to raise public awareness and foster accountability. However, broader criticism points to CSR and self-regulation initiatives as potential instances of "managerial opportunism," where actions may not be altruistic but seek to capitalize on marketing opportunities, such as attracting conscious consumers. To ensure a genuine commitment to sustainability and compassion, responsible banking must be reinforced by robust national and international regulations on animal welfare and climate justice (Parker & Sheedy-Reinhard, 2022).

The challenges of purely voluntary approaches to governance become particularly pronounced when dealing with the clean-and-green image of products (Cosby et al., 2022; Parker et al., 2021). Credibility and greenwashing issues can significantly undermine the integrity of such claims. If the clean-and-green image is not firmly underpinned by credibility and authenticity, it becomes susceptible to challenges from competitors and consumers alike (Cosby et al., 2022; Scanlan, 2013). For example, Cosby et al. (2022) argue that this is especially critical for the dairy sector concerning its environmental credentials. Without credible evidence to support its claims, the risk of greenwashing looms large, posing severe reputational and legal consequences. To ensure lasting trust and success, the dairy industry must prioritize transparency and verifiable evidence in upholding its clean-and-green image (Cosby et al., 2022).

Finally, we present genuine acceptance of change as an invaluable piece of greenwashing prevention. This is backed up by various researchers, such as Scanlan (2013), who stated that agribusiness can find it easier to change public opinion through greenwashing than to change their harmful practices. For Marchant et al. (2022), accepting new technologies can help agribusinesses mitigate climate change. Parker et al. (2021) focus on showing how consumers are beginning to change their habits and how an informed consumer may be able to spot and criticize greenwashing in agribusinesses, thus driving a transformative change in the agricultural value chain. To close the argument on the importance of change in avoiding greenwashing, Alons (2017) and Mehta et al. (2021) agree that even though policies need to be changed to increase sustainability in agriculture, only the change in mindsets (of both farmers and other actors in the agribusiness field) can mitigate greenwashing in the long run.

4.3 Greenwashing in entrepreneurial contexts: a content analysis

With the content analysis of nine papers from the SLR (Appendix C), we formulated a framework with the main Enablers, Consequences, and Prevention of Greenwashing in Entrepreneurial Environments, shown in Fig. 12 and elucidated below.

The corporate environmental strategy aims to achieve sustainable development by considering economic, environmental, and social aspects. Implementing environmental strategies can be challenging and resource-intensive but benefits the company and stakeholders throughout the life cycle of products and processes (Cremasco & Boni, 2022). If businesses choose to exclude any of the TBL concepts, namely economics, society, and the

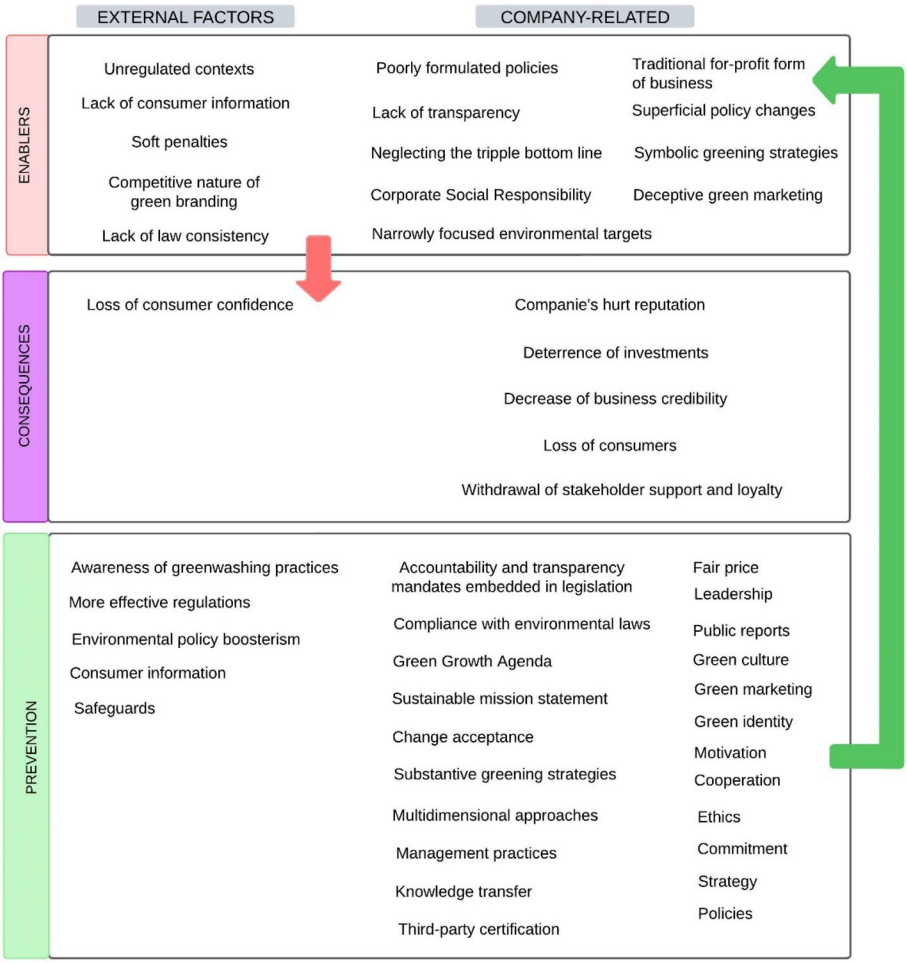


Fig. 12 Framework for greenwashing in entrepreneurship (*Source*: The Authors)

environment, from their mission statement, CSR vision, or overall strategy, they inadvertently create a vacuum susceptible to greenwashing. Emphasizing only one aspect while neglecting the others opens the door to deceptive practices, where companies may falsely portray themselves as environmentally conscious or socially responsible without truly integrating sustainable practices into their core operations. Thus, Yang et al., (2021a, 2021b) found that businesses prioritize economic performance, and if the economic opportunity behind greenwashing is more favorable than eco-innovation and the adoption of genuinely sustainable practices, businesses are likely to choose greenwashing.

Furthermore, Yang et al., (2021a, 2021b) highlighted the importance of stricter regulations so that the costs associated with greenwashing are greater than any potential benefits. Given that consumers do not have enough information to distinguish truly sustainable products from those that practice greenwashing, it is the role of the government—ideally cooperating with non-governmental organizations (NGOs)—to provide information and implement strict regulations in sustainability certification systems to prevent greenwashing.

To foster green entrepreneurship, eco-innovation, and the adoption of authentic sustainable practices, mere tax incentives are not enough. The government must increase penalties for greenwashing, intensify enforcement, collaborate with stakeholders, and regulate and unify green industry certification. Crutchfield and Lunde (2012) concur with the works of Cremasco and Boni (2022) and Yang et al., (2021a, 2021b), adding that a holistic approach that embraces all three dimensions is vital to avoid greenwashing and foster authentic and meaningful sustainability efforts and greening strategies within businesses.

Tangible actions must accompany the implementation of symbolic greening strategies, otherwise, they risk being classified as greenwash. Symbolic greening strategies involve actions taken by companies to demonstrate their dedication to environmental sustainability, but they may not result in substantial operational changes. Such strategies can include disclosing environmental information, adopting environmental management systems, or publicly stating environmental protection as a core priority. To avoid the pitfalls of greenwashing, firms must back these symbolic gestures with concrete and meaningful steps toward sustainability. By translating these signals into real environmental impact and genuine changes in their practices, companies can uphold their commitment to sustainability and maintain the trust of environmentally-conscious consumers and stakeholders (Neumann, 2021). Deceptive green marketing can further exacerbate the issue of symbolic greening strategies, as it may exploit superficial environmental signals without substantiating the claims with actual environmentally responsible practices, potentially misleading consumers and eroding their trust in companies' sustainability efforts (Crutchfield & Lunde, 2012; Rodrigues et al., 2021). Green marketing is concerned with promoting the environmental attributes of products and addressing environmental issues in marketing activities. It encompasses product design, production, packaging, labelling, and disposal. Marketers make public claims about product attributes and production processes. Green marketing assumes that the environmental attributes of products are inherently beneficial and aims to encourage consumers to buy green products, which can be misused in ways that lead to greenwashing (Rodrigues et al., 2021). Still, green marketing is growing as more entrepreneurs and well-consolidated firms seek to become "green brands".

In this context, the competition for green branding has intensified as companies seek to project an environmentally conscious image in today's environmentally-focused era (Geerts, 2014). Brand identity is a component of corporate reputation and includes positioning, values, and a promise to stakeholders. Green branding goes beyond green marketing and communication and involves creating a value-based relationship with stakeholders. It requires differentiation from competitors based on environmental attributes and aligning internal environmental performance with external brand communication. Positive word of mouth and media coverage can benefit environmentally oriented organizations. However, it may be challenging for firms that haven't built their brand identity on environmental values to communicate environmental protection as a core product attribute (Dragomir, 2020; Rodrigues et al., 2021). To successfully create a green identity that takes sustainability seriously and avoids the pitfalls of greenwashing, entrepreneurs must also foster and achieve a green culture and a green organizational identity (Dragomir, 2020).

A green organizational identity motivates personnel to view environmental protection as a legitimate goal. Environmental leadership, driven by top managers, shapes employee attitudes, behaviors, and performance. Ecological responsibility is a driving factor in green culture, encompassing initiatives such as green product lines, donations to environmental interest groups, material replacements, recycling, and other similar actions. Individuals known as "green agents" advocate for environmental sustainability and promote best practices within the organization. Ideally, the environmental manager should be a green agent,

creating a pervasive green workplace culture and proposing environmental protection programs (Dragomir, 2020).

To avoid greenwashing, it is imperative to foster a green culture within organizations, encompassing values, assumptions, and regulations concerning environmental conservation. Effective management is crucial in disseminating these values through formal eco-labels, policies and procedures, mission statements, sustainability reports, supplier guidelines, and training programs. A positive reputation for environmental responsibility, coupled with external awards, good product reviews, and environmental certificates, should boost employee satisfaction and pride, thus nurturing green innovation. An open systems culture is ideal for implementing the best environmental strategy. It emphasizes flexibility, scientific knowledge, differentiation, and adaptability. This approach enables the company to secure a competitive niche and effectively respond to environmental disasters and turbulent situations (Dragomir, 2020).

Organizational structure plays a crucial role in fostering a green culture (Dragomir, 2020; Rodrigues et al., 2021). Companies with environmental responsibility tend to have flatter, decentralized, and participatory decision-making structures. Developing a green culture involves continuous environmental improvement, employee training, organizational learning, stakeholder integration, and peer involvement and employee empowerment in maintaining the environmental management system. Peer involvement reflects team efficacy in achieving environmental goals, while employee empowerment promotes personal autonomy and readiness for organizational change (Dragomir, 2020). Incentives and rewards for innovative environmental proposals can further enhance employee autonomy (Dragomir, 2020; Rodrigues et al., 2021).

