

## **Sustainable practices in the cocoa value chain: a systematic literature review**

**Prácticas sostenibles en la cadena de valor del cacao: una revisión sistemática de literatura**

**Práticas sustentáveis na cadeia de valor do cacau: uma revisão sistemática da literatura**

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## Abstract

**Introduction:** This article identifies sustainable practices in cocoa farming, in the new scenarios of voluntary certifications and the circular economy. **Objective:** The main objective is to analyse and synthesise the sustainable strategies and approaches implemented in the cocoa value chain. **Methodology:** The PRISMA protocol was applied, which was used to define the 45 documents from the Scopus and Web of Science databases that were part of the systematic literature review with a publication range between 2016 and 2024. **Results:** Agroforestry widely emerges as the main production strategy to minimise the overall environmental and socioeconomic impacts associated with cocoa production. Sustainable practices focus on production and governance aspects. **Conclusions:** In relation to sustainability standards, there is a transition from voluntary approaches to stricter regulations within the value chain that force cocoa producers to adopt sustainable investment decisions, which not only comply with environmental and labour standards, but also generate long-term benefits.

**Keywords:** agriculture; environment; agricultural production; agricultural product.

**JEL:** Q01; Q13; Q18; Q56; Q57.

## Resumen

**Introducción:** Este artículo identifica las prácticas sostenibles en el cultivo de cacao, en los nuevos escenarios de las certificaciones voluntarias y la economía circular. **Objetivo:** El objetivo principal es analizar y sintetizar las estrategias y enfoques sostenibles implementados en la cadena de valor del cacao. **Metodología:** Se aplicó la metodología PRISMA, que sirvió para definir los 45 documentos de la base de datos Scopus y Web of Science que hicieron parte de la revisión sistemática de literatura con un rango de publicación entre el 2016 y 2024. **Resultados:** La agroforestería de manera generalizada emerge como la principal estrategia productiva para minimizar los impactos ambientales y socioeconómicos globales asociados con la producción de cacao. Las prácticas sostenibles se concentran en aspectos productivos y de gobernanza. **Conclusiones:** En relación con los estándares de sostenibilidad, hay una transición de enfoques voluntarios a regulaciones más estrictas dentro de la cadena de valor que fuerzan a los productores de cacao a adoptar decisiones de inversión sostenibles, que no solo cumplan con los estándares ambientales y laborales, sino que también generen beneficios a largo plazo.

**Palabras clave:** agricultura; medio ambiente; producción agrícola; producto agrícola.

**JEL:** Q01; Q13; Q18; Q56; Q57.

### Resumo

**Introdução:** Este artigo identifica as práticas sustentáveis na cultura do cacau, nos novos cenários das certificações voluntárias e da economia circular. **Objetivo:** O principal objetivo é analisar e sintetizar as estratégias e abordagens sustentáveis implementadas na cadeia de valor do cacau. **Metodologia:** Foi aplicado o protocolo PRISMA, que foi utilizado para definir os 45 documentos das bases de dados Scopus e Web of Science que fizeram parte da revisão sistemática da literatura com intervalo de publicação entre 2016 e 2024. **Resultados:** A agrofloresta surge amplamente como a principal estratégia de produção para minimizar os impactos ambientais e socioeconômicos globais associados à produção de cacau. As práticas sustentáveis centram-se em aspetos de produção e governança. **Conclusões:** Em relação aos padrões de sustentabilidade, há uma transição de abordagens voluntárias para regulamentos mais rigorosos dentro da cadeia de valor que forçam os produtores de cacau a adotar decisões de investimento sustentáveis, que não só cumprem as normas ambientais e laborais, mas também geram benefícios a longo prazo.

**Palavras-chave:** agricultura; ambiente; produção agrícola; produto agrícola.

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### Introduction

The increasing global demand for cocoa and the pressure from civil society are pushing the industry to adopt sustainable practices, driven by regulations such as those from the European Union, which require traceability and zero deforestation in exports. In countries like Côte d'Ivoire, where 46% of deforestation is attributed to cocoa production, only 43.6% of the output meets these requirements (Renier et al., 2023). Additionally, compliance with fair labor standards is mandated to eradicate child and forced labor (O'Rourke, 2014), which has led to initiatives such as the “International Cocoa Initiative” and the “Cocoa and Forests Initiative”.

