

From River to Runway: How small-scale Suppliers drive Sustainable Innovation in Global Fashion – The Case of Pirarucu Leather

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ABSTRACT

Title: From River to Runway: How small-scale Suppliers drive Sustainable Innovation in Global Fashion – The Case of Pirarucu Leather

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This thesis examines the role of small-scale suppliers in driving sustainable innovation within the global fashion industry, focusing on the specific case of Pirarucu leather. Through the use of theoretical frameworks like Sustainable Supply Chain Management and Stakeholder Theory, this research investigates how these actors contribute uniquely to sustainable practices and outlines the necessary arrangements needed for their success.

Through five semi-structured interviews with key stakeholders in the Pirarucu leather supply chain, a qualitative content analysis using Gioia's methodology was conducted. The findings confirm and extend current literature by highlighting six main success factors for integrating sustainable innovation across global supply chains: Close and transparent relationships, extensive networks, unique product offerings, open dialogue, partnerships with local initiatives and sustainable practices throughout the whole production process. However, the research also identifies several key challenges for small-scale suppliers, including high costs, certification difficulties and the difficulty to meet industry standards. Finally, the findings emphasize the intrinsic motivation and innovative spirit of small-scale suppliers, which enables them to drive sustainable practices throughout the entire supply chain.

For sustainable innovation to thrive, a collaborative effort among all supply chain stakeholders is essential. Distributors, retailers, brands and designers have to act as facilitators, supporting small-scale suppliers in overcoming challenges and promoting sustainable innovations to raise consumer awareness and adoption. This research provides a groundwork for future research and managerial strategies aimed at enhancing their contributions to global sustainability.

Key Words: Sustainable Innovation, Small-Scale Suppliers, Global Fashion Industry, Pirarucu Leather, Supply Chain Management, Stakeholder Theory

ABSTRATO

Título: Do Rio à Passarela: Como os Fornecedores de pequena escala impulsionam a Inovação Sustentável na Moda Global - O Caso do Couro de Pirarucu

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Esta tese examina o papel dos fornecedores de pequena escala na promoção da inovação sustentável na indústria global da moda, com foco no couro de Pirarucu. Utilizando as teorias de Gestão da Cadeia de Suprimentos Sustentável e Teoria dos Stakeholders, esta pesquisa investiga como esses atores contribuem para práticas sustentáveis e delinea as condições necessárias para seu sucesso.

Através de cinco entrevistas semiestruturadas com stakeholders chave na cadeia de suprimentos do couro de Pirarucu, foi realizada uma análise de conteúdo qualitativa usando a metodologia de Gioia. Os resultados destacam seis fatores de sucesso para a integração da inovação sustentável nas cadeias de suprimentos globais: relações próximas e transparentes, redes extensas, ofertas de produtos únicos, diálogo aberto, parcerias com iniciativas locais e práticas sustentáveis em todo o processo produtivo. No entanto, a pesquisa também identifica desafios importantes para fornecedores de pequena escala, incluindo altos custos, dificuldades de certificação e cumprimento de padrões da indústria. Além disso, os resultados enfatizam a motivação intrínseca e o espírito inovador dos fornecedores de pequena escala, que impulsionam práticas sustentáveis em toda a cadeia de suprimentos.

Para que a inovação sustentável prospere, é essencial um esforço colaborativo entre todos os stakeholders da cadeia de suprimentos. Distribuidores, varejistas, marcas e designers devem atuar como facilitadores, apoiando os fornecedores de pequena escala na superação de desafios e promovendo inovações sustentáveis para aumentar a conscientização e adoção pelo consumidor. Esta pesquisa oferece uma base para futuras pesquisas e estratégias gerenciais para aumentar suas contribuições para a sustentabilidade global.