The green identity and green culture can usually be linked to the environmental commitment of the entrepreneurs (Cremasco & Boni, 2022; Dragomir, 2020). Environmental commitment, which is necessary to prevent greenwashing, is fostered by disseminating ethical values from top management to middle managers and front-line employees, creating a company-wide system of pro-environmental learning and a sense of social responsibility. Training in environmental activities, rewards for environmental measures, and empowerment of employees are essential in nurturing their environmental commitment and encouraging information sharing and innovative solutions (Dragomir, 2020). Other fundamental aspects that give basis to environmental commitment are the cooperation with external stakeholders and the recognition that environmental protection should be valued equally to economic goals. Environmental responsiveness can be demonstrated through clear policies, research and development efforts, disaster prevention measures, employee training programs, and collaborative relationships with suppliers, customers, and NGOs. In contrast, when the environmental laws and policies are not inconsistent or unclear, and the context into which entrepreneurs and SMEs are inserted are unregulated, greenwashing tends to flourish (Cremasco & Boni, 2022; Dragomir, 2020; Stecker, 2016).

According to Dragomir (2020), the motivations that lead entrepreneurs, managers, or any leader in pursuing environmental actions and strategies are key in preventing greenwash. The author categorizes these motivations into relational, competitive, and comprehensive. Relational motivation refers to compliance with environmental legislation as a sense of obligation, often driven by the desire to avoid fines and sanctions, which is a first step towards sustainability. Still, it is not ideal, as this type of motivation can lead to greenwashing, where corporate disclosures are used to hide actual environmental performance or portray harmful actions in a positive light. On the other hand, competitive motivations are linked to a superior environmental strategy. While compliance with regulations remains important, leaders also seek resources and capabilities that provide a competitive

advantage in the market. This approach depends on strong leadership and aims to maintain pragmatic legitimacy, positioning the company as a responsible economic agent and corporate citizen, seeing green management as a strategic advantage rather than a mere obligation. The comprehensive motivation of organizations is focused on environmental ethics. It highlights the importance of cooperation with external stakeholders and recognizing that environmental protection should be valued equally to economic goals. This type of motivation also values environmental responsiveness, which can be demonstrated through clear policies, research and development efforts, disaster prevention measures, employee training programs, and collaborative relationships with suppliers, customers, and NGOs. In sum, this can be seen as an ethical motivation, and it is suggested that environmental protection should form the basis of the company's competitive strategy and a core value of its leadership. For Dragomir (2020), leaders whose motivation is comprehensive should employ transformational and transactional leadership approaches, participatory decision-making, setting eco-efficiency targets, allocating resources, and developing organizational capabilities.

Finally, managing change in a way that fosters acceptance of new mindsets, concepts, and technologies can help entrepreneurs to seek the competitive value of green practices, and not just the value of a green image, thus mitigating the occurrence of greenwashing (Andersson & James, 2018; Yang et al., 2021a, 2021b). The high importance of change management is supported by Dragomir (2020), who argues that the motivations necessary for implementing green practices (instead of merely greenwashing) can not be fully realized unless there is an acceptance of change at all levels of the organization.

4.4 Framework for supporting green agripreneurship while avoiding greenwashing

After a semantic analysis of the articles, two separate frameworks were developed with the categories emerging a posteriori, one for agricultural contexts and the other for entrepreneurial contexts. Following that, the challenge was to create a framework that integrates the main aspects of greenwashing to help agripreneurs who wish to take advantage of their sustainability efforts ethically. To that end, a new semantic analysis was performed, with the categories emerging a priori since the frameworks created were used as a basis for developing this new framework. In this framework (our main framework), three stages for fostering green agripreneurship while avoiding greenwashing were defined and seen as internal factors (i.e., highly dependent on the agripreneurs themselves), and two other stages were defined and seen as external factors (i.e., they depend on other actors, like politicians and stakeholders, not just the agripreneurs). Figure 13 shows the framework we propose for supporting green agripreneurship while avoiding greenwashing.

The first stage was defined as: "Change Management". This stage is highly important for the leaders in agribusinesses that seek to bring more sustainability to their environments, because they must be capable of convincing their employees and collaborators to implement real change (Alons, 2017; Dragomir, 2020; Mehta et al., 2021; Neumann, 2021). This involves the development of strategies for developing green practices and awareness of what greenwashing is to prevent the occurrence of it (Dragomir, 2020). In our view, this is the stage where agripreneurs become aware of the necessity to change and must strategically create ways to implement sustainable practices while mitigating the resistance to change, which, according to Yang et al., (2021a, 2021b), is high in this type of environment.

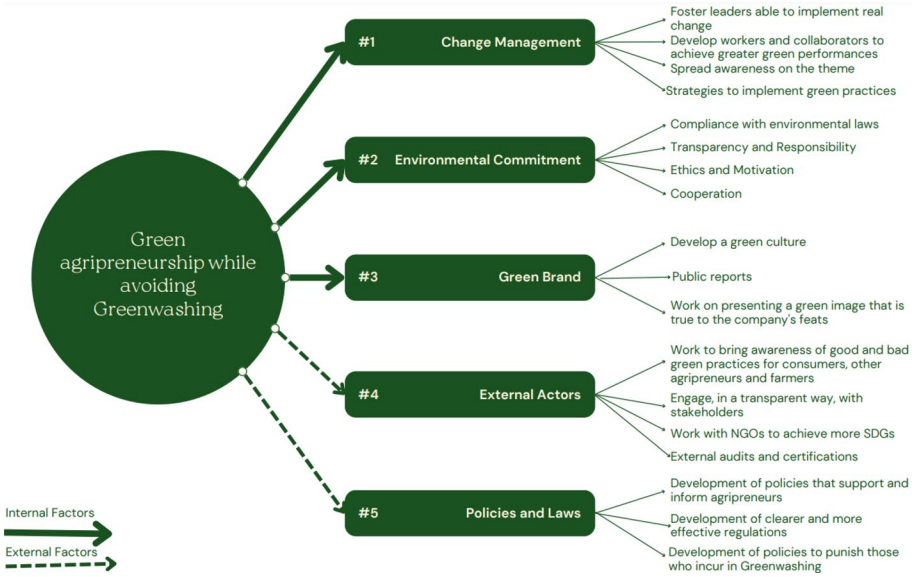


Fig. 13 Supporting green agripreneurship while avoiding greenwashing (*Source*: The Authors)

The second stage of the framework was defined as "Environmental Commitment''. Ideally, this stage will work concurrently with the first stage, as the more committed the agripreneur is, the higher the chances of bringing real change to their environment. The "Environmental Commitment" stage is defined by compliance with environmental laws and regulations (which all the articles analyzed see as the least companies can do to claim to be green or sustainable), transparency while advertising the results of sustainability programs and initiatives (Andersson & James, 2018; Bager & Lambin, 2020; Stecker, 2016), the responsibility with achieving SDGs (Parker et al., 2022), and broad cooperation between stakeholders, policymakers, consumers, farmers and agripreneurs (Cremasco & Boni, 2022; Crutchfield & Lunde, 2012; Yang et al., 2021a, 2021b). This stage, as the previous, should be ongoing, if the commitment towards sustainability diminishes or if the agripreneurs become resistant to future changes, the chances of greenwashing occurring returns.

The third stage of the framework was defined as "Green Brand". Here, ideally, a green culture will be developed, with the basis achieved in the previous stages. The agripreneur will present the results of sustainable initiatives and green practices in public reports, and this will be advertised as a way to bring positive attention and develop the company's green image (Cosby et al., 2022; Parker et al., 2021; Scanlan, 2013; Stecker, 2016). The agripreneur must always be aware that advertising a better green performance can only bring the desired results if it truly corresponds to the company's achievements. If the results are inflated or presented with falsehoods, then the agripreneur will have greenwashed the results, which will damage the company's image (Cosby et al., 2022; Raut et al., 2019; Yang et al., 2021a, 2021b).

The fourth stage was defined as "External Actors", which is more dependent on stakeholders and investors than the agripreneurs themselves. In this stage, greenwashing may be avoided by stakeholders that take their investments in sustainability seriously (Parker & Sheedy-Reinhard, 2022), and thus, seek to identify which firms are engaged in ethical

green advertisement instead of greenwashing. The more investments related to tangible green actions companies receive (specifically startups that are so dependent on investments in the initial stage of their lives), the higher the chance that farmers and agripreneurs will adopt green practices as a core feature of their businesses. To conclude, stakeholders and investors should support eco-innovation and the adoption of proper green practices as a way to curb greenwashing (Yang et al., 2021a, 2021b). To achieve that, access to audits and certifications is beneficial (Alons, 2017; Bager & Lambin, 2020; Parker & Sheedy-Reinhard, 2022). Additionally, an honest engagement with the various actors (NGOs, policymakers, consumers, farmers) is important to understand how the innovations brought on by agripreneurs are affecting society and the environment (Cremasco & Boni, 2022; Crutchfield & Lunde, 2012; Partzsch et al., 2019; Yang et al., 2021a, 2021b).

The final stage, "Policies and Laws", describes an agripreneurial environment that avoids and combats greenwashing, characterized more by politicians and policymakers than agripreneurs. In this stage, it was seen that since unregulated environments foster greenwashing, developing policies that support agripreneurs involved in green practices (Rodrigues et al., 2021) while informing them of the pitfalls of greenwashing is needed. To that end, regulations and laws related to greenwashing must be made effective and clear (Cremasco & Boni, 2022; Dragomir, 2020; Stecker, 2016). It is worth noting that the articles analyzed all touch on the fact that following environmental laws is the basis of every firm that wishes to be presented as green, however, no article offered an idea for specific laws punishing the occurrence of greenwashing, which can be seen as a contradiction. Laws and regulations are highly important for supporting sustainability practices (Lu et al., 2023)., and we propose that specific laws and regulations regarding greenwashing could curb the rise of false green claims.

The next topic presents a discussion of our results and the practical and theoretical implications of the research, which answers our RQ5.

5 Discussions

The frameworks developed in this research (shown in Figs. 11, 12, and 13) were done using content analysis techniques, which has an inherent problem: the subjectivity of the researcher's analysis (Bardin, 2016). To mitigate this subjectivity, we used LDA, which assumes that documents are represented as a mixture of latent topics and each topic is characterized by the distribution of terms or words (Blei, 2012). Using LDA in the 30 articles analyzed when developing our main framework (Fig. 13), eight possible topics were defined, as shown in Fig. 14.