Among small producers, sustainable practices such as agroforestry and agroecological management are on the rise, promoting biodiversity and mitigating the impacts of intensive

monoculture, such as deforestation and environmental toxicity (Parra & Verburg, 2022). These practices enhance soil fertility and contribute to the reduction of greenhouse gas emissions (Foley et al., 2011; Vitousek et al., 2009).

Sustainable investments are essential for this transition, promoting responsible resource management and benefiting farmers and communities (Cocoa Barometer Consortium Fountain, 2020; Darnhofer et al., 2010). These investments respond both to market pressures and to the growing demand for sustainability, turning risks into opportunities to improve socioeconomic conditions (International Institute for Sustainable Development, 2019).

### **Methodology**

This article examines the types of sustainable practices in the cocoa value chain through a bibliometric and qualitative analysis of 436 and 400 scientific articles obtained from searches in the Scopus and Web of Science databases, respectively, using the Bibliometrix analysis package for R-Studio. To conduct the systematic literature review, this work followed the PRISMA methodology (Moher et al., 2009). PRISMA stands for Preferred Reporting Items for Systematic Reviews and Meta-Analyses; it is a methodology that mitigates arbitrariness in conducting the review, enabling a comprehensive and objective examination of the topic. It serves as a tool to enhance transparency, accuracy, thoroughness, and the frequency of documented protocols for systematic reviews and meta-analyses. This type of analysis allows for both qualitative and quantitative assessments of research on a specific topic (Baquero, 2022). The same methodology has recently been used in publications related to sustainability (Ferreira et al., 2018; Merli et al., 2018; Niñerola et al., 2020) and indicators (Hahn & Kühnen, 2018).

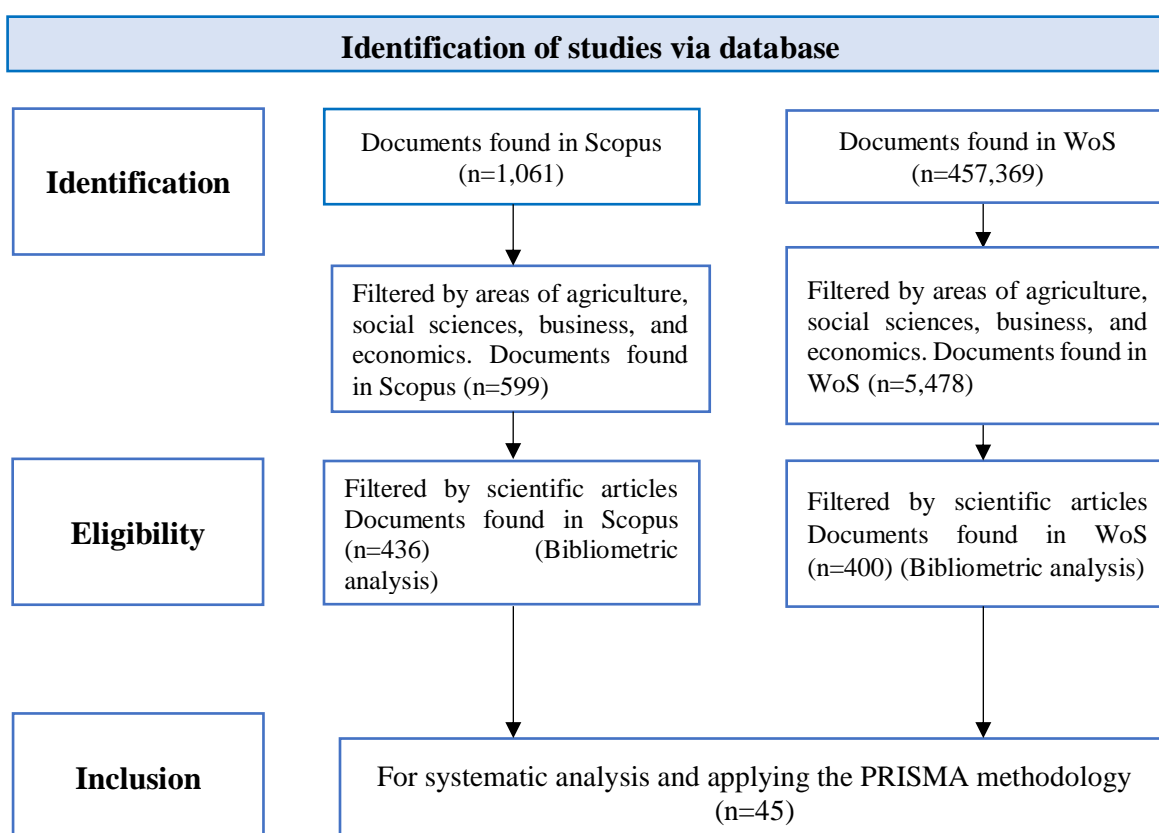
An initial search integrated four categories—sustainability, economic effects, social effects, and agriculture—to identify scientific output on this topic in other agricultural products. This first search yielded a total of 1,061 documents in the Scopus database and 457,369 documents in the Web of Science database. The search was then narrowed to the disciplinary areas of agriculture, social sciences, business and management, and economics, reducing the number of documents to 599 in Scopus and 5,478 in WoS. In the third step, the findings were limited to scientific articles, excluding other types of documents, further reducing the number to 525 and