Palavras-chave: Inovação Sustentável, Fornecedores de Pequena Escala, Indústria Global da Moda, Couro de Pirarucu, Gestão da Cadeia de Suprimentos, Teoria dos Stakeholders

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LIST OF ABBREVIATIONS

TBL	Triple-bottom-line
R&D	Research & Development
NGOs	Non-governmental Organizations
GHG	Greenhouse Gas
SSCM	Sustainable Supply Chain Management
SMEs	Small and medium-sized enterprises

1 INTRODUCTION

1.1 Background and Context

Within the global fashion industry, environmentally and socially responsible supply chain practices are becoming increasingly important. This is not least due to the industry's poor reputation, which is repeatedly criticized for its significant water consumption, inhumane working conditions and immense environmental damage along the entire supply chain (Niinimäki et al., 2020; Harsanto et al., 2023). Overall, the fashion industry records a consumption of over 92 million tons of waste and 79 trillion liters of water every year due to a steadily increasing production, which in turn leads to a global market value of over 1.04 trillion USD in 2021 (Niinimäki et al., 2020; Harsanto et al., 2023). Therefore, the integration of sustainable innovations, especially within supply chain management activities, remains a crucial and ongoing challenge for the industry.

Existing literature and case studies constantly mention the need to develop such sustainable innovations within global supply chains and emphasize the active and cooperative involvement of suppliers in relevant key activities in order to avoid negative environmental and social impacts along the entire supply and value chain (Pagell & Shevchenko, 2014; Carter & Rogers, 2008; Alexander et al., 2014). For this reason, this research focuses precisely on these suppliers, more specifically on comparatively small-scale suppliers, and examines their integral role in the process of sustainable innovation within global supply chains.

In particular, the focus of this research will evolve around the specific case of Pirarucu, an Amazonian fish whose skin represents a sustainable alternative to traditional leather within the fashion industry. The selection of this specific example will be explained in more detail in the course of this work; however, it can already be stated that the case of Pirarucu skin is well suited to show how small-scale businesses can be seen as drivers of sustainable innovation within the fashion industry. In doing so, this research aims to show the complex dynamics of sustainable innovation, supplier engagement as well as the transformative impact of small businesses on the sustainable development of an almost mature fashion industry.

1.2 Research Problem Statement

Although the need for green and sustainable innovation is acknowledged both within the fashion industry and within the literature, the role that suppliers, especially those producing on a small-scale, play during this development is largely unexplored. However, it could be these comparable small players that have a significant and essential influence on the development of sustainable innovations. Nevertheless, there is hardly any research on the actual influence of these small-scale suppliers with regard to designing sustainable innovation in global supply chains. This research gap may result in sustainability strategies not being implemented effectively, particularly in relation to supplier management, or in potentially innovative sustainable solutions from such suppliers being overlooked.

To fill this above-mentioned gap, this research aims to analyze the role of small-scale suppliers regarding the introduction of sustainable innovations across global supply chains within the fashion industry, by using the example of Pirarucu skin as an alternative to traditional leather. Furthermore, this work seeks to reveal the strategies and arrangements that are necessary for these actors to achieve such successful integration. Finally, it aims to develop a more precise understanding of how sustainability initiatives are distributed among supply chain partners, as suggested by Formentini and Taticchi (2016). Hence, the research questions can be stated as follows:

- 1) *How do small-scale suppliers actively contribute to sustainable innovation within the global fashion industry's supply chain?*
- 2) *What arrangements and mechanisms are necessary to achieve a successful integration of sustainable innovation within the global fashion industry's supply chain?*

1.3 Structure of the Thesis

This thesis is divided into several main sections. Following this introduction, a literature review presents the current state of research on sustainable innovation, supplier engagement as well as key stakeholders and their roles in global supply chains. Subsequently, three theoretical frameworks essential for the research part are presented. The following methodology section explains the research approaches as well as the selection of Pirarucu as a case example. Finally, the results are presented and discussed, followed by a concluding summary that outlines the most important findings.