When comparing the keywords of each topic with our main framework presented in Fig. 13, we see a validation of our analysis. The keywords highlighted in yellow are semantically close to our "Green Brand" stage, while those highlighted in green are more related to the "Environmental Commitment" stage. The blue ones are closer to the "Change Management" stage. Finally, the keywords highlighted in the colour purple are semantically similar to the "External Actors" stage, while the red words can be seen to represent the "Policies and Laws" stage.

Possibly due to the small sample (30 articles), it was not possible to define each topic (Asmussen & Møller, 2019) as one of the stages presented in our framework, however, it is clear to see that the semantic analysis we performed found validity when compared to the results presented in the LDA analysis. Additionally, the fact that no one topic was clearly

Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	Topic 7	Topic 8
report	environmental	green	carbon	animal	food	sustainability	green
urban	product	change	emission	bank	agriculture	discourse	government
culture	sustainable	strategies	credit	welfar	global	audit	policies
image	management	innovation	offset	law	land	certification	strategies
development	business	ceo	sustainable	green	awareness	estate	behavior
policies	compani	performance	climate	food	farmer	process	venture
brand	cooperation	environment	market	policies	farm	certification	market
green	practice	leader	blockchain	agriculture	ngo	account	transparency
responsibility	commitment	invest	reduction	regulation	biodiversity	economy	system
sustainable	ethic	fund	biofuel	climate	dairies	product	subsidies

Fig. 14 LDA Topics (*Source*: The Authors)

defined can indicate that authors studying greenwashing (in agriculture or entrepreneurial environments) are still unsure of the main phenomenon that fosters this type of practice and instead present various factors as leading influencers.

5.1 Practical implications

Change management can play a crucial role in helping agripreneurs steer clear of greenwashing, as by implementing effective change management strategies, they can ensure that their shift towards environmentally sustainable practices is well-planned, communicated, and embraced at all levels. This includes involving employees, suppliers, and stakeholders in the transition to green practices, fostering a shared commitment to sustainability, and minimizing the risk of token green initiatives that could lead to accusations of greenwashing. Thus, our framework can be a starting point for managers and leaders in agripreneurial contexts who seek to implement green practices ethically, avoiding greenwashing.

Environmental commitment is the cornerstone of avoiding greenwashing in agriculture. Agripreneurs must demonstrate genuine dedication to environmental sustainability by setting clear and measurable sustainability goals, investing in eco-friendly technologies and practices, and consistently reporting their progress transparently. An unwavering environmental commitment can help build trust with consumers, stakeholders, and the wider public, as they can see the tangible efforts being made to reduce the environmental footprint of agriculture practices. These are all criteria described in our framework, which can be used as a guide by startups and small businesses committed to improving agricultural sustainability.

A strong Green brand can be pivotal in safeguarding agripreneurs from greenwashing accusations. By cultivating a green brand synonymous with authentic sustainability, commitment to green practices, and ethical businesses, agripreneurs can differentiate themselves from those engaged in deceptive practices. A solid green brand communicates a consistent message of environmental responsibility, and it should be supported by transparent reporting, eco-friendly certifications, and a commitment to compliance with external standards and regulations, as shown in our framework. Policymakers and external actors, which can include regulatory bodies, the Food and Agriculture Organization (FAO), non-profit organizations, industries associations, and consumer advocacy groups, can further assist in preventing greenwashing by enforcing and promoting policies and laws that ensure companies adhere to genuine sustainability practices. These external mechanisms can provide accountability, standards, and certification processes that can help distinguish

legitimate sustainability efforts from greenwashing. Agripreneurs can benefit from such external guidance to navigate the complexities of environmental commitment and genuine green branding.

The need for more precise and accurate policies regarding greenwashing is confirmed by the fact that the European Commision found it necessary to propose the development of common criteria against greenwashing and misleading environmental claims, given the fact that 53.3% of environmental claims scrutinized in the EU were either unclear, deceptive, or lacked support, while 40% lacked evidence. The European Commission reached the conclusion that the absence of standardized regulations for companies making voluntary environmental assertions fosters 'greenwashing,' resulting in an unequal business environment in the EU, which puts authentically sustainable companies at a disadvantage (European Comission, 2023). In this context, we believe our study can offer great insights for the development of policies geared towards agripreneurial environments.

5.2 Theoretical implications and a research agenda

To our knowledge, no research has analyzed greenwashing in agricultural entrepreneurial contexts. Thus, our study extended the existing literature on both themes by examining the possible relationship between greenwashing in agricultural and entrepreneurial contexts. The study has theoretical implications for the literature. The first contribution of this study is to advance the knowledge of greenwashing in agriculture by identifying and elucidating the main variables involved (Fig. 11). The second contribution was the identification of enablers, consequences, and ways of preventing greenwashing in entrepreneurial environments (Fig. 12). To the best of our knowledge, no previous work had identified and analyzed these variables, thus, our study has advanced and innovated the knowledge on greenwashing in entrepreneurial environments. Finally, our main framework (Fig. 13) has provided a unique view and understanding of how we can support green agripreneurship while avoiding greenwashing, which, to our knowledge, had never been done before.

The theoretical analysis carried out in this study has also allowed us to indicate possible research avenues. Thus, a research agenda was developed. As the first research pathway, we suggest validating our framework with specialists and with case studies. The validation with specialists can improve our main framework by bringing practitioners' insights into it, and the validation with case studies can demonstrate the framework's applicability in real cases. Other research avenues include a deeper understanding of greenwashing in agricultural and entrepreneurial contexts, as will be described hereafter.

Regarding greenwashing in agriculture, there is a lack of consensus on the necessary actions to meet specific standards that mitigate greenwashing (Bager & Lambin, 2020; Francis, 2004; Francis et al., 2007). To tackle this, third-party certifications are crucial but must be rigorous and transparent (Bager & Lambin, 2020). Thus, we propose the systematization of greenwashing case studies (both in scientific and grey literature) as a research avenue. This can provide valuable information on the actions and strategies that lead to greenwashing, with researchers analyzing third-party certifications' practical role in mitigating this.

Another exciting research pathway would be the development of blockchain third-party certifications to bring more transparency (Dos Santos et al., 2021) to agriculture startups. The lack of transparency from companies remains one of the main facilitators of greenwashing in large firms as well as in small businesses and startups (Bager & Lambin,

2020; Christiansen et al., 2023; Mehta et al., 2021; Schermer, 2008). The incentive to this research avenue could help mitigate this greenwashing facilitator.

Finally, identifying and developing indicators of green practices in agripreneurship is another research avenue we propose. There is research on sustainability indicators in entrepreneurial ecosystems in agricultural startups (Aliabadi et al., 2022). Still, to the best of our knowledge, no indicators related to green practices and greenwashing in agripreneurial contexts exist. We believe this is a rich and, so far, unexplored research field, which should change in the following years, given the increased relevance of agricultural entrepreneurship for the innovation and sustainability of the agricultural value chain (Dutia, 2014; Klingenberg et al., 2022).

6 Conclusions and policy directions

6.1 Conclusions

In this paper, we aimed to create a framework combining greenwashing elements in agricultural and entrepreneurial environments, thus providing agripreneurs with valuable information on what they should avoid when planning and running their ventures. To achieve this, we first developed two auxiliary frameworks, one that analyzed the concepts related to greenwashing in agricultural environments and the other that explored the concepts of greenwashing in entrepreneurial environments. These theoretical frameworks involved a deep content analysis validated by LDA.

The main framework developed was called: "Supporting green agripreneurship while avoiding greenwashing", and it has five stages, with the first three stages defined as internal factors (i.e., highly dependent on the agripreneurs themselves) and the last two stages defined as external factors (i.e., highly reliant on the various stakeholders). We argued for the establishment of specific laws and regulations addressing greenwashing to combat the spread of misleading green claims (Cremasco & Boni, 2022; Dragomir, 2020; Lu et al., 2023; Stecker, 2016). With the development of the frameworks united with the discussion of their implications, all our research questions were answered, and our goal was achieved.

Our paper has a few limitations. First, since only scientific databases (WoS and Scopus) were used, the exclusion of grey literature may leave practical case studies behind and could be considered in future research. Second, none of our frameworks were validated in real-life situations yet, which can be seen as a real limitation in regard to the practical application of our main framework. However, we demonstrated that this work has a great value in bringing light to a theme that has sadly been underappreciated in the literature. In addition, we expected that the work can incentivize more research on the theme of agripreneurship and greenwashing (Zuin Zeidler, 2024) and that, in the near future, the framework develop here can be used by other specialists.

6.2 Policy directions

Firstly, the findings of our study show the critical role of policy intervention in combating greenwashing practices within the agricultural and entrepreneurial sectors. Given that misleading environmental claims and the potential detrimental effects they have on both consumers and authentically sustainable businesses, policymakers should prioritize the development and enforcement of standardized regulations that curb these harmful practices.

These regulations should aim to enhance transparency, accountability, and the use of rigorous third-party certifications to validate the sustainability claims made by agripreneurs. By establishing clear guidelines and standards, policymakers can create a more level playing field, thus reducing the unfair advantage that businesses that engage in greenwashing can have (i.e., doing none of the serious work while being able to present a sustainable and green image), while promoting genuine sustainability efforts.

Secondly, our study highlights the need for collaboration between policymakers and external stakeholders such as regulatory bodies, industry associations, and consumer advocacy groups to effectively address greenwashing. External mechanisms, including certification processes and compliance monitoring, can provide additional layers of accountability and assurance to consumers and stakeholders. Policymakers should work closely with these stakeholders to design policies that incentivize and reward genuine sustainability practices while imposing penalties on those found guilty of greenwashing. By fostering a collaborative approach, policymakers can leverage the expertise and resources of external actors to strengthen regulatory frameworks and enforcement mechanisms.

Lastly, our study suggests that policymakers should consider adopting innovative technologies, such as blockchain, to enhance transparency and traceability in green claims within the agricultural sector. Blockchain-based third-party certifications can provide immutable records of sustainability practices, thereby increasing trust and confidence among consumers and stakeholders. Additionally, policymakers should support research initiatives aimed at developing indicators of green practices specific to agripreneurship. By investing in research and innovation, policymakers can facilitate the development of robust tools and methodologies for evaluating and verifying sustainability efforts, ultimately promoting greater integrity and credibility within the agricultural industry.

To summarize, moving forward, policymakers should prioritize the development of specific laws and regulations aimed at curbing greenwashing practices. These regulations should enforce transparency, accountability, and the use of rigorous third-party certifications in the agricultural sector. Moreover, policymakers should collaborate with regulatory bodies, industry associations, and consumer advocacy groups to ensure consistent enforcement and promotion of these regulations.