599, respectively. The search was then refined to the areas of environmental sciences, agriculture, social sciences, economics, and management, yielding a total of 436 documents in Scopus and 400 in WoS, which were used for the bibliometric analysis. Finally, the search was focused on cocoa and duplicate documents were removed, resulting in a total of 45 articles for the systematic review. The publication range spans nine years, from 2016 to 2024.

The systematic literature review process, based on the PRISMA protocol, is presented in Figure 1.

**Figure 1**

*PRISMA Diagram*



*Source:* Prepared by the authors.

The PRISMA methodology provides a checklist for the documents to be reviewed, with an exclusion criterion for those that do not meet the requirements. In this particular study, the PRISMA methodology was used to determine the documents that formed part of the systematic review; to this end, the admissibility criterion was defined as documents explicitly mentioning in the title, abstract, or keywords one of the categories defined in the bibliometric review. These categories are sustainable production practices, sustainability standards, governance, sustainable finance, and other topics related to sustainability in cocoa production, as shown in Table 1.

**Table 1**

*Descriptive Information of Selected Articles*

Category	Number of Articles	Selected Articles
Sustainable production practices	326	24
Sustainability standards	54	8
Governance	135	7
Sustainable finance	88	6
Miscellaneous topics	92	0
<b>Total Selected Articles</b>		45

*Source:* Prepared by the authors.

The use of secondary sources entails several limitations in this study, considering the defined requirements. With the established criteria, articles that showed a clear sustainability focus were classified.

## Results

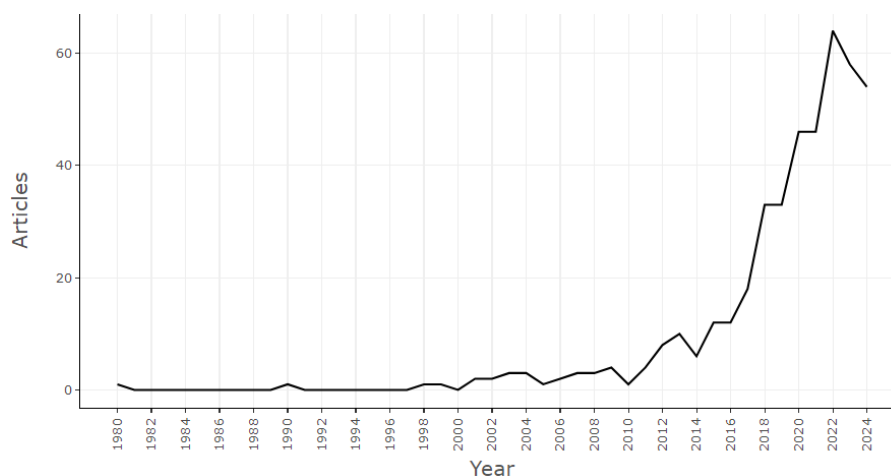
This section provides an overview of the main themes of various sustainable practices in the cocoa value chain. The analysis highlights the significant contributions of the reviewed articles, emphasizing emerging trends and key areas for future research and practices in the cocoa sector.

## Bibliometric Analysis

Scientific production related to sustainability has increased considerably in the last decade (Figure 2). From 1980 to 2024, annual production grew at an average annual rate of 9.5%, reaching 62 published articles in 2022, the year with the highest output.

