## UNIVERSIDADE ESTADUAL DO OESTE DO PARANÁ PROGRAMA DE PÓS-GRADUAÇÃO EM ADMINISTRAÇÃO MESTRADO PROFISSIONAL

# WESTERN PARANÁ STATE UNIVERSITY PROFESSIONAL MASTER'S IN ADMINISTRATION

Integrando a sustentabilidade à cadeia de suprimento da madeira: uma análise das práticas de sustentabilidade dos membros da cadeia de madeira localizadas no Oeste do Paraná

Integrating sustainability into the wood supply chain: an analysis of sustainability practices of wood chain members located in West Paraná

[TRADUÇÃO INGLESA]

VICTOR YURI POSSAMAI

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#### VICTOR YURI POSSAMAI

# Integrando a sustentabilidade à cadeia de suprimento da madeira: uma análise das práticas de sustentabilidade dos membros da cadeia de madeira localizadas no Oeste do Paraná

Dissertação apresentada ao Programa de Pós-Graduação em Administração em cumprimento parcial aos requisitos para obtenção do título de Mestre em Administração, área de concentração Competitividade e Sustentabilidade, linha de pesquisa Sustentabilidade, APROVADO(A) pela seguinte banca examinadora:



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#### **RESUMO**

Possamai, Victor Y. (2023). Integrando a sustentabilidade à cadeia de suprimento da madeira: uma análise das práticas de sustentabilidade dos membros da cadeia de madeira localizadas no Oeste do Paraná (Dissertação). Programa de Pós-Graduação em Administração (PPGAdm), Universidade Estadual do Oeste do Paraná – UNIOESTE, Cascavel, PR, Brasil.

Diante de evidências envolvendo a constante busca pela eficiência nas diversas cadeias de suprimentos, a temática sustentabilidade caracteriza-se como elemento fundamental no modelo produtivo do novo século. Por meio desta temática, destaca-se que o setor madeireiro possui grande representatividade para a economia global, diante da versatilidade e diversidade de opções para uso desse recurso; mesmo assim, nota-se uma constante intensidade em movimentos liderados por governos, indústrias e a sociedade em geral no que se refere à necessidade global de aderir às práticas de preservação ambiental a fim de garantir a permanência e sobrevivência dos recursos naturais. O estudo busca analisar quais práticas de sustentabilidade vêm sendo adotadas pelos integrantes da cadeia de suprimentos de madeira do Oeste do Paraná, de modo que seja possível realizar uma exploração econômica justa por meio do uso consciente desse recurso natural, o qual, apesar de se demonstrar abundante em volume, sabe-se que se trata de um recurso finito e de grande importância para a humanidade. Nesse sentido, o estudo consiste em uma pesquisa qualitativa voltada aos representantes de empresas atuantes na cadeia de suprimentos de madeireira, localizadas no Oeste do Paraná, em que se procurou identificar as práticas de sustentabilidade que já vêm sendo adotadas por esse setor. O processo metodológico utilizado neste estudo se caracteriza por um estudo de caso, o qual buscou investigar quais práticas vêm sendo empregadas por esse setor para, assim, garantir a sustentabilidade. Além disso, o estudo utilizou entrevistas e questionários semiestruturados para validação dos resultados com base no que foi encontrado na literatura. Por meio dos resultados, permitiu-se identificar as práticas que já vêm sendo adotadas pelos membros da cadeia de suprimentos com destaque a uma produção pautada na eficiência de processos frente a uma atividade econômica sustentável. Ademais, foram verificados os principais desafios existentes no setor, bem como puderam apresentar os principais desafios que estão envolvidos na atividade madeireira caracterizada na região Oeste do Paraná.

Palavras-chave: Gestão de cadeia de suprimentos; Sustentabilidade; Setor madeireiro;

#### ABSTRACT

Possamai, Victor Y. (2023). Integrating sustainability into the wood supply chain: an analysis of sustainability practices of wood chain members located in West Paraná (Dissertation). Post-Graduate Program in Management (PPGAdm), State University of Western Paraná – UNIOESTE, Cascavel, PR, Brazil.

Given the evidence involving the constant search for efficiency in the various supply chains, sustainability is a fundamental element in the production model of the new century. Through this theme, it should be noted that the timber sector is highly representative of the global economy, given the versatility and diversity of options for using this resource; even so, there is a constant intensity in movements led by governments, industries, and society in general concerning the global need to adhere to environmental preservation practices to guarantee the permanence and survival of natural resources. The study analyzes which sustainability practices have been adopted by members of the wood supply chain in western Paraná so that it is possible to achieve fair economic exploitation through the conscious use of this natural resource, which, despite being abundant in volume, is known to be a finite resource of great importance to humanity. In this context, the study consists of a qualitative survey of representatives of companies operating in the timber supply chain located in the west of Paraná, which sought to identify the sustainability practices that this sector has already adopted. The methodological process used in this study is characterized by a case study that sought to investigate which practices have been employed by this sector to guarantee sustainability. In addition, the study used semi-structured interviews and questionnaires to validate the results based on what was found in the literature. The results made it possible to identify the practices already adopted by supply chain members, emphasizing production based on process efficiency in the face of sustainable economic activity. In addition, the main existing challenges in the sector were verified, as well as being able to present the main challenges involved in the timber activity characterized in the western region of Paraná.

Keywords: Supply chain management; Sustainability; Timber sector;

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#### LIST OF ABBREVIATIONS AND ACRONYMS

- CSCMP Council of Supply Chain Management Professional
- CSR Corporate Social Responsibility
- DERAL Departamento de Economia Rural (Department of Rural Economy)
- **EMP** Environmental Management Practices
- FNDF Fundo Nacional de Desenvolvimento Florestal (National Forestry Development Fund)
- FSC Forest Stewardship Council
- GCS Global Supply Chain
- GDP Gross Domestic Product
- GG Greenhouse Gases
- GPS Global Positioning System
- GSCM Green Supply Chain Management
- IAP Instituto Ambiental do Paraná (Environmental Institute of Paraná)
- ISO International Organization for Standardization
- JIT Just in Time
- MIT Massachusetts Institute of Technology
- NGOs Non-governmental Organizations
- SC Supply chain
- SCM Supply Chain Management
- SD Sustainable Development

SEAB - Secretaria de Agricultura e Abastecimento do Paraná (Paraná Secretariat of Agriculture and Supply)

- SFB Serviço Florestal Brasileiro (Brazilian Forest Service)
- SFMP Sustainable Forest Management Plan
- SISNAMA Sistema Nacional de Meio Ambiente (National Environment System)
- SSCM Sustainable Supply Chain Management
- TBL Triple Bottom Line
- TQM Total Quality Management
- UN United Nations
- UNESCO United Nations Educational, Scientific, and Cultural Organization
- WPC Wood-Polymer Composite

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#### **1 INTRODUCTION**

The study of the timber supply chain is a topic that has been the subject of much discussion, given the environmental damage caused by the inadequate sourcing of this natural resource. Amid this scenario, governments and companies have come together to propose initiatives aimed at adapting timber harvesting policies, mainly by looking at the processes, dimensions, and actions generated by this activity.

This study is based on the literature on sustainable development and supply chain management, recognizing that a sustainable supply chain model is based on the principle that actions must start from a concern to meet the needs of the present without compromising the ability of future generations to meet their needs (WCED, 1987).

Through this approach, Gladwin *et al.* (1995) stated that the concept of sustainability would become a burning issue for most corporate organizations, given the growing environmental degradation and violation of human rights, which have since demanded new strategies for adapting the conventional model of exploitation to a model of supply chain management on a sustainable basis.

In the midst of this, Lelé (1991) also describes that, in recent decades, the term sustainable development (SD) has emerged as the latest development slogan involving a wide range of non-governmental and governmental organizations, which have adopted such possibilities as the new development paradigm; such a movement has had to act in the face of the weaknesses found in its various production processes that can cause inadequacies and contradictions in the elaboration of policies demonstrated mainly in the context of international trade, agriculture and forestry.

Over the years, the term sustainability has evolved in the organizational context, transforming itself into practical actions based on fundamental principles called the triple bottom line (TBL), introduced by Elkington (2004). Years later, this concept came to be discussed within the context of supply chains considering the logic of the TBL.

Given that, Seuring and Müller (2008) point out that sustainable supply chain management should be seen as " the management of material, information, and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements."

It should be noted that adopting a management model focused on sustainability offers the organization operational benefits, including a competitive advantage due to the organization's internal capacity to adapt to new rules, since, consequently, in the long term, corporate profits will be linked to the permanence of organizations which have adjusted to new market processes by adapting and restructuring the processes employed in the industries (Junqueira *et al.*, 2008).

Considering this, both the concepts of TBL and the sectoral vision of the model served as triggers for the development of the supply chain management structure, as indicated by the research carried out subsequently by various authors such as (Carter & Rogers, 2008; Carter & Easton, 2011; Winter & Knemeyer, 2013). For Beske and Seuring (2014), one of the main challenges for adapting supply chains stems from changing old ways of doing business or differing from the usual way of doing business since the transition process of any economic model lies in finding and selecting the right partners for the sustainable supply chain.

In the context of timber supply chains, it is worth noting that changes have already been made to current processes to improve management practices, be they in terms of management, exploitation, or even enforcement. These changes aim to ensure that the exploitation of timber resources is linked to the principles of sustainability, based on fair and balanced growth in line with the elements that make up this tripod, which, in turn, are characterized by actions aimed at the economic, social and environmental spheres.

Given the above, the adoption of sustainable practices for the wood supply chain is shown to be a fundamental element for safeguarding this activity, carrying out practices through actions that enable the generation of employment and the social development of the region, as well as the maintenance and preservation of green areas; this can guarantee an economic system that values the protection of all the links in its chain.

Based on this, Ferreira & Jabbour (2019) point out that, although the maturity levels of corporate environmental management and the adoption of sustainability practices are consolidating, there is still a long way to go to make such practices effective, since it serves to ensure green supply chain management in terms of guaranteeing commercial activity through the capture of natural resources. On this basis, it is essential to develop management practices aimed at minimizing the damage caused by the production process downstream, namely the adoption of more efficient technologies used in the production process, as well as a reduction in the levels of pesticides and agrotoxins.

In addition, Silva, Pigatto & Satolo (2023) add that the extraction of raw materials from Brazilian forests contributes to supplying various markets and boosts a significant part of the economy. The authors describe that the amount of waste generated by this activity is considerably substantial, thus highlighting the importance of adapting production processes to offer fewer environmental risks. The study observed the business processes that are susceptible to the application of sustainable practices to the management of the timber supply chain, such as eco-innovation, in which, through practices aimed at various fronts, it is possible to guarantee the achievement of environmental benefits, contributing to a better understanding of the applicability of eco-innovation in the timber industry.

#### 1.1 RESEARCH PROBLEM

The use of the sustainability theme in supply chains is a subject that has been gaining relevance, whether due to changes in user consumption patterns, pressure generated by environmental movements aimed at green consumption, or even because companies need to change their production processes to minimize environmental impacts, which are becoming increasingly evident today.

In this context, Lelé (1991) mentions that, given the recent literature that has emerged around the concept of Sustainable Development, the subject indicates a lack of consistency in its interpretation since there are convergences regarding the concepts of sustainability and sustainable development, which include an incomplete perception of the problems of poverty and environmental degradation, as well as confusion about the role of economic growth and the concepts of sustainability and participation.

Given this context, according to Lima (2021), even in the 1970s, according to a study by Guimarães (1974), there was already a need for more research and development of technologies for the timber sector. In addition, creating a system to better regulate the industry in Brazil and Paraná was a requirement to make progress in expanding foreign trade, whose exports in 1972 totaled 476,000/m3, or 80% of Brazilian exports in the period.

In response to this mobilization, plans were launched in the 1970s to develop the region's economic and ecological forestry zoning. In 1971, priority areas were defined for reforestation with exotic species such as Pinus and Eucalyptus, with a view to soil conservation, water management, and the future needs of wood industrialization.

Despite production zoning, in the late 1970s and early 1980s, the need for new tax incentive policies, the expansion of the area used to meet industrial demand to 60,000 hectares at the time, and the definition of long-term credits were necessary to maintain the supply of raw

materials and the state's potential in terms of reforestation, as well as the expansion of the industrial timber sector (Almeida & Macdonell, 1976; Lourenço, 1979).

In addition, Lima (2021) points out that in the 1970s and 1980s, the West, Southwest, and South Central regions of Paraná were the leading suppliers of raw materials for manufacturing plywood and other wood derivatives. At that time, the native supply of raw materials was already being envisioned for a 20-year horizon, i.e., until the beginning of the 21st century (Berger & Almeida, 1972).

Amid this reality, Calado (2010) points out that society has faced significant changes in recent decades concerning environmental issues and the choice of products that cause little or no environmental damage. Given this, the study analyzing sustainability practices for the supply chain aims to propose more appropriate ways of consciously exploiting natural resources in a balanced way.

Some studies on this subject have presented approaches that contextualize the reality of the timber sector. McKinnon (2010) aligns himself with this view, stating that implementing sustainable solutions in logistics processes will not only help the environment and improve the organization's image but can also bring financial benefits to companies. Following this line of thought, Wu and Pagell (2011), using a case study approach, demonstrated how organizations try to balance the achievement of profitability, environmental, and social goals under conditions of uncertainty.

For their part, García-Arca *et al.* (2014) recognize that the globalization of activities and the increase in raw material prices require the absolute implementation of sustainable solutions in supply chains. It can be assumed that the search for sustainable supply chain management stems from the needs of the modern world; moreover, efficiency and care for natural resources contribute not only to improving image but also to reducing waste, innovation, generating profits, and building an advantageous competitive market (Zimon, Tyan & Sroufe, 2020).

Based on a survey of the primary studies and publications on the subject on journal platforms and portals, it was identified that the topic has been proving to be relevant in achieving sustainability goals, whether through policies or even the urban and economic development of the western region of Paraná. A search was carried out in the databases using the terms "Supply chain management," "Sustainability," and "Timber sector" in Portuguese and English; hence, a more significant number of studies related to sustainable supply chain management were identified. However, there are not many studies focused on the timber sector.

In addition, according to studies by Souza and Pires (2008), Back, Schrippe, Pazuch, Weise and Kovaleski (2015), Aguiar, Shikida and Lobo (2018), Lima (2021), there is no evidence to describe how the timber supply chain has behaved over the last few decades, so it is not possible to identify the practices adopted by this sector, as well as the reflexes generated by this activity in the face of the intense growth of agribusiness actions in the region.

#### 1.1.1 Research Question

Given the context above, this study is guided by the following question: What sustainability practices are present in the timber supply chain in western Paraná?

## 1.2 OBJECTIVES

#### 1.2.1 General

The general objective of this study is to survey the sustainability practices of the timber supply chain in western Paraná.

#### 1.2.2 Specifics

- A. To map the timber supply chain in western Paraná;
- B. To identify the elements linked to the sustainable timber chain from the literature;
- C. To analyze the sustainability practices of the sustainable timber supply chain in Western Paraná;
- D. To understand how sustainability practices occur in the timber supply chain in Western Paraná;
- E. To highlight future scenarios for the timber supply chain in Western Paraná.

## 1.3 JUSTIFICATION AND CONTRIBUTION OF THE TECHNICAL PRODUCTION

This research focuses on the management practices of the timber supply chain in the western region of Paraná, from the perspective of the dimensions of sustainability, seeking to

understand the premises that make up this activity, as well as its causes and effects. As far as the theoretical aspect is concerned, this research is justified by the desire to carry out an indepth analysis of supply chain phenomena and the possibility of developing an analysis of practices aimed at contributing to the reality of this sector.

As for the professional relevance (Mascarenhas, Zambaldi & Moraes, 2011), the authors explain that scientific production, aligned with the objectives aimed at professional training, makes it possible to foster and complement training programs to offer elements and tools for debates; this results in arguments that support the understanding of phenomena in the context in which they are inserted. As for the personal relevance, this is due to the absorption of knowledge through the preparation of this study, as well as allowing the construction of a work that could become a new theoretical reference, thus contributing to the evolution of academic and professional science.

In addition, the relevance of studying the subject is reinforced by the importance of this sector for the region's economy and the particular sensitivity of this activity due to the environmental impacts generated by this structure. This is because, faced with the challenge of maintaining efficiency in an economic sector in the new century, the measures adopted in the present must be effective to guarantee the continued permanence of its activity.

Based on previous works on the subject, it can be seen that Pinto's (2006) study focuses on the recovery of forest areas devastated by activities such as illegal mining and illegal logging; this provides the study with the main environmental impacts generated by the irregular management of this industry, which has been causing severe damage.

The study by Seabra (2008) shows how sustainable practices take place in the timber market with a focus on exports, a market which, even in the face of remarkable growth, has been the target of various criticisms, especially about environmental issues; however, the study highlights that sustainable actions have been adopted in this chain to guarantee a sustainable economy and ecological balance.

In the study by Silvestre (2015), the author explains that supply chains in developing and emerging economies face more barriers to sustainability than those operating in developed countries; however, research focusing on developing countries is still limited, as sustainable supply chain management practices in these countries are relatively underdeveloped, as pointed out in the studies by (Kim, 2009; Silvestre, 2015; Esfahbodi *et al.*, 2016; Galal & Moneim, 2016).

Concerning the justification for choosing the object of research, it should be noted that the state of Paraná has a historic national representation due to the region's agribusiness activities, being responsible for the production of various commodities, standing out annually in terms of volumes produced and marketed.

In addition, the timber sector is also responsible for ensuring the efficiency of other sectors that indirectly demand this resource, either for direct use or for the production of energy through heat; based on this, the timber sector is characterized as an essential element in ensuring the productive efficiency of commodities in the state of Paraná.

This highlights the fact that the state of Paraná presents a scenario with growth potential for the timber sector, given that a study carried out by the *Departamento de Estatísticas de Comércio Exterior do Agronegócio Brasileiro* (Department of Foreign Trade Statistics of Brazilian Agribusiness) of the Ministry of Agriculture and Livestock points out that, in 2016, the state had the most significant volume of Pinus reforested area in Brazil. In addition, forestry products have been gaining ground compared to other inputs produced, and in 2018, they ranked third among the most traded inputs in the state, behind only the soy and meat complexes.

## 1.4 DISSERTATION STRUCTURE

This work is structured into chapters, and the content covered in each is shown in Table 1 below:

Chapter	Description	
Chapter 1	Introduction, contextualization of the problem, presentation of the research question, the general and specific objectives, delimitation of the study, as well as the justification and contribution of this study, thus exposing the structure of the dissertation;	
Chapter 2	The chapter is subdivided into the following themes: Sustainability, Supply Chain Management, Sustainable Supply Chain Management, Timber Supply Chain, Legislation and Certification for the Timber Industry, Sustainability in the Timber Chain;	
Chapter 3	Research methods and procedures, divided into: Research design and characterization, Data collection, Data analysis;	
Chapter 4	Research results are divided into Characterization of the links in the chain, Presentation of the research results, Description and analysis of the semi-structured interview, Description and analysis of the structured interview, Analysis of the results, Scenarios for the supply chain;	
Chapter 5	Final considerations;	
Appendix	Interview script for the timber supply chain; Questionnaire for supply chain actors; List of companies.	

Table 1: Dissertation S	tructure
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Source: Elaborated by the author (2023).

#### 2 THEORETICAL BACKGROUND

This chapter aims to present the theoretical framework for this research, based on bibliographic elements to build a conceptual foundation that will supplement the development of a study based on sustainability practices applicable to the Wood Supply Chain in Western Paraná. Thus, through a preliminary search of the state of the art, it is possible to expose the elements that highlight the theory used in this research, contributing to scientific and literal development.

It should be noted that, in the literature on supply chain management, the inclusion of sustainability is often based on the "triple bottom line" (TBL) approach, which requires equal consideration of all three pillars of sustainability, namely the economic, ecological and social spheres (Elkington, 1998).

Barton (2000) Giddings *et al.* (2002) contribute by pointing out that, through preliminary studies, it is possible to point out that researchers in the field of sustainable development have presented the three dimensions of sustainability as being figuratively composed of three interconnected rings, also known as the shared three-ring sectoral vision of sustainable development.

In a later study, Elkington (2004) reinforces that the focus of this model is on the intersection of the three elements that make up the TBL, so this model has become a reference point for research in the field of sustainability since the concept attempts to treat all three dimensions of sustainability with equal importance.

In this context, Seuring and Müller (2008) define the management of sustainable supply chains as the management of flows of materials, information, and capital, as well as cooperation between companies along the supply chain, taking into account the goals of all three dimensions of sustainable development, i.e., economic, environmental and social, derived from the requirements of the customer and other stakeholders.

Because of this, it should be noted that the first practice introduced at this point is a dedication to TBL, in which Pagell and Wu (2009, p. 39) state that "[...] to create sustainable chain managers need to integrate sustainability goals, practices, and cognitions into day-to-day supply chain management", so before moving on to the structure itself, it is necessary to clarify the terms "category" and "practice." The Oxford Dictionary (2013) defines a practice as "the usual or expected procedure, the way of doing something," so it is expected that actions adopted

in the sustainable supply chain are carried out genuinely, i.e., without the principle of action being exercised only by the ritual of fulfilling a specific requirement.

In addition, with the proliferation of studies on sustainability practices to be adopted in organizations and their supply chains, very diverse proposals for categorization have emerged, not always with an integrative perspective on sustainability, i.e., not considering either the different dimensions of sustainability or the various partners in the supply chain (Marshall *et al.*, 2014; Masoumik *et al.*, 2014; Das, 2017; Karaosman *et al.*, 2017). For example, in Supply Chain Management (SCM), a gap has already been identified in the literature regarding the availability of a suitable scale for practices that include the three dimensions of sustainability, as cited (Das, 2017).

#### 2.1 SUSTAINABILITY

Sustainability is a topic that is becoming increasingly common in the context of business and is mainly promoted through government actions. The term sustainability, in its broadest definition, is characterized as the duty to meet the needs of the current generation without compromising the needs of the future generation, originating from the Brundtland Commission (WCED, 1987), in which, through this commission, various definitions related to the dimensions that make up the term sustainability emerged, which pointed to actions based on economic, environmental and social policies.

Lelé (1991) describes that the concept of sustainability originated in the context of maintaining and preserving renewable resources, such as fisheries and forests, and was later adopted as a broad slogan for an environmental movement, which was considered by the majority of sustainability advocates to mean guaranteeing the existence of the ecological conditions necessary to sustain human life at a specific level of well-being for future generations.

The corporate sustainability approach seeks to gain an in-depth understanding of the company's challenges to devise efficient strategies for achieving maximum organizational effectiveness. Shrivastava (1995) states that, in the context of sustainability, an organization must manage not only short-term financial results but also risk factors, such as damage resulting from its production, environmental waste, and worker and public safety.

In this way, Shrivastava also describes that organizations have the ideal conditions to promote modern industrial development since industry has the resources and know-how, as well as the organizational capacity, that make it possible to adopt such actions, thus modifying its production process towards a more efficient and less predatory model.

From this perspective, it is reinforced that the concept of organizational sustainability is based on the triad of responsibilities encompassing sustainability and its relevance to the various sectors of the economy, as well as its primary practices associated with each of the pillars of the TBL. In addition, Gladwin *et al.* (1995) point out that sustainable development must encompass the concept of security so that security is required "from chronic threats and protection from harmful disruptions," including " biodiversity loss, climate change, freshwater scarcity, food insecurity, population growth [...]."

In this context, it is essential to mention the contribution of Haughton (1999), who defended five principles of equity from the perspective of sustainable development (SD), essentially conveying the spirit of sustainable development. In this sense, it is worth noting that a sustainable supply chain should contain most of these elements of equity and justice:

I) Equity (intergenerational equity),

II) Social justice (intergenerational equity),

III) Cross-border responsibility (geographical equity),

IV) Procedural equity (people treated relatively), and

V) Equity between species (importance of biodiversity).

According to Elkington (1998), sustainable development must be based on these three pillars so that they need to be operationalized simultaneously and interactively. For the researcher, "to refuse the challenge imposed by the three pillars is to run the risk of extinction" (Elkington, 2001, p. 2). In this context, Gallo (2007) demonstrates that sustainability can be seen as a relationship between two dynamic systems, the economic and the ecological, and that these systems are based on four principles, which cause slow changes but have a significant impact on the environment; in this case, the author defines these principles as:

- Human life can continue indefinitely;
- Individuals can prosper;
- Human cultures can develop, but that
- The results of human activities obey limits so as not to destroy the diversity, complexity, and function of the ecological system that supports life.

Because of the foundations that gave rise to sustainability, Elkington (2011) describes that the concept of sustainability in business has been evolving and adopting new instruments that are considered fundamental to the full development of this concept, which has since been molded to propose practices capable of meeting the objectives of sustainability and which are in line with the essence of the company.

Given this, the triple bottom line or "sustainability tripod" was a concept adjusted for the business sector, representing the composition of the three main dimensions that a company must have to operate healthily and competitively; the author describes these dimensions as People, Planet, and Profit. From this perspective, Elkington (2011) stresses that this approach demonstrates the need to transition traditional production processes to a model that fits the new standards framed in the dimensions of sustainable development so that its results can generate long-term economic benefits.

Thus, in order to understand the responsibility of each sector, companies must identify the axes present in their chain from the perspective of the sustainability factors described in the figure below, which aims to illustrate the primary responsibilities listed in each of the sustainability bases; the main objective is to achieve full implementation of the Triple Bottom Line, as exemplified in Figure 1.



#### Figure 1. Sustainability Tripod

Source: Elaborated by the author (2023).

Sustainability within organizations can be motivated by moral, instrumental, or relational factors, leading to sustainability practices in supply chain management, as pointed

out by preliminary studies by authors in the field, such as (Aguilera *et al.*, 2007; Sajjad *et al.*, 2015; Paulraj *et al.*, 2017; Garst *et al.*, 2017).

Bhari, Kaur, and Singh (2018) suggest that effective and efficient procurement improves competitiveness by reducing procurement costs but also minimizes the environmental impact of the manufacturing company. Ávila *et al.* (2018) point out that the world of organizations has been transformed by globalization, information technology, and the requirement to incorporate sustainability in all three dimensions (economic, environmental, and social) into their management, considering that people are equipped with a pro-sustainability conscience, which will prioritize the use of services and products only from organizations concerned about the future of generations.

Thakur and Mangla (2019) conclude that these authors suggest that integrating environmental thinking in the supply chain (i.e., green) with lean management makes it easier to adapt the production process to manage sustainable supply chains.

Along the same lines, Correia, Garrido & Carvalho (2023) state that, given a theoretical compilation of previous research demonstrating the implementation of sustainability practices, companies expect results aimed at improving the company's brand image and reputation, as well as improvements based on increased employee morale, cost reduction, financial performance, and other benefits, such as operational efficiency and increased sales, in which there may also be better environmental and social performance.

#### 2.1.1 Environmental

The environmental issue has been gaining notoriety in organizations, as it plays a role in guaranteeing the level of comprehensiveness of the information that is disclosed in the sustainability reports of companies, whether domestic or foreign, in which, given the adoption of such practices, it becomes a requirement for the company to regulate its internal activities to comply with the guidelines established by this pillar. The environmental or ecological dimension encourages companies to consider the impact of their activities on the environment in the way they use natural resources and contributes to integrating environmental management into the work routine (Amaral, 2002).

About the environmental pillar, it is clear that companies must check how their actions and conditions are implemented since their practices affect the planet's ecology; for example, concerning climate change, it is possible to take actions that promote the preservation of natural resources and the prevention of toxic waste (Elkington, 1998; Werbach, 2010).

Studies by Coral (2002) and Catalisa (2003) point out that this pillar is linked to the use of natural resources, to minimize damage to life-support systems, involving compliance with legislation, environmental impacts, environmentally friendly products, recycling, clean technologies, treatment of effluents and waste, as well as the sustainable use of natural resources.

Kassinis (2003) points out that high investment in environmental protection activities will result in low economic performance due to an increase in the industry's operating costs. However, strategic research literature emphasizes companies integrating environmental responsibility with financial strategy, which can reduce the use of resources and improve stakeholder relations and brand image. This factor can contribute to increased revenue and financial performance for the organization.

Calado (2010) points out that environmental responsibility has been a constant process of business analysis with the processes adopted by companies, in which there is a proposal to adopt a responsible environmental commitment, given that companies are increasingly seeking to adapt their processes, readjusting their strategies to prioritize corporate sustainability.

However, according to Carvalho (2011, p. 48), the process of accountability and social commitment to fully achieving the environmental practices adopted by the company shows that social responsibility is characterized by "transforming these users of the planet into environmental citizens, based on this same matrix of thought, which can lead to education for the environment as a synonym for good environmental behavior," in this case, the involvement of citizens in the company's existing practices.