Appendix A

Articles	Summary of the article	Points made regarding greenwashing
Parker et al. (2021)	The article critically examines labelling's potential, highlighting its limitations and advocating for a more comprehensive ecological regulatory approach to address the complexities of transformative food system change. It shows that the assessment of labelling as a regulatory mechanism for transformative food system change can be ineffectivy. The key pitfalls highlighted include the lack of power redistribution and the tendency for market segmentation. The evaluation emphasizes that labelling alone is insufficient for driving transformative change in food systems. The argument underscores the necessity for regulatory governance that is ecologically designed, stressing the importance of connecting labelling efforts to broader measures aimed at reducing meat consumption	Labelling is criticized for leading to market segmentation rather than fostering collective political action, with vulnerabilities to greenwashing and reductionism. Thus, the article argues that greenwashing can mislead consumers about the sustainability of products. It can lead to market segmentation rather than collective political action
Parker and Sheedy-Reinhard (2022)	The evaluation of Australian banks' animal welfare and climate disruption policies reveals concerns regarding potential greenwashing. The existing policies are criticized for often amounting to superficial commitments without sufficient investigation into their implementation or the effectiveness of regulatory governance. The authors call for banks to adopt more comprehensive animal welfare policies in line with responsible banking practices. The article emphasizes the need for a thorough evaluation of Australian banks' approaches to animal welfare and climate disruption. The key recommendation is for banks to enhance their animal welfare policies to align with principles of responsible lending. Additionally, it advocates for collaborative efforts involving the industry, regulatory bodies, and civil society to drive improvements in the policies addressing animal welfare and climate disruption by Australian banks	The article points out that greenwashing poses a significant threat to authentic initiatives focused on animal welfare and climate disruption, potentially deceiving consumers and investors with misleading sustainability claims. To combat this issue, it is essential for companies to implement clear and measurable policies regarding animal welfare and climate practices. The establishment of independent verification mechanisms becomes crucial to ensure strict adherence to these policies. Transparent reporting on initiatives related to animal welfare and climate is emphasized as a key strategy to build trust and credibility. Furthermore, collaboration with industry stakeholders, regulatory bodies, and civil society is recommended to facilitate comprehensive oversight and strengthen the effectiveness of efforts aimed at promoting genuine animal welfare and climate-friendly practices

Articles	Summary of the article	Points made regarding greenwashing
Crutchfield and Lunde (2012)	The proposed article aimed to develop a comparative assessment framework to address design dilemmas while considering socio-environmental concerns in architectural, engineering, and design projects. It introduced concepts like 'greenwash' and 'greenspin' to highlight potential ethical implications in architecture and construction. However, there are noted limitations, including a lack of detailed examples demonstrating the application of the assessment framework and limited discussion on the challenges associated with its implementation. Nevertheless, the framework promises to provide a structured approach for resolving design conflicts in socio-environmental projects and offers a means to mitigate greenwashing and greenspin in architecture and construction practices	The authors showed, as dangers of greenwashing, the fact that it can induce deceptive environmental claims, influencing consumer decisions and damaging a company's reputation, resulting in customer loss. Moreover, it contributes to adverse environmental and social consequences. To counteract greenwashing, businesses should prioritize transparent communication and reporting, aligning their practices with authentic green initiatives. Additionally, comprehensive corporate social responsibility (CSR) strategies are essential for promoting sustainable corporate practices
Marchant et al. (2022)	The article mainly explores how blockchain can enhance carbon credit markets for transparency and reliability, by analyzing ways in which Blockchain technology can address double counting issues in carbon markets. The discussion explores blockchain's potential in carbon credit markets, emphasizing its role in enhancing transparency and reliability. It addresses the need for a standardized framework for tokenizing securities in carbon markets and highlights blockchain's capacity to address issues such as double counting. However, it notes the challenges related to enforcing contractual efforts and monitoring transactions post-transaction. Overall, blockchain technology offers promising applications in carbon credit trading markets, holding potential for sustainability and improved market operations	Greenwashing, which misleads consumers about environmental practices, erodes a company's credibility and fosters skepticism towards sustainability claims. To address this issue, incorporating blockchain technology into carbon offset credit trading markets can enhance transparency and accountability. By utilizing smart contracts to automate transactions and enforce carbon reduction claims, companies can ensure the integrity of their sustainability efforts. Additionally, monitoring carbon offset credits from creation to retirement allows for greater accountability throughout the process. Experimentation with new blockchain applications further facilitates climate change mitigation efforts, demonstrating the potential of technology in promoting genuine environmental stewardship
Cosby et al. (2022)	The discussion of the article revolves around enhancing biodiversity conservation in the dairy industry through collaborative governance programs, which aim to integrate industry-led initiatives with regulatory objectives to manage environmental impacts effectively. The focus is on establishing integrity mechanisms to prevent greenwashing claims and address challenges related to farmers' self-reporting of performance. Additionally, there is an emphasis on incorporating existing environmental programs into formal co-governance structures and facilitating market rewards to incentivize pro-conservation behaviors among dairy industry stakeholders	The article highlights challenges such as credibility issues and greenwashing in sustainability efforts. It suggests incorporating third-party auditing measures to ensure realistic market advantages and promoting accurate and honest objective reporting, which should be audited by a third party to enhance credibility. Furthermore, it advocates for providing government-industry incentives instead of penalties to encourage practice changes in sustainability efforts. Overall, these measures aim to address credibility concerns and promote genuine sustainability practices

Articles	Summary of the article	Points made regarding greenwashing
Partzsch et al. (2019)	The article assesses NGO demands within cotton certification schemes for environmental sustainability and evaluates the effectiveness of certification programs in addressing environmental issues. It emphasizes that the EU Organic Regulation demonstrates superior environmental sustainability compared to other programs but cautions about the potential for 'greenwashing' corporate conduct resulting from NGO participation. Moreover, it highlights the limited ambition in NGO-participated programs compared to public standards and underscores the risk of 'greenwashing' corporate conduct due to NGO initiatives. The analysis identifies key NGOs and certification programs influencing environmental sustainability in agriculture, compares the environmental sustainability scores of different certification programs, and warns about the risk of 'greenwashing' due to NGO involvement, thus shedding light on the complexities of environmental sustainability within cotton certification programs	Thearticle outlines the risks of greenwashing associated with NGOs supporting labeling programs that fall behind public regulations and the potential contribution of multi-stakeholder initiatives to corporate greenwashing. It underscores the need for NGOs to prioritize and establish clear standards, advocate for mandatory requirements in certification programs to promote transparency, and prevent industry interference in setting environmental standards. Additionally, it suggests enhancing public regulation to exceed initiatives involving NGO participation, emphasizing the importance of robust and transparent environmental standards across all sectors
Alons (2017)	The article discusses the investigation into Environmental Policy Integration (EPI) within the EU's Common Agricultural Policy (CAP) and the transformation from exceptionalism to post-exceptionalism in European agriculture. It highlights the limited extent of EPI in the CAP, focusing on vertical integration within the agricultural sector. The analysis examines CAP reforms over two decades to assess the EPI process, output, and outcome, emphasizing the incomplete transformation hindering Environmental Policy Integration in European agricultural policy	The article highlights the issue of greenwashing, where companies mislead consumers with false environmental claims, leading to a lack of trust in their environmental commitments. To address this, the authors suggests implementing strict regulations and monitoring mechanisms to prevent misleading claims. Additionally, it emphasizes the importance of enhancing transparency in communication to ensure accurate dissemination of environmental information

Articles	Summary of the article	Points made regarding greenwashing
Christiansen et al. (2023)	The article delves into the discursive aspects of net-zero logics, particularly focusing on a case study of MAX, a company claiming to be 'climate-positive' through their burgers. It critiques MAX's communication strategy, highlighting how their net-zero claim justifies existing business practices and promotes non-transformative solutions like offsetting and voluntary corporate action. The authors also emphasizes the lack of transparency and documentation supporting emission reduction claims by MAX, ultimately arguing against distracting from real emissions reductions and advocating for genuine efforts to reduce emissions	The article highlights the risks associated with greenwashing and net-zero pledges, emphasizing how they can obscure real emission reductions and lack transparency. It points out that companies may resort to offsetting and voluntary actions to distract from their actual emissions. To address these issues, the authors suggested implementing transparent reporting mechanisms to verify emission reduction claims and prioritizing direct emission reductions over offsetting strategies to combat greenwashing. It also advocates for encouraging real reductions in emissions rather than relying solely on offsets and emphasizes the importance of holding companies accountable for their net-zero commitments through independent audits
Parker and Sheedy-Reinhard (2022)	The article explores the complexity of the regenerative agriculture (RA) discourse, identifying nine distinct discourses that contribute to it. It discusses the tensions inherent in RA that may make it vulnerable to co-optation and greenwashing, diluting its transformative potential. Additionally, it highlights the shared storyline for transformation formed around a discourse coalition within the RA discourse. The authors emphasize the need to understand the complexity of RA without oversimplification and underscores the importance of addressing tensions to preserve its transformative potential	The article highlights the issue of greenwashing, which deceives consumers about the environmental benefits of certain practices or products, often leading to accusations directed towards proponents of specific discourses. To combat greenwashing, it suggests defining clear criteria for regenerative agriculture practices and implementing transparent monitoring and reporting mechanisms. Additionally, it emphasizes the importance of educating consumers and stakeholders about greenwashing tactics and enforcing strict regulations and certifications to ensure authenticity in environmental claims
Munasinghe et al. (2021)	The article explores how sustainability certification enables industries to move beyond greenwashing, focusing on the case of the Sri Lankan tea industry. It conceptualizes sustainability certification as a marketization process for positive impacts, showcasing how accounting devices create visibility for sustainability-certified tea as a marketable good. The study highlights how producers become economic agents in markets for sustainability-certified tea, facilitating economic exchange that connects supplies from certified tea estates with ethically minded consumers. Overall, it emphasizes the role of sustainability certifications in improving social and ecological outcomes while enabling sustainable production practices through marketization	The article addresses the issue of greenwashing, which can mislead consumers about a company's environmental practices and undermine the credibility of sustainability certifications, potentially leading to negative social and ecological impacts. To combat this, the authors advocate for the implementation of accounting devices is suggested to enhance the visibility and marketability of sustainable products. Additionally, enabling producers to participate in markets for sustainability-certified goods and connecting supplies from certified estates with demands from ethically minded consumers are proposed strategies to mitigate greenwashing and promote genuine sustainability efforts