**Figure 2**

*Annual Scientific Production*

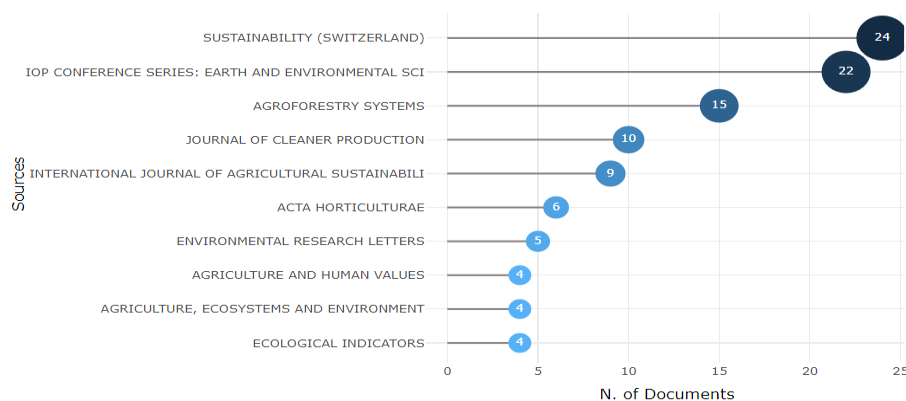


*Source:* Prepared by the authors using the Bibliometrix package.

On the other hand, a total of 254 sources (journals and books) were found to have published documents on this topic. Among them, the most relevant source, measured by the number of documents published in the analyzed period (24), is the journal *Sustainability* from Switzerland, with a Q2 ranking in environmental studies and Q1 in geography, planning, and development, as shown in Figure 3.

**Figure 3**

*Sources of Publication*

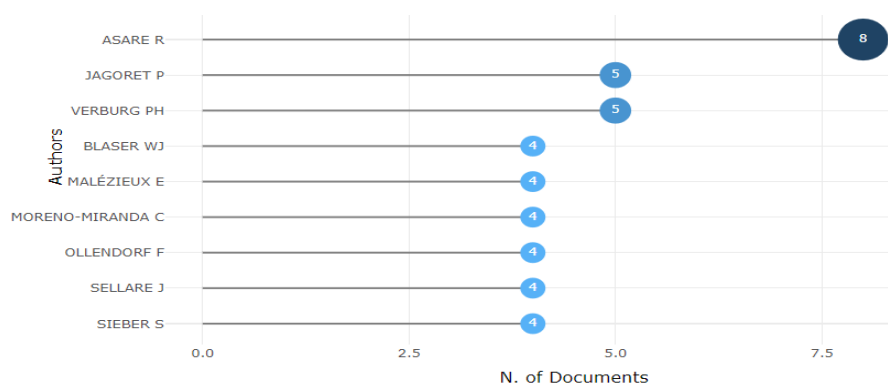


Source: Prepared by the authors using the Bibliometrix package.

Regarding the most prolific authors on this topic, a total of 1,570 researchers have contributed documents during the studied period (Figure 4). Among them, Professor Rebecca Asare, currently the Director of Programs and Research at the Nature Conservation Research Centre in Accra, Ghana, is considered one of the most important leaders in cocoa agroforestry and is the most prolific author. During the analyzed period, Professor Asare contributed a total of eight documents, published in the last five years.

**Figure 4**

*Most Prolific Authors in Scientific Production*



Source: Prepared by the authors using the Bibliometrix package.