2 LITERATURE REVIEW

2.1 Sustainable Innovation in Global Supply Chains

The term sustainable innovation, often referred to as green innovation within the literature, describes the development of new or modified products, technologies, processes and management approaches that serve to minimize environmental and social harm while simultaneously generating economic profit (Gupta et al., 2020; Kusi-Sarpong et al., 2019). Since such innovations are often associated with a more efficient use of resources, they achieve both sustainability goals and cost savings within an organization (Kusi-Sarpong et al., 2019; Yang & Lin, 2020). Accordingly, through sustainable innovations, companies can become environmentally friendlier, open up new business opportunities and set themselves apart from the competition. Moreover, such innovations tend to entail a positive effect on the general well-being of the communities in which the business operates (Kusi-Sarpong et al., 2019; Yang & Lin, 2020; Gupta et al., 2020).

Gupta et al. (2020) emphasize that green innovation is the main driver for businesses gradually shifting towards sustainability, as the integration of the triple-bottom-line (TBL) approach, i.e., the balanced fulfilment of economic, environmental and social goals, is being followed. For this reason, both the implementation and promotion of sustainable innovations are considered a core component of any future-oriented business strategy (Yang & Lin, 2020).

Sustainable innovations also play an essential role in global supply chains in terms of gaining a competitive advantage and promoting long-term sustainable development (Zhou et al., 2020). In order to efficiently integrate green innovations and guarantee their success, certain factors must be fulfilled within the supply chain. Hereby, the relative perception of fairness within the supply chain, the involvement of individual supply chain partners and a constant and stimulated exchange of knowledge between all parties involved are of particular importance (Zhou et al., 2020).

To summarize, the successful development and implementation of sustainable innovations prove to be extremely beneficial for companies that wish to respond effectively to stakeholder pressures and gain a significant advantage within the global economy (Kusi-Sarpong et al., 2019; Yang & Lin, 2020; Gupta et al., 2020; Zhou et al., 2020).

2.1.1 Drivers of Sustainable Innovations in Global Supply Chains

In terms of drivers of sustainable innovation within a supply chain, both internal and external factors can be identified that play a decisive role in the development and implementation of such solutions (Saeed & Kersten, 2019; Kusi-Sarpong et al., 2019). For instance, Kusi-Sarpong et al. (2019) emphasize stakeholder pressure, diverse government regulations as well as technological and scientific progress as significant drivers. Generally speaking, such forces are recognized by the fact that they encourage companies to pursue more sustainable and green approaches.

Yang & Lin (2020) divide these drivers into three main groups using a structured categorization:

- 1) Internal drivers within a company,
- 2) External drivers from the market and society, and
- 3) Inter-organizational drivers within the relationship between companies and their suppliers.

Internal drivers, such as technological capabilities and top management commitment, are crucial for the initial implementation and development of such innovations (Yang & Lin, 2020). Therefore, management must establish a clear strategy with regard to sustainable innovation and integrate it firmly into the company's vision. This also implies the allocation of necessary resources, such as investments in employee training and research and development (R&D).

External drivers comprise, among others, environmental regulations and consumer demands. These types of drivers ensure that companies are increasingly being pushed into the sustainability path, as such new legislation, societal demands and market pressures are forcing companies to establish sustainable approaches and innovations both within their organization as well as along their entire supply chain. In order to maintain long-term profitability, these factors are motivating businesses to also improve their social and environmental performance (Saeed & Kersten, 2019; Yang & Lin, 2020).

Finally, inter-organizational drivers specifically refer to the interactive collaboration between supply chain partners. According to Yang & Lin (2020), such collaboration is characterized by long-term relationships with a strong foundation of trust between supply chain partners and is essential for the introduction of sustainable innovations along the entire global supply chain.

Furthermore, Todeschini et al. (2020) emphasize that such collaboration in combination with an intrinsically motivated willingness to take responsibility is the key to bringing an entire industry, such as the fashion sector, to holistic sustainability. This is partly due to the fact that knowledge can be shared in order to achieve overlapping sustainability goals and successfully establish sustainable innovations jointly.