Articles	Summary of the article	Points made regarding greenwashing
Gittelson et al. (2022)	The article highlights the environmental injustices associated with biogas in rural communities, particularly focusing on the negative impacts of manure-to-energy projects. It showed that such projects are not sustainable and perpetuate environmental injustices, causing harm to local communities and locking farmers into debt. Additionally, it critiques the false marketing of biogas as a renewable energy solution and proposes policy improvements to protect frontline communities and farmers. Overall, the authors called for bridging social science and public health research to address these environmental justice issues effectively	The article shows the deceptive marketing of biogas as a renewable energy solution, which perpetuates harmful practices such as hazardous manure-to-energy projects that harm local communities and burden farmers with debt. It also underscores how greenwashing reinforces concentrated animal feeding operations (CAFOs), expands fossil fuel infrastructure, and negatively impacts communities. To address these issues, the authors suggested implementing transparent labeling and certification processes for environmental claims, enforcing strict regulations and penalties for false environmental marketing practices, educating consumers and stakeholders on recognizing and questioning greenwashing tactics, and supporting independent research and community-driven initiatives to expose greenwashing practices
Buseth (2017)	The article outlines the examination of the transfer of green economy discourse from the global to the national level in Tanzania. It discusses how the global discourse on the green economy is reshaped to suit local initiatives, particularly in the context of agri-business projects. However, it highlights the lack of attention given to policy implications and governance issues in developing countries like Tanzania, as well as the confusion surrounding various concepts of the green economy, which can affect project outcomes. The analysis also delved into how the green economy discourse is utilized and institutionalized at the national level in Tanzania, shedding light on the policy implications and governance aspects specific to developing countries	The article discusses the impact of greenwashing on green economy initiatives, highlighting how it distorts concepts and affects policy implementation and outcomes. Greenwashing involves reshaping the global discourse on the green economy to suit local initiatives, potentially leading to misinterpretation of green concepts in projects. To address this issue, the authors suggested implementing strict regulations and monitoring mechanisms to prevent misleading claims. It also emphasizes the importance of increasing transparency in reporting environmental impacts and sustainability efforts, encouraging independent verification and certification of green initiatives, and educating consumers and stakeholders to recognizegenuine green practices. These measures aim to mitigate the negative effects of greenwashing and promote genuine sustainability efforts in the green economy

Articles	Summary of the article	Points made regarding greenwashing
Geist (2021)	The article outlines a proposal for addressing the environmental sustainability of tobacco farming and promoting diversified agricultural practices. It suggests a post-2020 strategy that integrates indicators for tobacco land stewardship, emphasizing the need for political prioritization in land-use sustainability metrics. The proposal aims to redirect activities towards sustainable land stewardship, acknowledging the lack of progress in framing woody biomass destruction since 2007 and the tobacco industry's assertion of no economically sustainable alternatives to tobacco land use. Additionally, it reviews a UN study on tobacco's impact on natural resources, underscoring the importance of developing effective strategies for sustainable land management in the tobacco industry	The authors addressed the issue of greenwashing, which deceives consumers about a company's environmental practices. To combat this, it suggests implementing strict regulations and monitoring mechanisms to prevent deceptive practices. Additionally, increasing transparency through clear labeling and certifications for eco-friendly products is recommended. Moreover, educating consumers about greenwashing tactics is emphasized to enable them to make informed purchasing decisions. Overall, these measures aim to promote honesty and transparency in environmental claims made by companies
Alexander (2019)	The authors analyzed the exploration of Climate-Smart Agriculture (CSA) by stakeholders, focusing on how they define it and the challenges faced by the Global Alliance for CSA. It highlights that CSA outcomes are more critical than definitions, advocating for shared governance and farmer-centric approaches. The analysis reveals a debate over the role of agribusiness in CSA and the challenges in defining "smart" agriculture. Criticism is directed towards "Big Ag" companies shaping the CSA agenda. Moreover, there's an identified gap in education and culture regarding CSA, impacting its understanding and progress. The article emphasizes the importance of cooperation between farmers, researchers, and policymakers, advocating for context-specific approaches and data-driven education programs	The article addressed concerns regarding greenwashing and the influence of "Big Ag" companies on the Climate-Smart Agriculture (CSA) agenda, highlighting accusations of private interests shaping CSA policies and practices. It advocates for a system-based approach to CSA and emphasizes the importance of incorporating farmers into discussions to facilitate two-way dialogue. Prioritizing farmers' needs over creating divisions among stakeholder groups is suggested, along with the implementation of context-specific education programs tailored to farmers' requirements

Articles	Summary of the article	Points made regarding greenwashing
DeFries (2017)	The article evaluated the impact of voluntary certification on small-scale producers in tropical agriculture, focusing on environmental, economic, and social outcomes. It indicates that while certification programs show positive outcomes for 34% of response variables and no significant differences for 58%, negative outcomes are observed for 8%. However, certification alone is not deemed a complete solution for improving smallholder farmers' incomes. Despite the positive associations with sustainable development goals, rigorous analysis and independent evaluation are deemed crucial for accurately assessing the effectiveness of certification programs	The authors investigated the limitations of voluntary certification programs in improving social outcomes for farmers and as a guaranteed solution for small-scale producers' incomes. It underscores the importance of rigorous analysis and independent evaluation to assess the effectiveness of certification programs. To achieve this, the authors suggested establishing clear objectives, eligibility criteria, and reproducible methodologies for studies, conducting a systematic search for all relevant studies, and categorizing response variables for systematic evaluation of results
Francis (2004)	The article illustrated the impacts of corporate agriculture on sustainability and environmental concerns, highlighting challenges faced by large corporations in improving their environmental image. It addresses the trend of larger farming operations and examines the effects of globalization on local economies and food systems. Additionally, it outlines the negative aspects of corporate agriculture, such as a short-term focus on economic sustainability, inequity in benefits distribution, and the lack of long-term social stability and sustainability. Moreover, it discusses the need for positive alternatives to conventional mainstream business approaches in agriculture to address these challenges	The author addressed the deceptive nature of greenwashing, which misleads consumers about environmental practices and can damage public trust and corporate reputation. It emphasizes the importance of transparency in setting goals and operations to build legitimacy and advocates for the use of objective measures to track progress towards sustainability. Furthermore, it suggests the development of bio-logical substitutes for chemical practices in agriculture to mitigate environmental impacts. Additionally, it highlights the need to address the negative impacts of corporate agriculture on the environment and social stability while promoting positive alternatives to conventional mainstream business approaches
Mobilizing impermaculture—Temporary urban agriculture and the sustainability fix.pdf	The article discussed impermaculture as a model for urban agriculture sustainability, highlighting its role in stabilizing sustainability fixes in cities. It introduced impermaculture as a concept embraced by urban agriculturalists, emphasizing spatiotemporal impermanence and its contribution to sustainability fixes. Additionally, it examines impermaculture's role in urban development and sustainability capital, providing empirical insights from cities like Portland and Vancouver to illustrate its application in urban agriculture	The authors discussed the potential for impermaculture arrangements in urban development to be perceived as greenwashing, highlighting the symbolic and material dangers associated with sustainability fixes in urban settings. To address these concerns, they recommended implementing transparent reporting and certification processes to verify sustainability claims, engaging in independent audits to validate environmental impact and sustainability efforts, and educating consumers and stakeholders on greenwashing tactics to help them identify misleading practices

Articles	Summary of the article	Points made regarding greenwashing
Schermer (2008)	The authors examined the Austrian organic policy, particularly focusing on the concepts of "greening" and "greenwashing." They discuss the integration of environmental policy goals into various policy areas and the challenges associated with assessing ecological modernization in the agri-food sector. Additionally, it the presence of "greening" and "greenwashing" tendencies within Austrian agricultural policy were addressed, emphasizing the need for critical analysis and evaluation of these practices	The article is mainly focused on greenwashing, and, in summary, it highlights the deceptive nature of greenwashing, which falsely presents products as environmentally friendly. To combat this issue, it suggests implementing clear regulations and standards for organic labeling to ensure authenticity. Additionally, increasing transparency in supply chains can help verify organic claims and provide assurance to consumers. Lastly, it emphasizes the importance of consumer education on organic farming practices and certifications to make informed purchasing decisions and avoid falling victim to greenwashing tactics
Mehta et al. (2021)	The article addresses stakeholders' perceptions of bio-based plastics, particularly in Belfast. It uncovers a spectrum of awareness and concerns among stakeholders regarding these plastics, highlighting both their benefits and challenges. Among the findings are gaps in knowledge among students and consumers about bio-based plastics and concerns about potential food contamination from bio-based packaging made from slaughterhouse waste. Additionally, there's a reluctance among some stakeholders to pay more for bio-based plastics. The study underscores the importance of informing consumers about the environmental impacts ofbio-based plastics and suggests future communication strategies for both the public and industry. It also recommends incorporating life cycle assessment parameters into labeling using standards to enhance transparency and understanding in the bio-based plastics sector	The article addresses the issue of greenwashing, which deceives consumers regarding the environmental benefits of products, potentially damaging a company's reputation and eroding trust. To combat this, it suggests implementing clear labeling standards established by neutral organizations. Furthermore, educating consumers about the environmental impacts of bio-based plastics and providing information on life cycle assessment parameters for production processes are recommended. Additionally, the authors highlighted the importance of developing effective communication strategies for bio-based plastics aimed at both the public and industry stakeholders

Articles	Summary of the article	Points made regarding greenwashing
Bager and Lambin (2020)	The article explores sustainability strategies within the global coffee sector, noting variations in commitment among companies, with some demonstrating tangible efforts while others potentially engage in greenwashing practices. Market differentiation is observed, with progressive companies aligning sustainability strategies with stakeholders. However, there is a lack of common sustainability indicators and a transparent reporting framework. The analysis of 513 coffee companies highlights factors influencing the adoption of sustainability strategies, emphasizing the necessity for standardized sustainability indicators and transparent reporting frameworks to promote industry-wide sustainability practices	The article discusses the risks associated with greenwashing, where companies may mislead consumers about their sustainability efforts. It highlights the discrepancy between self-reported information and actual sustainability impact. Companies that claim sustainability without implementing corresponding practices are particularly at risk. To mitigate these risks, the study suggests implementing direct trade, internal standards, and codes of conduct. It emphasizes the importance of transparency in reporting sustainability efforts to prevent misleading claims. Additionally, the development of common sustainability indicators consistent with the Sustainable Development Goals is recommended to ensure credibility and accountability in sustainability practices
Scanlan (2013)	The authirs performed an analysis of agribusiness corporate environmental communications, specifically focusing on claims related to sustainability and hunger alleviation. It contrasts these claims with the concept of 'grainwashing', which refers to misleading tactics in corporate social responsibility. The analysis connects agribusiness, hunger, environmental sociology, and corporate environmental communication. While the paper does not explicitly mention limitations, it sheds light on the complexities of corporate messaging in the context of environmental and social issues	The article highlights the deceptive nature of greenwashing, where false claims of sustainability mislead the public. It identifies PR firms and agribusiness as perpetrators of greenwashing tactics to exert influence. To combat greenwashing, the summary suggests implementing transparent reporting and verification processes for sustainability claims. It also advocates for independent audits to validate environmental practices and increase consumer awareness through education on greenwashing tactics
Neumann (2021)	The article performns an analysis that delves into how greening strategies influence the performance of new firms, examining the relationship between different strategies and success. It finds that substantive greening strategies positively impact new firms, while symbolic ones do not provide significant benefits unless reinforced with substantive actions. Additionally, greenwashing negatively affects firms, particularly in later start-up phases. The relationship between substantive greening strategies and firm performance is complex and not linear. The study highlights the importance of substantive greening strategies for new firms and emphasizes the detrimental effects of greenwashing without substantive actions	The study shows the detrimental effects of greenwashing without substantive actions on firm performance, particularly for new firms. It emphasizes that symbolic greening strategies, which involve ceremonial communication without substantive actions, negatively impact new firm performance. Conversely, substantive greening strategies positively influence firm performance. The study advises against adopting symbolic greening strategies without substantive actions and suggests that combining substantive and symbolic greening strategies may not yield benefits. Additionally, it notes that greenwashing, which involves disclosing environmental information without implementation, does not significantly impact firm performance