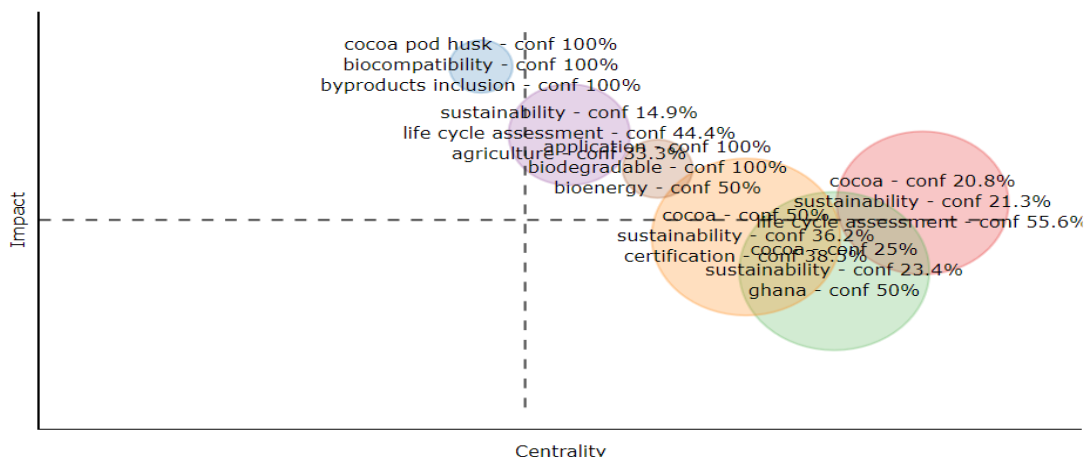
### Figure 5



The concept of sustainability appears recurrently in the documents found, suggesting that it is a well-established concept in the literature. Likewise, the grouping of terms such as "life cycle assessment" and "bioenergy" with sustainability may indicate a strong connection between these practices and sustainable cocoa production. The colors in the thematic map of the documents found, presented in Figure 6, suggest that there are at least three clusters in which the documents can be grouped. These results are expanded upon in the next section with the findings from the systematic analysis.

**Figure 6**

*Thematic Map of the Documents Found*



*Source:* Prepared by the authors using the Bibliometrix package.

## Systematic Analysis

### Practices Related to Agroforestry Systems

Agroforestry, adapted to various conditions, emerges as the main strategy to address environmental and socioeconomic challenges surrounding cocoa worldwide. However, practices are highly varied, and their implementation largely depends on the context in which they are developed. Furthermore, they not only provide a solution to deforestation but also offer numerous benefits across all dimensions of sustainability. The complexity of such systems presents greater challenges for research.

In Colombia, various studies showcase a wide range of practices and results. Abbott et al. (2023) emphasize the importance of support networks in the departments of Cesar and Caquetá as a differentiating element, comparing regions with land use problems and armed conflict, where differences in production with agroforestry systems and access to markets and services were observed. Rodríguez and Escobar (2022) demonstrated that agroforestry systems with *Gmelina arborea* increase cocoa production. Pérez et al. (2023) found that agroforestry systems diversify crops and improve food security compared to monocultures. Ruiz et al. (2023) evidenced that in Boyacá, these systems contribute to biodiversity, soil fertility, and quality of life. Diversification, in this context, emerges as a fundamental key for agroecological transformation.

In cocoa-producing countries, agroforestry systems have been valued for their ability to generate income. Mattalia et al. (2022) argue that these systems maintain yields comparable to those of monocultures but with additional benefits. Kouassi et al. (2023) observed in Côte d'Ivoire that cocoa cultivation, along with *Albizia zygia*, *Milicia excelsa*, and *Glyricidia* spp., improves both yields and soil fertility, while also providing natural pest control.

Coq Huelva et al. (2017) explore strong sustainability and coevolution in indigenous systems, highlighting the interaction between social and environmental factors. Traditional *chagra* systems are examples of agroforestry arrangements where agricultural production is adapted to family needs, demonstrating a biological and social coevolution that brings multiple conservation benefits while providing adequate yields. Meanwhile, Roziaty (2023) highlights the benefits of shade plants on productivity and carbon storage in West Sumatra, Indonesia. In all these cases, the positive impact of the economic factor has been confirmed.

Since cocoa has caused deforestation in Africa (Renier et al., 2023), Borda et al. (2021) highlight the benefits of redesigning the supply chain through agroforestry practices and traceability (Khoddamzadeh & Souza, 2023).

Treatments with timber and mixed trees in the Ecuadorian Amazon have had positive effects on biological soil health indicators, such as earthworm abundance and potential respiration, compared to cocoa monocultures. Through their functional traits, such as leaf nitrogen content, these treatments positively influence nutrient cycles, soil carbon storage, and soil macrofauna (Addo, 2024). Additionally, cocoa-based agroforestry systems have a high potential for carbon sequestration and offer additional economic benefits through the carbon market (Santhyami et al., 2023).

### **Agroecological Practices (Restoration, Regeneration, and Conservation)**

Sustainable practices in cocoa promote ecosystem resilience. Fisher et al. (2022) demonstrated that in Côte d'Ivoire, adapted cleaning practices regenerate vegetation while preserving diversity. The combination of traditional and modern techniques in agroforestry systems improves the adaptation of plantations to climate, highlighting the importance of diversification and conservation of native species (Jagoret et al., 2020). In the Ecuadorian Chocó,

reforestation and conservation can coexist with cocoa, enhancing ecological sustainability and local economies through forest products and ecotourism (World Centric, 2021).