To summarize, the main drivers of sustainable innovation are captured in the following table, categorized according to Yang & Lin (2020):

Category	Drivers
Internal Drivers	Top management commitment, Economic benefits, Corporate Social Responsibility, Employee’s education and training, Technological capabilities, Employee’s involvement and incentives, Environmental quality management system
External Drivers	Environmental regulations, Social recognition, Market competition, Guidance and support from regulatory authorities, Consumer demands
Inter-organizational Drivers	Long-term relationships with supply chain partners, Trust relationships with supply chain partners, Supervision of supplier performance, Supplier incentive system, Information and knowledge sharing with supply chain partners

Table 1: Drivers of Implementing Sustainable Innovation.

The categorization of these drivers highlights the multidimensional facets of sustainable innovation and emphasizes the need for an integrative business strategy involving multiple supply chain partners.

2.1.2 Types of Sustainable Innovations in the Fashion Industry

Within the fashion sector, sustainable innovations can be placed along three types: Product, process and organizational innovations (Harsanto et al., 2023). Product innovations focus on the development and design of environmentally friendly products. This involves eco-design, the use of environmentally friendly materials as well as eco labels, among others. These follow the goal of minimizing the environmental impact throughout the entire lifecycle of a product (Harsanto et al., 2023). Thereby, it is important that the expectations of customers and end consumers are incorporated into the product design process, as this is a decisive factor for the successful implementation of sustainable innovations. It is also important to conscientiously fulfil compliance measures such as laws and regulations, as this is crucial for the adoption and success of e.g., eco-labels (Rese et al., 2022).

Process innovations mainly relate to improving and increasing the efficiency of manufacturing processes. This type of green innovation includes strategies for reducing resources and emissions, but also improved waste management systems as well as clear production models (Harsanto et al., 2023). Rese et al. (2022) emphasize that knowledge about sustainable purchasing decisions and green creativity are crucial for this type of innovation, as they lead to the fulfilment of market and consumer demands. In addition, continuous investments in R&D support process innovations related to resource conservation and CO2 reductions (Rese et al., 2022).

Lastly, organizational innovations refer to changes in structures and the general corporate culture of a firm. To achieve this, strategies such as environmental management systems, the development of sustainable business models and increased cooperation between different industry players are used with the aim of ensuring environmental and social responsibility in the long term (Harsanto et al., 2023). Moreover, cooperation and knowledge sharing with actors from the entire supply chain is of particular importance, as these aspects are crucial for the cultural embedding of sustainable innovations (Rese et al., 2022). It is precisely this intrinsic organizational aspect that is crucial for the successful implementation of sustainable innovations along the supply chain (Rese et al., 2022).

The following table summarizes the main types of sustainable innovation in the fashion industry together with their respective sub-themes according to Harsanto et al. (2023):

Type of Innovation	Sub-Themes
Product Innovation	Eco-design, Eco-label, Material, Packaging
Process Innovation	Cleaner production, Eco-efficiency, Waste handling, Supply Chain Management, Enzymatic textile processing,
Organizational Innovation	Environmental Management System & Corporate Policy, Collaboration, Business Model Innovation, Culture and Knowledge Management, Risk Management

Table 2: Sustainable Innovations in the Fashion Industry.

It is essential to not compartmentalize the integration of the above-mentioned sustainable innovations to individual stakeholders, but rather to understand their implementation as a cooperative approach between all actors involved, including suppliers, regulatory authorities, consumers and competitors. It is the responsibility of all these stakeholders to enter into a

continuous, constructive dialogue characterized by mutual trust and transparency in order to effectively achieve common sustainability goals (Todeschini et al., 2020).

Finally, Harsanto et al. (2023) suggest that future research should focus on specific topics within the three categorizations mentioned. More specifically, the authors emphasize the topic of “*Materials*” in the area of product innovations and the subject of “*Supply Chain Management*” in the process innovation sector, which is explicitly what this research aims to explore in more detail through the example of Pirarucu leather.