For Bataglia *et al.* (2014), environmental management systems have a positive and significant correlation with organizational innovation, ultimately resulting in a competitive advantage for the company. Younis *et al.* (2016) showed that green purchasing is a practice that has the principle of having a positive and significant impact on a company's economic performance so that companies make adjustments to the processes of acquiring raw materials and manufacturing goods, to contribute to cleaner and more environmentally friendly processes.

In the same vein, Falzon *et al.* (2017) reinforce that both green purchasing and green production have a significant positive impact on the company's competitiveness since the company can also reach new markets by meeting such requirements. Froehlich & Bitencourt (2016) add that the environmental pillar of corporate sustainability refers to an organization's

ability to do business to minimize pollution and is reflected in the prudent management of natural resources.

Through the theoretical framework, it is possible to briefly describe the evolution of environmental practices to production processes; however, the discussion in which it is suggested that organizations seek to align the ecological processes of organizations, uniting them with a new management style, which is socio-environmental management, is already old. Freitas, Santos, and Crisóstomo (2019) point out that organizations are already showing a growing concern about the environmental impacts that can be generated by the exercise of their activities, highlighting that companies have been seeking to develop actions aimed at preventing and reducing ecological accidents, as well as reducing interference and exploitation of natural resources.

#### 2.1.2 Social

Corporate Social Responsibility (CSR), according to Ashley, Coutinho, and Tomei (2000), can be defined as the commitment that an organization must have to the society in which it is inserted, complying with what is expressed through legal acts in this way, it acts practically and coherently with regard to its specific role in society. In this sense, the social pillar encompasses a range of issues, including working conditions, which range from relevant aspects such as diversity, remuneration of the workforce, demands for training, etc.

For Amaral (2002), the social dimension consists of the social aspect related to the qualities of human beings, such as their skills, dedication, and experiences, covering both the company's internal and external environments. Even so, Catalisa (2003) points out that issues related to improving the population's quality of life, equity in income distribution, and reducing social differences are fundamental factors in the development of this pillar.

In view of this, Elkington (1998) and Coral (2002) have developed studies that describe that this pillar incorporates the issue of social responsibility; in this respect, the search for management practices that meet this call is fundamental. Welford and Frost (2006) argued that good internal CSR (Corporate Social Responsibility) practices increase morale, reduce absenteeism, foster workers' commitment to the organization, and increase productivity; they also mentioned that corporate social responsibility provides direct cost reduction, which is achieved by reducing energy use, water consumption, waste reduction and efficient use of raw materials so that it contributes to improving the organization's operational efficiency.

For society to seek a consensus on social responsibility, it needs to be aligned with a sustainable stance since social responsibility must encompass the concepts of sustainability, given that it is fostered by the cooperative integration of people in favor of collective wellbeing. It therefore needs to seek harmonious integration between the social, economic, cultural, environmental and local dimensions (Massa, Novak & Souza, 2007).

According to Vieira (2007), various concepts have been attributed to the term social responsibility over time; as a negative consequence of this plurality of concepts, distortion and voluntary manipulation of the meaning of the term has been created by some interest groups.

The social pillar covers actions and conditions affecting all members of society, such as poverty, violence, injustice, education, public health, labor, and human rights (Werbach, 2010). A report by Harvard Business Review Analytics Services (2013) indicates that, with regard to the social aspect, employee engagement is an essential element for organizational success, as it results in improved innovation, productivity, final performance and, at the same time, reduced costs due to employee retention.

Duarte *et al.* (2014) revealed that CSR practices improve a company's corporate image and its organizational attractiveness. Thus, social responsibility is intrinsically associated with two factors defining its practice's essence: ethics and transparency in business management (Melo, 2014).

For Vilella (2015), whatever the perspective of social responsibility - be it compliance with legislation, compensation for workers, fair remuneration of capital, proper relations with all stakeholders, initiatives that favor the community, projects to preserve and restore the environment - it will always be based on an ethical foundation so that its association with ethics is inevitable.

As a result, it can be seen that defining what social responsibility is would be everything beneficial to society and the environment, helping the low-income classes, which can also highlight the social role in such a way that social sustainability will help a company achieve a high level of benefits. Otherwise, it can be negatively affected by poor social responsibility management (Eriksson & Svensson, 2015).

Social responsibility has been practiced for several years in developed countries, such as the United States, Canada, and several European countries. In this sense, Froehlich and Bitencourt (2016) describe that, in Brazil, social responsibility gained momentum with the advent of non-governmental organizations (NGOs), the strengthening of trade unions, and the campaign for the disclosure of the social balance sheet.

Following this line of reasoning, Vilella (2015) points out that in the 1980s, society experienced productive periods with the participation of society in movements for change, such as strikes, re-democratization, Diretas Já, the new constituent assembly, women's achievements, racial struggles, and global movements in favor of the environment.

In the light of various preliminary studies related to the social pillar, it can be seen that socially inclusive practices for employees range from the provision of fair wages and bonuses, a safe, healthy and positive working environment, health benefits, leave and other additional benefits, as well as growth opportunities (Welford & Frost, 2006; Hutchins & Sutherland, 2008; Marshall *et al.*, 2014; Mani *et al.*, 2015; Zhu *et al.*, 2016).

The same authors present a concept focused on socially inclusive practices for the community, which refers to the investments made by the company in creating opportunities for the surrounding community in terms of generating jobs and business and in offering education, training, and health services, to make the company progressive in the eyes of stakeholders, that is, they are actions aimed at the organization's surroundings.

Finally, Zhu *et al.* (2016) revealed that social practices related to community involvement and development have a significant impact on the company's financial performance, so Hong, Zhang, and Ding (2017) state that social responsibility means that companies must act in the best interests of their environment and society as a whole.

From the above, it can be concluded that an organization's social performance is usually covered by the employee- and community-centered social performance, as Das (2017) points out. In addition, the importance and implementation of social practices described to workers, observed in all companies, is highlighted, mainly related to employee development, training and education, and labor practices.

#### 2.1.3 Economic

As a consequence of the structuring bases of sustainability, the economic pillar aims to finance the proposals and objectives based on the previous pillars, whereby an economic balance can ensure that all practices are developed. According to his proposals, in this context, Porter's (1991) theory is demonstrated, which introduced the 'win-win' perspective concerning the conflict between the environment and the economy; in this sense, he argued that companies could be environmentally friendly and, at the same time, make a profit, thus breaking an ancestral paradigm.

As a result, new pillars are being added to the old profit and loss instructions, in which, according to Elkington (2001), a company's environmental performance increasingly determines the ease with which it enters the market and attracts capital. Executives are, therefore, realizing that their old way of doing business must be rethought and based on sustainable practices. Although many companies have begun their journey towards sustainability, there are still those that are focused on economic and environmental performance proposals, highlighting that executives around the world are waking up to the fact that critical markets are on the margins of a rapid change in direction due to environmental standards and customer demands.

In this sense, Foladori (2002) points out that, despite significant advances, sustainable development remains tied to the capitalist market system without questioning its misappropriations, which generate poverty, social differentiation, and injustice. Coral (2002) states that this pillar represents the strategies of each business, ranging from markets and the quality of products and services to costs, results, and competitive advantages. Another model called 'nested sustainable development' was suggested by Giddings *et al.* (2002), in which the economy is aligned in society, which in turn is nested in the environment.

From this perspective, Catalisa (2003) states that this pillar deals with the regularization of the flow of investments, compatibility between production and consumption patterns, balance of payments, and access to science and technology. For Banerjee (2003), development has become another name for economic growth, which is supposed to alleviate poverty by creating wealth.

However, economic growth has had several adverse social consequences and has increased the disparity between rich and poor so that the financial area has increasingly begun to define social and cultural aspects; in this case, the author points out that as long as conceptions of sustainable development are driven solely by competitive advantage, nature, and sustainability will have no place.

Therefore, according to Ruscheinsky (2003), for a policy aimed at sustainability to be effective, it is essential to unravel the economic forces responsible for the current situation so that, from this, the sustainability of the system has been based on economic logic since its inception.

Banerjee (2003) mentions that sustainable development today is still based on economic rationality, so that, for the author, sustainable development, instead of representing a significant theoretical advance, is subject to the domination of financial issues and, therefore, results in a

loss of power for the majority of the world's population and the majority influence of large corporations in determining the environment.

In a narrower view, the system's sustainability consists of maintaining natural capital to guarantee the durability of economic development; in a broader view, the debate around sustainability involves financial aspects, not only them (Arroyo & Schuch, 2006).

According to Dias and Barros (2008), implementing a sustainability policy in organizations is strongly related to strategic management, which aims to guarantee long-term gains, as sustainable practices result in better product acceptance, innovation, and cost reduction. The authors also add that if the company has a sustainable profile, it will have less exposure to lawsuits, a better reputation, and more excellent market value, directly affecting the organization's financial performance.

Therefore, it is impossible to call sustainable development the reality of economic growth to the detriment of social and environmental issues (Guerra, 2008). Based on this principle, Seuring and Müller (2008) point out that good relations with suppliers will result in the minimization of environmental and social risks; this plays a particularly important role in the development of a sustainable supply chain.

This reality of undervaluing the environmental and social pillars to the detriment of the economic pillar can be understood from Luhmann's (2010) concepts of Structural Coupling, Autopoiesis, and Complexity. Porter and Kramer (2011) introduced another concept entitled 'shared value creation,' in which they explained that this policy could allow a company to increase its competitiveness and, at the same time, promote the economic and social conditions of the community in which the company operates. However, this concept is somewhat analogous to the TBL concept and attributes equal importance to all three aspects of sustainability.

In this sense, it can be seen that the language of capital is widely considered in sustainable development discourses, which preach that growth or wealth should be created without depleting resources, as evidenced by Oliveira and Sola (2013). However, Markman and Krause (2016) point out that economic results are always prioritized before social or environmental issues are addressed in both academic research and practice in almost all of the three approaches above.

Froehlich and Bitencourt (2016) describe that the economic pillar consists of operating at a profit, using practices that move the people and companies involved to satisfy their needs, proposing a similar model; this was also proposed by Montabon *et al.* (2016), with specific reference to sustainable supply chain management, called 'ecologically dominant logic.'

In other words, it means that ecological constraints and social goals must be met before economic goals are satisfied. However, this seems highly ambitious and somewhat difficult to operationalize for an individual company. Based on this, several scholars, such as Elkington (2001), Arroyo and Schuch (2006), Banerjee (2003), Dias and Barros (2008), Zioni (2005); Montibeller (2007); Munck, Borim-de Souza and Zagui (2011); Foladori (2002); Ruscheinsky (2003); Guerra (2008), warn of a possible valorization of the economic pillar to the detriment of the social and environmental pillars of sustainability.

Among the factors that these authors highlight is the undervaluing of social and environmental issues to the detriment of economic engineering, based on capitalism's failure to consider the needs of the impoverished and environmental issues, in which the idea that sustainable development is still based on economic rationality. In addition, the authors point out that the implementation of a sustainability policy in organizations related to strategic management and sustainable development can sometimes be linked to a capitalist market system without questioning its practices, which can use means such as misappropriation and other measures that generate poverty, social differentiation and injustice.

Table 2 below presents a summary of the main elements highlighted by the authors, among the variables that make up the theme of sustainability, in light of the concepts presented by the authors in the theoretical construct of this chapter.

Tripod	Variable	Description	Authors
Environmental	Environmental	It encourages companies to	Almeida 2002; Calado 2010;
	Commitment	consider the impact of their	Younis et al. 2016.
		activities on the environment.	
	Preservation	Actions that promote the	Elkington 1998; Coral 2002;
	and Prevention	preservation of natural resources	Catalisa 2003; Werbach 2010;
		and the prevention of toxic waste.	Froehlich and Bitencourt 2016.
	Environmental	Citizen involvement in the	Kassinis 2003; Carvalho 2011;
	education	company's practices.	Morais 2018; Freitas, Santos and
			Crisóstomo 2019.
Social	Working	Relevant aspects such as	Elkington 1998; Almeida 2002;
	conditions	diversity, remuneration of the	Coral 2002; Welford and Frost
		workforce, and the demand for	2006; Vilella 2015; Froehlich and
		training.	Bitencourt 2016.
	Quality of life	Issues related to improving the	Catalisa, 2003; Welford, and Frost,
	and income	quality of life of the population,	2006; Hutchins and Sutherland,
		equity in income distribution, and	2008; Marshall et al., 2014; Mani et
		reducing social differences.	al., 2016; Zhu et al., 2016.
	Corporate	Compliance with legislation,	Melo 2014; Vilella 2015; Saeidi et
	Social	compensation for workers, fair	al. 2015; Das 2017; Hong, Zhang
	Responsibility	remuneration of capital, proper	and Ding 2017.
	(CSR)	relations with all stakeholders,	
		initiatives that benefit the	
		community, and projects to	

**Table 2: Summary of Sustainability Variables** 

		preserve and restore the environment.	
Economic	Win-win perspective	Companies can be environmentally friendly and	Porter 1991; Elkington 2001; Luhmann 2010; Porter and Kramer
		make a profit at the same time.	2011.
	Sustainable	Sustainable development remains	Coral 2002; Foladori 2002;
	capitalism	basically tied to the capitalist	Giddings et al. 2002; Catalisa 2003;
		market system without	Arroyo; Schuch 2006; Dias and
		questioning its misappropriations,	Barros 2008; Guerra 2008; Seuring
		which generate poverty, social	and Müller 2008 Luhmann 2010;
		differentiation, and injustice.	Porter and Kramer 2011.
	Maintenance	Growth or wealth must be created	Oliveira and Sola 2013; Markman
	and	without depleting resources.	and Krause 2016; Froehlich and
	preservation		Bitencourt 2016; Montabon et al.
			2016.

Source: Elaborated by the author (2023).

## 2.2 SUPPLY CHAIN MANAGEMENT

The term supply chain management (SCM) originated in the late 1950s as a proposal by engineer and MIT professor Jay W. Forrester, who initially developed physical distribution and transportation, using industrial dynamics techniques to solve an inventory management problem caused at the time by the General Electric appliance factory in Kentucky in the United States. Carvalho *et al.* (2014) describe that this was motivated by the "ups and downs" in inventories suffered by the factories, which caused a crisis in operations, thus affecting their entire supply chain.

Supply chain management arose from the need for industries to adapt their production processes with a focus on gaining productivity and making better use of available resources. Based on this premise, Forrester identified a production system capable of integrating logistics processes into a more efficient production model. In addition, Forrester introduced a theory of distribution management that recognized the integrated nature of organizational relationships so that organizations were interconnected, arguing that the dynamics of the system could influence the performance of functions such as research, engineering, sales, and promotion.

Management is on the verge of a major breakthrough in understanding how industrial company success depends on the interaction between the flows of information, materials, money, manpower, and capital equipment. The way these five flow systems interlock to amplify one another and to cause change forms a basis for anticipating the effects of decisions, policies, organizational forms, and investment choices. (Forrester 1958, p. 37)

Forrester (1971) added his vision of an ideal dynamic organizational behavior, developing the so-called bullwhip effect, which would later be used in today's supply chains, thus increasing the number of partners or links in the chain. Years later, Stevens (1989) identified four phases of supply chain integration and discussed the planning and operational implications of each phase:

- Phase 1) Represents the baseline case. The supply chain is a function of fragmented operations within the individual company and is characterized by phased inventories, independent and incompatible control systems and procedures, and functional segregation.
- Phase 2) Begins to focus on internal integration, characterized by an emphasis on cost reduction rather than performance improvement, reserve inventory, initial assessments of internal commitments and reactive customer service.
- Phase 3) Returns to internal company integration and is characterized by full visibility of purchases through distribution, medium-term planning, tactical rather than strategic focus, emphasis on efficiency, extensive use of electronic support for calls, and a continuous reactive approach to customers.
- Phase 4) Achieves supply chain integration by extending the scope of integration outside the company to include suppliers and customers.

Years later, faced with the industrial process fostered by the end of the Second World War, Forrester's concept was given a new guise, calling for a more robust production system with fewer prospects of loss, which would involve dynamic systems aligned with engineering and operational strategy. This movement was called Just-in-Time, which means doing "only what is needed, when it is needed and in the quantity needed"; based on the concept, Mehra and Inman (1992) introduced 20 elements of JIT implementation practices, which were grouped into four factors:

- Management commitment,
- JIT production strategy,
- JIT supplier strategy, and
- JIT education strategy.

In this sense, Lambert (1993) considers that supply chain management refers to the integration of key business processes, from the end user to the original suppliers, which provide products, services, and information that add value for consumers and other business stakeholders. In this way, they point out that managing a supply chain can be a major challenge because, in many cases, it requires the involvement of companies and people with different focuses and objectives.

For example, Flynn *et al.* (1994) introduced seven dimensions of quality management, while Vuppalapati *et al.* (1995) developed 12 Total Quality Management (TQM) constructs; in both works, most of the quality management practices construct proved to be identical in nature, such as top management commitment, customer focus, use of process control, product design quality, employee involvement, supplier involvement, among other members that are present in both results.

An early article pointing to this normative level by New (1997, p.2) "advocates an expanded scope for supply chain management research which accounts for the social function and the political and economic implications of supply chain developments." Cooper *et al.* (1998) point out that practitioners and educators have approached the concept of SCM as an extension of logistics, both in concept and in a comprehensive approach to business integration.

However, according to Lambert, Stock and Ellram (1998), there are important differences between the definition of supply chain management and the Council of Logistics Management's (1985) definition of logistics:

Logistics is the process of planning, implementing, and controlling the efficient flow and storage of raw materials, in-process inventory, finished products, services, and related information from the point of origin to the point of consumption (including inbound, outbound, internal, and external movements) with the aim of satisfying customer requirements.

In addition, the Global Supply Chain Forum, in 1998, described supply chain management as the integration of key business processes from the end consumer to the original suppliers, which provide products, services, and information that add value for customers and other participants in the chain. However, Lambert, Cooper, and Pagh (1998) state that managing a supply chain is a challenging task and that it is much easier to write definitions about these processes than to implement them.

Eisenhardt and Martin (2000) reinforce that dynamic capabilities, therefore, are the organizational and strategic routines by which companies achieve new resources configurations. However, as Lambert and Cooper (2000) point out, several scholars have shown that there have already been various adaptations from the primary supply chain management model to the usual model adopted by the current production system so that in 2000, a Supply Chain Management structure was presented as a new business model and a way of creating competitive advantage by strategically managing relationships with key customers and suppliers.

It is thus based on the idea that organizations do not compete solely as autonomous entities but as members of a network of companies (Anderson, Hakansson, & Johanson, 1994).

In fact, it is common for companies to buy from many of the same suppliers and sell to the same customers, so the organizations that win most often are those that best manage these relationships.

Lambert and Cooper (2000, p. 65) stated that "until now, there has been little guidance from academia, which has generally followed, rather than led, business practice." Given that "Supply chain management is the integration of key business processes from the end user to the original suppliers that provide products, services, and information that add value for customers and other stakeholders,."

In view of this, Ching (2002) describes the process of supply chain management as the integrated way of planning and controlling the flow of goods so that information and resources, from suppliers to the end customer, seek to manage all the relationships between the layers in the logistics chain in a cooperative manner. This aims to benefit everyone involved; in this context, O'Brien (2002) O'Brien, Kenley e Vrijhoef (2002) p. 10 argue that:

Supply chain management focuses on understanding and improving the coordination of the multiple companies that make up a supply chain. The explicit identification of companies differentiates supply chain management from other approaches that focus more narrowly on production processes.

According to Mentzer *et al.* (2001), a number of studies show that the definition of the term supply chain management has been intensely debated, reaching not a clear consensus on its real definition; this is shown in the table below:

Authors	Definition
Jones and Riley	"Supply chain management deals with the total flow of materials from suppliers
(1985)	to end users."
Houlihan (1988)	Differences between supply chain management and classic materials and
	production control:
	1) The supply chain is seen as a single process. Responsibility for the various
	segments of the chain is not fragmented and relegated to functional areas such
	as manufacturing, purchasing, distribution, and sales.
	2) Supply chain management requires, and ultimately depends on, strategic
	decision-making. "Supply" is an objective shared by virtually every function in
	the chain and has special strategic significance because of its impact on overall
	costs and market share.
	3) Supply chain management requires a different perspective on inventories,
	which are used as a balancing mechanism of last resort rather than first.
	4) A new approach to systems is needed - integration rather than interface.
Stevens (1989)	"The aim of supply chain management is to synchronize customer requirements
	with the flow of materials from suppliers in order to achieve a balance between
	the often contradictory objectives of high customer service, low inventory
	management, and low unit cost."
La Londe and	Supply chain strategy includes "two or more companies in a supply chain
Masters (1994)	entering into a long-term agreement; the development of trust and commitment

Table 3: Theoretical definition of supply chain management

	to the relationship; the integration of logistics activities involving the sharing of
	data on demand and sales; the potential for a change in the locus of control of
	the logistics process."
Cooper et al. (1998)	Supply chain management is "an integrative philosophy for managing the total
	flow of a distribution channel from supplier to the end user."
Monczka, Trent, and	SCM requires the traditionally separate materials functions to report to an
Handfield (1998)	executive responsible for coordinating the entire materials process and requires
	joint relationships with suppliers at various levels. SCM is a concept "whose
	main objective is to integrate and manage the procurement, flow, and control of
	materials, using a total system perspective across multiple functions and multiple
	supplier levels."

Source: Adapted from Mentzer et al. (2001).

Mentzer adds that, based on an analysis of the literature, it is proposed that the sustainable supply chain, as a management philosophy, has the following characteristics:

- A systemic approach that makes it possible to see the supply chain as a whole and manage the total flow of merchandise inventory from the supplier to the end customer.
- A strategic orientation towards cooperative efforts in order to synchronize and converge the company's internal and external operational and strategic capabilities into a unified whole;
- A customer focus to create unique and individualized sources of value for the customer, leading to customer satisfaction.

In this same context, Akkermans *et al.* (2003) demonstrate that the supply chain is like a network, made up of suppliers, manufacturers, distributors, resellers, and consumers, composed of three types of flows described as material flow, information flow, and financial flow, as well as supported by three pillars called processes, organizational structures and enabling technologies.

In this way, Kaynak (2003) made use of similar TQM constructs when investigating the impact of TQM practices on company performance since the genesis of SCM seems to be an evolutionary phenomenon with the development of TQM, just in time (JIT) and lean production in Japanese factories.

The main objectives of TQM are to design quality into products and services by institutionalizing a broad corporate culture, emphasizing customer focus, continuous improvement, employee training, and data-based decision-making (Kannan & Tan, 2005). According to a report by Dyer and Hatch (2006), the supply chains of US car companies can be compared with those of Toyota, which shows that sharing knowledge between supply chains can improve efficiency.

Seuring and Muller (2008) point out that the starting points are external pressures and incentives established by different groups; although stakeholders form the broadest possible description, two groups are of particular relevance. On the one hand, customers are of great

importance, as operating the supply chain is only justified if the products and services are finally 'accepted' by customers, given that all forms of government control, whether from local municipalities, national governments, or multinationals, are of great relevance.

The characterization of the supply chain management model has undergone changes over time, so various researchers have noted that the evolution of the systemic model fosters new meanings for this theory. Table 4 below identifies the characteristics of supply chain management maturity.

Authors	Characteristics	
Stevens (1989)	Inventory level, organizational boundaries, customer focus, supply chain	
	costs, planning, visibility and demand orientation, strategic focus,	
	partnership and collaboration, responsiveness, information technology and	
	control systems and information sharing.	
Ayers and Malmberg	Supply chain costs, planning, strategic focus, partnership and	
(2002)	collaboration, supply chain management philosophy, project management,	
	process formalization and structuring, process integration, information	
	technology and control systems, information sharing, and profit sharing.	
Lockamy and	Organizational boundaries, customer focus, customer satisfaction, supply	
McCormack (2004)	chain costs, planning, strategic focus, partnership and collaboration,	
	structured processes, process integration, information technology and	
	control systems, information and profit sharing, performance	
	measurement, and competitiveness as a differentiator.	
Daozhi et al. (2006)	Supply chain costs, partnership and collaboration, responsiveness, risk	
	management, information sharing, resource sharing, regulation and	
	incentives in the chain, and resources used in the chain.	
Performance	Organizational boundaries, planning, strategic focus, partnership and	
Measurement Group -	collaboration, responsiveness, formalization and structuring of processes,	
PMG (2007)	process integration, information technology and control systems, and	
	performance measurement.	
Oliveira (2009)	Customer focus, customer satisfaction, planning, visibility and on-demand	
	orientation, strategic focus, partnership and collaboration, responsiveness,	
	process formalization and structuring, process integration, information	
	technology, and control systems, information sharing, and performance	
	measurement.	

**Table 4: Maturity Characteristics for Supply Chain Management** 

Source: Adapted from Frederico (2016).

Martins and Laugeni (2009) explain how the process worked in the old view of companies: in the old view of the business, each of the companies involved only "saw," at best, its immediate customer. Thus, for example, the supplier of raw materials only saw the factory that was going to use it; the factory that produced the finished product only saw its dispatch or, at most, the distributor of its products, which, in turn, only saw the retailer, until, fortunately, the retailer saw the customer.

Lambert (2014) points out that supply chain management is the management of relationships in the network of organizations, from end customers to original suppliers, using key cross-functional business processes to create value for customers and other stakeholders.
Therefore, according to the description of the Council of Supply Chain Management Professionals and quoted by Georges and Mascioli (2020), it can be understood that:

The supply chain management (SCM) profession has continued to change and evolve to meet the needs of the growing global supply chain. With supply chains covering a wide range of disciplines, the definition of what a supply chain is can be unclear.

Hong, Zhang, & Ding (2017) add that supply chain management has become one of the main ways for companies to control costs and improve economic performance in an increasingly competitive market. However, with emerging issues such as environmental protection, company transparency, employee benefits, and safety, companies need to transform their supply chain models.

Das (2018) reinforces that the supply chain is a broad concept, being inherently complex, which includes numerous activities spread across various functions within an organization and across different organizations, both upstream and downstream. That said, Akyuz and Gursoy (2019) point out that the focus of supply chains has been shifting from an operational to a strategic perspective, and this phenomenon is repeatedly cited in the literature as a strategic management tool with a profound effect on the survival of organizations.

The model proposed by Mentzer, characterized on the basis of his previous studies, can demonstrate a similarity to the conventional supply chain patterns used by the industrial production process in recent decades, as illustrated in the figure below:



#### **Figure 2. Mentzer Model**

Source: Mentzer et al. (2001).

The concept of Supply Chain Management continues to evolve and new approaches have been linked to it, such as Green Management, which gave rise to Green Supply Chain Management (Srivastava, 2007; Tachizawa, 2015), Sustainability, which led to Sustainable Supply Chain Management (Carter & Rogers, 2008; Seuring & Müller, 2008; Beske & Seuring, 2014), and Circularity (Lahane; Kantb & Shankar, 2020; Tavana *et al.*,2022), presenting Circular Supply Chain Management or Closed Cycle Supply Chain Management. Each of these approaches shows an approach to studying and understanding the supply chain. In this sense, the following topic delves into what is now known as Sustainable Supply Chain Management.

#### 2.3 SUSTAINABLE SUPPLY CHAIN MANAGEMENT

According to the general context given in the previous chapter, supply chain management arose out of a need to improve logistics processes in the 19th century, with the aim of the model being to divide the production process into logical production stages. Thus, each stage would manage its own supplies and operational processes in order to guarantee that there would be no shortage of manufactured products in the American market; years later, it was introduced into other supply chain models.

In this way, Shrivastava (1995, p. 955) describes that sustainability integrated into the chain can be understood as a model aimed at "the potential to reduce the long-term risks associated with resource depletion, fluctuations in energy costs, product liabilities, and pollution and waste management," in other words, since the last century, the search for efficiency has already considered acting along the lines of sustainability.

Lambert and Cooper (2000) define supply chain management as the integration of the key processes of a business, driven by demand from the end user and thus linking the layers of supply, reaching the one that produces it.

From this context, it is pointed out that the buyer-supplier relationship, characterized as one of the pillars of supply management, has the potential to stimulate environmental changes in the supply chain so that, as well as the ideas of 'strategic coordination,' 'value chain' and 'sustainable competitive advantage,' they are also emphasized in works, especially after 2000 (Lambert *et al.* 1998; Mentzer *et al.*, 2001).

Despite the history of sustainability, its application in the supply chain only emerged from the late 1980s onwards, given that most research into sustainable supply chain management addressed issues such as environmental protection or social responsibility separately, without considering the possible interrelationships between these and other aspects of social responsibility (Carter & Jennings, 2002).

From the same perspective, Bakker and Nijhof (2002) demonstrate the effects caused by the process and emphasize the importance of the degree of responsibility of the organizations that are part of these chains since responsibility for sustainability cannot be granted to a separate entity within the organization; it must be part of everyone's work, starting with professionals and managers at the strategic level. This shows that organizations seeking to develop the supply chain in a sustainable way and gain from it must make the principles of sustainability meaningful and awaken a sense of responsibility in everyone involved in this process.