Adeyemi et al. (2017) analyzed how cocoa rehabilitation through topping and grafting in Nigeria can make it more productive and sustainable, despite the ongoing challenges of funding shortages and low technological adoption. Caicedo et al. (2023) in Ecuador emphasized that diversified agroforestry systems with low input use and agroecological management generate better environmental outcomes and similar incomes compared to conventional systems. In Ghana, Obeng et al. (2022) observed that pruning reduces cocoa diseases, but the lack of training limits its adoption. In Côte d'Ivoire, where cocoa is responsible for 38% of deforestation, the 2022 Forestry Law and the African Regional Standard (ARS) 1,000 seek solutions, though their implementation depends on environmentally friendly technologies (Kouassi et al., 2023; Sianipar, 2022). Pokharel et al. (2023) emphasize that agroforestry and biodiversity can be integrated into the cocoa value chain, improving environmental and economic sustainability.

### **Sustainability Standards (Certifications)**

Regulations like the European Deforestation Regulation (EUDR), which will begin in 2025, and the European Union's due diligence, driven by civil society initiatives such as the Cocoa & Forest Initiative (Renier, 2023), have intensified the need for sustainable practices in cocoa production to comply with Voluntary Sustainability Standards (VSS). These standards set criteria for the production and marketing of agricultural products, promoting environmental, social, and economic sustainability (DeFries et al., 2017).

Cocoa buyers have made sustainability commitments that require producers to meet certified standards, offering premiums and better market access (Vogel et al., 2020). Standards such as Good Agricultural Practices (GAP), UTZ, Rainforest Alliance, and Fairtrade require investments in sustainability, labor improvements, traceability, and audits. Fairtrade guarantees a minimum price and a community premium, while UTZ and Rainforest Alliance focus on traceability and environmental sustainability (Hernanz et al., 2023). However, certification can increase costs for small farmers, especially if done individually (Camargo & Nhantumbo, 2016), and is influenced by value chain factors (Tennhardt et al., 2022).

In Ecuador and Uganda, 394 producers who adopted Good Agricultural Practices, such as agroforestry and the use of organic fertilizers, improved environmental, social, and economic sustainability. Traceability is key to achieving sustainable initiatives, but its implementation in the cocoa supply chains of Côte d'Ivoire and Ghana has been complex. The integration of sustainability at the farm and regional levels, along with stakeholder collaboration, is essential to achieve sustainable outcomes (Obeng, 2022).

### **Circular Value Chains (Life Cycle)**

Sustainable practices also include the circular economy, which aims to reuse by-products and reduce waste. There is little literature on the comprehensive use of waste from cocoa production within a circular economy approach. However, recent studies highlight the potential of cocoa nib shell (CNS) waste in sustainable practices. Izzah et al. (2023) identified bioactive compounds in CNS that can be used as organic fertilizers, biochar, and bio-adsorbents, improving soil health and efficiently managing industrial waste. Similarly, Girón et al. (2024) explored the extraction of pectin from cocoa shells for tissue engineering applications, demonstrating high cell viability and properties, suggesting its potential use as a sustainable bioink. On the other hand, Aschemann & Peschel (2019) investigated consumer acceptance of food products based on by-products of the food chain, finding that effective communication about sustainability benefits improves consumer perception.

These studies highlight that cocoa waste has great potential within the circular economy, serving as fertilizers and in innovative applications.

### **Finance for Sustainability**

Financial mechanisms are key to fostering sustainable practices in cocoa production, as they have the potential to either promote or limit them. Alforte et al. (2013) explore how small farmers and forest producers in the Philippines, Vietnam, Kenya, and Brazil contribute to food security and emission reductions through innovative financing approaches, such as the Landscape Fund. This fund includes microcredits and revolving funds managed by local banks and NGOs, helping to mitigate risks and promote agricultural sustainability. Similarly, Charnley (2023) emphasizes that investments in livelihoods, such as savings and loan associations and seedling

nurseries, have been fundamental to community forestry and forest management, providing rural communities with the resources needed to sustain long-term sustainable practices.

Braga et al. (2023) investigate the relationship between sustainable rural development and agricultural practices in the Brazilian Amazon. In 95 households, they observed that combined cocoa and livestock strategies can generate an acceptable standard of living in areas on the edge of agricultural frontier expansion. Public and private investments in social infrastructure and sustainable production systems are essential for development in the Amazon.