Articles	Summary of the article	Points made regarding greenwashing
Andersson and James (2018)	The research goes into the intricate relationship between green place branding and urban environmental policymaking, particularly focusing on Växjö, Sweden. It analyzes how contradictory impulses, such as altruism, competition, and policy tourism, shape green place branding and environmental policy in the region. The study highlights the impact of altruism and competition on green place branding, shedding light on how these factors influence environmental policies and branding practices. Notably, it explores the phenomenon of policy tourism and its effects on both environmental policies and branding strategies in Växjö	The authors argue that greenwashing practices often entail cherry-picking easily achieved goals within environmental policies, resulting in superficial environmental branding that lacks comprehensive policymaking efforts. This approach prioritizes image and economic growth over genuine environmental benefits, with decision-making driven by marketing measures rather than actual environmental impact. To combat greenwashing, it is crucial to implement strict regulations and standards for environmental claims, enhance transparency in reporting environmental efforts and achievements, and encourage independent verification and certification of green initiatives. These measures aim to ensure that environmental claims are substantiated by meaningful actions and genuine contributions to sustainability rather than mere branding exercises
Stecker (2016)	The article seeks to analyze how benefit corporations serve as a strategic business structure for social entrepreneurs, offering legal protection for pursuing social objectives.These entities enhance trust, accountability, and social responsibility within businesses	The main point made is in regards to safeguards that should be implemented to mitigate concerns of greenwashing, such as harsher policies and education of consumers, ensuring authenticity in sustainability claims
Dragomir (2020)	The paper discusses various aspects related to environmental risks, supplier selection, and ecological improvements, with a focus on internal processes linked to a reactive strategy for economic performance. It emphasis is placed on stability, control, and efficiency, often quantified in monetary terms. However, the article is theoretical, and no specific practical results are provided, and there are no explicit limitations mentioned in the given contexts	The authors point out that, greenwashing, the deceptive practice of portraying a company's environmental efforts inaccurately, misleads consumers. To combat this, implementing clear labeling and certifications for eco-friendly products is crucial. Additionally, enhancing transparency in supply chain practices and environmental impact assessments can help consumers make informed choices. Green practices, when aligned with lean production principles for continuous improvements, further contribute to sustainability efforts

Articles	Summary of the article	Points made regarding greenwashing
Rodrigues et al. (2021)	The study focuses on identifying marketing strategies for green businesses in the cosmetics sector to overcome consumer distrust. It presents a model for building consumer trust in natural products, contributing to theoretical knowledge in green marketing. The research highlights the importance of sustainable products and effective promotion in combating consumer distrust. Additionally, it underscores the potential for a strong natural cosmetics sector in Brazil dueto its biodiversity. Overall, the study offers valuable insights and strategies for businesses aiming to gain consumer confidence in sustainability, which can be replicated by other green businesses	The focus of the discussion is on the deceptive nature of greenwashing, which misleads consumers about a company's environmental practices, leading to erosion of consumer trust and damage to the brand's reputation. To counteract this, the emphasis is placed on creating genuinely sustainable products and transparently promoting them. Building close relationships with customers based on trust and transparency is recommended, along with exposing greenwashing practices in the industry. Additionally, encouraging customer feedback and monitoring social media interactions are suggested strategies to combat greenwashing and build consumer trust
Cremasco and Boni (2022)	The study delves into how investment funds adhere to the EU's Sustainable Finance Disclosure Regulation. It reveals that investment funds, irrespective of their sustainability objectives, exhibit similar behavior. Interestingly, even funds without explicit sustainability objectives prioritize sustainability within their portfolios. However, the research lacks detailed insights into specific behaviors of investment funds, and there is a limited focus on differentiating sustainability attributes across fund categories. Despite this, it sheds light on the uniformity in behavior among investment funds, highlighting challenges in differentiating sustainability attributes, particularly in European funds	The authors showed that greenwashing, the deceptive use of sustainability for marketing purposes, persists in financial markets without proper regulatory oversight. Financial actors often misuse sustainability labels to enhance their market positioning, taking advantage of the lack of clear boundaries. To counter this, aligning management fees with sustainability performance and implementing regulations to control such practices are suggested measures. By doing so, it is possible to combat greenwashing and ensure authenticity in sustainability claims within financial sectors

Appendix B

Title	Authors	Year	Journal
Our burgers eat carbon: Investigating the discourses of corporate net-zero commitments	Christiansen, K.L., Hajdu, F., Planting Mollaoglu, E., Andrews, A., Carton, W., Fischer, K	2023	Environmental Science & Policy
Regenerative agriculture: a potentially transformative storyline shared by nine discourses	Gordon, E., Davila, F., Riedy, C	2023	Sustainability Science

Title	Authors	Year	Journal
Are Banks Responsible for Animal Welfare and Climate Disruption? A Critical Review of Australian Banks' Due Diligence Policies for Agribusiness Lending	Parker, C., Sheedy-Reinhard, L	2022	Transnational Environmental Law
Bringing Technological Transparency to Tenebrous Markets: The Case for Using Blockchain to Validate Carbon Credit Trading Markets	Marchant, G.E., Cooper, Z., Gough-Stone, P.J., VI	2022	Natural Resources Journal
Connecting Nature: The Potential of Australian Dairy Initiatives in Collaborative Biodiversity Governance	Cosby, A, Lawson, A, Gudde, J, Fogarty, ES	2022	Agronomy-Basel
The False Promises of Biogas: Why Biogas Is an Environmental Justice Issue	Gittelson, P., Diamond, D., Henning, L., Payan, M., Utesch, L., Utesch, N	2022	Environmental Justice
Sustainability Practices and Greenwashing Risk in the Italian Poultry Sector: A Grounded Theory Study	Toscano, A., Balzarotti, M., Re, I	2022	Sustainability
Can Labelling Create Transformative Food System Change for Human and Planetary Health? A Case Study of Meat	Parker, C, Carey, R, Haines, F, Johnson, H	2021	Accounting Forum
Exploring perceptions of environmental professionals, plastic processors, students and consumers of bio-based plastics: Informing the development of the sector	Mehta, N., Cunningham, E., Roy, D., Cathcart, A., Dempster, M., Berry, E., Smyth, B.M	2021	Sustainable Production and Consumption
Sustainability certification as marketisation: Rainforest Alliance in the Sri Lankan tea production industry	Munasinghe, A, Cuckston, T, Rowbottom, N	2021	Environmental Science and Pollution Research
Tobacco and deforestation revisited. How to move towards a global land-use transition?	Geist, H.J	2021	Sustainability
The evolution of new ventures' behavioral strategies and the role played by governments in the green entrepreneurship context: an evolutionary game theory perspective	Yang, X, Liao, S, Li, RM	2021	International Journal of Health Policy and Management
Sustainability strategies by companies in the global coffee sector	Bager, S.L., Lambin, E.F	2020	Business Strategy and the Environment
Cotton certification in Sub-Saharan Africa: Promotion of environmental sustainability or greenwashing?	Partzsch, L., Zander, M., Robinson, H	2019	Global Environmental Change-Human and Policy Dimensions

Title	Authors	Year	Journal
What climate-smart agriculture means to members of the Global Alliance for climate-smart agriculture	Alexander, S	2019	Future of Food-Journal on Food Agriculture and Society
Environmental policy integration in the EU's common agricultural policy: greening or greenwashing?	Alons, G	2017	Journal Of European Public Policy
Is voluntary certification of tropical agricultural commodities achieving sustainability goals for small-scale producers? A review of the evidence	DeFries, R.S., Fanzo, J., Mondal, P., Remans, R., Wood, S.A	2017	Environmental Research Letters
The green economy in Tanzania: From global discourses to institutionalization	Buseth, JT	2017	GEOForum
Feeding the Planet or Feeding Us a Line? Agribusiness, 'Grainwashing' and Hunger in the World Food System	Scanlan, Stephen J	2013	The International Journal of Sociology of Agriculture and Food
Avoiding greenwash by design: Resolving market and socio-environmental ethical conflicts	Crutchfield, D.A., Lunde, M	2012	ICSDC 2011: Integrating Sustainability Practices in the Construction Industry—Proceedings of the International Conference on Sustainable Design and Construction
Organic policy in Austria: Greening and greenwashing	Schermer, M	2008	International Journal of Agricultural Resources, Governance and Ecology
Greening of agriculture: Is it all a greenwash of the globalized economy?	Francis et al	2007	Journal of Crop Improvement
Greening of agriculture for long-term sustainability	Francis	2004	Agronomy Journal

Appendix C

Title	Authors	Year	Journal
Altruism or entrepreneurialism? The co-evolution of green place branding and policy tourism in Växjö, Sweden	Andersson, I., James, L	2018	Urban Studies
Awash in a Sea of Confusion: Benefit Corporations, Social Enterprise, and the Fear of "Greenwashing"	Stecker, MJ	2016	Journal of Economic Issues

Title	Authors	Year	Journal
Does it pay for new firms to be green? An empirical analysis of when and how different greening strategies affect the performance of new firms	Neumann, T	2021	Journal of Cleaner Production
Environmental certification schemes: Hotel managers' views and perceptions	Geerts, W	2014	International Journal of Hospitality Management
Ethical Aspects of Environmental Strategy	Dragomir, V.D	2020	SpringerBriefs in Applied Sciences and Technology
I'm Really Green! Marketing Strategies in the Creative Economy to Overcome Consumer Distrust	Rodrigues, L.B., da Silva, F.E.R., Romero, C.B.A	2021	Revista de Gestão Social e Ambiental
Is the European Union (EU) Sustainable Finance Disclosure Regulation (SFDR) effective in shaping sustainability objectives? An analysis of investment funds' behaviour	Cremasco, C, Boni, L	2022	Journal of Sustainable Finance and Investment
Sustainability Practices and Greenwashing Risk in the Italian Poultry Sector: A Grounded Theory Study	Toscano, A., Balzarotti, M., Re, I	2022	Sustainability
The evolution of new ventures' behavioral strategies and the role played by governments in the green entrepreneurship context: an evolutionary game theory perspective	Yang, X, Liao, S, Li, RM	2021	Environmental Science and Pollution Research

Acknowledgements The authors are thankful for the partial funded for this research provided by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001 and by the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), Process nº 2022/15377-1.