2.2 Sustainable Innovation and Supplier Engagement

Companies who are only focusing on their internal sustainability are not able to develop and implement outstanding green innovations (Cheng, 2020). To achieve this, an active involvement of suppliers is necessary, especially considering the sustainability of a firm's supply chain. Therefore, the approach of supplier engagement not only refers to direct interactions with respective suppliers but also to the establishment of a strategic management of those suppliers and the relationships, as pointed out by Liu et al. (2018). It encompasses acts like capacity building to address both economic and environmental performance aspects, with the focus exceeding traditional supplier evaluation through joint development efforts and long-term partnership goals to encourage sustainable innovations across the entire supply chain. A study by Lintukangas et al. (2019) reveals that companies which strategically engage their suppliers and involve them early on in the product development process often achieve a higher overall sustainability performance within their organization than those that do not follow this approach. Viewing suppliers as innovation partners rather than just sources of materials encourage an atmosphere of collaboration, which in turn is crucial for promoting sustainability within a global supply chain.

Cheng (2020) identifies two specific forms of supplier engagement: Using suppliers as a source of green knowledge as well as engaging them as co-creators in the innovation process. As already indicated, the latter can be achieved through joint projects, regular assessments as well as the agreement of common goals and measures regarding sustainability (Lintukangas et al., 2019). Rather than simply pushing them to implement sustainability innovations, it is important to actively integrate suppliers into the innovation process and use them as a resource for sustainable knowledge, since this helps to acquire new information which in turn leads to improved R&D and overall sustainable innovation performance (Cheng, 2020). Moreover, Liu

et al. (2018) highlight the active involvement of various other stakeholders, including non-governmental organizations (NGOs), industry associations and consulting firms, as essential for the success of sustainable practices and innovations in supply chain management.

Furthermore, it is worth mentioning that the active engagement of suppliers not only plays a crucial role when referring to sustainable innovation but also when considering overall greenhouse gas (GHG) emissions. Generally speaking, around 80% of a firm's total emissions can be categorized as Scope 3 emissions, meaning indirect GHG emissions that occur in a company's value chain, including those from suppliers and transportation. By collaborating with suppliers, companies can set up common measures, like e.g., decarbonization targets, sustainable sourcing practices, optimized transport routes as well as reducing packaging waste. These actions aim to reduce environmental impacts and promote sustainable innovation, leading to an environmentally friendly and resilient supply chain structure in the long term (Deloitte, 2023).

By integrating suppliers as innovation partners and actively involving them into the firm's sustainability strategy, green R&D is being supported, which ultimately leads to a more sufficient and sustainable development of new products. Through long-term partnerships, trust and combined efforts, firms are able to improve both their economic, environmental and social performance and thus driving sustainable innovation forward. Hence, supplier engagement can be seen as an essential approach in driving and implementing sustainable innovation across global supply chains.

2.3 Key Actors and their roles in Global Supply Chains

Global supply chains consist of a variety of different actors, from raw material suppliers to end consumers, with each of these actors taking on different roles to ensure a smooth movement of goods. Fang et al. (2022) roughly define these actors as follows:

- **Material Suppliers:** They provide raw materials that are required for the production.
- **Manufacturers:** They process these raw materials into finished materials or products.
- **Distributors:** They move these products from manufacturers to retailers.
- **Retailers:** They make the products available to the end users.
- **Consumers:** They purchase and use the end products.

Within the fashion industry, the number of these players and the associated allocation of roles largely depends on the specific supply chain. Textile suppliers, for example, are responsible for the provision of fabrics and materials, while fashion brands create the designs, which in turn are created by manufacturers on the basis of the raw materials provided. Wholesalers are placed between manufacturers and retailers, assisting in the wide distribution of products, whilst logistic service providers are responsible for transport and warehousing. Additionally, retailers and end consumers play a crucial role, as their feedback has a direct influence on market trends and the adoption of sustainable innovations (FashionUnited, 2022).