Arbaaz et al. (2021), in “Mind the Gap,” address how to overcome information asymmetries between investors and projects to catalyze complementary private investments in forest conservation. Using a literature review and interviews with 50 experts, Seeberg et al. (2009) suggest that carbon credits and payments for ecosystem services, managed by institutions like the World Bank's Carbon Fund, provide additional income and encourage the adoption of sustainable practices.

In Colombia, Villarino et al. (2023) surveyed 930 producers and found that more than 60% of them are willing to conserve the environment, though they expect to achieve profitability in return. They analyze the incentives available and appropriate for different types of producers to promote deforestation-free cocoa production. These include credit incentives, conservation agreements, and payments for environmental services.

Viteri et al. (2023), in the Ecuadorian Amazon, highlight that diversification and product improvement initiatives show potential if investors are connected with sustainable projects, and access to credit and organizational capacities is expanded. These experiences underscore that financial mechanisms, such as microcredits and carbon credits, along with institutional support, have the potential to promote sustainable practices and open new opportunities in international markets. Instituto Interamericano de Cooperación para la Agricultura (2023), in its annual report, addresses global financing for climate change mitigation, exploring how investments in sustainable practices can be profitable and environmentally beneficial. Through data analysis and case studies in various countries, it highlights financing models such as mitigation funds, carbon credits, and blended finance, which integrate public and private resources. These models involve financial institutions such as the World Bank, the Green Climate Fund, and commercial banks.

## **Governance Models and Value Chain**

Governance is fundamental for sustainability in the cocoa sector, and there is currently strong pressure to drive changes in value chains. In Ghana, initiatives such as voluntary sustainability standards (VSS), child labor monitoring and remediation systems (CLMRS), and the Living Income Differential (LID) aim to improve farmers' conditions. However, poverty persists, requiring more coordinated and transparent approaches (Grohs et al., 2023). In the Ecuadorian Amazon, Kichwa producers face capital and market access limitations despite implementing sustainable agroforestry practices (Viteri et al., 2023). This raises questions about whether incorporating sustainability into the value chain truly benefits all nodes, suggesting that other factors need to be considered in this process.

In Colombia, government policies and emerging technologies have not fully addressed the needs of small farmers, emphasizing the need for an inclusive perspective (Talero et al., 2024). Certification processes have contributed to increasing incomes and conserving local cocoa varieties (Rueda et al., 2023). Similarly, in Peru and Switzerland, inclusive business strategies and solidarity economies have proven more effective than traditional certification schemes (Oberlack et al., 2023). Collective action emerges as a key element for sustainability; participation in cooperatives allows farmers to access high-value chains and reap economic and environmental benefits, such as higher incomes and biodiversity conservation. This underscores the fundamental role of community organizations in promoting sustainability (Rueda et al., 2023).

There is a growing trend towards a more equitable distribution of risks along the value chain, accompanied by a greater allocation of resources to sustainable practices. Corporate sustainability reporting is driving this type of new governance; however, uncertainty persists as to whether these requirements will actually benefit or harm smallholder farmers. In addition, efforts to act collaboratively in the chain, along with buyer leadership, emerge as key factors that can incentivize the adoption of sustainable practices.

The decision-making structure is crucial in promoting or hindering investments and sustainable practices; however, the lack of inclusion in government policies in Colombia, for example, fails to fully address the demands of small farmers by not participatively identifying essential aspects of production (Talero et al., 2024).

In this context, the study by Quiroga et al. (2024) examines the impact of post-conflict policies on the socio-ecological restoration of Afro-Colombian communities in southern Colombia. Using a survey of 245 small cocoa producers in Tumaco, the study identifies motivations for deforestation and the transition from illicit crops to cocoa. The results highlight that local economic development and land decentralization are essential for replacing illicit crops and supporting forest conservation and restoration, aligning with socio-ecological restoration objectives.

Governance in the cocoa sector must integrate inclusive public policies, sustainable practices, and support for farmers' livelihoods to ensure a sustainable and equitable future. Collective action, land-use planning, and continuous sustainability assessment are essential to overcoming current limitations and fostering sustainable growth while seeking to balance the distribution of responsibilities within the value chain.

### **Conclusions**

Based on the findings related to agroforestry systems in the cocoa value chain, it can be concluded that agroforestry generally emerges as the main productive strategy to minimize the global environmental and socioeconomic impacts associated with cocoa production. The diversity of agroforestry practices observed worldwide demonstrates their adaptability and effectiveness in different contexts, offering solutions not only to combat deforestation but also to improve biodiversity, soil fertility, and local livelihoods. However, the inherent complexity of these systems presents research challenges, requiring multidisciplinary teams, participatory methodologies, and an emphasis on the context of ecosystems, businesses, and technology adaptation, increasingly relevant to climate change effects and biodiversity conservation.