Even so, the management of returns, reverse logistics, control, and prevention are managed within the company and between the main members of the supply chain (Rogers *et al.*, 2002). Thus, the correct implementation of this process allows management not only to make the reverse flow of products efficient but also to identify opportunities to reduce unwanted returns and control reusable assets, such as packaging and other potentially contaminating waste. In addition, Walters (2004) points out that sustainable supply chain management involves sustainable development issues to the extent that companies can be held responsible for the social and environmental impacts resulting from the supply chain.

Hadley (2004) points out that the main purpose of a supply chain is to support all of a company's competitive strategies and goals; for this reason, it must be aligned with companies' competitive strategies in order to introduce the term sustainable management into the operations and organization of supply chains.

Carter and Rogers (2008) point out that by adopting processes aimed at integrating the elements of sustainability, companies can gain competitive advantages in their actions and generate positive benefits for the environment and society. In view of this, the authors suggest that systemic coordination of key intra-organizational processes will be applied to the chain, guided by four important factors:

- Risk management Managing chain risks contributes to building more resilient and agile supply chains;
- Transparency making corporate practices more visible and transparent to all stakeholders, providing channels for participation and using feedback and suggestions to ensure legitimacy, but above all, to improve the chain's processes;

- Strategy positive results stand out when the organization's initiatives and its corporate sustainability strategy are interlinked rather than when there are separate programs managed independently;
- Culture organizations that transform themselves into sustainable companies don't simply superimpose sustainability initiatives on business strategies; they also change the company's culture and mentality.

*Risk management* seeks to identify the risks considered relevant to the chain in question in such a way as to allow the manager to develop strategies to overcome the challenges that exist in supply chain processes. These range from the scarcity of natural resources used as inputs for the supply chain to fluctuations in energy costs.

In this sense, Peck (2005) states that supply chain vulnerabilities are linked to risks in the sense that something is liable to be lost or damaged. Corroborating this perspective, Ritchie and Brindley (2007) and Wagner and Bode (2008) state that if risks interfere with a chain's performance, it should be subjected to a study aimed at managing and possibly mitigating these elements.

In addition, Tomas and Alcantara (2013) also point out that the identification of risks should follow a holistic approach so that a broad observation is made in order to identify weaknesses, potential threats, and all relevant vulnerabilities. Furthermore, they draw attention to the fact that risk management in the supply chain involves identifying and controlling internal and external risks that can affect the performance of a chain through a coordinated approach between members in order to prevent or mitigate the vulnerabilities of the chain as a whole.

With regard to *transparency*, it can be seen that achieving satisfactory and adequate levels of transparency can be linked to an organization's greater commitment to sustainability, so transparency includes not just reporting to stakeholders about the situation but actively involving them, using their comments and contributions to ensure adherence and improve supply chain processes. Hart (1995, p. 1000) states that, increasingly, local communities and external stakeholders are demanding that corporate practices become more visible and transparent [...] in order to maintain legitimacy and build reputation.

Transparency can be improved through vertical coordination throughout the supply chain, as well as horizontal coordination between networks, such as common auditing procedures adopted by an industry coalition, which can enable a single, effective supplier sustainability audit to be carried out. This increases transparency and supplier sustainability while reducing transaction costs for both the supplier and the various purchasing organizations that may do business with that supplier.

In this way, through transparency, an organization can promote improvements to its relationship and integration with stakeholders; moreover, many consumers suggest that transparency, in addition to stimulating trade, is one of the main factors in increasing the degree of their loyalty to the company (Craig, 2018). Therefore, access to quality information is essential for transparency to be ensured and effective in the organization's strategy (Albu & Flyverbom, 2019).

When dealing with *strategy*, Hamel and Prahalad (1989) found that a long-term vision shared throughout the organization was significant for generating the internal drive and passion to stimulate innovation and change. In this sense, in their study of "visionary companies" that outperformed their competitors over long periods, Collins and Porras (1994) found that profit maximization was not the main driving force of these organizations.

Instead, Shrivastava (1995) describes that these companies had core values and cultures and a sense of purpose beyond the economic bottom line, so that an organization's sustainability initiatives and its corporate strategy should be closely intertwined rather than separate programs that are managed independently of each other.

With regard to organizational culture refers to the ideologies, values, laws, and daily rituals that are verifiable in an organization; the strategy factor for supply chains can be understood as an intentional model of organizations that seeks to generate competitive advantages throughout the network through the delivery of superior value to the end customer and based on collaborative relationships (Harland, Lamming & Cousins, 1999), as further support for the role of corporate culture in sustainability.

Carter and Jennings (2004) found a significant relationship between environmentally and socially responsible purchasing activities and an organizational culture that considers the well-being of others that is fair and supportive. Furthermore, organizations that become sustainable enterprises do not just overlap sustainability initiatives with corporate strategies; through this, these organizations also have (or have changed) their corporate cultures and mindsets (Savitz and Weber, 2006).

Typically, Seuring and Müller (2008) point out that SSCM is the management of materials, information, and capital flows, as well as cooperation between companies along the supply chain, with the goals of all three dimensions of sustainable development. In the light of the factors presented by Carter and Rogers, it can be added that SSCM is:

"The strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key interorganizational business processes for improving the long-term economic performance of the individual company and its supply chains" (Carter & Rogers, 2008, p.368).

In fact, when combined with economic objectives to develop a long-term strategy, SSCM can actually provide access to the highest level of organizational performance (Carter & Rogers, 2008). Pagell and Zhaohui (2009) argue that companies should make profits over time while performing well in all aspects of the triple bottom line.

Based on these prominent and complementary definitions of supply chain management and our review of the sustainability literature, we define SSCM as the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key intra-organizational business processes, to improve the longterm economic performance of the individual company and its supply chains.

The figure below illustrates this reality by means of a Venn diagram, which aims to demonstrate the value of the interconnection between social performance, economic performance, and environmental performance in achieving sustainability, integrating the principles detailed above, as shown in the table above.



Figure 3. Visual map of the supply chain model under the sustainability variable

Source: Carter and Rogers (2008, p. 369).

Carter and Rogers (2008) propose a model in which there is a systemic coordination of key intra-organizational business processes that are applied to the chain, guided by four important factors, namely risk management, transparency, strategy, and culture. In this way, sustainable supply chain management is the strategic and transparent integration and execution of an organization's social, environmental, and economic objectives in the systemic coordination of key intra-organizational business processes to improve the long-term economic performance of a company and its supply chain.

In this context, Pagell and Wu (2009, p. 08) add that "the sustainable supply chain should therefore consider good performance in both the traditional measures of gains and losses, as well as the expanded conceptualization of performance with the inclusion of social and environmental dimensions." Continuing to explain the theoretical framework, Faisal (2010) presented an approach to effectively adapting sustainable practices to a supply chain, analyzing the dynamics between various facilitators that help transform a supply chain into a truly sustainable entity so that such practices could lead to improvements in the development of the chain's processes.

When dealing with sustainable practices, it is essential to highlight their breadth and how they interrelate with each other so that in order to promote improvements in a given sector, it is necessary to develop a group of sustainable practices to effectively make up the group of sustainable practices that make up the integration with the other pillars of the chain. This division can be seen in Figure 4 below.



**Figure 4. Dimensions of sustainable practices** 

Source: Elaborated by the author (2023).

Companies have long been asked to address social and environmental issues along their supply chains in a responsible way, but it is unclear how companies can benefit from such an expensive change at the expense of efficiency gains. In light of this, Johnson and Templar (2011) point out that "cash generation and asset efficiency" has been considered as an alternative measure to obtain results consistent with achieving sustainability.

In addition, sustainability in the supply chain must cover the entire supply network demanded by the activity, requiring changes and improvements so that there are inspection and monitoring actions in the processes that make up the activity. In addition, it can include everything from the purchasing function (Miemczyk *et al.*, 2012) to the other layers related to suppliers (Gimenez & Tachizawa, 2012), which are part of the supply chain; linked to this are aspects of sustainability performance throughout the supply chain.

Ashby *et al.* (2012) and Taticchi *et al.* (2013) point out that there is evidence for achieving sustainable performance and that in order to do so, some aspects and practices in the supply chain may have to be changed in order to allow processes to be managed in a different way.

Considering the above, Beske, Land and Seuring (2013) point out that, in the case of the food chain, food safety is a concern for almost all consumers; governments are closely watching the practices and products of companies in the food industry. Secondly, environmental issues such as deforestation or social problems such as fair wages for farmers, which are often reported by government agencies or non-governmental organizations, highlight how concerns and their effects within a supply chain should be managed.

In this framework, Piercy and Rich (2015) point out that lean operations have the potential to produce sustainability improvements, including an advantage in the working conditions of focal companies, in the workplace of suppliers and in the community. In addition, Das (2017) points out that traditionally, most operations and supply chain managers are simply concerned with the economic objectives of an organization and do not feel motivated enough to pay the necessary attention to the environmental and social issues faced by an organization.

The author also points out that contemporary developments in the business environment since the last decade indicate that the mere pursuit of economic motives is not a good decisionmaking alternative for an organization from the point of view of long-term sustainability and profitability. This is because the organization's actions have caused irreversible damage to the ecosystem and failed to guarantee safety, security, a living wage, healthcare, better working conditions for employees, and better living conditions for the surrounding community and society in general.

For Paulraj *et al.* (2017), the moral motivation for SSCM is intrinsic motivation, in which companies practice SSCM not so much to avoid external pressures, but because of the value systems of managers and employees. Following this strand, Das (2017) proposes an SSCM scale that includes the elements of SSCM practices and performance, covering all three dimensions of sustainability; in this way, the author points out that the boundary of the SSCM domain could be expanded even further by incorporating several important elements, such as:

- Mitigating the risk of supply interruptions due to a reduced supplier base;
- Managing risks from NGOs, competitors, etc;
- The practice of reuse and recycling and recycling efficiency;
- Innovation for sustainability and;
- Technology as an enabler of sustainability.

Das (2017) conceptualized and developed a scale to measure the sustainability practices adopted by a company and its performance in the environmental, social, operational and competitiveness dimensions. The author points out that Sustainable Supply Chain Management (SSCM) combines the objectives of CSR in addition to Green Supply Chain Management (GSCM) practices, which in turn helps organizations achieve their economic, environmental, and social objectives at a micro level and ultimately improve the image of companies in the eyes of stakeholders.

The aforementioned concept is based on measuring different elements that may or may not be exercised by the companies investigated in this study, being adapted into five groups of practices and five groups of organizational performance measures according to the practices arising from their activity, as highlighted in Table 5 below.

SUSTAINABILITY	PRACTIC	CES IN SUPPLY CHAIN MANAGEMENT			
	EMP 1	Environmental management practices are structured under the terms of ISO 14001 certification.			
Environmental	EMP 2	Project/design specifications are provided to suppliers regarding environmental compliance per item purchased.			
Management Practices (EMP)	EMP 3	Suppliers are required to establish environmental management systems and/or obtain ISO 14001 certification.			
	EMP 4	Customers' environmental concerns are addressed by establishing eco- friendly product design and distribution.			

Table 5:	Sustainab	oility Pra	ctices in	Supply	Chain I	Management

	EMP 5	Products have been designed to consume less raw materials and energy is production.		
	OP1	The Just-in-Time inventory control technique is followed consistently to maintain inventory and minimize costs.		
Operational Practices (OP)	OP2	Lean production is adopted, and we seek to minimize costs in all actions.		
	OP3	Economies of scale are achieved in the transportation of incoming inputs and raw materials and outgoing finished products.		
	SCM1	The production plan is updated according to customer needs and these demands are shared with suppliers		
Supply Chain Management	SCM2	The organization responds quickly to customer needs by maintaining adequate stock		
(SCIVI)	SCM3	Suppliers are quickly informed of future customer requirements		
	SIPE1	The safety measures adopted by the organization are advanced and reduce the risk of accidents		
	SIPE2	The organization provides a positive and healthy working environment for employees		
Social Inclusion Practices for Employees (SIPE)	SIPE3	The use of enslaved, forced or child labor is not permitted in the organization		
Linployees (Sir L)	SIPE4	Wages and benefits paid to employees are sufficient to cover their basic needs		
	SIPE5	Employees are entitled to vacation, social security, health and other benefits		
	SIPC1	Employment and business opportunities are provided to the local community		
Social Inclusion	SIPC2	Medical assistance is provided to the local community		
Practices for the Community (SIPC)	SIPC3	Primary education units are provided for the people around the organization		
Performance Measu	res for Su	stainability Practices in Supply Chain Management		
	CPM1	Improved service levels with equal or less stock		
	CPM2	Improved product and service quality		
	CPM3	Improved use of the organization's capacity/productivity		
Competitiveness Performance	CPM4	Advance in competitive advantages in terms of offering differentiated products to customers		
Measure (CPM)	CPM5	Retention of the customer base		
	CPM6	Greater opportunities for the company to reach and win new customers		
	CPM7	Improved company image by being considered "green" (environmentally responsible)		
	EPM1	Reduction in effluent treatment and discharge costs		
Environmental	EPM2	Reduced discharge of toxic waste (solid, liquid or gaseous)		
Performance	EPM3	Reduction in the frequency of environmental accidents		
Measure (EPM)	EPM4	Reduction in the frequency of accidents in the operational sector		
	EPM5	Protection of local biodiversity		
Operational	OPM1	Lower production costs		
Performance	OPM2	Reduced energy consumption		
Measure (OPM)	OPM3	Improved efficiency of inbound logistics (inputs/raw materials)		

	OPM4	Improved efficiency of outbound logistics (of finished products)	
	ESPRM 1	Reduction in the inequality of remuneration and other benefits paid to employees of the same hierarchical level	
Employee-Centered Social Performance	ESPRM 2	Reducing differences in allowable compensation packages (salaries + benefits) paid to employees of different hierarchical levels	
Measure (ESFRM)	ESPRM 3	Improving the organization's working environment and boosting employee morale	
	CSPRM 1	Improving the company's image by being responsible to the community	
Community- Centered Social	CSPRM 2	Improved opportunities for the local community in terms of jobs and business generated by the organization	
Performance Measure (CSPRM)	CSPRM 3	Improved education levels for people in the surrounding area	
	CSPRM 4	Increased time people are free from illness due to the improved health services offered by the organization	

Source: Adapted from DAS (2017).

In a subsequent study, Das (2018) explains that, in the current scenario, some organizations meet the needs of the surrounding community and wider stakeholders by practicing CSR, while others try to minimize their negative environmental impact by adopting internal policies, such as ISO 14001, or implementing Green Supply Chain Management (GSCM) practices.

Having developed the theoretical framework, it is possible to understand the concepts and theoretical elements highlighted in the literature, which describe the key elements that allow the supply chain to be analyzed from a sustainability perspective. The table shows the main variables found in the literature, which can be used as a basis for analyzing sustainable practices in supply chains.

Tripod	Variable	Description	Authors
Environmental	Respect for natural limits by making the best use of raw materials and avoiding waste.	Inventory levels, organizational boundaries, customer focus, supply chain costs, planning, visibility and demand orientation, strategic focus, partnership and collaboration, responsiveness, information technology, and information sharing and control systems.	Stevens (1989), Ayers, and Malmberg (2002) Lockamy and McCormack (2004), Hong; Zhang; Ding, (2017)
	Maintenance of natural resource stocks	Inventory levels, organizational boundaries, customer focus, supply chain costs, planning, visibility and demand orientation, strategic focus, partnership and collaboration, responsiveness, information technology and control, and information sharing systems.	Daozhi <i>et al.</i> (2006)

Table 6: Summary of Sustainability Variables in Supply Chains

Social	Dynamic capacities involved in the extractive process Adoption of social and corporate responsibility practices	They state that managing a supply chain is a challenging task and that it is much easier to write definitions about these processes than to implement them. [] reinforce that dynamic capabilities, therefore, are the organizational and strategic routines by which companies achieve new resource configurations. some organizations meet the needs of the surrounding community and wider stakeholders by practicing Corporate Social Responsibility	PMG (2007) Oliveira (2009), Das (2017)
	Adoption of integrative and collaborative strategies	The strategy factor for supply chains seeks to generate competitive advantages throughout the network by delivering superior value to the end customer based on collaborative relationships.	Hamel and Prahalad (1989), Shrivastava (1995), Harland, Lamming, and Cousins (1999), Savitz and Weber (2006)
	Transparency and fairness	Transparency includes not just reporting to stakeholders but also actively involving stakeholders and using their comments and contributions to ensure buy-in and improve supply chain processes.	Hart (1995), Craig (2018), Albu, and Flyverbom (2019)
Economic	Operational flow management	Logistics comes in as a process of planning, implementing, and controlling the flow, ensuring the efficient storage of raw materials, in-process inventory, finished products, services, and related information, from the point of origin to the point of consumption.	Lambert (1993), Cooper, <i>et al.</i> , (1997), Lambert, Stock, and Ellram (1998), Ching (2002)
	Innovation in production processes	It allowed operational efficiency to be gained through the development of total quality management (TQM), just in time (JIT) based on the Japanese industrial model.	Kannan and Tan, (2005). Dyer and Hatch (2006)
	Long-term partnerships	It involves two or more companies in a supply chain entering into a long-term agreement.	La Londe and Masters (1994)

**Source:** Elaborated by the author (2023).

#### 2.4 TIMBER SUPPLY CHAIN

The wood supply chain is made up of all the operations and activities related to the supply of products made from wood and is represented from its base, characterized by seedling production and reforestation activities, and ending with the processing and industrialization of this commodity.

According to Noce *et al.* (2005), the wood industry has for many years contributed to internal development and the growth of Brazil's GDP by collecting taxes and creating jobs that

have made it possible to improve the country's structure and balance of trade through the exploitation and processing of wood. Logging has also played a key role in the urban development of the regions around the areas exploited by logging activities.

Even in the face of the expectations created in relation to the growth of logging activity and the significance it has achieved in the economic sector, these actions have gone against the grain from an ecological, environmental, and social point of view.

Souza *et al.* (2005) point out that accelerated economic growth without effective controls can lead to the deforestation of forests, the exhaustion of mineral reserves, and the extinction of certain species of fish, highlighting open-air activities such as timber industries or even agricultural activities that tend to occupy vast areas of land where forests once stood.

In this context, the forestry production process can be divided into three main phases:

The *first phase*, according to Yuba (2005), can be considered to refer to the process of intensive forestry with the use of exotic species, with *Eucalyptus spp* and *Pinus spp* being the most widely used for planting in Brazilian forests. Thus, the process of forest plantations is chosen in order to obtain an increase in productivity per unit area, with the aim of obtaining a reduction in the area set aside for planting in the shortest possible time, as demonstrated in the study by Edgar (1978).

The study describes that the forestry production process involves the selection of species, soil preparation with the use of fertilizers, pest and insect control, as well as the correct use of water, soil maintenance, and the controlled use of pesticides. Opie, Curtin and Incoll (1978, p. 180) describe the management stage as "a set of treatments applied to a forest during a rotation," which are considered fundamental for the tree's growth phase until it reaches the felling stage.

The *second stage* is harvesting; it involves sectioning the tree in its lower portion using manual or automatic tools, with or without motorization, followed by delimbing the log and cutting it into standard lengths in order to enable its transportation or facilitate the handling and movement of the pieces (Gonçalves, 2000, p.100).

The next stage involves processing the wood to turn it into by-products, such as firewood, chips, briquettes, or even for the splitting process. This process is an efficient way of optimizing the process of sawing and processing raw logs (Leite, 1994).

The *third phase* is distribution and consumption, which generally consists of the logistics and distribution of this raw material as a source of supply for industry and can already be characterized as commodities and their derivatives (Santos, 2008). In order to manage these resources from the point of view of the activities related to wood supply, logistics is seen as an

activity that aims to supply the consumer unit, at the right time and place, with quality and at a low cost, through planning, execution and control processes.

In this context, the wood supply chain is defined by a logical system that seeks to achieve efficiency in the production process; in addition, its process requires the involvement of other players who work on the other fronts of the production process. The wood transformation process goes through all the stages mentioned above until it reaches its final form, which is commonly used by industries or even the end user; however, in order to ensure that there is a balance in this chain, it is necessary to identify how these links relate to each other and which factors are crucial for each of them, in order to guarantee the use of sustainability in this chain.

The Brazilian Forestry Service (SFB) has demonstrated, in its study published in 2007, based on the advances and prospects for Amazon forest conservation, evidence that already indicated that the actions of this phenomenon did not take into account the real impacts caused by the activity, as well as noting that the start of logging in the region did not take place according to sustainability standards.

Given this context, Costa (2008) points out that, before promoting continuous economic growth, it is necessary to take certain precautions to protect the integrity of the environment, respecting its limits, in order to avoid the irreversible loss of substances or the content of the most diverse biological systems on which we depend. Furthermore, it should be noted that competitive advantage is greater in supply chains based on long-term relationships (Fynes *et al.*, 2008)

Along with the value of the product comes the environmental and social burden incurred during the different stages of production. What justifies this growth in the exploitation of the timber market is the high level of urbanization in small districts, driven by the rural exodus; however, it should be noted that, in the same period, there were already projections regarding the export of this raw material, as mentioned by Macpherson *et al.* (2009).

It is also noteworthy that the extraction of Roundwood increased significantly during the industrial period, given the movement that contributed to the increase in the country's Gross Domestic Product (GDP). According to Pereira *et al.* (2010), the increases in annual wood consumption were due to the growth in the number of timber industries driven by the energy and pulp sectors, which, during this period, pointed to a scenario of continuous growth in this sector.

According to Päivinen *et al.* (2012), given the set of processes through which forest resources are converted into products and services, each process is considered a basic element

in the analysis of the forest supply chain. In view of the various diversification possibilities arising from timber resources, Figure 5 below illustrates the various possibilities that describe the consumption cycle and destination of reforested timber, as well as the activities for which it is used.



#### Figure 5. Production chain in the planted tree sector

Source: Ibá/ Pöyry (2018).

Only companies with sustainability as a core value seem to make an extra effort to transform their supply chain, or at least part of it, into a sustainable supply chain and thus use this "opportunity-driven" strategy (Windolph *et al.*, 2013, p. 214).

In this sense, Lopes (2018) points out that, given the intensification of logging, which took place from the 1980s onwards, regional development can be seen as a result of this activity, such as the installation of sawmills along highways and small communities of workers around them. This, according to the author, would justify these improvements, which, in fact, occurred because they were associated with the movement to reduce the costs of transporting this raw material.

#### 2.4.1 Characterizing the context of the timber sector in the western region of Paraná

The western region of the state of Paraná is composed of three micro-regions: Foz do Iguaçu, Toledo, and Cascavel, which are subdivided by the districts that make up the microregions of each municipality. (Figure 6).



**Figure 6. Representation of the municipalities in the Western Region of Paraná** Source: Elaborated by the author (2023).

This region was very important to the timber industry from the 19th century onwards because, according to Lavalle (1981), there was an extensive Araucaria Angustifolia forest in Paraná, which made logging one of the most important activities in the region. At the start of logging, due to the lack of infrastructure, timber was harvested in coastal areas because of the difficulty in connecting the coast, such as the ports of Paranaguá and Antonina and the river port of Foz do Iguaçu, to the plateau, where the Araucaria forests were located.

According to the Department of Rural Economy of Paraná, the main activity in the western region is livestock farming, which accounts for 60% of its revenue, followed by agriculture, with 38%, and forestry, with 1%. In addition, the region is considered the main producer of broiler chickens and pigs for breeding and rearing and stands out in the production of soybeans, broiler chickens, corn, and bovine milk.

Even so, although the forest still represents little in terms of its performance, it is possible to identify forestry production as an important adjunct to other supply chains, such as the use of firewood for drying grain, heating, and poultry litter.

Nunes *et al.* (2009) mention that the timber movement in Paraná began with the opening up of trade in Brazil, undergoing constant modernization processes because, given the current availability of forest resources at the time, such investments were justified as the timber industries became increasingly competitive, both in the domestic and foreign markets.

In the view of Duda *et al.* (2010), in the 1990s, the state of Paraná already stood out for having a privileged stock of raw materials and technology for the timber industry; however, in the face of vast exploitation, this industry had to adapt by migrating to new work fronts. According to Bittencourt and Oliveira (2009), the last 15 years have seen a restructuring of the timber industry, which has been fundamental to maintaining and expanding the domestic and foreign markets, thus promoting development for the country, all due to the opening up of trade.

According to a study published by the Secretariat of Agriculture and Supply of Paraná (SEAB, 2020), in partnership with the Department of Rural Economy (DERAL), it is estimated that, throughout the state of Paraná, there are approximately 4,327 companies operating in the wood distribution and industrial production sector, of which 1,140 are characterized as sawmills, representing a 15% share of the volume of companies operating in the same sector nationwide.

However, according to a study presented by Apre Florestas (2022), it is estimated that the number of companies operating in the forestry sector could be even higher, representing around 6,100 companies operating in the entire forestry chain throughout the state of Paraná. The western region of Paraná is made up of a total of 138 companies operating in the timber industry, as found through searches based on an internet browser using filters and georeferencing data; the number of companies located by region is listed in (Appendix C).

Of this total, 105 companies fall into the second stage of the process, classified as timber mills and sawmills, and 33 companies fall into the third stage of the production process, classified as furniture factories, sawmills, and joinery shops (Table 7). However, it is believed that this number could be even higher if the distribution and final consumption stages of these resources are taken into account.

Compan	ies by region	First phase	Second phase	Third phase
Micro-region	Toledo	0	40	18

 Table 7: Classification of companies by region

	Cascavel	0	29	6
	Foz do Iguaçu	0	36	9
1	Totals	0	105	33

**Source:** Elaborated by the author (2023).

According to Apre's Sector Study (2022), Paraná's supply chain, based on Piuns and Eucalyptus forestry, is the most complete and best represents Brazil's industrial forestry complex, supplying logs for the pulp, paper, reconstituted panels, plywood, sawn timber, energy and higher value-added products segments (solid wood flooring, doors and windows, moldings, among others), as illustrated in Figure 7.



**Figure 7. Schematic model of the forest-based supply chain in the state of Paraná** Source: Estudo setorial APRE (2017).

Currently, the timber supply chain in western Paraná is responsible for supplying companies in various segments of the region, guaranteeing the supply of firewood for poultry farms, grain drying, and woodworking companies, as well as supplying the demands of the construction industry, among other activities.

It is worth noting that the volume of timber stocks produced in the region is not enough to meet the demand of the local market in the western region of Paraná so the sector is looking to raise these resources in other regions in order to guarantee its supply. As a result, several companies have been investing in their own areas for reforestation or working on new fronts in order to produce wood for their supply.

#### 2.5 LEGISLATION AND CERTIFICATIONS FOR THE TIMBER INDUSTRY

The definitions governing environmental regulations for the exploitation of Paraná's timber supply chain are governed by State Law 10.066, of 27/07/1992, which established the State Secretariat for the Environment (SEMA); in addition, there is the Paraná Environmental Institute (IAP), which acts as one of the bodies that releases and supervises timber activity in the state of Paraná, based on the main laws, decrees and regulations, both state and federal, which provide for the appropriate regulations for activity in this segment.

In addition to Law 10.066/92, other regulations guide activity in this sector. Table 8 below shows the main regulations that outline the environmental practices adopted in the forestry sector.

Main laws, decrees, regulations,	Content
and institutional mandates linked	
to protection policies in Brazil	
Decree-Law 23.793, of 01/23/1934,	It established the so-called protective forests (permanent
Brazil's first Forest Code	preservation forests), where clear-cutting is not tolerated. These
	are those located at points of fragile environmental balance, such
	as the banks of watercourses around springs and hilltops.
Law 6.938, of 31/08/1981	It deals with the definition of pollution. It made it compulsory for
	companies or activities that could in any way degrade the
	environment to have an environmental license. As a result,
	inspection became stricter and the rules stricter for, among other
	things, logging activities. Created the National Environmental
	System - SISNAMA.
State Law 10.155, of 01/12/1992	It stipulates that natural or legal persons who economically use
	forest raw materials are obliged to replenish them.
State Law 11.054, of 11/01/1995 -	In the state of Paraná, the Legislative Assembly approved the
Forestry Law of the State of Paraná	State Forestry Law, which determined and legislated on the
	forest protection regime; education, research, and dissemination
	of principles and values related to environmental preservation
	issues; reforestation, management, and exploitation of forests;
	programs and fees to encourage environmental awareness; and
	control and inspection in companies.
Law 11.284, of 02/03/2006	Provides for the management of public forests for sustainable
	production; establishes, within the structure of the Ministry of
	the Environment, the Brazilian Forest Service - SFB; creates the
	National Forest Development Fund - FNDF.
Federal Decree 6.063/2007	Regulates, at the federal level, provisions of Law No. 11.284 of
	March 2, 2006, which provides for the management of public
	forests for sustainable production.
Law 11.428, of 22/12/2006	Provides for the use and protection of native vegetation in the
	Atlantic Forest Biome and other measures.
Federal Law 12.651/2012	Provides for the protection of native vegetation
State Law 11.054/1995	Provides for the State Forestry Law.
Federal Law 12.305/2010	Establishes the national solid waste policy. Amends Law No.
	9.605 of February 12, 1998.