The innovative capacity of any supply chain is closely linked to the respective actors and their roles. Oke et al. (2013) emphasize that especially suppliers have a decisive role in the provision and development of innovative materials and technologies, which means that they have a direct influence on the product performance and strategies of downstream players. Distributors have a direct influence on the efficiency and costs of the supply chain, while customers and consumers drive the development of new products through expressing their needs.

In order to fully utilize this innovation potential, high-quality collaboration between these players within the supply chain is essential. As already mentioned, strategic relationships as well as an innovative corporate climate play an important role in applying the innovative approaches of other supply chain partners to one's own strategies (Oke et al., 2013). Once again, becomes evident that innovation requires joint interaction between all supply chain actors, each of whom plays a crucial role in delivering sustainable innovation and actively seeking to build trusting relationships with each other. As such, the continuous interaction and feedback loop among material suppliers, manufacturers, distributors, retailers and end users within the fashion industry are essential to achieving sustainable innovation in the global supply chain.

2.4 Important Theoretical Framework

In the following, some fundamental theoretical frameworks will be presented, that build the basis for the research part of this thesis. First, the concept of Sustainable Supply Chain Management (SSCM) will be introduced. SSCM provides a theoretical framework for understanding how sustainability principles can drive innovation throughout the supply chain, including the adoption of alternative materials like e.g., Pirarucu leather. It therefore assists to explore the research question regarding how small-scale suppliers contribute to sustainable innovation in the fashion industry's supply chain. In the following, Freeman's Stakeholder

Theory will be presented. Due to the fact, that this research focuses on the role of small-scale suppliers (a stakeholder group) in driving sustainable innovation in the fashion industry's supply chain, Stakeholder Theory is being considered helpful when analyzing how these suppliers interact with other stakeholders as well as the challenges and opportunities that are connected to this. Finally, Roger's Diffusion of Innovation Theory, along with its five key characteristics, will be explained as it is both a widely used framework as well as regarded helpful for examining the adoption potential of Pirarucu leather during the research part of this work.

2.4.1 Sustainable Supply Chain Management

Integrating social and environmental aspects into the supply chain is considered decisive for the success of an organization as a whole. Therefore, companies must find and implement innovative and environmentally friendly approaches not only inside their own organizational borders but also throughout the entire supply chain network in order to adapt to new developments and shifting trends. Hence, companies bear responsibility for actions influencing the environment, society and the economy, both inside their own business as well as among their supply chain partners (Saeed & Kersten, 2019).

According to Carter and Rogers (2008, p. 368), SSCM can be defined as:

“The strategic, transparent integration and achievement of an organization's social, environmental and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual organization and its supply chains”.

In other words, SSCM is a concept that aims to promote sustainability at all supply chain levels (Saeed & Kersten, 2019; Zhou et al., 2020; Kusi-Sarpong et al., 2019). The term SSCM is based on the idea of TBL approach, combining environmental, social and economic sustainability (Gupta et al., 2020). The goal of SSCM is to manage processes, resources, information and financial means in a way that maximizes profits while minimizing environmental impact and maximizing social welfare (Gupta et al., 2020; Zhou et al., 2020). To achieve this, all participants in the supply chain must work together and meet the requirements of customers and other stakeholders. Only this comprehensive collaboration allows for a truly sustainable supply chain to be realized that delivers both economic, as well as environmental and social performance results (Saeed & Kersten, 2019; Carter & Rogers, 2008). The integration of SSCM not only helps to reduce the negative impact of a firm's supply chain, but it can also increase

efficiency from various perspectives, e.g., by cutting costs (Gupta et al., 2020). However, an important aspect of SSCM is, that companies must pursue multiple and often conflicting goals. While maximizing profits usually goes hand in hand with cost reductions, minimizing environmental impacts and maximizing social welfare often require additional investments from the focal firm (Gupta et al., 2020). This can make the decision-making process complex and presents a challenge among the various companies of a supply chain.