Regarding sustainability certifications in the cocoa value chain, which impose costs and operational efforts, such market-driven practices arise from the need for greater transparency and traceability in supply chains. At times, they become opportunities to enhance value, while paradoxically acting as mechanisms of exclusion. There is uncertainty about the transition from voluntary to mandatory mechanisms and how certifications support new legal regulations. There is also a new configuration of standards and the certification business.



What practices are behind these changes? The retroactive nature of some standards, the distribution of risk in the chain, and the role of premiums in the face of rising cocoa prices. The future of these certifications will depend on the ability to mitigate these challenges through technological innovations, inclusive policies, and greater collaboration among all stakeholders, thus ensuring a positive and continuous impact on the economic, social, and environmental sustainability of cocoa worldwide.

As for circular value chains, improving the life cycle in the chain is another sustainability trend. The use of waste and the search for by-products in cocoa production, such as in the production of organic fertilizers and biomaterials, highlight the potential to optimize resource efficiency in the cocoa industry.

On the other hand, financing, which had been seen as restrictive and a collateral factor for not adopting sustainable practices, now begins to take on a new face through emerging financial mechanisms, such as landscape funds and green credits. These mechanisms show the potential to influence and promote sustainable agricultural practices. Producers, by nature, are often willing to conserve and adopt good practices. Having mechanisms that translate this willingness into tangible benefits could support this intention. However, product distribution and access are determining factors to ensure the equitable inclusion of small farmers in these schemes.

Concerning governance and the cocoa value chain, it is clear that collective action and integrated planning across all nodes of the chain are essential for advancing toward more sustainable practices. However, it is crucial to address the structural and financial limitations faced by small producers, such as limited access to markets and financing. Developing inclusive business models and promoting appropriate technologies are essential to ensure that sustainability initiatives not only benefit the major players in the chain but also improve the livelihoods and resilience of rural communities. A multidisciplinary and collaborative approach is necessary to achieve sustainable development in cocoa production, ensuring that all actors, from producers to consumers, share the benefits of more responsible and equitable agricultural practices.

Sustainable practices in the cocoa value chain in Colombia are emerging as a fundamental pillar in addressing current environmental and socioeconomic challenges. Research reveals that agroforestry and crop diversification not only contribute to biodiversity conservation and soil

health but also enhance productivity and market access for small producers. The Colombian context, marked by the need to include farmers in decision-making and the implementation of inclusive policies, highlights the importance of collective action and support networks in promoting these practices. Thus, advancing toward a sustainable cocoa production model not only benefits the environment but also offers significant economic opportunities for rural communities, creating a balance between profitability and sustainability.

### **Future Research Lines**

The obtained results suggest the need to expand the number of studies that delve deeper into the relationship between investments in sustainable practices and the determinants of social, economic, and environmental returns in cocoa cultivation. This will allow for identifying the most advantageous practices and contributing to investment decisions both in the private sector and public policy. This is particularly important as, in the bibliometric review, no significant results have emerged linking finance and sustainable investments in cocoa.

There is also an opportunity for studies that observe how the decision-making processes of different actors in the value chain develop when investing in sustainable practices. This would include the evaluation of factors that influence the adoption of these practices and their long-term impact, a topic that has not been strongly explored in the literature to date.

While certifications stand out as a key category, it is essential to expand research that evaluates the impacts of certifications (such as Fairtrade, IFOAM, Rainforest Alliance, and UTZ Certified) on the economic, social, and environmental returns of cocoa producers. This is crucial for understanding the effectiveness of these market tools in promoting sustainability.

### **Ethical Considerations**

This study did not require approval from an Ethics or Bioethics Committee as no living resources, biological agents, biological samples, or personal data posing a risk to life, the environment, or human rights were used.

### **Conflict of Interest**

The authors declare that there is no conflict of interest related to this article.

### **Author Contribution Statement**

Mónica María Olarte Libreros: Conceptualization, Methodology, Software, Validation, Formal Analysis, Investigation, Resources, Writing – Original Draft, Visualization, Project Administration, Funding Acquisition.

Carlos Mario Muñoz Maya: Data Curation, Writing – Review and Editing, Supervision.

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