Table 8: Main laws, decrees, regulations, and institutional mandates and their content

Source: Elaborated by the author (2023).

In addition to these measures, one of the alternatives for supervising and monitoring activities, with a view to controlling and balancing the timber chain, is the adoption of a Sustainable Forest Management Plan (SFMP), certified by the internationally recognized FSC (Forest Stewardship Council) seal.

According to Castro, Fernandes and Carvalho (2012), having the certification guarantees that its manufactured products, which use wood in their composition, whether for packaging or in part of its manufacturing process, can be made with controlled wood from management plans and harvested using reduced-impact techniques. In this way, according to the company, they are managed in an environmentally correct, socially fair, and economically viable way, thus guaranteeing the full adoption of the principles that encompass sustainability.

In addition to the FSC, recent years have seen the introduction of the ISO 14000 standard, which has an environmental management system divided into three sections, covering initial planning, implementation, and evaluation of objectives. This standard basically deals with the environmental management of the company as a whole, where, from the point of view of certifications, this proposal was developed with the aim of creating an Environmental Management System that helps companies to fulfil their responsibilities towards the environment that permeates the organization within concepts and procedures, without losing sight of regional characteristics and values.

ISO 14000 standards apply to industrial, extractive, agro-industrial and service activities, certifying company facilities, production lines and products that meet environmental quality standards. In this way, ISO 14000 makes some specific requirements that complement the pillars of sustainability, including:

a) Senior management commitment to environmental management;

b) Development and communication of an environmental policy;

c) Establishment of requirements that are relevant from a legal and regulatory point of view;

d) Establishment of environmental objectives and targets;

e) Establishing and updating a specific environmental program or programs designed to achieve the objectives and targets;

f) Implementation of support systems such as training, operational control and emergency planning;

g) Frequent monitoring and measurement of all operational activities;

h) A procedure for a full audit to review the functioning and suitability of the system.

Alzawawi (2014) points out that several studies claim that companies certified by ISO 14001 are more likely to adopt green practices in supply chain activities, which is considered an internal facilitator for sustainability. In addition, because it is a resource that is exploited in

its entirety and does not generate solid waste or special processing, reverse logistics practices are not adopted, as well as practices aimed at the national solid waste plan.

Along these lines, Beske and Seuring (2014) suggested the adoption of environmental standards and certifications, such as ISO 14001, by the focal company and its suppliers to minimize the risk of adverse environmental impact. On the other hand, Oelze (2017) argues that certification is an invaluable source of organizational learning, which can guide the company in developing and instilling the right capabilities for responsible supply chain management.

In light of this, it should be noted that legislations correspond to legal means aimed at regulating the practices of any economic activity. On this basis, the timber sector uses legal devices to ensure that harvesting practices meet the requirements determined by the corresponding regulatory bodies, i.e. compliance with the activity's legal practices.

With regard to certifications, this process stems from the external validation of the processes adopted by the company, in order to demonstrate to stakeholders that the production processes employed in this chain follow strict quality criteria, as well as using operational resources that comply with sustainability guidelines.

#### 2.6 SUSTAINABILITY IN THE TIMBER CHAIN

In light of the above, it can be seen that the exploitation of timber resources has been fostered by the industrial sector, which exerts strong pressure on the upstream and downstream sectors.

In this context, the use of sustainable practices in this chain is proving vital for its balance, ensuring that the volume of wood processed does not exceed the amount of forests planted in the forestry process, which causes an imbalance in the supply of this chain. Along these lines, SANTOS; SILVA, (2013) points out that it is necessary to mobilize discussions aimed at promoting more sustainable production and consumption, proposing the use of forest management techniques in native forests as a mechanism to prevent predatory logging.

Based on the sustainability guideline, Min and Galle (1997) conducted an empirical survey of purchasing managers in the United States in relation to green purchasing and found that the main driving force for green purchasing is a desire to comply with regulations, rather than environmental monitoring or partnerships; moreover, the effectiveness of green purchasing also depends on whether the company has centralized or decentralized decision-making.

It is known that the search for reforested timber is increasing every year, to make up the stocks of the timber industries, making it possible to operate factories and industries in various segments, such as pulp and paper; however, it is necessary to think of ways to support this chain, so that it can be managed in a sustainable way, in order to guarantee the supply of industries in this sector.

Baldwin & Clark (1999) point out that organizations that focus on individual sustainable development practices are rarely able to find optimal solutions to sustainable problems in their supply networks.

Even so, in order to achieve this degree of sustainability, it is necessary to work together with the main players involved in the chain in order to formulate an action plan capable of benefiting the entire chain, excluding the possibility of obtaining a raw material from a free source. This shows that the timber sector is constantly seeking to improve its processes, based on increasing efficiency per hectare planted.

Investing in projects aimed at ensuring the sustainable development of the timber chain has been a major challenge over the last few decades, but there is still a lack of projects to help predict the behavior of this sector over time. According to Amaral (2002), the projects provide support for communities by providing technical training for community members, support for product certifications and positioning themselves as a link between companies and communities, in other words, through this context, joint development can be seen, which favors the growth and benefit of the entire chain exploited.

Through an analysis carried out in the industrial timber sector during promising periods, Picoli (2004) points out that, from the outset, unbridled logging was seen as a source of profit without the need to pay attention to preservation and control practices. This is because, most of the time, the industrial timber sector manages to reproduce the same extractive practices used in previous decades, using tropical forests in a predatory way, without respecting the soil, vegetation, air or water sources, and exploiting the workforce to an unlimited degree.

Cavalcanti (2004) points out that despite all the growth, treating development and the environment in an integrated manner, the management of natural resources means more than providing adequate protection for nature and thinking about the management of its resources on a sectoral basis. The interaction of man as the main protector and manager of this chain is fundamental, in order to ensure that the practices adopted can be aligned with the principles of sustainability, protecting resources in order to avoid their depletion.

The study carried out by the Brazilian Tree Institute (2018) shows how the reforestation areas of the main species sold in the country are distributed, showing that in Brazil, the total

reforested area is close to 8 million hectares, distributed among several states that fill the five regions of Brazil, as shown in Figure 8.



## Figure 8. Map showing the distribution of forest plantations in Brazil, both in Portuguese and English

Source: Ibá, Indústria Brasileira de Árvores (2016).

In this context, the aim was to highlight the various variables that make up a sustainable supply chain for the timber industry. Among the various topics covered, fundamental elements related to previous research on the subject and the debate between various authors were highlighted, exposing their different points, which served as the basis for this work. Below is a summary table of the sustainability variables in the timber chain, bringing the chapter to a close and continuing with the research methods.

Tripod	Variable	Description	Authors
Environmental	Control and	The consumption of natural stocks on	Philippi (2005), Picoli
	preservation of	an unsustainable basis consequently	(2004)
	native species	degrades the physical, biological and	
		social systems, generating conditions	
		conducive to the occurrence of diseases	
		and a low quality of life.	
	Combating illegal	Predatory actions range from the illegal	Bittencourt and
	exploitation and	clearing of forests to unfair economic	Oliveira (2009),
	management	and environmental damage.	Carvalho (2012)
	practices		

Table 9: Summary of Sustainability Variables in the Timber Chain

	Inadequate exploitation of natural resources, not respecting their natural limits.	It was noted that the start of logging in the region did not take place according to sustainable standards.	SFB (2007)
Social	Environmental education and behavior	The transformation of these users of the planet into environmental citizens, based on this same matrix of thought, can lead to environmental education as a synonym for good environmental behavior.	Carvalho (2011), Costa (2008), Santos; Silva (2013)
	Confronting the interests of the organizations analyzed regarding the use of sustainable practices.	Sustainable development remains basically tied to the capitalist market system, without questioning its misappropriations, which generate poverty, social differentiation and injustice.	Foladori (2002), Lopes (2016), Santos (2008), Pereira <i>et al.</i> , (2010), Souza (2005)
	Professional training	Supporting communities by providing technical training for community members, supporting product certifications, and positioning itself as a link between companies and communities, in other words, through this context we can see that joint development favors the growth and benefit of the entire exploited chain.	Gallo (2007), Elkington (1997); Werbach (2010)
Economic	Adoption of sustainable practices with a view to improving reputation and market value.	The implementation of a sustainability policy in organizations is strongly related to their strategic management (which aims to guarantee long-term gains), as sustainable practices result in better product acceptance, innovation and cost reduction.	Dias and Barros (2008), Elkington , Coral (2002) and Catalisa (2003)
	Production planning driven by customers, thus requiring operational planning.	Planning and controlling the flow of goods, information and resources from suppliers to the end customer, in order to manage all the relationships between the links in the logistics chain in a cooperative way, with the aim of benefiting everyone involved.	Ching (2001), Ballou (2002)
	The flow relationships of the wood production process and the management of waste in this chain.	The relationships that make up its flow are understood as inputs and outputs in the form of agents, products and residues (outputs). This process consists of capturing the input, planting, cutting and processing the wood, carrying out the delimbing process, removing the bark, in the case of the manufacture of boards and planks that are destined for industries, intermediaries, manufacturing companies and finally reaching the end customer.	Edgar (1978), Yuba (2005), Opie, Curtin and Incoll (1978), Gonçalves (2000), Leite (1992)

Source: Elaborated by the author (2023).

#### **3 RESEARCH METHOD AND PROCEDURES**

This topic presents the research procedures used to conduct this study, in order to meet the general and specific objectives of this dissertation.

#### 3.1 RESEARCH DESIGN

The research seeks to analyze the sustainability practices of the sustainable timber supply chain in Western Paraná, and the choice of research method is based on the philosophical essence of the researcher, in which, through the interpretation of the elements found in the work, it is possible to find results created from their theoretical involvement, in addition to their respective points of view (Francisconi, 2008; Creswll, 2014).

Thus, this research has a qualitative and descriptive approach, which, according to Richardson (1999, p. 8), can be defined as "studies that employ a qualitative methodology can describe the complexity of a given problem, analyze the interaction of certain variables, understand and classify dynamic processes experienced by social groups". In addition, a descriptive study aims to provide aspects and behaviors of a particular organization, using, as a basis, the applied nature aimed at solving practical problems, seeking to apply scientific knowledge directly (Beuren *et al.*, 2014).

In order to meet the objectives, we decided to carry out a case study, focusing on the companies that correspond to the second and third tiers of the timber supply chain in the west of Paraná. Yin (2005) indicate that a qualitative case study produces knowledge in a descriptive, contextualized and concrete way; thus, the research carried out is defined as a qualitative case study, in the sense that it seeks to understand and present sustainability practices aimed at the timber supply chain in the western region of Paraná.

The single case study, chosen as the research strategy, was conducted using the research protocol shown in the table. The use of a research protocol provides more rigorous research, especially in relation to supply chain management (Seuring, 2008; Yin, 1994).

Stage	Task	Description
1st	Identifying the layers of the timber supply chain in	The aim is to map the activities
	the western region of Paraná and contacting them.	corresponding to each layer of the supply chain.

#### **Table 10: Research protocol**

2nd	Survey of sustainability practices and rules for timber activities in the region.	It seeks to classify the main existing practices in the activity.
3rd	Interviews with representatives of the timber supply chain.	It aims to gain access to the reality of the agents working in this chain.
4th	Data coding.	The aim is to process and segment the data collected.
5th	Analysis and cross-checking of data between the literature and the actors interviewed.	The aim is to use the data collected to describe the scenario found, comparing the data discussed in theory with the real practices that exist in this supply chain.

**Source:** Elaborated by the author (2023).

### 3.2 DATA COLLECTION

In order to meet the objectives of this research, it was decided to use multiple sources of data in order to understand the structure of the chain under study and its sustainable practices. The following techniques were chosen: bibliographical research, semi-structured interviews and structured interviews.

The purpose of choosing each of these techniques was to gather the data needed to meet the specific and general objectives, as explained in Table 11 below.

Table 11: Definition of data collection techniq	ues
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Specific Objective	Data Collection	Data Analysis			
To map the timber supply chain in western Paraná.	Bibliographical research;				
To identify the elements linked to the sustainable timber supply chain from the literature.	Bibliographical research; Semi-structured interviews;	Content			
To survey the sustainability practices of the timber supply chain in western Paraná.	Bibliographical research; Semi-structured interviews;	Analysis			
To understand how sustainability practices occur in the timber supply chain in western Paraná.	Bibliographical research; Semi-structured interview and Structured interview.				

Source: Elaborated by the author (2023).

#### 3.2.1 Bibliographical research

The research in question used bibliographic data collection in order to support empirical research, which, according to Gil (2017), provides an advantage for the researcher in obtaining existing phenomena and perceptions on the subject.

According to Sá-Silva, Almeida and Guindani (2009), bibliographical research can be perceived with a greater degree of relevance when a researcher uses documents in order to extract information and content relevant to the work. In this way, the researcher investigates, examines or even uses appropriate techniques for handling and analyzing them, so that, following stages and procedures for organizing the information to be categorized, they then analyze it and, finally, it is possible to draw up syntheses based on the treatment of all the information previously collected.

In accordance with the specific objectives of this research, validation and scientific evidence are fundamental when it comes to preparing a new work, and it is possible, by identifying works already published on the subject, to compare data and information that serves to support the evolution of the literature.

The construct was based on the work of Das (2017) and was complemented by a literature review, with contributions from Baldwin and Clark (1999), Cavalcanti, (2004), Carter and Rogers (2008), Seuring and Müller (2008), Beske and Seuring (2014), Wang and Dai (2017), Correia *et al.* (2017), Laosirihongthong *et al.* (2020) and Correia *et al.*, (2021).

#### 3.2.2 Semi-structured and structured interviews

The interview can be understood as a technique or tool for carrying out research or fieldwork, and is used "in the broad sense of verbal communication, and in the narrow sense of collecting information on a particular scientific topic [...]" (Minayo, 2016, p. 59). This method of data collection presents itself as a possibility of perceiving the thoughts of others, identifying relationships that allow the researcher to carry out reworkings, considering new instruments that are relevant to the historical and social moment in which they are inserted (Souza & Pucci, 2022).

In this way, it can be seen that the interview is the means by which the author can find out elements to diagnose a problem or effect to be researched, by means of the content shown by people who are part of the context being analyzed. This gives the author credibility with regard to the content collected, which will ultimately guarantee a coherent analysis and interpretation of the facts pointed out.

In order to meet the proposed objectives, we chose to use interviews organized into two parts, one semi-structured and one structured. The semi-structured interview was guided by a script made up of 29 questions, divided into 3 groups, based on the model presented by Das (2017) and adapted from the theoretical framework (Table 5 and Figure 3), as shown in Appendix A. The questions were asked leaving the interviewee free to express their ideas on a given topic or subject and with the aim of guiding the interview along a path that would contribute to understanding the information.

The interviews were directed at the main players in the chain who had technical and practical knowledge of the activity carried out by the company and the practices adopted by it. The companies were selected through a survey of companies in the region that carry out commercial activities in the timber sector. This selection began with a general search in a browser, where, with the help of a GPS tool, the search area could be delimited and, using filters, the type of company for which the study was aimed could be selected.

Subsequently, filters were used to eliminate companies that did not fit the proposed study, as well as segmenting them according to their size and main activity. According to Sebrae (2013), companies can be classified as:

- Individual Microentrepreneur Annual turnover up to R\$ 81 thousand;
- Microenterprise Annual turnover of up to R\$ 360 thousand;
- Small Business Annual turnover between R\$ 360 thousand and R\$ 4.8 million;
- Medium-sized company Between R\$ 16 million and R\$ 90 million annually;
- Medium-large company Between R\$ 90 million and R\$ 300 million annually;
- Large annual turnover above R\$ 300 million.

In addition to turnover, Sebrae also classifies companies by the number of employees, as shown in Table 12 below.

Tal	le	12	: D	efin	nitio	n of	the	size	of	est	ab	lis	hmei	nts	accor	ding	to	the	num	ber	of	emp	lov	ees
				~					•••						accor	·····	•••				•		- v , '	

Size	Trade and Services	Industry			
Microenterprise	Up to 9 employees	Up to 19 employees			
Small Business	10 to 49 employees	20 to 99 employees			
Medium-sized company	50 to 99 employees	100 to 499 employees			
Large companies	100 or more employees	500 or more employees			

Source: SEBRAE (2013).

The semi-structured interviews were scheduled with the actors by telephone, and there was the option of conducting them face-to-face or via the Microsoft Teams remote platform, due to the interviewees' schedules and travel. All the actors who agreed to take part in the

interview answered the questions remotely at their respective headquarters, which took place between 15/11/2022 and 28/08/2023; in addition, Table 13 below aims to illustrate the entire description of the participants who make up this study.

Company	Company	Size	Interviewee	Interviewee's	City	Interview	
A	Timber and	Small	Interviewee 1	Manager	Foz do	46 min 34	
В	Logging, sawmills and processing	Small business	Interviewee 2	Manager	São Miguel do Iguaçu	sec.	
С	Timber and sawmills	Small business	Interviewee 3	Owner and financial manager	Medianeira	47 min 37 sec.	
D		Small business	Interviewee 4	Manager	Cascavel		
E	Logging, sawmilling and processing	Small business	Interviewee 5	Manager	São Miguel do Iguaçu	48 min 48 sec.	
F	Logging, sawmilling and processing	Small business	Interviewee 6	Manager	Medianeira		
G	Handicrafts and processing	Small business	Interviewee 7	Manager	Encarnacion (PY) and Foz do Iguaçu	57 min 32 sec.	
Н	Manufacturing and processing	Small business	Interviewee 8	Manager	Foz do Iguaçu	50 min 34 sec.	

 Table 13: Representation of the actors studied based on the number of employees

Source: Elaborado pelo autor (2023).

It should be noted that the interviewees featured in the survey work in their companies, and the size of their companies is classified using SEBRAE's definition, based on the number of employees, as shown in Table 12. In addition, it should be noted that many entrepreneurs point out that, when it comes to the number of employees indirectly involved in all stages of the timber supply chain, many of these companies could be classified in the higher size bracket.

To determine the final number of interviews, the Snowball model was used as an exhaustion method. The validation of information consists of the relationship between the elements investigated, making it possible to describe and analyze interactions between a defined set of actors, based on the assumption that those who are united by some interest interact with each other (Barbosa *et al.*, 2000). Therefore, based on this technique of analysis applied according to theory, answers can be found that are capable of explaining complex phenomena.

The structured interview had its research instrument (Appendix A) derived from the studies presented in the theoretical framework, related to the pillars of sustainability, combined with the study by Das (2017), referring to sustainable supply chain management practices and

their performance (Table 5). In this way, the research construct was developed in relation to the practices presented by the author based on his previous studies, with a focus on sustainability practices in supply chain management.

Das (2017) proposed a model covering five dimensions to measure SSCM practices, which were adopted from the study by Pagell and Zhaohui (2009), based on supply chain coordination and trust, supply chain learning, supply chain strategic orientation, supply chain risk management and supply chain continuity.

In addition, five dimensions, containing 19 items, to measure supply chain dynamic capabilities were obtained from Zheng (2017), Shin and Aiken (2012), Klassen and Vereecke (2012), Ramesh (2014), Beske and Seuring (2014), Lin *et al.* (2015) and Meinlschmidt *et al.* (2016), including knowledge acquisition and absorptive capacity, market-oriented perception capacity, innovation capacity, internal reconstruction capacity and social network relationship capacity.

The questionnaire applied was derived from Table 5, proposed by Das (2017), containing 3 blocks, with a total of 40 questions on a 5-point Likert scale, as shown in (Appendix B). The aim was to assess the practices most in line with the reality of each company analyzed; the instrument was applied to those responsible for the companies analyzed based on their perceptions of each topic questioned.

#### 3.3 DATA ANALYSIS

The data was analyzed through content verification and validation, subdivided into the stages of pre-analysis, coding, treatment and interpretation of the results according to the content presented by the respondents, characterizing the research through content analysis. According to Bardin (1977, p. 42), Content Analysis can be defined and represented as a set of communication analysis techniques aimed at obtaining, through systematic and objective procedures for describing the content of messages, indicators (quantitative or not) that allow the inference of knowledge relating to the conditions of production/reception (inferred variables) of these messages.

This technique seeks to demonstrate how sustainability practices are proving relevant to the organizational context, as well as to the wood supply chain.

The first step in the analysis was to transcribe the data collected through the semistructured interviews, using Google Forms to tabulate the data and Google Docs to transcribe the interviews; after transcribing the data, coding was determined according to each group of analyses in order to observe the results in line with the triangulation of each group of questions. This later allowed the analysis and interpretation of this information to be aimed at explaining or understanding the meaning of the content described and analyzed.

For the questions in the questionnaire (Appendix B), a descriptive statistical analysis was carried out using the Google Sheets tool based on the answers obtained for each of the questions developed using the Likert scale concept, and the results were then calculated through on the analysis of the answers collected. This was done by considering the relevance indices presented by the interviewees through their perceptions, based on the context of their activities.

The data collected in the semi-structured and structured interviews, as well as the documents used, allowed us to understand the context of the timber supply chain in the west of Paraná, contributing to meeting the proposed objectives.

Next, the companies taking part in this research are presented, contextualizing their operational history, as well as the activities carried out according to each link in the supply chain.

This chapter presents and analyzes the data collected using the tools described in the methodology, with the aim of answering the proposed problem. To this end, the analysis is divided into sub-chapters, which cover the characterization of the links in the supply chain, the identification of the company's main activity and the products and services generated for the market, as well as the authors' vision of these practices for the region.

#### **Company A**

Characterized as a family business, company "A" was founded in 1978 and is based in Foz do Iguaçu. From the outset, its main activity was in the timber industry; over time, it was able to expand its activities to include the production of doors, windows, hinges and others. The company works with various types of wood, but it has been specializing in reforested wood, investing in green areas and expanding its structures. In this way, it aims to meet the needs of the growing market, since this volume of reforested material now accounts for around 70 to 80 percent of the company's total turnover.

#### **Company B**

Consolidated in April 2021 and headquartered in São Miguel do Iguaçu, the company works exclusively in the processing and sale of treated wood, such as pine and eucalyptus; the choice to work with raw materials of reforested origin was due to the fact that no environmental license was required to operate. The raw material used is acquired in the regions of Paraná and Santa Catarina, and the company adopts a treatment process for these materials in order to guarantee greater durability for this material; the interviewee describes that the treated raw material is destined for civil construction, since the material treatment process does not allow these materials to be used for burning or crushing.

#### **Company C**

The company analyzed is located in the municipality of Medianeira; it works with the collection and processing of wood in general to be transformed into firewood, planks, rafters and the like. The company works with reforested material, such as pine and eucalyptus, since it does not need forestry permits to operate in this segment. As such, the company works to order, i.e. it doesn't have large stocks, as it considers itself a small company. The entrepreneur mentions that he chose to exploit reforested resources because he disagreed with the exploitation of native forest areas, pointing out the damage caused by the unbridled exploitation of various native species during the process of colonizing the municipality.

#### **Company D**

Company D is made up of a group of 3 companies located in the city of Cascavel, which carry out different activities within the wood supply chain; the entrepreneur points out that his companies operate in the door manufacturing, autoclave wood treatment and wood industry sectors. The group of companies is family-run, working on various fronts, with the aim of scaling up the operation, thus achieving greater process efficiency, cost reduction and productivity gains. The interviewee mentions that the timber resource can be easily diversified, so that full use can be made of this resource; even the waste from the production process can be used in other industrial activities, such as burning and heat sources.

#### **Company E**

Operating since August 2008, with headquarters in São Miguel do Iguaçu, after being reacquired by a group of entrepreneurs, the company began its activities only by providing sawmill services. Over the years, when it acquired a suitable structure, it began to process and sell exotic species, thus adapting the plant's operational process. Currently, the company's key activity consists of sawing and selling Pinus and Eucalyptus, as well as providing sawmilling services on presentation of ownership documentation and authorization from environmental agencies such as Ibama and IAP.

#### **Company F**

Company F is a small business specializing in handmade carpentry, making doors, windows, tables and other items from wood sourced from reforestation and demolition timber. The owner points out that he chose this business model because of the major crises that affected the family business, which had a large company in the region, founded in 1959. The company employed around 50 people and had an average production flow of 400 to 1000 cubic meters of sawn timber per month. However, due to the high level of defaults, the entrepreneur felt forced to switch businesses; currently, the company operates exclusively by providing services, which, according to the entrepreneur, allows him to increase his financial gain, since the company doesn't have to invest in stocks, large machinery or even losses of raw materials.

#### **Company G**

The company is characterized as family-owned and is in its third generation of loggers, so that, in view of the break-up processes generated by family successions, the company under study was formed, operating in the reforested wood sector. This company operates mainly with Pinus and Eucalyptus, producing sawn timber, high-end residential doors, Finger Joint, WPC and others, which are destined for the domestic and export markets. The entrepreneur mentions that such a structure can be formed in the face of international demands regarding the quality of the product marketed and product traceability, investing heavily in the adoption of sustainable practices in order to obtain the international sustainability seal, the FSC.

#### **Company H**

The company in question can be characterized as an arm of the company "G", operating in the import, marketing, installation and maintenance of residential doors manufactured by company G. This company was founded in 2011, with its main focus being the sale of madeto-measure doors, so that it operates exclusively in the field of doors produced from reforested wood and recycled material, such as PET bottles, encouraged by the strong demand from the construction market, which lacked specific products for each project that had specific characteristics, being resistant, durable and of quality.

#### 4.1 CHARACTERIZATION OF THE LINKS IN THE CHAIN

According to the searches carried out and the compilation of the data found in the survey, two main groups related to timber activity were identified, characterizing the second layer of the chain. This sector focuses on sawmilling activities and the transformation of raw wood into first layer wood products, such as boards, beams and their by-products.

The other group, on the other hand, is characterized by the third layer and stands out for the process of industrializing this material, adding technological and industrial resources, so that it is possible, through the transformation process, to use wood inputs to make a final product, such as furniture, handicrafts and other articles of forest origin, which, as a result of the manufacturing process, result in goods with a quality and finish superior to the raw material, as highlighted in Figure 9 below.



# CHARACTERIZATION OF THE WOOD

#### Figure 9. Characterization of the Wood Supply Chain in Western Paraná

Source: Elaborated by the author (2023).

During the interviews, it was asked whether any of the companies were active in the first phase of the supply chain, whether they were engaged in reforestation or forestry; however, no companies were found that were active in the first layer of the chain in the region, as shown in Figure 9.
## 4.2 RESULTS DEMONSTRATION

The selected research instrument was used to get to know the reality of the members of the supply chain selected, with a view to understanding the characteristics of the sector, as well as its challenges. The objective of the interview is to characterize the reality presented by the interviewees, so that, through this method, it is possible to identify the main points that may be related to sustainability practices in the timber sector.

4.2.1 Description and analysis of the semi-structured interview - characterization of the timber supply chain in western Paraná and sustainability

This chapter aims to determine the results found from the interviews carried out and the elements addressed by the respondents at the time of the interview, in such a way that the results set out in the chapter are based on the individual reality existing in the activity of each of the interviewees.

# 4.2.1.1 Availability of reforested resources in the region

Company A's representative said that in the past, it was easier to access forestry inputs in the western region of Paraná, with the main source of access to raw inputs being the import of raw wood from the triple border countries. However, the businessman points out that, over time, the process of importing wood has become unfeasible, given the greater rigor in the process of importing this input by customs agencies.

When asked about the supply and volume of wood resources from reforested sources to supply the western region of Paraná, interviewee 1 pointed out that reforestation activity is more intense in the south of the country, thus favoring access and competitiveness with the choice of this crop.

Company B points out that Pinus is a species with little availability of forests in the region, unlike Eucalyptus, which is characterized by a species with a greater volume of cultivation in the region, given its great versatility and adaptability to the region's soil. The businessman points out that one of the main challenges for the timber sector is the rising price of wood in the region, so that it is necessary to source these inputs from increasingly distant regions.

Interviewee 2 points out that the volume of timber inputs produced in the region is not abundant, so that it is possible to supply all those who need the input for their activities, especially when it comes to grain storage and poultry farming. These are sectors that require a high volume of firewood to guarantee their production, but the sharp rises in the prices of this commodity affect the daily lives of timber companies, as well as these producers.

Company B points out that Eucalyptus is a species that does not allow for good grain production in its surroundings, due to the shade generated by its trees; therefore, it can be seen that many rural producers, when felling and selling these inputs, choose not to reforest the areas previously cultivated with timber resources, thus migrating to farming activities in view of the greater productive viability of this resource.