According to Zailani et al. (2012), practices such as green design, for example the development of environmentally friendly products, reverse logistics, energy use, waste management as well as production planning and control, are among the most frequently used practices within SSCM. Gupta et al. (2020) states that the activities of one member of a supply chain can have a significant impact on the other members, especially for those further down the supply chain. It is therefore important that members of the supply chain integrate sustainability into their processes and manage it collectively. By working together in a coordinated way, companies can achieve the common goal of a sustainable supply chain more effectively (Gupta et al., 2020). In particular, multinational companies and those from developed countries are considered to share their sustainability initiatives and experiences with partners from emerging and developing countries in order to advance the sustainability goals of the entire supply chain (Gupta et al., 2020). Furthermore, effective communication and cooperation between supply chain partners is essential as it facilitates the implementation of environmental management systems and environmentally friendly product innovations, which in turn are critical to achieve supply chain sustainability goals (Gupta et al., 2020).

Moreover, Deloitte (2023) emphasizes that companies need to rethink their supply chain, moving away from the historical focus on cost efficiency and speed to the integration of social responsibility and environmental aspects. Three key principles must be followed to find such new balance within the supply chain:

1. Strategic, long-term, and multi-dimensional Thinking
2. Using Partnerships
3. Emphasizing Technology

The first principle states that companies should think in the long run rather than simply reacting to current trends when it comes to SSCM. Deloitte (2023) points out, that such reactive approaches often lead to expensive and ineffective measures, while long-term strategies help to

promote sustainability effectively. Using partnerships implies a close collaboration within the industry but also with supply chain partners through shared data and joint projects, while emphasizing technology refers to the use of modern technology to provide insights into the supply chain and allow for risk minimization as well as for promoting sustainable practices.

2.4.2 Stakeholder Theory

Stakeholder theory, according to Parmar et al. (2010), emphasizes that a business should serve the interests of all stakeholders that are impacted by its decisions, including the community, suppliers, customers and employees and thus going beyond the approach of solely serving the interests of shareholders. If implemented correctly, Stakeholder Theory leads to a more sustainable and ethical value and supply chain, as it takes into account the needs and expectations of a broad stakeholder group and does not only focus on short-term financial gains (Parmar et al., 2010). Thus, it differs from traditional corporate models, as the focus shifts from exclusively maximizing returns for shareholders (Gibson, 2000).

Three different approaches can be defined within Stakeholder Theory (Gibson, 2000; Siems et al., 2023; Sajjad et al., 2015):

- 1) The descriptive approach,
- 2) The instrumental approach, and
- 3) The normative approach

The descriptive approach describes whether stakeholder interests are taken into account and how companies actually deal with those (Gibson, 2000; Siems et al., 2023). The instrumental approach deals with the impact of proactive stakeholder management on company's economic performance (Gibson, 2000; Sajaad et al., 2015). Thirdly, the normative approach looks at the moral reasons why companies should take stakeholder's interests into account (Siems et al., 2023). The latter emphasizes the moral obligation of companies to consider the interests of all stakeholders and is based on the idea that all stakeholders have intrinsic values and that their interests should be taken into account for ethical reasons, even in the absence of direct economic benefit (Sajjad et al., 2015).

However, Phillips (2003) underlines the distinction between Stakeholder Theory and other moral and political theories. This theory is designed to take the ethical aspects of corporate

governance into account and is therefore a theory of corporate strategy and ethics, but not a theory of political economy as a whole. It requires companies to consider the interests of stakeholders without directly requiring legal changes. Moreover, Stakeholder Theory shall not be viewed as a framework that is intended to regulate the entire economy. Rather, the theory is limited to the strategic and ethical management of organizations. Furthermore, it is essential not to over-extend the term “*Stakeholder*” by referring to the whole of society, as this would significantly falsify the whole theory.