Data availability I confirm that I have included a citation for all available data in my references section, unless my article type is exempt. The final set of data supporting the conclusions of this study is available from the corresponding author upon reasonable request.

References

Alexander, S. (2019). What climate-smart agriculture means to members of the Global Alliance for climate-smart agriculture. *Future of Food-Journal on Food Agriculture and Society*. https://doi.org/10.17170/kobra-2018122073

Aliabadi, V., Ataei, P., & Gholamrezai, S. (2022). Identification of the relationships among the indicators of sustainable entrepreneurial ecosystems in agricultural startups. *Journal of Innovation and Knowledge, 7*(4), 100245. https://doi.org/10.1016/j.jik.2022.100245

Alons, G. (2017). Environmental policy integration in the EU's common agricultural policy: Greening or greenwashing? *Journal of European Public Policy*. https://doi.org/10.1080/13501763.2017.1334085

Andersson, I., & James, L. (2018). Altruism or entrepreneurialism? The co-evolution of green place branding and policy tourism in Växjö, Sweden. *Urban Studies*. https://doi.org/10.1177/0042098017749471

Asmussen, C. B., & Møller, C. (2019). Smart literature review: a practical topic modelling approach to exploratory literature review. *J. Big Data*. https://doi.org/10.1186/s40537-019-0255-7

Bager, S. L., & Lambin, E. F. (2020). Sustainability strategies by companies in the global coffee sector. *Business Strategy and the Environment*. https://doi.org/10.1002/bse.2596

Bardin, L. (2016). Análise de Conteúdo. *Edições 70*.

Belle, A. B., El Boussaidi, G., Lethbridge, T. C., Kpodjedo, S., Mili, H., & Paz, A. (2021). Systematically reviewing the layered architectural pattern principles and their use to reconstruct software architectures. https://doi.org/10.48550/arXiv.2112.01644

Blei, D. M. (2012). Probabilistic topic models. *Communications of the ACM, 55*(4), 77–84. https://doi.org/10.1145/2133806.2133826

Buseth, J. T. (2017). The green economy in Tanzania: From global discourses to institutionalization. *Geoforum*. https://doi.org/10.1016/j.geoforum.2017.08.015

Caferra, R., Imbert, E., Schirone, D. A., Tiranzoni, P., & Morone, A. (2023). Consumer analysis and the role of information in sustainable choices: A natural experiment. *Frontiers in Environmental Economics, 1*, 1044206. https://doi.org/10.3389/frevc.2022.1044206

Camilleri, M. A., Cricelli, L., Mauriello, R., & Strazzullo, S. (2023). Consumer perceptions of sustainable products: A systematic literature review. *Sustainability, 15*(11), 8923.

Carvalho, A. P. P., Lorandi, R., Collares, E. G., Di Lollo, J. A., & Moschini, L. E. (2021). Potential water demand from the agricultural sector in hydrographic subbasins in the southeast of the state of São Paulo-Brazil. *Agriculture, Ecosystems & Environment, 319*(June). https://doi.org/10.1016/j.agee.2021.107508

Christiansen, K. L., Hajdu, F., Planting Mollaoglu, E., Andrews, A., Carton, W., & Fischer, K. (2023). Our burgers eat carbon: Investigating the discourses of corporate net-zero commitments. *Environmental Science and Policy*. https://doi.org/10.1016/j.envsci.2023.01.015

European Commission. (2023). *Consumer protection: enabling sustainable choices and ending greenwashing*. Available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1692. Accessed in november, 2023.

Condor, R. (2020). Entrepreneurship in agriculture: A literature review. *International Journal of Entrepreneurship and Small Business, 40*(4), 516–562. https://doi.org/10.1504/IJESB.2020.109013

Cosby, A., Lawson, A., Gudde, J., & Fogarty, E. S. (2022). Connecting nature: The potential of Australian dairy initiatives in collaborative biodiversity governance. *Agronomy*. https://doi.org/10.3390/agronomy12020366

Couto, J., Borges, O., Ruiz, D., Marczak, S., and Prikladnicki, R. (2019). A mapping study about data lakes: an improved definition and possible architectures. In *31St international conference on software engineering and knowledge engineering (SEKE 2019), Lisbon, Portugal* (pp. 453–458). https://doi.org/10.18293/SEKE2019-129

Cremasco, C., & Boni, L. (2022). Is the European Union (EU) Sustainable Finance Disclosure Regulation (SFDR) effective in shaping sustainability objectives? An Analysis of Investment Funds' Behaviour. *Journal of Sustainable Finance and Investment*. https://doi.org/10.1080/20430795.2022.2124838

Crutchfield, D.A., & Lunde, M. (2012). Avoiding greenwash by design: Resolving market and socio-environmental ethical conflicts. *ICSDC 2011: Integrating Sustainability Practices in the Construction Industry - Proceedings of the International Conference on Sustainable Design and Construction*. https://doi.org/10.1061/41204(426)21

D'Adamo, I. (2023). The analytic hierarchy process as an innovative way to enable stakeholder engagement for sustainability reporting in the food industry. *Environment, Development and Sustainability, 25*, 15025–15042. https://doi.org/10.1007/s10668-022-02700-0

D'Amato, D., Droste, N., Allen, B., Kettunen, M., Lähtinen, K., Korhonen, J., Leskinen, P., Matthies, B. D., & Toppinen, A. (2017). Green, circular, bio economy: A comparative analysis of sustainability avenues. *Journal of Cleaner Production, 168*, 716–734. https://doi.org/10.1016/j.jclepro.2017.09.053

De Fries, R. S., Fanzo, J., Mondal, P., Remans, R., & Wood, S. A. (2017). Is voluntary certification of tropical agricultural commodities achieving sustainability goals for small-scale producers? A review of the evidence. *Environmental Research Letters*. https://doi.org/10.1088/1748-9326/aa625e

Doğan, B., Rao, A., Ferraz, D., et al. (2023). What do we learn from Nexus between trade diversification and structural change: Informing the future about climate action and Sustainability. *Environmental Science and Pollution Research, 30*, 92162–92181. https://doi.org/10.1007/s11356-023-28770-9

Dos Santos, R. B., Torrisi, N. M., & Pantoni, P. (2021). Third party certification of agri-food supply chain using smart contracts and blockchain tokens. *Sensors, 21*(16), 5307. https://doi.org/10.3390/s21165307

Dragomir, V. D. (2020). Ethical aspects of environmental strategy. *SpringerBriefs in Applied Sciences and Technology*. https://doi.org/10.1007/978-3-030-29548-6_3

Dutia, S. G. (2014). Agtech: Challenges and opportunities for sustainable growth. *Innovations, 9*(1–2), 161–193. https://doi.org/10.1162/inov_a_00208

Ferraz, D., & Pyka, A. (2023). Circular economy, bioeconomy, and sustainable development goals: A systematic literature review. *Environmental Science and Pollution Research*. https://doi.org/10.1007/s11356-023-29632-0

Francis, C. A. (2004). Greening of agriculture for long-term sustainability. *Agronomy Journal, 96*(5), 1211–1215. https://doi.org/10.2134/agronj2004.1211

Francis, C. A., Elmore, R., Ikerd, J., & Duffy, M. (2007). Greening of agriculture: Is it all a greenwash of the globalized economy? *Journal of Crop Improvement, 19*(1–2), 193–220. https://doi.org/10.1300/J411v19n01_10

Franco, D., Ganga, G. M. D., & de Santa-Eulalia, L. A. (2017). Gestão ambiental em cadeia de suprimentos: revisão sistemática da literatura. *Revista Produção Online, 17*(1), 295–324. https://doi.org/10.14488/1676-1901.v17i1.2536

Gao, S., Lim, M. K., Qiao, R., Shen, C., Li, C., & Xia, L. (2022). Identifying critical failure factors of green supply chain management in China's SMEs with a hierarchical cause–effect model. *Environment, Development and Sustainability, 24*, 5641–5666. https://doi.org/10.1007/s10668-021-01675-8

Geerts, W. (2014). Environmental certification schemes: Hotel managers' views and perceptions. *International Journal of Hospitality Management*. https://doi.org/10.1016/j.ijhm.2014.02.007

Geist, H. J. (2021). Tobacco and deforestation revisited ? How to move towards a global land-use transition. *Sustainability, 13*, 9242. https://doi.org/10.3390/su13169242

Gittelson, P., Diamond, D., Henning, L., Payan, M., Utesch, L., & Utesch, N. (2022). The false promises of biogas: Why biogas is an environmental justice issue. *Environmental Justice*. https://doi.org/10.1089/env.2021.0025

Gordon, E., Davila, F., & Riedy, C. (2023). Regenerative agriculture: A potentially transformative storyline shared by nine discourses. *Sustainability Science*. https://doi.org/10.1007/s11625-022-01281-1

Govindan, K., Khodaverdi, R., & Jafarian, A. (2013). A fuzzy multi criteria approach for measuring sustainability performance of a supplier based on triple bottom line approach. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2012.04.014

Gregorio, V. F., Pié, L., & Terceño, A. (2018). A systematic literature review of bio, green and circular economy trends in publications in the field of economics and business management. *Sustainability*, *10*, 4232. 10.3390/su10114232.