Company D points out that, faced with the various ups and downs of the timber market, the strategy it has found for the operational viability of its business is characterized by negotiation between producers in Santa Catarina, who carry out monthly negotiations determining the monthly volume to supply all the group's companies: "this has been outsourced for a long time, right, so we don't do this part, our process starts with the logs in the yard". The entrepreneur points out that he opted for this operation because of the seasonal nature of the products on offer in the region and because, in many cases, it wasn't economically viable for his business.

Company E says that it buys Eucalyptus logs directly from rural producers, since, as it is reforested wood, there are no legal documentation requirements for exploiting this resource. In addition, those responsible for the company point out that they choose to buy these inputs from rural producers, with a view to the mutual development of the region, since the district's economy is basically driven by agriculture, and in many cases it is common for them to pay for part of the forest resource collected on the property, which is used for wood for furnaces and poultry on these properties.

Company G points out that it mainly processes reforested Pinus and Eucalyptus wood, but may occasionally work with other species if there is a specific contract or request to fulfill. This is because the choice of reforested wood came about because of the intense control of native woods, which led entrepreneurs to add reforested wood to their production process.

The entrepreneur points out that one of the ways to get around the challenges of sourcing reforested raw materials in the region was to set up his factory in Paraguay, where the greater availability of reforested resources and more flexible rules for his business enabled him to operate more efficiently, turning to the industrialization of this raw material.

# 4.2.1.2 Relationship with suppliers

The relationship between suppliers consists of negotiating and guaranteeing supplies for companies in the region, so that, through planning, efficient production control can be developed and the supply of subsequent layers of the supply chain can be guaranteed.

With regard to the relationship between suppliers, company A believes that many of its suppliers have been working together with the company for many years, so that there is a fairly consolidated relationship and working method between the parties. For the entrepreneur, this is considered a fundamental point, given the impossibility of making constant visits to the extraction areas where his suppliers are located, given the great distances and travel time.

The entrepreneur points out that access to reforested wood in the region requires greater commitment, since in most cases this activity is concentrated on obtaining raw materials from small producers, which generates a constant flow of negotiations (Interviewee 1).

Company B, on the other hand, points out that its operation can be characterized by two systems of relationships between suppliers, one of which is through contracts, in which its suppliers produce a specific type of input, which already has its characteristics predetermined, and are then delivered to its client.

The other type of relationship is negotiated between owners of plots with forest reserves, where Eucalyptus areas are very common in the region; in this case, the company points out that, for each negotiation, there must be a prior analysis of the quality and viability of the input, as well as checking that certain technical criteria are met that are considered fundamental for subsequent marketing:

Always before we buy or close a deal, we go to see the areas because we work to a quality standard, so the strut depends on having a standard, it has to be straight, it has to be at least 6 to 8 centimeters thick, it has to be Eucalyptus that can't be dry, so we study everything that can be done and analyze whether it's worth it or not, because it's a reserve area where you can't take it, so we evaluate all of this. (Interviewee 2)

Company C points out that its means of contacting suppliers in the region is informal and is carried out through visits to the property, searching for offers on social networks or websites. The entrepreneur points out that, when possible interested parties are identified, he visits the site and points out all the terms of the extraction process, after which the amounts and frequency of the volume removed are determined.

As for company D, the entrepreneur points out that, in certain regions, there are even strict rules regarding the extraction of reforested timber, since many forest reserves have adopted international criteria to obtain these resources, as the interviewee points out. These people who extract the wood in the forest are obliged to follow strict rules, you know, because the companies that own the big forests in Brazil today are generally in the hands of foreigners, right, and they have some very strict rules, like the truck can't go in there if it's dripping with oil, the whole safety thing, there's a lot of it, it's something very specific, and these are very strict rules that they have to follow. (Interviewee 4)

In this case, Interviewee 4 mentions that, in order to achieve operational efficiency, they have opted to outsource the process of acquiring and collecting raw materials, having agreements that guarantee a minimum volume of wood resources in the yard of their industries, which are then treated and processed according to the purpose for which they will be used.

Company E adds that "here in our region there is no company that works with reforestation" (Interviewee 5); in this case, a lot of wood ends up coming from other regions of the state, especially wood that requires a specific measure for processing.

Interviewee 5 mentions that his industry is basically supplied by acquiring its raw materials from rural producers. In many cases, these are old species of Eucalyptus that were planted in areas where agriculture was not viable in the region, due to the fact that the areas were very hilly, with rocks. However, with the passage of time and the evolution of mechanization, these areas can now be used to grow cereals.

For company F, there is no need for a relationship with suppliers in order to obtain stocks, since the company's activity is focused on providing services; however, the entrepreneur points out that the relationship with the client, before starting any service, is something that is considered fundamental, since it is necessary to align details in advance, be it regarding the final product, the resources needed or the waste generated. As such, the entrepreneur points out that the main objective is to make the best use of the resources made available, with the aim of achieving the greatest possible transparency among his clients, since they handle hardwoods with high added value.

In addition, interviewee 6 points out that his relationship with suppliers is restricted to the supply of products and tools needed to provide services, and that it is not essential to obtain considerable volumes to build up stock and supply supplies.

Company G points out that, in order to guarantee the supply of its resources, it is essential to invest in networking, so that the range of suppliers can be expanded to guarantee the volume of timber resources needed for the operation. The entrepreneur mentions that, given the context and reality of his company, it is very common to import wood from other countries in order to guarantee the volume of wood needed.

For example, I bring in a lot of wood from Argentina, not just because of the price, but also because of the quality, because there's been a culture of reforestation there for many

years, so the wood I buy there is already better, right? The wood I buy there is already kiln-dried and planed, so it's already dimensioned, so my process goes backwards and takes a leap forward in the industrial process. (Interviewee 7)

In this case, the entrepreneur points out that he works with a team that tries to find available resources in order to negotiate them in advance, according to need, quality and other criteria determined by the industry. He also stresses that, when it comes to an industrial process, having a good relationship with your suppliers can be crucial to the success of your business.

Company H, on the other hand, points out that its supply is based on the progress of contracts with construction companies in the region, so that, depending on the volume of work, it places new orders with its supplier, characterized by company G.

Given this scenario, as this is an operation initiated through future contracts, it is necessary to place an import order in order to obtain this supply; in this case, the entire company operates on the basis of long-term planning, holding a regulatory stock to guarantee the necessary supply for its activities.

# 4.2.1.3 Environmental legislation and licenses

With regard to legislation and compliance with environmental rules, company A points out that forestry origin documents are only required for native species that are commonly purchased in the northern states of Brazil; for exotic species, the interviewee describes that there are no documentary requirements, since they come from reforestation.

In this context, environmental rules aim to control the undue exploitation of timber resources of native origin, with the aim of ensuring that extraction takes place in a controlled manner, respecting the stipulated environmental guidelines. In this way, a resource is obtained that is backed up by its origin; using this example, the interviewee points out that "if you don't go through this process, the moment you get to the first tax office you'll be fined, you'll even be imprisoned." (Interviewee 1)

Those responsible for companies B and C report that, as they only work with wood of reforested origin, treating Pinus and Eucalyptus, there is no need to obtain forestry documentation. In this case, the necessary processes are limited to the purchase of the raw material via the producer's invoice issued by the owner of the property.

Interviewees 2 and 3 point out that operating in the reforested wood segment exempts the company from paying for annual environmental licenses, which is mandatory for companies that harvest hardwoods. In this sense, it is possible to point out that the environmental rigor is aimed at protecting the remaining areas of native forest in the region. This is because, during the period when the region was colonized, various species were improperly exploited, causing irreparable environmental damage to the region, as Interviewee 3 points out: "In the old days, it was Cedar, Angico, Pau-Brasil, whatever came up, they sawed it and took it in the middle of the road, there wasn't much legislation."

Companies C and D point out that one of the major challenges faced by entrepreneurs in the region is that it is not compulsory to reforest the areas exploited in the region. This, consequently, because there is no compensation for exotic species, causes a shortage of timber inputs, so that companies are forced to raise funds from increasingly distant regions. This has a direct impact on the composition of the price charged for the product for the subsequent layers of the chain.

Interviewee 3 points out that, currently, "any piece of land that exists, that can be planted [...] people choose to plant it, right? so the wood in our region, even the reforested wood, has diminished a lot, and we're already looking for it in Santa Catarina."

On a positive note, company D points out that the environmental rigor provided by regulations reinforces the companies' commitment to transparency in their business, as well as guaranteeing full compliance with the stipulated standards. In this way, the interviewee reinforces their commitment to complying with the legal practices for their activity.

Look, in this matter of social causes and reforestation, our position is that under no circumstances do I saw hardwood if it hasn't been authorized by IBAMA or the IAP and if it doesn't have documentation destined for my timber company, so I think that this point is my credibility, when someone needs to saw some wood and does so with an IAP license, they go directly to my company's register number for the person to do the service with me, so I believe that this is our market credibility, yes, because if you ask anyone if they can saw hardwood with me, I'm sure that 100% of the answers will be no, they won't do it without a document, so this is something we make very clear, we don't do hardwood services without documentation and another thing, our yard is an open yard, so anyone who wants to can go in and look at what I have. (Interviewee 4) Entrepreneur E, on the other hand, points out that there are no regulatory pressures in

his business. This is because his business is all about providing services and using the resources provided by his client.

In terms of legislation, the entrepreneur points out that the tax rules do not favor the entrepreneur, so it is not possible to see a significant return on the tax burden for larger companies. "Brazil has become a strange business to work in, because the more you work, the more tax burden you generate and sometimes you can't pass it on, most of the time you can't pass it on because things have become absurdly out of context" (Interviewee 5).

Entrepreneurs F and G, on the other hand, point out that the rules are often confusing and that the biggest barrier in the sector is the lack of a clear definition of the rules:

What I think has an impact is when there's a very sudden innovation in the law, 'oh no, now you have to control what, I don't know what', but in the end you see that in practice it's a bureaucracy and then the state body that's demanding it from you doesn't even know what to do with this information, right? (Interviewee 7)

In view of this, the entrepreneur of Company G also points out that, on several occasions, he has had to reformulate his business strategy in the face of various changes to regulations, statutes and technical criteria, which has an impact on the slowness of the economic process.

4.2.1.4 Challenges facing the sector

Regarding the sector's challenges, the entrepreneurs interviewed were unanimous in pointing out that self-sufficiency in the timber industry is one of the determining factors for their business. As a result, many entrepreneurs in the sector have been investing in new work fronts, especially in practices in the stages prior to the process in which their business is inserted.

Even so, the entrepreneurs point out that all this investment is only possible if there is a way to obtain a healthy financial return, based on the existing challenges in the sector; the interviewees point out their opinions of what they consider relevant to the context of the activity:

**Interviewee 1**: "Man, so, I think the most difficult thing for us in terms of sustainability is that we depend a lot on other people, for example today if I don't know, hypothetical of course, right, but let's suppose that 100% of the people who sell logs sold them for export, I'd have to close my doors, so I can't manage today with what we have to be self-sustainable, it's impossible, impossible because the market is in the hands of three or four companies, right, Guararapes, Clabin, which are gigantic companies, right, and publicly traded, so today if you go to Santa Catarina where there's pine, 99% of the three companies, so today it's very difficult to be self-sustainable, even if we have insignificant sales compared to these companies, but it's still very difficult to achieve this".

**Interviewee 4**: "we already work in an environment that is very much targeted by the inspectorate and by society itself, as if we were the loggers who are destroying the forests, and that's not the case, we want wood for life, so much so that reforestation is there to prove it, because if we don't have wood we won't have anything to do in a while, right, and ten, fifteen, twenty years go by very quickly, so this is a wrong mentality in which we already have to adopt practices in accordance with the regulations, right, with the legislation, so we already have to work in the most sustainable way possible".

**Interviewee 5**: "I think that in ten years' time, whoever has a sawmill is going to be a museum, I think that all of this is going to be industrialized and the wood is going to have to be revised based on this issue, but this company of ours that is active in the market, I think it does have an end, an end that isn't too far away because the cost of maintaining it is very expensive, right, and you'll have to bring in wood from a long way away, which will increase the cost a lot, and what will pay off is for you to buy from a distributor or a timber company where you only work with this, right, where you only buy wood and resell it".

**Interviewee 7**: "I think it all depends on the use of the land, right, so you see the west of Paraná is essentially agriculture, right, the guy is going to plant soya there is going to be a price per ton, so that land has to pay off for him, right, although there are studies that say that reforestation is almost as good as soya, I think it's going to be a long time before the people who plant soya today say I'm going to plant 100 hectares of wood there and let's see what happens, right, so while in Argentina, for example, they've already done this region here in Missiones, they already changed the forest cover a long time ago and there they allowed you to remove native forest at one time and plant it again, so it was important to change "Green for Green", although we know that with all the environmental discourse that exists today, it's not quite like that, but when it was done in the past, that's how it was done".

Based on what was said by the interviewees and reinforced by the theoretical framework of this research, it was identified that sustainability in the timber supply chain is a measure aimed at achieving operational efficiency, which also poses major challenges; as such, it requires investment in different spheres in order to guarantee balance in this sector.

The environmental certification process stands out as one of the measures to certify that the production model used is in line with sustainability standards. In this way, it aims to demonstrate to the market that the company is practicing environmentally correct practices and guarantees that its entire supply chain complies with sustainability standards.

However, interviewee 7 states that the costs involved in maintaining the sustainability label are high and often financially unviable for the company. This is because many of their customers don't care whether they have the label or not, and are unwilling to pay more for a certified product.

Furthermore, interviewee 8 contributes by saying that forest certification is no longer a reality in the company, since the domestic market does not show importance for a product of sustainable origin.

The entrepreneur also mentions that there is a lot of resistance in the Brazilian domestic market when it comes to the prices given to sustainable products, since in many cases the customer won't accept paying more for a product that is identical to a conventional one, which doesn't follow any sustainability practices or guarantees.

# 4.2.2 Description and analysis of the structured interview - Sustainable practices in the Western Paraná timber chain

Sustainability practices are characterized as actions aimed at proposing strategies capable of generating improvements, starting with organizations in relation to the ecosystem in which they operate. These actions contribute to fairer and more sustainable growth, since these practices are based on each weakness found in each of the links in the chain. Sustainability practices are characterized as: (i) environmental management practices; (ii) operational practices; (iii) supply chain management practices; (iv) social inclusion practices; and (v) socially inclusive practices (Das, 2017).

# 4.2.2.1 Environmental Management Practices

With regard to environmental management practices, it was found that the companies included in the survey have similar practices to each other, given their main activities and nature of operation. The study can highlight that companies A, D and E presented practices 2, 4 and 5 with a focus on meeting the conformities and specifications provided in the project, as well as addressing environmental concerns, using means that allow them to consume less raw materials in the process. This is because their business model also allows them to invest in the other layers of the supply chain, thus developing strategies to minimize losses and gain in scale.

As for companies B, C and F, it was clear that their practices are limited to practices 4 and 5 and are limited to processes to make better use of raw materials. Thus, there are no practices involving compliance with technical criteria that correspond to environmental demands or even project specifications, since the companies listed above only trade in reforested wood, given that they do not require environmental licenses to exploit these species, as they are exotic species.

Company F points out that it doesn't sell any wood resources, but only transforms wood, whether it's demolition wood or the transformation and use of a particular hardwood into rustic furniture or handicrafts. As a result, the company's concern is limited to practices aimed at ensuring the best use of the material provided by its customers.

As for companies G and I, since they are industries, their main objective is to capture and guarantee wood inputs in order to maintain their full operational activities. As a result, they focus on practices 1 and 5, demonstrating that in order to achieve sustainability in their industrial process, they must invest in actions structured around robust practices, such as ISO 14001.

However, the companies mentioned that their activities are carried out based on technical and environmental criteria. However, they describe that the standards they follow do not have certification as their ultimate goal, but only to guarantee the supplies necessary for their operation. Based on this, the researches of Shen *et al.* (2013) and Pham and Kim (2019) point out that the use of sustainability-based criteria for selecting suppliers encourages companies within the supply chain to adopt environmental policies, such as certifications and the implementation of green practices.

For company H, there is a greater predominance for following a greater number of environmental practices, given the company's activity, as it is a door trade and installation company. In this way, there is contact with the end consumer of a finished product; this activity brings greater pressure and demands from the market, so the company conveys that the product it offers respects practices that ensure environmental management and guarantees that there are no actions that degrade the environment in the previous layers of the supply chain.

With regard to ISO 14001 certification, company H points out that it has already worked with this certification and has the sustainability seal on its products; however, it points out that it currently maintains the practices required by ISO but has opted not to renew the seal in view of the high costs of obtaining and maintaining it. This seal aims to validate that the company's practices are in line with environmental criteria; in addition, the entrepreneur points out that one of the challenges encountered in environmental certification is the fact that many markets do not recognize or give importance to the existence of the seal.

Table 14 below highlights the practices found in each of the companies analyzed.

Company	А	В	С	D	Е	F	G	Н
EMP 1							х	x
EMP 2	х			х	х			х
EMP 3								
EMP 4	х	х	х	х	х	х		х
EMP 5	х	Х	Х	х	Х	х	Х	х

 Table 14: Environmental management practices

Source: Elaborated by the author (2023).

In view of the environmental management practices found based on Das (2017), it is suggested, based on the studies by Beske and Seuring (2014), that the focal company and its

suppliers adopt environmental standards and certification (e.g. ISO 14001) to minimize the risk due to adverse environmental impact. This could mobilize actions aimed at reusing and recycling products in its production line.

# 4.2.2.2 Operational Practices

With regard to operational practices, the companies analyzed also follow a similar profile to each other; with regard to the actions they take, companies A, B, C, D, E and H highlighted that they carry out all the operational practices identified in the survey, such as organizing the production process, adopting concentrated production in order to minimize costs, as well as adopting practices aimed at economies of scale, prioritizing delivery to their customers as a way of making the processes viable.

Company F, on the other hand, does not require stocks to operate its activities, as the company operates exclusively in the provision of services, using techniques for restoring and processing the raw materials offered by its customers. For this reason, it does not consider the practice of stock control techniques.

However, the answers described a diversification of results based on this practice, which is explained by the reality of each company's production process through the different strategies used in each business model. In this sense, the result seeks to describe the opinion of each interviewee regarding the production process considered ideal for them.



Figure 10. Levels of importance related to inventory control

Source: Elaborated by the author (2023).

With regard to companies G and I, again, the group of companies had the same operating practices, as they are industries with a similar profile in terms of operating activities. In this context, the companies do not consider that the adoption of lean production practices is aimed at minimizing costs, given that the operating strategy used by these companies only occurs by making maximum use of the resources and implements made available by the operation.

In this context, it should be noted that, according to Pusavec, Krajnik and Kopac (2010), the industry has been making efforts to promote sustainability by changing the design of its products, developing new materials, reusing and recycling materials and reducing waste, and there is a prospect of increased investor interest in industries with sustainability practices and the application of the 6Rs concept (remanufacture; redesign; recover; recycle; reuse; and reduce), as the evolution of green production and the basis of sustainable production.

Table 15 below shows the operational practices found in each company analyzed.

Compan y	А	В	С	D	Е	F	G	Н
OP 1								
	Х	Х	Х	Х	Х		Х	Х
OP 2								
	Х	Х	Х	Х	Х	Х		Х
OP 3								
	Х	Х	Х	Х	Х	Х	Х	Х

Table 15: Operational Practi	ces
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Source: Elaborated by the author (2023).

For Das (2017), operational practices involve the introduction of operations management techniques to increase efficiency, improve quality, reduce inventories and minimize waste throughout the value chain, and the best-known practices include TQM, six sigma, value engineering, JIT, lean production, inventory management, etc. Yang *et al.* (2010) indicated that the implementation of supply chain practices and continuous improvement, such as JIT and TQM, leads to a company's industrial competitiveness in terms of cost, quality and delivery.

## 4.2.2.3 Supply Chain Management Practices

As for the practices related to supply chain management, there was a strong tendency among companies A, B, C, D, E and G to adopt practices 1 and 2 highlighted in this study. Thus, the practices aim to observe whether, for the companies, the production plan is developed in such a way that it is in line with customer needs. This allows them to share their demands among their suppliers, thus guaranteeing greater speed when it comes to serving their customers.

Company F pointed out that it only follows practice 1 because of the planning and maintenance of its work schedule, given the need to assess issues such as the time required to carry out the services, the tools needed and travel, but described the other practices as not fitting in with its business model.

For company G, the system is inversely proportional; the entrepreneur points out that, because he has developed a more robust business model, he doesn't specifically need to share his demand with his suppliers, since his company has regulatory stocks to maintain its activities.

Company H points out that its demand comes from future contracts signed between large construction companies with previously stipulated deadlines and conditions; therefore, as these are tailor-made products, the entrepreneur points out that he does not maintain orders according to occasional needs. The company uses extensive planning, taking into account various variables, and draws up a production plan for its supplier, who has the finished material available before the start of the door installation phase, in accordance with the deadline specified in the contract.

The entrepreneur mentions that the company focuses on practices 2 and 3, highlighted in the survey, so that it takes responsibility for responding quickly to its supplier's needs. It also aims to communicate quickly about the needs determined by its customers; in addition, the entrepreneur mentions the need to keep a regulatory stock for possible replacements due to damage or malfunctions during the installation process.

Figure 11 below shows a broad overview of the opinions divided between the different members of the supply chain in the western region of Paraná. The graph reinforces that, across the different realities of the companies, concerns about the supply chain are focused exclusively on meeting the demands of their operational structure.



**Figure 11. Levels of importance in relation to future needs determined by customers Source**: Elaborated by the author (2023).

For company I, the concern about supply chain management involves all spheres, since its main activity requires a large volume of raw materials to guarantee the continuity of industrial processes. In this way, there is no need for partial or temporary stoppages in the factory's activities due to the availability of resources; the company mentions that supply chain management measures are heavily invested in, including reforestation practices in the western region of Paraná.

In this sense, Vachon and Klassen (2006) point out that a company can choose to get directly involved and invest its own resources to improve the environmental practices of the members of the chain, but it can also use its power or market mechanisms to influence them.

In view of the description of operational practices in relation to the reality of the companies in the study, Table 16 below visually demonstrates the practices found in the supply chain in the western region of Paraná.

Company	А	В	С	D	Е	F	G	Н
SCMP1								
	Х	Х	Х	Х	Х	Х	Х	
SCMP2								
_	Х	Х	Х	Х	Х		Х	Х
SCMP3								
								Х

**Table 16: Supply Chain Management Practices** 

Source: Elaborated by the author (2023).

Supply chains generally include numerous activities spread across multiple functions within an organization and also across different organizations, both upstream and downstream. In this context, Das (2017) points out that the challenge of managing a supply chain is faced not only by coordinating production, transportation and inventory decisions, but more generally by integrating the initial end of the supply chain, from customer demand to the final end of that chain.

# 4.2.2.4 Employee-Centered Social Performance Measure (ESPRM)

With regard to employee practices, the companies under study were unanimous in their compliance with and appreciation of the processes. Entrepreneurs pointed out that complying

with practices aimed at employees guarantees their right to a livelihood and, moreover, is mainly a legal obligation that allows employees access to the job market and labor rights without violating any rules.

In view of this, Jacobi (2002) points out that this process of inclusion has generated new job opportunities, as well as contributing to the environmental awareness of this group of workers, who, until then, had been marginalized by public authorities and local society. In addition, in a study carried out in the construction sector, Silva *et al.* (2006) point to the decision by the Belo Horizonte city council to formulate and implement a municipal policy for the integrated management of construction waste, based on the following principles and guidelines, which are similar to the practices proposed by the study on the wood supply chain:

- To promote the formation of partnerships between various actors (public and private), based on trust and cooperation, with the aim of improving the efficiency of the waste management process, reducing operating costs and encouraging the use of installed skills;
- To promote environmental education with the aim of raising the awareness of various types of interested public, such as construction companies, waste collectors and transporters, public authorities and citizens, among others; and
- To promote social inclusion by generating employment and income, taking into account processes.

In this section, all of the practices were complied with by all of the companies analyzed, with only the business owners' opinions differing as to what governs social inclusion practices for employees. In addition, they stand out in the concern given to entrepreneurs regarding the selection of labor employed in their operations, so that enslaved, forced or child labor is not accepted or allowed, as shown in Figure 12 below.



Figure 12. Levels of importance regarding the non-use of enslaved, forced and child labor.

Source: Elaborated by the author (2023).

The business owners interviewed said that the employee selection process requires a thorough analysis of the candidate's previous experience, since the reality of the business requires not only physical skills, but also technical and practical skills aimed at correctly processing the raw material, as well as the proper use of protection for each activity performed.

It is known that social inclusion practices for employees are aimed at guaranteeing compliance with labor rights, as proposed by the Ministry of Labor and Employment, however, there are already companies that consider investing in practices aimed at developing actions aimed at improving the quality of work for employees in their work activities, even if these practices are not a requirement proposed by regulatory bodies or through compliance with mandatory practices.

According to Das (2017), practices aimed at employees range from provision for fair wages and benefits, a safe, healthy and positive working environment, health benefits, leave and other additional benefits, as well as opportunities for growth. In addition, there is the prohibition of child labor and the protection of labor rights, which were also considered within the scope of socially inclusive practices for workers, as described by Mani *et al.* (2015) and Zhu *et al.* (2016).

# 4.2.2.5 Socially Inclusive Practices for the Community

Practices aimed at social appeal are seen as fundamental for all the companies analyzed in the study. Thus, practice 1 is practiced by all the members of the supply chain studied; the analysis shows that the companies consider it important to make investments that create jobs for the local community, so that this investment does not allow the operational activities of their business to be extinguished in their region due to a lack of contingents for the operational activities of the business.



**Figure 13. Levels of importance regarding socially inclusive practices for the community Source**: Elaborated by the author (2023).

However, the adoption of socially inclusive practices for the community is not as widespread for practices 2 and 3 as it is for practice number 1. The context of the companies that carry out activities focused on investment practices in the areas of medical assistance and assistance to the community's education, in short, are companies made up of large amounts of capital, as these practices require a high level of investment in the company's economic structure, in other words, they are actions carried out by companies that, in theory, carry out activities that require investment in various sectors and their work fronts.

In this way, it is possible to guarantee the predominance of their activities, so that they also end up carrying out primary assistance actions, with the aim of proposing elements capable of supplying their own supply chain. Table 17 below illustrates socially inclusive practices for the community, highlighting the companies that adhere to each of the practices listed in the survey.

Compan								
<b>y</b>	Α	В	С	D	Ε	F	G	Н
SIPC1								
	Х	Х	Х	Х	Х	Х	Х	Х
SIPC2								
SIPC3								

**Table 17: Socially Inclusive Practices for the Community** 

Source: Elaborated by the author (2023).

Das (2017) points out that socially inclusive practices for the community refer to the investments made by a company in creating opportunities for the surrounding community, in terms of generating employment and business. In addition, it also refers to the provision of education, training and health facilities, with a view to making the company progressive in the eyes of the public and other stakeholders. However, it can be seen that there is still a lack of adherence to broader practices by companies, so that the community can be assisted by the main resources needed.

#### 4.2.3 Performance measures

Similar to sustainability practices, performance measures can be characterized as metrics to measure the strategies proposed by the organization so that they function as mechanisms that allow the company to carry out its strategies in order to achieve the practices described as the organization's sustainability objectives. The performance measures mentioned above can be described as (i) competitiveness performance measures; (ii) environmental performance measures; (iii) operational performance measures; (iv) social performance measures for the community (Das, 2017).

# 4.2.3.1 Competitiveness Performance Measures

With regard to competitiveness performance measures, the diversity of possibilities found in the operational strategy of each organization stands out, highlighting the predominance of measures aimed at improving the quality of the products and services offered, better use of the productive capacities of each organization, advancing competitive advantages by offering differentiated products, greater retention and the opportunity to attract new customers.

As a characterization of the region's competitiveness performance measures, Balzan, Brum, Trennpohl and Kohler (2020) point out that the furniture industry is a sector that is well distributed in Brazil, with the supply chain developed mainly in the South and Southeast regions. Thus, through the links, it seeks to develop products to meet the increasingly demanding market, also targeting the foreign market. This corroborates the fact that different strategies are fundamental means of guaranteeing the sustainable performance of the timber chain in the region.

With regard to the measures found, there was a strong adherence to CPM3, which aims to measure performance in terms of mechanisms for adjusting and improving the use of the organization's capacity/productivity. Thus, by calculating the elements proposed by the respondents, a strong influence was found regarding this measure in relation to the performance expected by the organizations, as shown in Figure 14.



**Figure 14. Levels of importance regarding adherence to CPM3 Source**: Elaborated by the author (2023).

Performance measures provide the company with the means to develop actions aimed at effectively achieving sustainable practices. Shen *et al.* (2013) point out that the use of sustainability-based criteria for selecting suppliers encourages companies within the supply chain to adopt environmental policies, such as certifications and the implementation of green practices.

Furthermore, as awareness of such practices has evolved, it is natural to seek to acquire products or services that offer low cost, high quality and compliance with environmental standards (Miranda *et al.*, 2018).