Gupta, H., & Barua, M. K. (2018). A framework to overcome barriers to green innovation in SMEs using BWM and Fuzzy TOPSIS. *Science of the Total Environment, 633*, 122–139. https://doi.org/10.1016/j.scitotenv.2018.03.173

Hameed, I., Hyder, Z., Imran, M., & Shafiq, K. (2021). Greenwash and green purchase behavior: An environmentally sustainable perspective. *Environment, Development and Sustainability, 23*, 13113–13134. https://doi.org/10.1007/s10668-020-01202-1

Horne, J., Recker, M., Michelfelder, I., Jay, J., & Kratzer, J. (2020). Exploring entrepreneurship related to the sustainable development goals - mapping new venture activities with semi-automated content analysis. *Journal of Cleaner Production, 242*(1), 118052. https://doi.org/10.1016/j.jclepro.2019.118052

Hosseininia, G., Aliabadi, V., Karimi, H., & Pouria, A. (2023). The interaction between exploratory behaviours and entrepreneurial opportunity recognition by agriculture students: The mediating role of strategic learning and mindfulness. *Innovations in Education and Teaching International*. https://doi.org/10.1080/14703297.2023.2192511

Klingenberg, C. O., Antunes Júnior, J. A. V., & Müller-Seitz, G. (2022). Impacts of digitalization on value creation and capture: Evidence from the agricultural value chain. *Agricultural Systems, 201*, 103468. https://doi.org/10.1016/j.agsy.2022.103468

Kuckertz, A., Hinderer, S., & Rohm, P. (2019). Entrepreneurship and entrepreneurial opportunities in the food value chain. *npj Science of Food, 3*, 6. https://doi.org/10.1038/s41538-019-0039-7

Kumar, R., & Kumar, R. (2013). Green marketing: Reality or green washing. *Asian Journal of Multidisciplinary Studies, 1*(5), 47–53.

Lee, K.-H., Cheol, B., & Lee, E. Y. (2016). Environmental responsibility and firm performance: The application of an environmental, social and governance model. *Business Strategy and the Environment, 25*, 40–53.

Lu, Z., Lin, Y., & Li, Y. (2023). Does corporate engagement in digital transformation influence greenwashing? Evidence from China. *Finance Research Letters, 58*, 104558. https://doi.org/10.1016/j.frl.2023.104558

Marchant, G. E., Cooper, Z., & Gough-Stone, P. J. (2022). Bringing technological transparency to tenebrous markets: the case for using blockchain to validate carbon credit trading markets. *Nat. Resources J., 62*, 159.

Martins, L. C. G., & Garcia, R. E. (2015). Validation of user interface model: a systematic literature review. Proceedings of the International Conference on Software Engineering Research and

Practice (SERP); The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp), 145–151.

Mehta, N., Cunningham, E., Roy, D., Cathcart, A., Dempster, M., Berry, E., & Smyth, B. M. (2021). Exploring perceptions of environmental professionals, plastic processors, students and consumers of bio-based plastics: Informing the development of the sector. *Sustainable Production and Consumption*. https://doi.org/10.1016/j.spc.2020.12.015

Mendes, J. A. J., Carvalho, N. G. P., Mourarias, M. N., Careta, C. B., Zuin, V. G., & Gerolamo, M. C. (2022). Dimensions of digital transformation in the context of modern agriculture. *Sustainable Production and Consumption, 34*, 613–637. https://doi.org/10.1016/j.spc.2022.09.027

Mirna, M., Jezreel, M., Brenda, D., & Claudia, V. (2014). Software process improvement from a human perspective. In: Rocha, Á., Correia, A., Tan, F., Stroetmann, K. (eds) *New perspectives in information systems and technologies*, Volume 1. Advances in Intelligent Systems and Computing, vol 275. Springer. https://doi.org/10.1007/978-3-319-05951-8_28

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2017). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine, 151*, 264–269. https://doi.org/10.7326/0003-4819-151-4-200908180-00135

Mousa, S. K., & Othman, M. (2020). The impact of green human resource management practices on sustainable performance in healthcare organisations: A conceptual framework. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2019.118595

Munasinghe, A., Cuckston, T., & Rowbottom, N. (2021). Sustainability certification as marketisation: Rainforest Alliance in the Sri Lankan tea production industry. *Environmental Science and Pollution Research*. https://doi.org/10.1080/01559982.2021.1893053

Neumann, T. (2021). Does it pay for new firms to be green? An empirical analysis of when and how different greening strategies affect the performance of new firms. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2021.128403

Parker, C., Carey, R., Haines, F., & Johnson, H. (2021). Can labelling create transformative food system change for human and planetary health? A case study of meat. *Accounting Forum*. https://doi.org/10.34172/ijhpm.2020.239

Parker, C., & Sheedy-Reinhard, L. (2022). Are banks responsible for animal welfare and climate disruption? A critical review of australian banks' due diligence policies for agribusiness lending. *Transnational Environmental Law*. https://doi.org/10.1017/S204710252200022X

Partzsch, L., Zander, M., & Robinson, H. (2019). Cotton certification in Sub-Saharan Africa: Promotion of environmental sustainability or greenwashing? *Global Environmental Change-Human and Policy Dimensions*. https://doi.org/10.1016/j.gloenvcha.2019.05.008

Petticrew, M., & Roberts, H. (2006). *Systematic reviews in the social sciences: a practical guide* (1st ed.). Blackwell Publishing.

Raut, R. D., Luthra, S., Narkhede, B. E., Mangla, S. K., Gardas, B. B., & Priyadarshinee, P. (2019). Examining the performance oriented indicators for implementing green management practices in the Indian agro sector. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2019.01.139

Rodrigues, L. B., da Silva, F. E. R., & Romero, C. B. A. (2021). I'm Really Green! Marketing strategies in the creative economy to overcome consumer distrust. *Revista de Gestão Social e Ambiental*. https://doi.org/10.24857/RGSA.V15.2780

Romani, L. A. S., Bariani, J. M., Drucker, D. P., Vaz, G. J., Henrique Vaz Mondo, V. H. V., Moura, M. F., Bolfe, E. L., de Sousa, P. H. P., Oliveira, S. R. de M., & Luchiari Junior, A. (2020). Role of research and development institutions and AgTechs in the digital transformation of agriculture in Brazil. *Revista Ciência Agronômica, 51*(Special Agriculture 4.0), 20207800. https://doi.org/10.5935/1806-6690.20200082

Ruiz-Blanco, S., Romero, S., & Fernandez-Feijoo, B. (2022). Green, blue or black, but washing—What company characteristics determine greenwashing? *Environment Development and Sustainability, 24*, 4024–4045. https://doi.org/10.1007/s10668-021-01602-x

Scanlan, S. J. (2013). Feeding the planet or feeding us a line? Agribusiness, 'grainwashing' and hunger in the world food system. *The International Journal of Sociology of Agriculture and Food*. https://doi.org/10.48416/ijsaf.v20i3.169

Schermer, M. (2008). Organic policy in Austria: Greening and greenwashing. *International Journal of Agricultural Resources, Governance and Ecology*. https://doi.org/10.1504/ijarge.2008.016978

Shepherd, M., Turner, J. A., Small, B., & Wheeler, D. (2020). Priorities for science to overcome hurdles thwarting the full promise of the 'digital agriculture' revolution. *Journal of the Science of Food and Agriculture, 100*(14), 5083–5092. https://doi.org/10.1002/jsfa.9346

Stecker, M. J. (2016). Awash in a sea of confusion: Benefit corporations, social enterprise, and the fear of "greenwashing." *Journal of Economic Issues*. https://doi.org/10.1080/00213624.2016.1176481

Thephavanh, M., Philp, J. N. M., Nuberg, I., Denton, M., & Larson, S. (2023). Perceptions of the institutional and support environment amongst young agricultural entrepreneurs in Laos. *Sustainability, 15*, 4219. https://doi.org/10.3390/su15054219

Toscano, A., Balzarotti, M., & Re, I. (2022). Sustainability practices and greenwashing risk in the Italian poultry sector: A grounded theory study. *Sustainability*. https://doi.org/10.3390/su142114088

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidenceinformed management knowledge by means of systematic review. *British Journal of Management, 14*, 207–222. https://doi.org/10.1111/1467-8551.00375

Vachon, S., & Klassen, R. D. (2008). Environmental management and manufacturing performance: The role of collaboration in the supply chain. *International Journals of Production Economics, 111*, 299–315. https://doi.org/10.1016/j.ijpe.2006.11.030

Wohlin, C. (2014). Guidelines for snowballing in systematic literature studies and a replication in software engineering. *EASE '14: Proceedings of the 18th International Conference on Evaluation and Assessment in Software Engineering*, Article N° 38, pp. 1–10, https://doi.org/10.1145/2601248.2601268

World Economic Forum Annual Meeting. (2023). *Consumers want sustainable options. What food producers, suppliers, and retailers can do now*. Available at: https://www.weforum.org/agenda/2023/01/consumer-power-net-zero-food-producer-retailer-davos23/. Accessed in 29 of March, 2023.

Yang, N. H. N., Bertassini, A. C., Mendes, J. A. J., & Gerolamo, M. C. (2021a). The '3CE2CE' framework—Change management towards a circular economy: Opportunities for agribusiness. *Circ. Econ. Sust., 1*, 697–718. https://doi.org/10.1007/s43615-021-00057-6

Yang, X., Liao, S., & Li, R. M. (2021b). The evolution of new ventures' behavioral strategies and the role played by governments in the green entrepreneurship context: An evolutionary game theory perspective. *International Journal of Health Policy and Management*. https://doi.org/10.1007/s11356-021-12748-6

Yellowlees, P. M., Chorba, K., Parish, M. B., Wynn-Jones, H., & Nafiz, N. (2010). Telemedicine can make healthcare greener. *Telemedicine Journal and E-Health*. https://doi.org/10.1089/tmj.2009.0105

Zuin Zeidler, V. G. (2024). Sustainable chemistry and food systems lessons—The same procedure as every year? *Science*. https://doi.org/10.1126/science.ado2352

Authors and Affiliations

Jéssica Alves Justo Mendes[1] · Arthur Yassine Oliveira[2] · Lígia Suniga Santos[3] · Mateus Cecílio Gerolamo[1,4] · Vânia Gomes Zuin Zeidler[5]

✉ Jéssica Alves Justo Mendes
jessy.a.j.mendes@usp.br; jessy.mendes10@gmail.com

Arthur Yassine Oliveira
arthuryo@usp.br

Lígia Suniga Santos
ligia.amb@usp.br

Mateus Cecílio Gerolamo
mateus.gerolamo@usp.br

Vânia Gomes Zuin Zeidler
zuin@leuphana.de

[1] Department of Production Engineering, São Carlos School of Engineering (EESC), University of São Paulo (USP), Av. Trab. São Carlense, 400, São Carlos, SP 13562-190, Brazil

[2] Department of Aeronautical Engineering, São Carlos School of Engineering (EESC), University of São Paulo (USP), Av. Trab. São Carlense, 400, São Carlos, SP 13562-190, Brazil

[3] Department of Hydraulics and Sanitation, São Carlos School of Engineering (EESC), University of São Paulo (USP), Av. Trab. São Carlense, 400, São Carlos, SP 13562-190, Brazil

[4] Department of Economics, Administration and Sociology, Luiz de Queiroz College of Agriculture (ESALQ), University of São Paulo (USP), Av. Pádua Dias, 11, Piracicaba, SP 13418-900, Brazil

[5] Leuphana Universität Lüneburg, Lüneburg, Germany