About CPM7, companies that work with the industrial processing of timber resources point out that the industrial process allows the company to achieve total efficiency, so that everything from the raw material to the by-products generated by the production process is used. From this perspective, Ociepa-Kubicka and Pachura (2017) described that eco-innovation practices in production processes involve the insertion of new technologies, processes and services aimed at contributing to the preservation of the environment.

Table 18 below illustrates the distribution of companies in terms of their adherence to each of the performance measures found in the field.

Company	А	В	С	D	Е	F	G	Н
CPM1						Х		
CPM2	Х	х	Х	Х	Х	Х	Х	х
CPM3	X	X	Х	Х	Х		Х	Х

**Table 18: Adherence to Competitive Performance Practices** 

CPM4	Х	Х	х	х	х		Х	
CPM5	Х	Х	Х	Х	х	Х	Х	Х
CPM6	х	Х	х	Х	Х	х		х
CPM7							Х	Х

Source: Elaborated by the author (2023).

The competitiveness dimension seeks to offer unique elements, consistent with the reality and perspectives of each company. Given this essence, Das (2017) points out that the traditional dimension of competitiveness only includes the attributes that interface between the company and the market, so it does not consider environmental practices. Das (2017) also highlights the seminal work of Porter & Van der Linde (1995), which reveals that a company can become immensely competitive by undertaking green initiatives. In this sense, the companies investigated have been seeking different measures to guarantee their market share and thus stand out among their competitors.

#### 4.2.3.2 Environmental Performance Measures

Due to the great worldwide appeal for environmental preservation, it is necessary that products do not contain dangerous chemical substances, presenting a safe use that does not harm the environment. Thus, innovation takes place mainly in design, in order to meet consumer interest (Formóbile, 2019).

In this context, various supply chains have been looking for ways to produce efficiently with as little environmental damage as possible. Through these proposals, the timber sector is also taking steps to achieve sustainable economic results through efficient environmental performance measures.

The environmental performance measures stand out, with measures 1 and 5 having the highest incidence rates in the companies analyzed, with adherence to aspects aimed at reducing effluent treatment and discharge costs, as well as actions aimed at preserving the region's biodiversity. In this sense, it is possible to include sustainable practices throughout the supply chain, such as eliminating or restricting the use of hazardous raw materials, as cited by Hsu and Hu (2009), or through other requirements, such as verifying environmental performance, pollution control practices and obtaining environmental certifications, as cited by Bai and Sarkis (2010).

Figure 15 below highlights the importance of actions aimed at protecting local biodiversity; the item was scored as an initiative taken by all the companies in the study object,

but there is a divergence of opinions regarding the degree of importance that companies attach to this aspect.



**Figure 15. Levels of importance in relation to adherence to EPM5 Source**: Elaborated by the author (2023).

Table 19 below shows the distribution of the environmental performance measures highlighted as a priority for the actions carried out by the companies analyzed. It can be seen that, of all the measures scored, EPM3 did not appear in any of the companies studied; this can be seen from the fact that the timber companies studied do not fell trees to harvest timber in the western region of Paraná; they only process the raw material, which is considered to be an activity with less potential for environmental risk.

Company	А	В	С	D	Ε	F	G	Н
EPM1	х	х	х	x	x		x	х
EPM2		x			x			
EPM3								
EPM4	х	х		x			х	
EPM5	х	х	х	х	х	х	x	x

**Table 19: Adherence to Environmental Performance Measures** 

Source: Elaborated by the author (2023).

Based on the measures presented, Das (2017) points out that there are various performance metrics by which environmental performance measures are measured. This is reflected in actions ranging from a reduction in the release of solid waste, liquid waste, gaseous waste, toxic materials, a reduction in the cost of treating and releasing effluents, a reduction in

the frequency of environmental accidents, but also a reduction in the occurrences of accidents on the shop floor.

#### 4.2.3.3 Operational Performance Measures

According to Siqueira (2000, p.183), measures of operational performance, referring to the network approach, "can be important for describing the new and complex relationships resulting from institutional apparatuses and, above all, the multiple actors involved in these processes [...]", given that, in order to achieve operational viability, companies need to adjust their business model, looking for a model that presents the best operational performance indices.

In view of this, the companies stressed that the performance measures highlighted in the study correspond to the activities carried out by the organizations, in such a way that efficiency in the processes allows the company to deliver more satisfactory results. Table 20 below illustrates the distribution of the operational performance measures found in the survey.

Company В С D Е F G Η Α OPM1 Х Х Х Х Х Х Х х OPM2 х Х х Х х Х х OPM3 Х х х Х Х х Х OPM4 Х х х х Х х Х Х

**Table 20: Adherence to Operational Performance Practices** 

Source: Elaborated by the author (2023).

Das (2017) points out that operational performance measures imply the extent of improvement in organizational performance in terms of cost reduction and efficiency improvement throughout the supply chain. Based on this, Das cites the findings of Gonzalez-Benito (2005), which reveal a significant positive association between advanced operations management systems; thus, allowing measures to be strategically designed in relation to the reality and challenges pertinent to each organization.

# 4.2.3.4 Employee-Centered Social Performance Measure

Performance measures for employees are unanimous when it comes to adopting actions aimed at generating improvements for workers, ranging from ideal working conditions, fair salaries equivalent to the duties performed, to actions aimed at reducing inequalities. In this sense, the table below highlights all the social performance practices aimed at employees that are carried out by each of the companies.

Measures 1 and 2 propose alternatives to reduce inequalities related to remuneration criteria, as well as the benefits paid to employees; while measure 3 highlights actions aimed at improving the working environment. Table 21 below highlights the adherence of all the companies to the social performance measures for employees considered in this study.

**Table 21: Adherence to Employee-Centered Social Performance Practices** 

Company	Α	В	С	D	Ε	F	G	Н
ESPRM1	Х	х	Х	х	х	Х	х	х
ESPRM2	Х	Х	Х	Х	Х	Х	Х	Х
ESPRM3	Х	Х	Х	Х	Х	Х	Х	Х

Source: Elaborated by the author (2023).

According to Das (2017), an organization's performance is usually covered by employee-centred social performance and community-centred social performance. Social performance measures for employees are reflected in terms of reducing inequality in workers' pay, improving the health, working and living conditions of employees, so that they are allowed to develop their capabilities within the organization.

## 4.2.3.5 Community-Centered Social Performance Measure

Measures aimed at social performance can basically be described as closing off and guaranteeing the full implementation of the measures listed above, because in order to reach out to the community, the first step is to guarantee the rights of every citizen. This shows that collaboration is one of the basic principles of supply chain management and is expressed in the integration of key business processes, from the end user to the initial suppliers. This integration provides products, services and information that add value for customers and other stakeholders (Croxton, Garcia-Dastugue, Lambert & Rogers, 2002).

In the face of all the economic disruption that has taken place in recent times, from the use of technologies, tools, weapons and various other means that have been part of the industrialization movement and have generated production processes that allow for faster and faster means of production, the impacts of climate change and its damage to the environment can be seen. Furthermore, it is known that many of these consequences stem from traditional industrial production models, based on the burning of fossil fuels, heavy agriculture and deforestation (Santos, Fernandes, Azevedo & Holanda, 2011).

In the name of the increasingly rapid growth of the western region of Paraná over the past decades, various supply chains have demanded laborers to work in manual activities involving farming, construction and also logging. In view of this, it should be noted that during this period there were high rates of workers who were considered illiterate because, given the reality of families at the time, many workers had to leave school to start work early.

In this context, many companies began to adopt new community-oriented performance measures, with the aim of promoting new opportunities for the community around the organization, as well as improving the company's image compared to past practices.

Table 22 below describes the community-focused social performance measures developed by the companies analyzed.

**Table 22: Adherence to Community-Centered Social Performance Practices** 

Company	Α	В	С	D	Ε	F	G	Н
CSPM1							х	Х
CSPM2	Х	х	х	х	х	х	х	х
CSPM3								Х
CSPM4								

Source: Elaborated by the author (2023).

Based on this reality, community-centered performance actions seek to propose actions aimed at mitigating the social damage caused in the name of the economic development of the time. In this context, Santa-Eulalia *et al.* (2010) point out that in order to improve their economic, social and environmental performance, organizations must develop a collaborative and harmonious relationship between the components of the supply chain in which they operate.

Thus, relationships between companies have become a determining factor for competitiveness and sustainability, so sustainability practices (economic, social and environmental) should be included in the supplier selection process, seeking partnerships with companies that have similar behaviors with regard to sustainability.

# 4.3 ANALYSIS AND DISCUSSION OF RESULTS

It can be seen that timber activity in the western region of Paraná is limited to the second and third tiers of the supply chain, so that the main activity of these companies consists of diversifying the wood in their sawing process, allowing timber companies to process and distribute this resource. Furthermore, it should be noted that no reforested areas were found in the region to obtain raw materials, even though agricultural activities in the region have intensified in the face of grain production, such as barley, corn and soybeans, which reduces the supply of the central raw material for this chain.

The region's logging activity is characterized, above all, as commercial with major challenges; however, despite this, the results of the research show that sustainability practices are carried out that aim to guarantee rights based on the three pillars of sustainability. The results show that the sustainable practices adopted by the members of the supply chain in their day-to-day activities are aimed at guaranteeing the continuity of the chain, in view of a challenging future scenario. Even in the face of the difficulties faced by the chain, the interviewees point to opportunities for their activity, such as encouraging reforestation in the region, mechanizing the production process, adopting a production model focused on productivity and less environmental damage, as well as producing a forest resource that minimizes the use of pesticides in the region.

With regard to the social aspect of sustainability in the timber supply chain, it was observed that this pillar is still not widely worked on by the companies in the chain. The interviews showed that many entrepreneurs are still unaware of the essence of this pillar, corroborating Amaral (2002) and Catalisa (2003). It was also found that the companies belonging to this chain have few actions with the community, since they focus on meeting the legal requirements of the business.

The study points out that there is still a lot of confusion on the part of companies when it comes to social practices. Many companies choose not to adhere to social practices, in line with what has already been pointed out by scholars on the subject. Zhu *et al.* (2016), Hong, Zhang and Ding, (2017) and Das (2017) state that valuing the social pillar is conditional on the pillar's performance. This is evident in the statement made by the representative of company B: "our priority today is to increase and grow our company more and more and when we reach a certain level where we consider that we have achieved what we wanted, then we will seek to develop these social issues more thoroughly".

Performance measures for the social pillar found in the chain include compliance with labor legislation through fair pay, the provision of personal protective equipment (PPE) and improved working conditions for employees. However, there was no evidence of social performance actions focused outside the company, i.e. practices aimed at the community in order to promote social development around these organizations. It is worth noting that the social practices found in the timber supply chain are the promotion of education and training, as well as the generation of new job opportunities in the region.

Despite the results showing the existence of practices aimed at the social pillar, it is clear that there is still a lack of them, and that greater investment is needed in disseminating information about the benefits generated for the entire supply chain through more efficient actions based on this pillar. This is because many companies still don't realize the benefits they bring, according to the approaches taken in the studies by Elkington (2001); Arroyo and Schuch (2006); Banerjee (2003); Robinson (2000); Dias and Barros (2008); Zioni (2005); Montibeller (2007); Munck, Borim-deSouza and Zagui (2011); Foladori (2002); Ruscheinsky (2003); Guerra (2008); Alperstedt *et al.* (2006).

From an environmental point of view, the analyses show that there is a predominance of concern about the issues surrounding this pillar, since the environmental resource is the driving force behind this economic activity. In this way, companies are encouraged to consider the impact of their activities on the environment in the way they use natural resources, as described by Almeida (2002), in order to minimize pollution and environmental damage from commercial activity, as pointed out by Hsu and Hu (2009) and Froehlich & Bitencourt (2016).

The environmental practices highlighted by the interviewees corroborate the elements described by various authors used in this study, such as Vachon and Klassen (2006), Carvalho (2011), Freitas (2019), Younis *et al.* (2016) and Santos and Crisótomo (2019). The most prominent environmental practices were the preference for forestry inputs from reforested sources, the development of actions aimed at making better use of timber resources through the acquisition of more sophisticated equipment, the planning of operations and the possibility of reusing the waste generated by the production process to make by-products, as highlighted in environmental management practices 5.

In addition, Company C points out that the environmental pillar focused on the wood supply chain aims to: "Encourage planting [...], encourage reforestation and the preservation of native forest"; this allows economic activity to take place in accordance with the environmental performance measures listed by Das (2017).

Based on the performance measures, it was noted that they are exercised differently between the links in the chain, since they may or may not correspond to the company's economic activity, with environmental performance measure 5, related to the protection of local biodiversity, standing out the most. This corroborates the fact that the region's timber business values the origin of its resources and does not engage in irregular exploitation or degradation of the region's biodiversity. With regard to the economic issue, it should be noted that this pillar receives greater attention from the companies' strategic point of view, since the actions carried out are aimed at guaranteeing the subsequent bases. This corroborates the theory observed in the context described by Porter (1991), with regard to the 'win-win' perspective. Elkington (2001) describes that current ways of doing business must be rethought and based on sustainable practices.

Based on the economic pillar, the interviews revealed that the practices related to this chain are characterized by supplier relations, management of resources and losses from the production process, through operational efficiency, as well as management of the company's logistics processes, since they source their inputs from other regions.

The practices described mention not only an appeal to sustainability, but are based on a necessary reality for companies, aimed at guaranteeing the economic viability of their operational process. The practices in the economic pillar are in line with Lambert (1993), La Londe and Masters (1994), Cooper *et al.* (1998), Stock and Ellram (1998), Ching (2002), Kannan and Tan (2005) and Dyer and Hatch (2006). Also, with regard to actions aimed at managing the flow of operations, there are innovations in production processes, with a focus on operational efficiency, as well as the establishment of long-term partnerships between the other links in the supply chain. This is also in line with what was described in the study by Das (2017).

Based on the data collected, it was possible to observe that the main practices adopted by the links in the chain studied are based on the environmental and economic pillars (Table 5). The main practices adopted by the members studied are also within these pillars, as explained in Table 23 below.

Practice	Number of links	Description of the practice as observed in the chain
Environmental aspect		
Circular economy and	8	Adoption of the best techniques and equipment
reuse of wood waste		configurations for maximum productivity
Transformation of forestry	5	Transformation of waste such as leaves, branches,
waste to produce biomass		bark and chips into biomass inputs
Economic aspect		
Verticalization of the	7	Investment in new areas of the production process,
production chain		mainly focused on reforestation actions
Import of reforested	3	Importing sawn timber as well as processed
resources		resources such as doors, MDF sheets, siding, etc.
Social aspect		
Support for municipalities	5	Donation of wood resources for public events and
and needy communities in		religious festivals
the region		
Donations of resources to	5	Assistance to needy families in the region
needy communities in the		
region		

Table 23: Wood supply chain practices in western Paraná

Source: Elaborated by the author (2023).

In order to illustrate the most frequently used terms during the interviews, Figure 16 and the Table 24 show the most frequently cited terms in the interviews. Wood was the most repeated term during the interviews, which can be correlated with the fact that it is the fundamental resource for the economic activity of the members studied.

The word reuse was the 8th most cited, which is related to sustainability, since reuse results in less use of natural resources, reducing extraction and optimizing the useful life of the resource. Another term that refers to sustainability, which stood out among the most repeated, is tree species, such as Pinus and Eucalyptus, which represent the basis of reforested resources in the state and can attest to the importance of reforested timber in the region. Due to the author's nationality, the cloud below is in Portuguese, but the words will be translated in Table 24.



Figure 16. Interview word cloud depicting several terms related to forestry, management, and milling (in Portuguese).

Source: Elaborated by the author (2023).

The table below identifies the most repeated words throughout the semi-structured interviews, highlighting the terms most frequently used by the interviewees.

Position	Word	Repetitions
1st	Madeira (wood)	262
2nd	Recurso (resource)	122
3rd	<i>Empresa</i> (company)	116
4th	Clientes (clients)	105
5th	Toras (logs)	96
6th	Produto (product)	95
7th	Material (material)	71
8th	Reaproveitamento (reuse)	69
9th	Portas (doors)	67
10th	Eucalipto (Eucalyptus)	66
11th	Pinus (Pinus)	63
12th	Preço (price)	60
13th	Ambiente (environment)	59
14th	Problema (problem)	57
15th	Obra (work)	55

**Table 24: Ranking of Words Mentioned in the Interview** 

Source: Elaborated by the author (2023).

Given the context analyzed, it is worth considering that the companies that make up the wood supply chain in the western region of Paraná have already understood the benefits that reforested inputs offer for supplying the region. However, it is possible to mention that the lack of investment in reforestation in the region has a negative impact on the continuation of this activity, given the operational challenges cited by the interviewees, such as guaranteeing the traceability of the material purchased, understanding the constant regulatory changes, as well as the devaluation of timber activity in the region.

## 4.4 SCENARIOS FOR THE TIMBER SUPPLY CHAIN

In view of what has been highlighted in the previous analyses, the research considers describing the possible scenarios, based on the contexts presented by the interviewees and the theoretical elements of the research. In this way, it can identify the opportunities and challenges pertinent to the different members of this supply chain.

With regard to the future scenario for the timber business, the interviewees do not have a very optimistic outlook, as they point out that, given the intensification of areas destined for agriculture, there is a scarcity of timber resources in the region for obtaining raw materials, which is a vital resource for making the operational process of the industries in this sector installed in the region viable.

Interviewees 1, 2, 4 and 5 expressed concerns about the continuity of operations in the sector, especially with regard to the supply of raw materials. As a result, they see the need to look further and further afield for their raw materials; the alternatives they see to remedy the lack of timber resources in the region are based on investment and the development of reforestation areas in the western region of Paraná, however, there is a business model in the region that would minimize the problem highlighted by these interviewees.

One of the alternatives in the interviewees' view is investment in verticalizing the supply chain, which is the incorporation of upstream activities, especially with regard to forestry, which corresponds to the first phase of the processing chain, since the scarcity of timber resources could result in the extinction of these companies' activities.

**Interviewee 1**: "So today we're not self-sustainable, right, where if any supplier stopped giving us logs, we wouldn't have the undergrowth to be self-sustainable, right, we even have something very small, right, but it wouldn't even last a year."

**Interviewee 2**: "In our region Pinus has very little, it's a species that doesn't have a lot of undergrowth, while Eucalyptus has a lot of undergrowth in our region."

**Interviewee 4**: "Eucalyptus areas have decreased a lot, right, but what happens before is that these areas were planted where it was unfeasible to produce soybeans, right, areas with stones, very bent areas, and today with the technology of planting mechanisms, these areas have also become viable in terms of price [...] but yes, our sector has felt a lot that the supply of log-related products is becoming very scarce."

An important point for the future of this supply chain, as mentioned by one of the interviewees, is the mechanization of the production process, as it provides more efficient

means of obtaining raw materials through the use of technology, as well as helping to reduce accidents.

Another possible scenario is investment in intensive forestry practices promoted by large companies in the region, with a focus on producing certified wood or even carbon credits. The aim of such a proposal is to meet the region's demand for different markets, especially in view of the opportunities for transport that are about to emerge in the region, such as improvements to highway infrastructure and the implementation of railroads.

In addition to encouraging forestry for the various supply chains, one of the ways of intensifying green areas in the region has become opportune in the face of major investment policies in the generation of green energy, through the installation of plants with organic plant energy sources, which would strengthen investment in reforestation areas in the western region of Paraná. This would ensure the standardization of the production process, in order to make processes more efficient.

Finally, in view of the proximity to neighboring countries, the import process stands out among the possible scenarios for the timber sector and its derivatives, with a view to supplying the local market. Among the main imported products are sawn timber and processed wood products such as MDF, siding, pallets, among others.

There are many opportunities for the region's timber sector, but in order for this market to become more competitive, it is essential to develop measures aimed at protecting local biodiversity and investing in forestry, with a focus on guaranteeing the sector's activities. In this context, the practices described by the interviewees show that there is a great opportunity to exploit the sector in the region, given the growing demand for forest resources in the region in the face of the scarcity of raw materials available.

# **5** FINAL CONSIDERATIONS

The management of a supply chain is characterized by the involvement of various criteria that challenge its effectiveness, focused on processes, mechanisms and rules that make up the regulations of the sector in which it operates. This dissertation sought, through theoretical identification of the elements of sustainability, to list the practices that are consistent with the reality of timber supply chains in western Paraná, seeking to verify whether the practices found in theory are consistent with the actions practiced in the timber industry in western Paraná, as well as describing the reflection of these practices for companies in the region.

The guiding premise for the study is the importance of the timber sector for the economic development of the region, so that understanding the sustainable practices adopted in this sector could contribute to maintaining it. The dissertation therefore set out to answer the question: what sustainability practices are present in the timber supply chain in western Paraná? To this end, the study's objectives were reviewed and its final considerations, practical and theoretical implications, limitations and possibilities for future studies were presented.

The theoretical contributions of the dissertation are presented in its theoretical framework and synthesis of the theoretical models and frameworks that study the practices and processes of the timber supply chain, based on the principles of sustainability, so as to enable a reflection on how the practices highlighted have been reflecting on the sustainable development of the timber activity.

After choosing the model to be used for the study and determining the methodological procedures, the general objective of the research is to survey the sustainability practices of the timber supply chain in western Paraná. To this end, four specific objectives were outlined: (i) to map the timber supply chain in Western Paraná; (ii) to identify the elements linked to the sustainable timber supply chain from the literature; (iii) to analyze the sustainability practices of the sustainable timber supply chain in Western Paraná; (iv) to understand how sustainability practices occur in the timber supply chain in Western Paraná; and (v) to highlight future scenarios for the timber supply chain in Western Paraná.

The timber supply chain in western Paraná can be mapped by identifying its respective links through a search among the companies that make up the timber supply chain in western Paraná. Subsequently, these companies were identified and classified according to their activity; based on this classification, the research could be segmented and the different premises surrounding the sector described. With regard to the activities carried out by the companies analyzed, it was identified that the main activity stems from the sawing process and the diversification of the raw material. This allows different by-products to be obtained through the process of transforming logs into boards, slats, rafters, as well as waste from the production process, which can also be given commercial value depending on the purpose.

With regard to the practices carried out by the companies analyzed, the study shows that actions focused on preserving forest resources receive the most attention from the interviewees, who highlighted practices that are in line with the individual reality of their business. Thus, they aimed to contribute to the development of sustainable actions while these companies can obtain economic gains.

Despite the various advances that have been made, the timber industry in general aims to achieve better production results and, consequently, greater financial gains by adopting these practices. However, it should be noted that social practices were less powerful than actions aimed at the economic and environmental pillars, which reinforces the fact that the current economic model still requires improvements in the sector, in order to ensure that sustainability is a clear element for the entire timber supply chain in the region.

The study makes contributions to scientific development aimed at the academic sector, with regard to the timber industry and business, and stands out due to the economic context of the companies that carry out their activities based on this sector. As for limitations, the study highlights the access to companies in the first phase of the chain, which were not accessed due to the cut-off point proposed by the study.

Hence, and since this research has not been exhausted, possibilities for future investigations are considered, such as:

- The impact of wood shortages on other supply chains.
- Investigating companies in the closed-loop timber sector.
- Mapping the chain and identifying weaknesses and challenges according to their respective link.
- Prospecting future scenarios for the timber sector in the western region of Paraná.

Finally, the research shows that the practices practiced by the timber industry in the western region of Paraná ensure the continuity of the activity of the companies that make up this market; however, these practices are not enough to guarantee a sustainable supply chain in the region.

## REFERENCES

- Aguilera, R.V., Rupp, D.E., Williams, C.A. and Ganapathi, J. (2007) Putting the S Back in Corporate Social Responsibility: A Multi-Level Theory of Social Change in Organizations. Academy of Management Review, 32, 836-863. http://dx.doi.org/10.5465/AMR.2007.25275678
- AKKERMANS, H. A.; BOGERD, P.; YUCESA, E.; WASSENHOVE, L. The impact of ERP on supply chain management: exploratory findings from European Delphi study. European Journal of Operational Research, p. 284-301, 2003.
- Akyuz, G. A., & Gursoy, G. (2019). Becoming Smart, innovative, and socially responsible in supply chain collaboration. In Advanced methodologies and technologies in business operations and management, (Ed. Mehdi Khosrow-Pour) (pp. 919-941). IGI Global.
- Albu, O. B., & Flyverbom, M. (2019). Organizational transparency: Conceptualizations, conditions, and consequences. Business and Society, 58(2), 268–297. doi:10.1177/0007650316659851
- ALPERSTEDT, G. D.; MARTIGNAGO, G.; FIATES, G. G. S. O processo de adaptação estratégica de uma instituição de ensino superior sob a ótica da teoria institucional. Revista de Ciências da Administração. V.8, n.15, jan/jun 2006.
- Alzawawi, M., Drivers and Obstacles for Creating Sustainable Supply Chain Management and Operations. ASEE Zo. Conf. Proc. 1–8, 2014.
- AMARAL NETO, Manuel Almeida. Manejo florestal comunitário na Amazônia brasileira: análise da participação e valorização de saberes de grupos locais na implementação de três projetos pilotos. 2002. 135 f. Dissertação (Mestrado em Agriculturas familiares e desenvolvimento sustentável) Universidade Federal do Pará, Belém, 2002.
- ANDERSON, James C.; HAKANSSON, Hakan e JOHANSON, Jan. Dyadic Business Relationships Within a Business Network Context. Journal of Marketing, Vol.58, Issue 4, 1994.
- Antunes-Souza, T., & Pucci, R. H. P. (2022). Articulação Teórico-Metodológica: a entrevista em pesquisas educacionais na abordagem histórico-cultural. Educação, 47(1), e46/ 1–23. https://doi.org/10.5902/1984644455259
- ASHLEY, Patrícia A.; COUTINHO, Renata B. G.; TOMEI, Patrícia A. Responsabilidade

Social Corporativa e Cidadania Empresarial: Uma análise conceitual comparativa. In: 24° ENANPAD (2000: Florianópolis). Anais, Santa Catarina: ANPAD, 2000.

- ARROYO,J. C. T.; SCHUCH, F. C. Economia popular e solidária: a alavanca para um desenvolvimento sustentável e solidário. São Paulo: Editora Fundação Perseu Abramo, 2006.
- ASSOCIAÇÃO PARANAENSE DE EMPRESAS DE BASE FLORESTAL (APRE). Painel interativo. 2022. Disponível em: https://apreflorestas.com.br/publicacoes/estudosetorial-apre-2022/
- ASHBY, A.; LEAT, M.; HUDSON-SMITH, M. Making connections: a review of supply chain management and sustainability literature. Supply Chain Management: An International Journal, v. 17, n. 5, p. 497–516, 2012.
- Avila, S.P., R. Cordeiro, P. Madeira, L. Silva, A. Medeiros, A.C. Rebelo, C. Melo, A.I. Neto, R. Haroun, A. Monteiro, K. Rijsdijk, and M.E. Johnson, 2018, Global change impacts on large-scale biogeographic patterns of marine organisms on Atlantic oceanic islands, Marine Pollution Bulletin, 126, 101-112, doi: 10.1016/j.marpolbul.2017.10.087.
- AYERS, J. B.; MALMBERG, D. M. Supply Chain Systems: Are You Ready? Information Strategy: The Executive's Journal, p. 18-27, 2002. Disponível em: <a href="http://ayersconsulting.com/download/SC%20Systems%2020Are%20You%20Ready.pd">http://ayersconsulting.com/download/SC%20Systems%2020Are%20You%20Ready.pd</a> f>.
- Back, L., Schrippe, P., Pazuch, C., Weise, A., & Kovaleski, J. (2015). Gestão da Cadeia de Suprimentos: Análise de Uma Indústria Moveleira do Oeste do Paraná. Iberoamerican Journal of Industrial Engineering, 7(14), 55-68.
- BAKKER, F.; NIJHOF, A.. Responsible chain management: a capability assessment framework. Business Strategy and the Environment, v. 11, n. 1, p. 63-75, 2002.
- Bai, C. and Sarkis, J. (2010) Green Supplier Development: Analytical Evaluation Using Rough Set Theory. Journal of Cleaner Production, 18, 1200-1210. https://doi.org/10.1016/j.jclepro.2010.01.016
- BALLOU, Ronaldo H. Logística empresarial. São Paulo, Atlas, 2002.
- Balzan, Karine & Brum, Argemiro & Trennepohl, Dilson & Kohler, Romualdo. (2020). Aspectos da cadeia produtiva moveleira do Brasil e o Rio Grande do Sul nesse contexto. Revista Perspectiva. 44. 7-18. 10.31512/persp.v.44.n.166.2020.95.p.7-18.

- BANSAL, T., 2010. Network for Business Sustainability. Disponível em: http://nbs.net/wpcontent/uploads/Primer\_Business\_Sustainability.pdf.
- BANERJEE, S.B. Who Sustains Whose Development? Sustainable Development and the Reinvention of nature. Organization Studies, 24(1): 143–180, 2003.
- BARDIN, Laurence. Análise de conteúdo Lisboa: Edições 70, 1977.
- BARTON, D. ET AL. (EDS.) SITUATED LITERACIES: READING AND WRITING IN CONTEXT. LONDRES E NOVA YORK: ROUTLEDGE, 2000, 219 PÁGS.
- Bataglia, W., Popadiuk, S. & Rivera, E. (2014). Heterogeneity of Isomorphic Pressures: Intertwining the Resource-Based View and the Neoinstitutional Approach. BAR, Brazilian Administration Review, 11(4), 455-475.
- Beske, P., & Seuring, S. (2014). Putting sustainability into supply chain management. Supply Chain Management: an international journal, 19(3), 322-331.
- BEUREN, I.; MAZZIONI, S.; SILVA, M. Remuneração dos Executivos Versus Desempenho das Empresas. Revista Adm. Faces Journal, [s.l.], v. 13, n. 2, p. 8-25, 2014.
- Bhari, R., Kaur, M., Singh, R.S., Pandey, A. and Larroche, C. (2018) Bioconversion of Chicken Feathers by Bacillus aerius NSMk2: A Potential Approach in Poultry Waste Management. Bioresource Technology Reports, 3, 224-230. https://doi.org/10.1016/j.biteb.2018.07.015
- BITTENCOURT, L.P.E.; OLIVEIRA, G.B. A indústria madeireira paranaense nos anos recentes. Revista das Faculdades Santa Cruz, Santa Cruz, n.1, p.33-41, janeiro/junho 2009.
- Bowersox, Donald J., "Integrated Supply Chain Management; A Strategic Perspective," Annual Conference Proceedings, Chicago, Illinois: Council of Logistics Management (1997), pp. 181-189; George E. Stigler, "The Division of Labor Is Limited by the Extent of the Market," Journal of Political Economy, Vol. 59, No. 3 (1951), pp. 185-193; and, R. H. Coase, "The Nature of the Firm," Economica, Vol. 4 (1937), pp. 386-405.
- BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. <http://www.agricultura.gov.br/internacional/indicadores-e-estatisticas/informesdeprodutos)
- Broman, G., & Robèrt, K. (2017). A framework for strategic sustainable development. Journal of Cleaner Production, 140(Part 1), 17-31.
- Brundtland, G. H. Prologue. in.: Global Sustainable Development Report 2019: The Future is
Now – Science for Achieving Sustainable Development. United Nations, New York, 2019.

- CALADO, C. D. M. (2010). Desempenho sustentável A importância do marketing ambiental para as empresas tornarem-se "verdes". Monografia de conclusão de Pós-graduação em Gestão Ambiental. Instituto AVM.
- Carter, C.R. and Easton, P.L. (2011) Sustainable Supply Chain Management: Evolution and Future Directions. International Journal of Physical Distribution & Logistics Management, 41, 46-62. http://dx.doi.org/10.1108/09600031111101420
- Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: moving toward new theory. International Journal of Physical Distribution & Logistics Management, 38(5), 360–387.
- Carter, C.R. and Jennings, M.M. (2002) Social Responsibility and Supply Chain Relationships. Transportation Research Part E, 38, 37-52. https://doi.org/10.1016/S1366-5545(01)00008-4
- Carter, CR e Jennings, MM (2004), "O papel das compras na gestão socialmente responsável da cadeia de suprimentos: uma análise de equação estrutural", Journal of Business Logistics, vol. 25 No. 1, pp. 145-86.
- Carvalho, J. C., Martins, A. L., Ramos, T., Dias, E. B. (2014). Strategic Fast Supply Demand-Chains in a Network Context: Opportunistic Practices That Can Destroy Supply Chain Systems. American Journal of Industrial and Business Management, 2014, 4, 123-133
- CARVALHO, Isabel Cristina de Moura; AMARO, Inês; FRANKENBERG, Claudio Luis Crescente. Ambientalização curricular e pesquisas ambientalmente orientadas na PUCRS: um levantamento preliminar. 2011.
- Castro, M., J.; Fernandes, C., S. Carvalho, H., S. ESTUDO DA CADEIA DE SUPRIMENTO DO SETOR MADEIREIRO NO ESTADO DO ACRE. O CASO DA EMPRESA LAMINADOS TRIUNFO. IX SEGET 2012 - Simpósio de excelência em gestão e tecnologia.
- Catalisa. (2003). Rede de Cooperação para a Sustentabilidade. Disponível em: http://www.catalisa.org.br/content/view/30/59/
- CHING, Hong Yuh. Gestão de estoques na Cadeia de Logística Integrada: Supply Chain. São Paulo: Atlas, 2002.

- Clark, Kim & Baldwin, Carliss. (2002). The Option Value of Modularity in Design: An Example from Design Rules, Volume 1: The Power of Modularity. SSRN Electronic Journal. 10.2139/ssrn.312404.
- Claro, PBO; Claro, DP Sustentabilidade estratégica: existe retorno no longo prazo? R.Adm., São Paulo, v.49, n.2, p.291-306, 2014.
- Collins, JC e Porras, JL (1994), Built to Last, HarperCollins Publishers, Nova York, NY.
- COOPER, M. C.; LAMBERT, D. M.; PAGH, J. D. Supply Chain Management: More Than a New Name for Logistics. The International Journal of Logistics Management, v. 8, n. 1, p. 1–14, jan. 1997.
- CORAL, E. Modelo de planejamento estratégico para a sustentabilidade empresarial. 2002. 282f. Tese (Doutorado em Engenharia da Produção). Universidade Federal de Santa Catarina, Florianópolis – SC, 2002.
- Correia, MM; Ashley, PA Desenvolvimento Sustentável, Sustentabilidade, Educação Ambiental e Educação para o Desenvolvimento Sustentável: Reflexões para o ensino de graduação. Rev. Eletrônica Mestr. Educ. Ambiente. Rio Grande, v. 1, pág. 92-111, 2018.
- Correia, E., Garrido, S., & Carvalho, H. (2023). Sustainability supply chain practices: Proposal for a framework. The International Journal of Logistics Management, The international journal of logistics management, 2023.
- Costa, P. et al. Pobreza e desenvolvimento. In.: Erradicação da pobreza: contribuições da Embrapa. Brasília, DF: Embrapa, 2018.
- Costa, M. R. M. Sustentabilidade Ambiental: dificuldades e alternativas. 2008. Monogradia (Bacharel em Ciências Econômicas)- Universidade Federal de Santa Catarina, Florianópilos, 2008.
- Craig, W. (2018). 10 Things transparency can do for your company. Forbes. Recuperado de https://www.forbes.com/sites/williamcraig/2018/10/16/ 10-things-transparency-can-dofor-your-company/#4d53204b25d0
- CRESWELL, John W. Investigação qualitativa e projeto de pesquisa. 3 ed. Porto Alegre: Penso, 2014.
- CRISÓSTOMO, V. L.; GIRÃO, A. M. C. Análise do compliance das empresas brasileiras às boas práticas de governança corporativa. REVISTA AMBIENTE CONTÁBIL -

Universidade Federal do Rio Grande do Norte - ISSN 2176-9036, [S. l.], v. 11, n. 2, p. 40– 64, 2019. DOI: 10.21680/2176-9036.2019v11n2ID16369. Disponível em: https://periodicos.ufrn.br/ambiente/article/view/16369.

- DAOZHI, Z. et al. A New Supply Chain Maturity Model With 3-Dimension Perspective. In: INFORMATION TECHNOLOGY AND INOVATION CONFERENCE - ITIC, 2006, Hangzhou. Proceedings... Hangzhou: ITIC, 2006.
- DAS, D. Development and validation of a scale for measuring Sustainable Supply Chain Management practices and performance. Journal of Cleaner Production, Oxford, v. 164, p. 1344-1362, 2017.
- DAS, D. The impact of Sustainable Supply Chain Management practices on firm performance: Lessons from Indian organizations. Journal of Cleaner Production, Oxford, v. 203, p. 179-196, 2018.
- DIAS, E. A.; BARROS, L. A. Sustentabilidade empresarial e retorno ao acionista: um estudo sobre o ISE. XXXII Encontro da ANPAD. Rio de Janeiro, set./ 2008.
- Dias, R.; Cassar, M.; Zavaglia, T. Introducao a administracao da competitividade a sustentabilidade. Campinas, Sao Paulo: Alinea, 2003.
- Duarte, A.P., Gomes, D.R., Neves, J.G.das, 2014. Tell me your socially responsible practices, I will tell you how attractive for recruitment you are! the impact of perceived CSR on organizational attractiveness. Tekhne e Rev. Appl. Manag. Studies 12 (1), 22e29.
- DUDA, J.G.; VELOSO, L.F.; MELO, R.P.F. O Colapso das Exportações Paranaenses de Madeira de 2005 a 2010. Vitrine da Conjuntura, Curitiba, n.8, p.1-8, outubro 2010.
- Dyer, J. H., & Hatch, N. W. (2006). Relation-specific capabilities and barriers to knowledge transfers: creating advantage through network relationships. Strategic Management Journal, 27(8), 701719. doi:10.1002/smj.543
- EDGAR, J. G. (1978) Social and environmental implications. In: Eucalypts for wood production. HILLIS, W. E; BROWN, A. G. Australia: CSIRO. p. 377-389.
- Eisenhardt, K.M. and Martin, J.A. (2000) Dynamic Capabilities: What Are They? Strategic Management Journal, 21, 1105-1121. http://dx.doi.org/10.1002/1097-0266(200010/11)21:10/11<1105::AID-SMJ133>3.0.CO;2-E

Elkington, J. (1998) Cannibals with Forks: The Triple Bottom Line of 21st Century Business.

New Society Publishers, Gabriola Island, Stony Creek.

ELKINGTON, J. Canibais com Garfo e Faca. São Paulo: Makron Books, 2001.

- Elkington, J. (2004) Enter the Triple Bottom Line. In: Henriques. A. and Richardson, J., Eds., The Triple Bottom Line, Does It All Add up? Assessing the Sustainability of Business and CSR, Earths can Publications Ltd., London, 1-16. https://doi.org/10.1108/13598540910941948
- ELKINGTON, J. (2011). Canibais com garfo e fala. São Paulo: Makron Books.
- Esfahbodi, Ali, Yufeng Zhang e Glyn Watson. 2016. "Gestão sustentável da cadeia de abastecimento em economias emergentes: Trade-offs between environmental and cost performance." International Journal of Production Economics 181:350-66. doi: https://doi.org/10.1016/j.ijpe.2016.02.013.
- Eriksson, D., & Svensson, G. (2015). Elements affecting social responsibility in supply chains. Supply Chain Management, 20(5), 561-566.
- Faisal, M. (2010). Sustainable supply chains: a study of interaction among the enablers. Business Process Management Journal, 16(3), pp. 508-529.
- Falzon, B., Liu, H., & Tan, W. (2017). Comment on "A tensorial based progressive damage model for fibre reinforced polymers". Composite Structures, 176, 877-882.
- Fernandes, &., Carvalho, M., Carvalho, L., & Santos Neto, A. (2012). Avaliação de um sistema de irrigação pelas metodologias de keller e karmeli, e de denículi em citros irrigados por gotejamento. Revista Brasileira De Agricultura Irrigada, 6(2), 74-80.
- Flynn, B.B., Schroeder, R.G. and Sakakibara, S. (1994) A Framework for Quality Management Research and an Associated Measurement Instrument. Journal of Operations Management, 11, 339-366. https://doi.org/10.1016/S0272-6963(97)90004-8
- FOERSTL, K. A. I. Drivers of Supplier Sustainability : Moving Beyond Compliance To Commitment. n. January, p. 67–92, 2015.
- FOLADORI, G. Avanços e limites da sustentabilidade social. Revista Paranaense de
- Desenvolvimento, Curitiba, n. 102, p. 103-113, jan./jun. 2002.
- FORRESTER, J. Industrial dynamics, a major breakthrough for decision makers. Harvard Business Review, Boston, v. 36, p. 37-66, 1958.
- Forrester, J.W. (1971) Counterintuitive Behavior of Social Systems. Technology Review, 73,

- FRANCISCONI, Karine. Configuração estrutural do campo científico em estudos organizacionais no Brasil: o período 1997 – 2007. Dissertação de Mestrado. UFPR – Universidade Federal do Paraná. Mestrado em Administração, área de concentração Estratégia e Organizações. Curitiba, 2008.
- Frederico, G., & Martins, R. (2012). Modelo para alinhamento entre a maturidade dos sistemas de medição de desempenho e a maturidade da gestão da cadeia de suprimentos. Gestão & Produção, 19(4), 857-871.
- Freitas, M.R. O., Santos, S. M., & Crisóstomo, V. L. (2019). Nível de abrangência da informação ambiental divulgada nos relatórios de sustentabilidade de empresas brasileiras com potencial de impacto ao meio ambiente. Revista Contabilidade e Controladoria, 10(3), 143-161.
- FROEHLICH, C.; BITENCOURT C. C. Sustentabilidade Empresarial: Um Estudo de Caso na Empresa Artecola. GeAS, v. 5, n.3, p. 55-71, 2016.
- FSC® (Forest Stewardship Council®). Conselho Intenacional de Manejo Florestal, disponível em: http://www.fsc.org/.
- Fynes, Brian & Búrca, Seán & Mangan, John. (2008). The Effect of Relationship Characteristics on Relationship Quality and Performance. International Journal of Production Economics. 111. 56-69. 10.1016/j.ijpe.2006.11.019.
- Galal, N. M., & Moneim, A. F. A. (2016). Developing sustainable supply chains in developing countries. Procedia CIRP, 48, 419-424. http://dx.doi.org/10.1016/j.procir.2016.03.156.
- GALLO, Zildo. Ethos, a grande morada humana: economia, ecologia e ética. Itu: Ottoni, 2007.
- García-Arca, J., González-Portela, A., & Prado-Prado, J. C. (2014). Packaging as source of efficient and sustainable advantages in supply chain management. An analysis of briks. International Journal of Production Management and Engineering, 2(1), 15–22. https://doi.org/10.4995/ijpme.2014.1860
- GARLET, V. et al. Sustainable Development Goals SDG: an analysis of the main characteristics of publications. RISUS. Journal on Innovation and Sustainability, v. 13, n. 2, p. 14-26, 2022. Available at: h□ps://doi.org/10.23925/2179-3565.2022v13i2p14-26.

- Garst,A.D.,Bassalo,M.C.,Pines,G.,Lynch,S.A., Halweg-Edwards,A.L.,Liu,R.,Liang,L.,Wang, Z.,Zeitoun,R.,Alexander,W.G.,andGill,R.T. (2017).Genome-widemappingofmutationsat single-nucleotideresolutionforprotein,metabolic andgenomeengineering.Nat.Biotechnol. 35,48–55.
- Giddings, B., Hopwood, B. and O'brien, G. (2002) Environment, Economy and Society: Fitting Them Together into Sustainable Development. Sustainable Development, 10, 187-196. https://doi.org/10.1002/sd.199
- GIMENEZ, C.; TACHIZAWA, E. M. Extending sustainability to suppliers: a systematic literature review. Supply Chain Management: An International Journal, v. 17, n. 5, p. 531– 543, 2012.
- Giunipero, LC e Eltantawy, RA (2004), "Securing the upstream supply chain: a risk management approach", International Journal of Physical Distribution & Logistics Management, vol. 34 No. 9, pp. 698-713. pp. 63-76.HARLAND, C,M; Lamming. R. e COUSINS, P.; Developing the Concept of Supply
- Gladwin, T., Kennelly, J. J., & Krause, T. (1995). Shifting paradigms for sustainable development: implications for management theory and research. Academy of Management Review, 20, 874–907.
- GOMES, Magno Federici; FERREIRA, Leandro José. SANTOS, Ariel Augusto Pinheiro dos. Multidimensionalidade e regulamentação do desenvolvimento sustentável. Revista de Direito, Economia e Desenvolvimento Sustentável, Florianópolis, v. 2, n. 2, p. 17-33, jul./dez. 2016b. Disponível em: <a href="http://dx.doi.org/10.26668/IndexLawJournals/2526-0057/2016.v2i2.1385">http://dx.doi.org/10.26668/IndexLawJournals/2526-0057/2016.v2i2.1385</a>>
- GONÇALVES, M. T. T. (2000) Processamento da madeira. Bauru: Marcos Tadeu Tibúrcio Gonçalves. 242 p.
- González-Benito, J. and González-Benito, O. (2005) Environmental Proactivity and Business Performance: An Empirical Analysis. Omega, 33, 1-15. http://dx.doi.org/10.1016/j.omega.2004.03.002
- GUERRA, S. O direito de ingerência em matéria ambiental. In: DIREITO, C. A. M.;TRINDADE, A. A. C.; PEREIRA, A. C. A. (Org.). Novas perspectivas do direito internacional contemporâneo: estudos em homenagem ao Professor Celso D. Albuquerque

Mello. Rio de Janeiro: Renovar, 2008.

- GIL, A. C. Como elaborar projetos de pesquisa. 2. reimpr. 6. ed. São Paulo: Atlas, 2017.
- GUIMARÃES, D. Madeira e derivados. Revista Paranaense de Desenvolvimento, nº 40, p. 09-28, 1974.
- HADLEY, S. Making the supply chain. Strategic Finance. Montvale, v. 85, n. 10, p. 28-34, Apr. 2004. ISSN: 1524-833X
- Hamel, G. e Prahalad, CK (1989), "intenção estratégica", Harvard Business Review, vol. 67 nº
  3, Erlich, PR e Erlich, AH (1991), The Population Explosion, Touchstone, Nova York, NY.
- Strategy. International Journal of Operations & Production Management, Vol.19, Issue 7,Bradford- 1999, pg.650.
- Hart, SL (1995), "Uma visão baseada em recursos naturais da empresa", Academy of Management Review,
- Holmes, SM, Power, ML e Walter, CK (1996), "Um programa de bem-estar para transportadoras motorizadas: desenvolvimento e testes", Transportation Journal, vol. 35 No. 3, pp. 33-48.
- JACOBI, Pedro. Educação ambiental, cidadania e sustentabilidade. Cadernos de Pesquisa. N. 118, p189-206. 2003. Disponível em: <a href="http://www.scielo.br/pdf/cp/n118/16834.pdf">http://www.scielo.br/pdf/cp/n118/16834.pdf</a> >
- Jennings, PD e Zandbergen, PA (1995), "Organizações ecologicamente sustentáveis: uma abordagem institucional", Academy of Management Review, vol. 20 No. 4, pp. 1015-52.
- Klassen, RD e McLaughlin, CP (1996), "O impacto da gestão ambiental no desempenho da empresa", Management Science, vol. 42 No. 8, pp. 1199-214. Vol. 20 No. 4, pp. 986-1014.
- HAUGHTON, G. (1999). Environmental Justice and the sustainable city. In: SATTERTHWAITE,
- Hong, Jiangtao, Yibin Zhang e Minqiu Ding. 2017. "Sustainable supply chain management practices, supply chain dynamic capabilities, and enterprise performance." Journal of Cleaner Production. doi: https://doi.org/10.1016/j.jclepro.2017.06.093.
- Houlihan, J. B. International supply chains: a new approach. Management Decisions: Quarterly Review of Management Technology, 26 (3), 1988. p.13-19
- Hsu, C.P., Hu, T.L. and Lin, C.F. (2009) A Dynamic Model Assisted Evaluation on the Effects

of Organic Matter Application after Changing Land Use to Paddy-Upland Rotation. Geoderma, 153, 241-253. http://dx.doi.org/10.1016/j.geoderma.2009.08.013

- HUTCHINS, M. J.; SUTHERLAND, J. W. An exploration of measures of social sustainability and their application to supply chain decisions. Journal of Cleaner Production, v. 16, n. 15, p. 1688-1698, 2008.
- Johnson, M., & Templar, S. (2011). The relationships between supply chain and firm performance The development and testing of a unified proxy. International Journal of Physical Distribution & Logistics Management, 41(2), 88-103.
- Jones, T., & Riley, D. (1985). Using Inventory for Competitive Advantage through Supply Chain Management. International Journal of Physical Distribution and Materials Management, 15(5), 16-26.
- JUNQUEIRA, C. G., ADORNO-SILVA, D.A., RODRIGUES, M.L.G. & BARBIERI, Y.C. (2008). Sustentabilidade como importância da Imagem da Marca. In: XXXI CONGRESSO BRSILERO DE CIÊNCIAS DA COMUNICAÇÃO.2008, Natal. Anais...Intercom – Sociedade Brasileira de Estudo Interdisciplinares da Comunicação, Natal.
- Klassen, Robert & Vereecke, Ann. (2012). Social issues in supply chains: Capabilities link responsibility, risk (opportunity), and performance. International Journal of Production Economics. 140. 103–115. 10.1016/j.ijpe.2012.01.021
- Kannan, V.R. & Tan, K.C. (2005) 'Just in time, total quality management, and supply chain management: understanding their linkages and impact on business performance', Omega, vol. 33, no. 2,pp. 153-162.
- Kassinis GI, Soteriou AC. Esverdeando a cadeia de lucro do serviço: o impacto das práticas de gestão ambiental. Production and Operations Management 2003;12(3):386–403 [levantamento, meio ambiente].
- Karaosman, H., Morales-Alonso, G., & Brun, A. (2017). From a Systematic Literature Review to a Classification Framework: Sustainability Integration in Fashion Operations. Sustainability, 9(1), 30. https://doi.org/10.3390/su9010030
- Kaynak, H. (2003) The Relationship between Total Quality Management Practices and Their Effects on Firm Performance. Journal of Operations Management, 21, 405-435. http://dx.doi.org/10.1016/S0272-6963(03)00004-4

- Kumar, S.; Kumar, N.; Vivekadhish, S. Objectivos de Desenvolvimento do Milénio (ODM) para Objectivos de Desenvolvimento.
- LAHANE, S.; KANT, R.; SHANKAR, R. Circular supply chain management: A state-of-art review and future Opportunities. Journal of Cleaner Production, 258, 2020
- LA LONDE, B. J. & MASTERS, J. M. Emerging Logistics Strategies: Blueprints for the Next Century. International Journal of Physical Distribution & Logistics Management, v. 24, n. 7, p. 35-47, 1994.
- LAMBERT, D. M. Strategic logistics management. Homewood: R. D. Irwin, 1993.
- LAMBERT, D.; COOPER, M.; PAGH, J. Supply Chain Management: Implementation Issues and Research Opportunities. The International Journal of Logistics Management, v. 9, n. 2, p. 1-19, 1998.
- LAMBERT, D. M.; COOPER, M. C. Issues in Supply Chain Management. Industrial
- Marketing Management, vol. n. 29, p. 65-83, 2000.
- LAMBERT, D. M.; STOCK, J. R.; ELLRAM, L. M. Fundamentals of logistics management. Boston: Irwin/McGraw-Hill, 1998b.
- Lambert, Douglas. (2014). Supply Chain Management: Processes, Partnerships, Performance, Chapter 1 Supply Chain Management. 10.1007/978-3-8349-6515-8\_29.
- Laosirihongthong, Tritos & Samaranayake, Premaratne & Nagalingam, Sev & Adebanjo, Dotun. (2020). Prioritization of sustainable supply chain practices with triple bottom line and organizational theories: industry and academic perspectives. Production Planning & Control. 31. 1207-1221. 10.1080/09537287.2019.1701233.
- LAVALLE, A. M. A madeira na economia paranaense. Curitiba: Grafipar/SECPR, Curitiba, 1981.
- Leal Filho, W. et al. Revigorar a agenda de investigação para o desenvolvimento sustentável: o papel dos objectivos de desenvolvimento sustentável (ODS). Jornal Internacional de Desenvolvimento Sustentável e Ecologia Mundial. 2017. http://doi.org/10.1080/13504509.2017.1342103 Menezes, HZ;
- LEE, K.; KIM, J. Current Status of CSR in the Realm of Supply Management: The Case of the Korean Electronics Industry. Supply Chain Management: An International Journal, v. 14, p. 138–148, 2009.

- LEITE, Denise; MOROSINI, Marília. Universidade no Brasil: a Idéia e a Prática. Rev. Bras. Est. Pedag., Brasília,v. 73, n. 174, p. 242-254, maio/ago. 1992.
- Lele, S. (1991). Sustainable development: A critical review. World Development, 19(6), 607-621.
- Lima, J. (2021). A localização da produção silvícola no estado do Paraná. Colóquio (Taquara.), 18(2), 177-192.
- Lockamy III, A. and McCormack, K. (2004) Linking SCOR Planning Practices to Supply Chain Performance: An Exploratory Study. International Journal of Operations & Production Management, 24, 1192-1218. http://dx.doi.org/10.1108/01443570410569010
- Lopes de Sousa Jabbour, Ana Beatriz, Charbel Jose Chiappetta Jabbour, Moacir Godinho Filho, e David Roubaud. 2018. "Indústria 4.0 e a economia circular: uma proposta de agenda de pesquisa e roteiro original para operações sustentáveis." Annals of Operations Research 270 (1-2):273-86. doi: https://doi.org/10.1007/s10479-018-2772-8.
- LUHMANN, N. Introdução à Teoria dos Sistemas. Petrópolis: Vozes, 2010.
- MacPherson, D.W., Gushulak, B.D., Baine, W.B., Bala, S., Gubbins, P.O., Holtom, P., Segarra-Newnham, M., 2009. Population mobility, globalization, and antimicrobial drug resistance. Number 11 —November 2009. Emerg. Infect. Dis. J. –CDC 15. https://doi.org/10.3201/eid1511.090419.
- Marco-Ferreira, A., & Jabbour, C. (2019). Relacionando níveis de maturidade em gestão ambiental e a adoção de práticas de Green Supply Chain Management: Convergência teórica e estudo de múltiplos casos. Gestão & Produção, 26(1), Gestão & produção, 2019, Vol.26 (1).
- MASSA, Adriana Accioly Gomes; NOVAK, Amanda S.; Souza, Raquel Pusch. Responsabilidade social: um caminho para sustentabilidade. CD-Rom 2º Seminário sobre sustentabilidade, v.1, p.1, 2007.
- MANI, V.; AGRAWAL, R.; SHARMA, V. Supply Chain Social Sustainability: A Comparative Case Analysis in Indian Manufacturing Industries. Procedia -Social and Behavioral Sciences, v. 189, p. 234–251, 2015.
- Marshall, D., McCarthy, L., Heavey, C., & McGrath, P. (2014). Environmental and social supply chain management sustainability practices: construct development and measurement. Production Planning & Control: The Management of Operations, 6(8), 673-

690. https://doi.org/10.1080/09537287.2014.963726

- MARTINS, Petrônio G.; LAUGENI, Fernando P. Administração da Produção e Operações. São Paulo: Saraiva, 2009.
- MASCARENHAS, A. O., ZAMBALDI, F., MORAES, E. A. (2011) Rigor, relevância e desafios da academia em administração: Tensões entre pesquisa e formação profissional. Editorial. RAE-revista de administração de empresas. v. 51, n. 3, p. 265-279, 2011.
- Masoumik, S.M., Abdul-Rashid, S.H., Olugu, E.U., & Ghazilla, R.A.R. (2014). Sustainable Supply Chain Design: A Configurational Approach, The Scientific World Journal, 2014. https://doi.org/10.1155/2014/897121
- MARKMAN, G. D.; KRAUSE, D. Theory Building Surrounding Sustainable Supply Chain Management: Assessing What We Know, Exploring Where to Go. Journal of Supply Chain Management, p. n/a–n/a, 2016.
- McKinnon, A., Browne, M., Whiteing, A., & Piecyk, A. (2010). Green Logistics. Improving the Environmental Sustainability of Logistics (3nd ed.). Published by Kogan Page.
- MEHRA, Satish; INMAN, R. Anthony. Determining the Critical Elements of Just-in-Time Implementation. Decision Sciences, v.23, p.160-174, 1992.
- Meinlschmidt, Pia & Ueberham, Elke & Lehmann, Jörg & Schweiggert-Weisz, Ute & Eisner, Peter. (2016). Immunoreactivity, sensory and physicochemical properties of fermented soy protein isolate. Food Chemistry. 205. 10.1016/j.foodchem.2016.03.016.
- MELO, Edson de. Responsabilidade Social: uma Análise das Ações no Centro Universitário para o Desenvolvimento do Alto Vale do ItajaíUNIDAVI. XI Simpósio de Excelência em Gestão e Tecnologia. Rio de Janeiro. 2014.
- Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). Defining Supply Chain Management. Journal of Business Logistics, 1-25.
- MIEMCZYK, J.; JOHNSEN, T. E.; MACQUET, M. Sustainable purchasing and supply management: a structured literature review of definitions and measures at the dyad, chain and network levels. Supply Chain Management: An International Journal, v. 17, n. 5, p. 478–496, 2012.
- Min, H. & Galle, W., 1997. Green Purchasing Strategies: Trends and Implications. International Journal of Purchasing and Materials Management, Volume module4, pp. 10-17.

- Minayo, M. C. de S. (2016). O desafio da pesquisa social. In R. Minayo, Maria Cecilia de Souza; Deslandes, Suely; Gomes (Ed.), Pesquisa Social: teoria, método e criatividade (pp. 9–27). Editora Vozes.
- Minayo, M. C. S. (2016). Trabalho de campo: contexto de observação, interação e descoberta.In Pesquisa social: teoria, método e criatividade.
- MNE, (Ministério dos Negócios Estrangeiros). (2017). Relatório nacional sobre a implementação da Agenda 2030 para o Desenvolvimento Sustentável PORTUGAL https://sustainabledevelopment.un.org/content/documents/15766Portugal2017\_EN\_REV \_FINAL\_29\_06\_2017.pdf
- Monczka, R., Trent, R., & Handfield, R. (1998). Purchasing and supply chain management. 2nd ed. Ohio: SouthWestern - Thomson Learning.
- Montabon, F., Pagell, M., & Wu, Z. (2016). Making sustainability sustainable. Journal of Supply Chain Management, 52(2), 11-27. https://doi.org/10.1111/jscm.12103
- MONTIBELLER FILHO, G. Empresas, desenvolvimento e ambiente: diagnóstico e diretrizes de sustentabilidade. Barueri: Manole, 2007.
- MORAIS, D., O., C. O PILAR SOCIAL: Dimensão Invisível das Cadeias de Suprimentos Sustentáveis. São Paulo, FGV, 2018.
- MUNCK, L.; BORIM-DE-SOUZA, R.; ZAGUI, C. A gestão por competências e sua relação com ações de sustentabilidade. Pretexto, Belo Horizonte, v. 12 n. 4 p. 55 – 79 out. /dez. 2011.
- Natalia Troccoli Marques da Silva, Giuliana Aparecida Santini Pigatto, & Eduardo Guilherme Satolo. (2023). PRÁTICAS DE ECOINOVAÇÃO E PROCESSOS DE NEGÓCIOS NA GESTÃO DA CADEIA DE SUPRIMENTOS MOVELEIRA. Revista Brasileira De Gestão E Inovação, 10(3), Revista Brasileira de Gestão e Inovação, 2023, Vol.10 (3).
- New SJ. O escopo da pesquisa em gerenciamento da cadeia de suprimentos. Supply Chain Management: An International Journal 1997;2(1):15–22 [teoria, sustentável].
- NOCE, R. et al. Análise de risco e retorno do setor florestal: produtos da madeira. Revista Árvore, v.29, n.1, p.77-84, 2005.
- Nunes, P., A.; Melo, C., O.; Teixeira, D. A PARTICIPAÇÃO DO SETOR MADEIREIRO NA ECONOMIA DAS MICRORREGIÕES GEOGRÁFICAS DO PARANÁ - 2009 - Revista

Brasileira de Agropecuária Sustentável (RBAS), v.2, n.1., p.8-20, Julho, 2012

- O'BRIEN, W. J. A call for cost and reference models form construction supply chains. In: ANNUAL LEAN CONSTRUCTION CONFERENCE, 10., Gramado, 2002. Proceedings... International Group of Lean Construction (IGLC), 2002.
- Ociepa-Kubicka, Agnieszka & Pachura, Piotr. (2017). Eco-innovations in the functioning of companies. Environmental research. 156. 284-290. 10.1016/j.envres.2017.02.027.
- OELZE N. Sustainable Supply Chain Management Implementation–Enablers and Barriers in the Textile Industry. MDPI https://doi.org/10.3390/su9081435
- Oliveira, E. W. M.; Sola, D. D. L. A Institucionalização do Pilar Econômico da Sustentabilidade e a Subvalorização dos Pilares Social e Ambiental (2013). Revista Capital Científico Editora UNICENTRO ISSN 2177-4153
- OLIVEIRA, Marcos Berberick de, LONGO, Orlando Celso. Gestão da Cadeia de Suprimentos. Iv Congresso Nacional de Excelência em Gestão. Responsabilidade Socioambiental das Organizações Brasileiras. Niterói, RJ, Brasil, 31 de julho, 01 e 02 de agosto de 2008.
- OLIVEIRA, M. P. V. Modelo de Maturidade de Processos em Cadeias de Suprimentos: Precedências e os Pontos-Chave de Transição. 2009. Tese (Doutorado em Administração)-Universidade Federal de Minas Gerais, Belo Horizonte, 2009.
- OPIE, J. E.; CURTIN, R. A.; INCOLL, W. D. (1978) Stand management. In: Eucalypts for wood production. HILLIS, W. E; BROWN, A. G. Austrália: CSIRO. p. 179-225. Oxford University Press. (2013, September). Success. In Oxford English dictionary.
- PAGELL, M.; WU, Z. Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars. Journal of Supply Chain Management. v.45, n.02, p.37-56, 2009.
- PAGELL, M.; ZHAOHUI, W. Building a more complete theory of sustainable supply chain management using case studies from 10 exemplars. Journal of Supply Chain Management, v. 45, p. 37-56, 2009. http:// dx.doi.org/10.1111/j.1745-493X.2009.03162.x
- PARANÁ. Departamento de Economia Rural DERAL. < chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.agricultura.pr.gov.br/sites/d efault/arquivos\_restritos/files/documento/2020-12/Boletim%20Florestal%202020%20-%2017.12.20.pdf)

- PÄIVINEN, R. et al. A concept for assessing sustainability impacts of forestry-wood chains. European Journal of Forest Research, Freising, v. 131, n. 1, p. 7-19, 2012.
- Paulo Alexandre Nunes, Carmem Ozana de Melo, & Diego Teixeira. (2012). A PARTICIPAÇÃO DO SETOR MADEIREIRO NA ECONOMIA DAS MICRORREGIÕES GEOGRÁFICAS DO PARANÁ – 2009. Revista Brasileira De Agropecuária Sustentável, 2(1). https://doi.org/10.21206/rbas.v2i1.53
- Paulraj, Antony & Chen, Injazz & Blome, Constantin. (2017). Motives and Performance Outcomes of Sustainable Supply Chain Management Practices: A Multi-theoretical Perspective. Journal of Business Ethics. 145. 10.1007/s10551-015-2857-0.
- Peck, H. (2005). Drivers of supply chain vulnerability: an integrated framework. International Journal of Physical Distribution & Logistics Management, 210-232.
- Pereira, D.; Santos, D.; Vedoveto, M.; Guimarães, J.; Veríssimo, A. 2010. Fatos Florestais da Amazônia 2010. IMAZON. Belém, 126p. Schneider, R., Arima, E., Veríssimo, A., Barreto, P., Souza Jr., C., 2000. Amazônia Sustentável: limitações e oportunidades para o desenvolvimento rural. Banco Mundial e IMAZON, Brasília (Brasil).
- PHAM, H.; KIM, S.-Y. The effects of sustainable practices and managers' leadership competences on sustainability performance of construction firms. Sustainable Production and Consumption, Netherlands, v. 20, p. 1-14, 2019.
- PICOLI, Fiorelo. Amazônia: o silêncio das árvores uma abordagem sobre a indústria de transformação de madeiras. Sinop: Fiorelo, 2004. 124 p.
- Piercy, Niall & Rich, Nick. (2015). The relationship between lean operations and sustainable operations. International Journal of Operations & Production Management. 35. 282-315. 10.1108/IJOPM-03-2014-0143.
- PINTO, A. C. B. (2006) Regeneração florestal associada a tamanhos de clareiras: implicações para o manejo florestal sustentável – Tese de Doutorado em Desenvolvimento Sustentável do Trópico Úmido. – PPGDSTU/NAEA.
- PERFORMANCE MEASUREMENT GROUP PMG. Competitive Advantage of Best in Class Supply Chains. Pennsylvania: PMG, 2007. Disponível em: <a href="http://www.pmgbenchmarking.com/public/survey/advantagesofbic.pdf">http://www.pmgbenchmarking.com/public/survey/advantagesofbic.pdf</a>>.

Porter, M. (1991), "America green strategy", Scientific American, Vol. 264 No. 4, p. 168.

- PORTER, M. E.; KRAMER, M. R. Criação de valor compartilhado. In: Harvard Business Review, v. 89, n. 1/2, p. 62-77, 2011.
- Porter, M.E. and van der Linde, C. (1995) Toward a New Conception of the Environment Competitiveness Relationship. Journal of Economic Perspectives, 9, 97-118. http://dx.doi.org/10.1257/jep.9.4.97
- Pušavec, Franci & Krajnik, Peter & Kopac, Janez. (2010). Transitioning to sustainable production-Part I: application on machining technologies. Journal of Cleaner Production -J CLEAN PROD. 18. 174-184. 10.1016/j.jclepro.2009.08.010.
- Ramesh, R. (2014) Efficacy of Nanozinc Particle on Growth and Yield of Crop Plant.
- https://www.semanticscholar.org
- RICHARDSON, Roberto J. Pesquisa social: métodos e técnicas. São Paulo: Atlas, 1999. p.334
- RITCHIE, B., BRINDLEY, C. Supply chain risk management and performance: a guiding framework for future development. International Journal of Operations and Production Management, v. 27, p. 303-322, 2007. http://dx.doi.org/10.1108/01443570710725563
- Rogers, Dale & Lambert, Douglas & Croxton, Keely & Garcia-Dastugue, Sebastian. (2002). The Returns Management Process. The International Journal of Logistics Management. 13. 1-18. 10.1108/09574090210806397.
- Roma, J. C. Os Objetivos de Desenvolvimento do Milenio e sua transicao para os Objetivos de Desenvolvimento Sustentavel. Ciencia e Cultura, V..71, no 1, Sao Paulo, 2019.
- RUSCHEINSKY, A. No Conflito das Interpretações: O Enredo Da Sustentabilidade. Revista eletrônica do Mestrado em Educação Ambiental, v. 10, jan./jun, 2003.
- Sajjad, A., Eweje, G., Tappin, D., 2015. Sustainable supply chainmanagement: motivators and barriers. Bus. Strat. Environ. 24(7), 643–655.
- Saeidi, S., Sofian, S., Saeidi, P., Saeidi, S., & Saaeidi, S. (2015). How does corporate social responsibility contribute to firm financial performance? The mediating role of competitive advantage, reputation, and customer satisfaction. Journal of Business Research, 68(2), 341-350.
- Santa-Eulalia, L. A., Araújo, J. B., Kettani, O., Francioli, L. A., Azevedo, R. C., & Bremer, C.
  F. (2010). An essay on green supply chain design and dynamic alignment. In 3rd International Conference on Information Systems, Logistics and Supply Chain: Creating

Value Through Green Supply Chains, Casablanca, Morrocos.

- SANTOS, Joaquim. Diagnóstico das serrarias e das fábricas de laminados e compensados do estado do Amazonas. Acta Amazônica. nº 18 v. 1 e 2, p. 67-82, 1988.
- SANTOS, Boaventura de Souza.Pela Mão de Alice: o social e o político na pós-modernidade. 12. ed. São Paulo: Cortez, 2008.
- Sá-Silva, J. R., Almeida, C. D. de, & Guindani, J. F. (2009). Pesquisa documental: pistas teóricas e metodológicas. Revista Brasileira De História & Ciências Sociais, 1(1). Recuperado de https://periodicos.furg.br/rbhcs/article/view/10351
- Savitz, AW e Weber, K. (2006), The Triple Bottom Line, Jossey-Bass, San Francisco, CA.
- SCHEEREN BRUM, R. et al. Early Biofilm Formation on Rough and Smooth Titanium Specimens: a Systematic Review of Clinical Studies. Journal of oral & maxillofacial research, v. 12, n. 4, p. e1, 2021.
- SEABRA, M. F. F. (2008). Atividades agroflorestais e desenvolvimento sustentável: estudo de caso dos empreendimentos madeireiros exportadores do município de Paragominas, PA. Tese de Mestrado em Administração pela Universidade de Taubaté – UNITAU
- SERVIÇO FLORESTAL BRASILEIRO (SFB). Sistema Nacional de Informações Florestais SNIF. Brasília, 2007. Disponível em:<https://www.gov.br/agricultura/ptbr/assuntos/servico-florestal-brasileiro/concessao-florestal/plano-anual-de-outorgaflorestal/PAOF\_2007\_2008\_compressed1.pdf >
- Seuring, S. and Müller, M. (2008): From a literature review to a conceptual framework for sustainable supply chain management, Journal of Cleaner Production, n. 16, p.1699-1710. https://doi.org/10.1016/j.jclepro.2008.04.020
- Shen, Demei & Cho, Moon-Heum & Tsai, Chia-Lin & Marra, Rose. (2013). Unpacking online learning experiences: Online learning self-efficacy and learning satisfaction. The Internet and Higher Education. 19. 10–17. 10.1016/j.iheduc.2013.04.001.
- Shin, S., Aiken, K., 2012. The mediating role of marketing capability: evidence from Korean companies. Asia Pac. J. Mark. Logist. 24 (4), 668e677.
- Shrivastava, P. (1995) Environmental Technologies and Competitive Advantage. Strategic
   Management Journal, 16, 183-200. https://doi.org/10.1002/smj.4250160923

- SRIVASTAVA, S. K. Green supply-chain management: A state-of-the-art literature review. International Journal of Management Reviews, v. 9, n° 1, March, p. 53–80, 2007.
- Silva, D. F.; Adolfo, L. G. S.; Carvalho, S. A. Direitos humanos, desenvolvimento sustentável e sustentabilidade. Revista Eletronica do Curso de Direito da UFSM. V. 10, no. 1, 2015.
- SILVESTRE, B. S. Sustainable supply chain management in emerging economies: Environmental turbulence, institutional voids and sustainability trajectories. International Journal of Production Economics, v. 167, p. 156–169, 2015.
- de Souza, M. A., & Pires, C. B. Colheita Florestal: Mensuração e Análise dos Efeitos das Variáveis Controláveis e Não Controláveis no Custo das Atividades de Corte e Descasque Mecanizado. Anais Do Congresso Brasileiro De Custos - ABC. Recuperado de https://anaiscbc.emnuvens.com.br/anais/article/view/1199
- Souza, C. M., D. A. Roberts, and M. A. Cochrane (2005), Combining spectral and spatial information to map canopy damage from selective logging and forest fires, Rem. Sens. Envir., 98, 329-343.
- Stafford-Smith, M. et al. Integration: the key to implementing the Sustainable Development Goals. Sustain Sci. V.12, p. 911–919, 2017.
- Stevens, G. C. (1989). Integrating the Supply Chain . International Journal of Physical Distribution & Logistics Management, 3-8.
- Tachizawa, E. M.; Gimenez, C.; Sierra, V. Green supply chain management approaches: drivers and performance implications. International Journal of Operations& Production ManagementVol. 35 No. 11, 2015.
- Taticchi, P., Tonelli, F., & Pasqualino, R. (2013). Performance measurement of sustainable supply chains. International Journal of Productivity and Performance Management, 62(8), pp. 782-804.
- TAVANA, M.; KIAN, H.; NASR, A. K.; GOVINDAN, K.; MINA, H. A comprehensive framework for sustainable closed-loop supply chain network design. Journal of Cleaner Production, 332, 2022.
- Thakur, V., Mangla, S.K., 2019. Change management for sustainability: evaluating the role of human, operational and technological factors in leading Indian firms in home appliances sector. J. Clean. Prod. 213, 847e862.

- Tomas, R., & Alcantara, R. (2013). Modelos para gestão de riscos em cadeias de suprimentos: Revisão, análise e diretrizes para futuras pesquisas. Gestão & Produção, 20(3), 695-712.
- TOUBOULIC, A.; WALKER, H. Theories in sustainable supply chain management: a structured literature review. International Journal of Physical Distribution & Logistics Management, v. 45, n. 1/2, p. 16–42, 2015.
- Vachon, S. and Klassen, R.D. (2006) Extending Green Practices across the Supply Chain. International Journal of Operations & Production Management, 26, 795-821. http://dx.doi.org/10.1108/01443570610672248
- VIEIRA, Roberto Fonseca. RP em Revista. Salvador/BA, ano 5, n. 22, mai. 2007.
- VILELLA, Josely Nunes. Responsabilidade social e ambiental como nova competência da gestão de RH. Disponível em http://idemp-edu.com.br/artigos/36.
- VUPPALAPATI, Kiran; AHIRE, Sanjay L.; GUPTA, Tarun. JIT and TQM : a case for joint implementation.
- International Journal of Operations & Production Management, v.15, n. 5, p. 84-94, 1995.
- WAGNER, S. M.; BODE, C. An empirical examination of supply chain performance along several dimensions of risk. Journal of Business Logistics, v. 29, n. 1, p. 307-325, 2008. http://dx.doi.org/10.1002/j.2158-1592.2008.tb00081.x
- WALTERS, D., RAINBIRD, M. The Demand Chain as an Integral Component of the Value Chain. Journal of Consumer Marketing, v. 21, n. 7, 2004. http://dx.doi.org/10.1108/07363760410568680
- Welford, R., & Frost, S. (2006). Corporate Social Responsibility in Asian Supply Chains. Corporate Social Responsibility and Environmental Management, 13, 166-176. https://doi.org/10.1002/csr.121
- WERBACH, Adam. Estratégia para sustentabilidade: uma nova forma de planejar sua estratégia empresarial. Rio de Janeiro: Elsevier, 2010.
- Windolph, S., Harms, D., & Schaltegger, S. (2014). Motivations for Corporate Sustainability Management: Contrasting Survey Results and Implementation. Corporate Social Responsibility and Environmental Management, 21, 272-285. https://doi.org/10.1002/csr.1337
- Winter, M. and Knemeyer, A.M. (2013) Exploring the Integration of Sustainability and Supply

Chain Management: Current State and Opportunities for Future Inquiry. International Journal of Physical Distribution and Logistics Management, 43, 18-38. https://doi.org/10.1108/09600031311293237

- WOLF, J. Sustainable Supply Chain Management Integration: A Qualitative Analysis of the German Manufacturing Industry. Journal of Business Ethics, v. 102, n. 2, p. 221 – 235, 2011.
- WORLD COMISSION ON ENVIROMENTAL AND DEVELOPMENT (WCED). Our common future. Oxford: Oxford University Press, 1987.
- Yang,J.,Benyamin,B.,McEvoy,B.P.,Gordon,S.,Henders,A.K.,Nyholt,D. R., & Visscher, P. M. (2010). Common SNPs explain a large proportion of the heritability for human height. Nature Genetics, 42, 565–569. https://doi.org/10.1038/ng.608
- YIN. R. K. Estudo de caso: planejamento e métodos. 3 ed., Porto Alegre: Bookman, 2005.
- Yin, R. K. (1994). Pesquisa Estudo de Caso Desenho e Métodos (2 ed.). Porto Alegre: Bookman.
- Younis, K. M., Usup, G., & Ahmad, A. (2016). Secondary metabolites produced by marine streptomyces as antibiofilm and quorum-sensing inhibitor of uropathogen Proteus mirabilis. Environmental Science and Pollution Research International, 23(5), 4756-4767. http://dx.doi.org/10.1007/s11356-015-5687-9. PMid:26538254.
- Yuba, A. N. (2005). Análise da pluridimensionalidade da sustentabilidade da cadeia produtiva de componentes construtivos de madeira de plantios florestais. Tese de Doutorado, Escola de Engenharia de São Carlos, Universidade de São Paulo, São Carlos. doi:10.11606/T.18.2005.tde-13062006-193817. Recuperado em 2023-10-12, de www.teses.usp.br
- Zheng, Z., Xie, S., Dai, H., Chen, X. and Wang, H. (2017) An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends. 2017 IEEE International Congress on Big Data (BigData Congress), Honolulu, 25-30 June 2017, 557-564. https://doi.org/10.1109/BigDataCongress.2017.85
- ZHU, Q.; LIU, J.; LAI, K. Corporate social responsibility practices and performance improvement among Chinese national state-owned enterprises. International Journal of Production Economics, Netherlands, v. 171, p. 417-426, 2016.
- Zimon, D., Tyan, J., & Sroufe, R. (2020). Drivers of sustainable supply chain management:

practices to alignment with unsustainable development goals. International Journal for Quality Research, 14(1), 219–236.

ZIONI, F. Ciências Sociais e Meio Ambiente. In: PHILIP Jr, Arlindo; PELICIONI, Maria Cecília Focesi. Educação ambiental e sustentabilidade. Barueri: Manole, 2005, p.39-58.

# APPENDIX A – Interview guide for the timber supply chain

#### Characterization of the company.

1. What is the company's main activity? How does the operational process of your business work (such as relationships with suppliers, storage, distribution)?

# Sustainability block

2. Based on the three aspects of sustainability, environmental, social, and economic, what actions does the company take based on these concepts?

## Environmental management practices (EMP) block

- 3. Does the company practice environmental responsibility and care about regional biodiversity?
- 4. Does the company care about the origin of the material it buys? Is there any control over this practice?
- 5. In terms of the technology used in the operational process, do these resources enable productivity gains and minimize environmental damage?
- 6. Does the company promote environmental education for its employees?

## Supply Chain Management Practices Block

- 7. In your business, do you have to deal with intermediary companies, or can you negotiate directly with the first layer of the production chain?
- 8. Are there any criteria that companies need to meet in order to get involved in the timber industry?
- 9. Can you highlight how this contact takes place? Are there any specific rules that must be followed for each negotiation?
- 10. Based on the sustainable development goals proposed by the UN, which ones does the company already follow? Does the company develop projects to improve operations and achieve these goals?
- 11. Does the company work with uncertified wood? Is it possible to operate in this sector without certifications of origin or by purchasing raw materials that do not come from sustainable management?
- 12. How do standards and legislation affect the business? Are there any difficulties for the company in adapting to existing regulations?
- 13. Does the company have an adequate structure for operating the economic process in which it operates?
- 14. Does the company agree that by adopting sustainable practices it can achieve a better reputation and market value?

- 15. Does the company seek to evaluate strategic decisions and measure whether the practices adopted have shown satisfactory results?
- 16. Does the company carry out recycling or circular economy actions in order to comply with environmental practices?
- 17. Does the company develop practices aimed at quality management? Do these practices have a significant effect on the company? How?

#### Social inclusion practices for employees (SIPE)

- 18. Does the company promote actions aimed at equity and social justice among employees and people involved with the company?
- 19. Does the company promote training and programs for personal development among its employees?
- 20. Do working conditions respect the minimum criteria proposed by the Ministry of Labor and Employment?
- 21. Are there any internal practices aimed at combating the use of child labor and enslaved labor?
- 22. Is the use of PPE provided and enforced?

## Social inclusion practices for employees (SIPE)

- 23. Based on the practices listed above, can the company highlight economic advantages in adopting these practices? Is there a significant financial return from complying with these processes?
- 24. Does the company practice prices that are different from the market, given the sustainability factors used in the business?
- 25. By adopting sustainable practices, does the company consider that it has reduced its costs in terms of time off work and accidents, as well as in terms of materials management?
- 26. Are employees involved in the company's activities? Do they have the same commitment and see advantages in contributing to sustainable practices in the company?
- 27. Does the company carry out long-term projects? Do the company's results allow projections to be made for future improvements?

#### Socially inclusive practices for the community (SIPC)

- 28. In terms of corporate social responsibility, does the company practice ethics and transparency in its business dealings? How do they occur?
- 29. Given the whole context of sustainability practices, what are the biggest challenges faced by the company in adopting sustainability-oriented practices?

Variables	QUESTIONS - SUSTAINABLE ACTIONS X PRACTICES		
Environmental	1. Is the company aware and does it agree that adopting sustainable practices brings long-term benefits, favoring environmental preservation?	Answer on a Likert scale from 1 to 5	
	<ol> <li>Is it a determining factor for the company to develop practices that are aligned with the terms of ISO 14001?</li> <li>With regard to suppliers, are project/design specifications regarding environmental compliance provided per item purchased/contracted service?</li> <li>Are suppliers required to establish environmental management systems and/or obtain ISO 14001 certification?</li> <li>Are the environmental concerns of customers/companies addressed by establishing environmentally friendly product design/engineering and distribution?</li> <li>Have products been designed to consume less raw materials and energy in production?</li> <li>Are practices adopted to reduce the cost of treating raw materials and discharging effluents?</li> <li>Are practices adopted to reduce the discharge of toxic waste (solid, liquid or gaseous)?</li> <li>Are practices adopted to reduce the frequency of accidents in the operational sector?</li> <li>Does the company adopt projects aimed at protecting local</li> </ol>	(Score according to the degree of relevance to your organizatio n) Legend: 1 - Not at all important 2 - Not very important 3 - Important 4 - Very Important 5 - Extremely important	
	biodiversity?		
Social	<ol> <li>Is the level of education of the company's professionals a determining factor in hiring?</li> <li>Are the safety measures adopted by the organization advanced and do they reduce the risk of accidents?</li> <li>Does the organization provide a positive and healthy working environment for employees?</li> <li>Are the organizations taking action to combat the use of enslaved, forced or child labor in the organization?</li> <li>Are the salaries and benefits paid to employees sufficient to cover their basic needs?</li> <li>Are employees entitled to vacation, social security, health and other benefits?</li> <li>Are employment and business opportunities provided to the local community?</li> </ol>	Answer on a Likert scale from 1 to 5 (Score according to the degree of relevance to your organizatio n) Legend: 1 - Not at all important 2 - Not very important 3 - Important	

**APPENDIX B** – Questionnaire for supply chain actors

	8. Are there actions aimed at providing assistance to primary education units for the people around the organization?	4 - Very Important
	9. Are there practices aimed at reducing the inequality of remuneration	5 - Extremely
	and other benefits paid to employees of the same hierarchical level?	important
	10. Are there policies aimed at reducing the differences in allowable	
	compensation packages (salaries + benefits) paid to employees of	
	different hierarchical levels?	
	11. Are actions taken to improve the organization's working	
	environment and increase employee morale?	
	12. Are actions taken to improve the company's image by being	
	responsible to the community?	
	13. Are actions taken to improve opportunities for the local community	
	in terms of jobs and business generated by the organization?	
	14. Are actions taken to improve the education levels of people in the	
	surrounding area?	
	15. Is it measured whether there is an increase in the time people are	
	free from illness due to improvements in the health services offered	
	by the organization?	
Economic	1. Does the company consistently follow the Just-in-Time inventory	Answer on
	control technique to maintain inventory and minimize costs?	a Likert
	2. Is lean production adopted and do we seek to minimize costs in all	1 to 5
	actions?	(Saora
	3. Do you try to achieve economies of scale in the transportation of	according
	incoming inputs and raw materials and outgoing finished products?	to the
	4. Is the production plan updated in line with customer needs and are	relevance
	these demands shared with suppliers?	to your
	5. Does the organization respond quickly to customer needs by	n)
	maintaining adequate stock?	Legend
	6. Are suppliers quickly informed of future customer requirements?	1 - Not at
	7. Are mechanisms adopted to adjust and improve the use of the	all important
	organization's capacity/productivity?	2 - Not
	8. Is there progress in competitive advantages in terms of offering	very important
	differentiated products to customers?	3 -
	9. Is there a positive customer base retention rate?	Important 4 - Verv
	10. Are there greater opportunities for the company to reach and win	Important
	new customers?	5 - Extremelv
	11. Are there any actions aimed at improving the company's image	important
	because it is considered "green" (environmentally responsible)?	
	12. Are there any actions aimed at reducing production costs?	
	13. Are there actions aimed at reducing energy consumption?	

14. Are there any practices adopted to improve the efficiency of	
incoming logistics (for inputs/raw materials)?	
15. Are there any practices adopted to improve the efficiency of	
outbound logistics (of finished products)?	

	Timber and Sawmills –	Processing and
District	Phase 2	distribution - Phase 3
Assis Chateaubriand	2	
Diamante D' Oeste	0	
Entre Rios do Oeste	2	1
Formosa do Oeste	1	
Mercedes		1
São José das Palmeiras		2
Terra Roxa	2	
Guaíra	6	
Marechal Cândido Rondon	3	4
Nova Santa Rosa	3	
Quatro Pontes	1	2
Palotina	5	
Toledo	10	4
Iracema do Oeste	1	2
Maripá	2	
Ouro Verde do Oeste		1
Santa Helena	1	1
São Pedro do Iguaçu	1	
Cafelândia		1
Cascavel	16	1
Céu Azul	5	
Matelândia	2	
Ramilândia	3	
Serranópolis do Iguaçu	1	
Guaraniaçu	4	
Santa Tereza do Oeste		1
Foz do Iguaçu	15	2
Medianeira	2	3
Santa Terezinha de Itaipu	3	
Vera Cruz do Oeste		1
Braganey	1	1
Capitão Leônidas Marques	2	1
Corbélia	3	
Ibema	1	1
Três Barras do Paraná	2	
Missal	1	1
São Miguel do Iguaçu	4	2
Total	105	33

APPENDIX C – Companies found by district