Stakeholder Theory is one of the most frequently employed concepts in SSCM (Siems et al., 2023; Sajjad et al., 2015). This means that in the context of SSCM, companies need to identify and consider the requirements and expectations of their stakeholders in order to implement sustainable practices and design their supply chain sustainably in the long run. Stakeholders play a crucial role within SSCM by acting as drivers, facilitators or inspectors. Drivers are stakeholders who increase awareness of sustainability through pressure or incentives, such as NGOs, customers, but also the focal company itself. Facilitators support companies in implementing sustainable practices by providing knowledge and resources, such as government agencies and research institutions. Inspectors evaluate the implemented sustainable practices along the supply chain, such as media and trade unions (Siems et al., 2023; Sajjad et al., 2015).

Finally, Siems et al. (2023) further divide diverse stakeholders into different categories according to their position within the supply chain, thus making it either to understand the Stakeholder Theory in the context of SSCM. This categorization can be presented as follows:

Category	Stakeholders
Upstream Stakeholders	Raw Material Producers, Suppliers, Supplier’s suppliers
Focal Company	Internal stakeholders of the focal company, e.g., Top Leadership and Employees
Downstream Stakeholders	Retailers, Wholesalers, Logistical Intermediaries
Market Stakeholders	Unions, Competitors, Financial Intermediaries
Societal Stakeholders	NGOs, Governmental Actors, Research Institutes, Universities

Table 3: Stakeholder Categorization within the supply chain.

2.4.3 Roger's Diffusion of Innovation Theory

The Diffusion of Innovation Theory by Everett Rogers describes how new innovations, ideas and technologies are being adopted in the market and within the society (Sahin, 2006). Within this theoretical framework, five key characteristics have been identified that influence the adoption process of new innovations: *Relative Advantage*, *Compatibility*, *Complexity*, *Testability* and *Observability* (Smerecnik & Andersen, 2011; Johnson, 2015). A study by Smerecnik and Andersen (2011) examines those main characteristics in the context of sustainable innovations by showing how these characteristics influence the acceptance and diffusion of such innovations, while Johnson (2015) analyses these characteristics in the context of small and medium-sized enterprises (SMEs).

The *Relative Advantage* of an innovation refers to the extent to which an innovation is believed to be superior to the previous alternative, incorporating elements such as reduced expenses, enhanced performance, and social standing. Sahin, 2006). The clearer the perceived benefits of a sustainable innovation are, the faster it will be adopted and accepted (Smerecnik & Andersen, 2011).

Compatibility refers to how similar the innovation is to existing values and practices within an organization and how well it matches with current needs and values of its users (Sahin, 2006; Smerecnik & Andersen, 2011). Hence, sustainable innovations are more likely being adopted if they are compatible with current products or processes as this reduces uncertainty among users and thus fosters acceptance (Sahin, 2006; Smerecnik & Andersen, 2011). Additionally, Johnson (2015) notes that SMEs already adopting green practices are more likely to adopt further sustainability management tools.

The difficulty of understanding and using an innovation can be defined as *Complexity* (Sahin, 2006). Simplicity, the opposite of complexity, turns out to be the strongest predictor when it comes to the adoption of sustainable innovations (Smerecnik & Andersen, 2011; Johnson, 2015). If innovations are relatively easy to use, they are being more effortlessly and efficiently adopted, both by companies and the end users (Sahin, 2006).

The *Testability* of an innovation refers to the level to which users can test a certain innovation on a limited basis (Sahin, 2006). Sustainable innovations are more likely being adopted if they can be previously tested on a smaller scale, as potential risks can be identified before fully

implementing the new innovation (Smerecnik & Andersen, 2011). Through pilot projects or test versions, organizations and end users are able to gain more trust and confidence towards the new innovation, which is especially essential for SME's (Sahin, 2006; Johnson, 2015).

Finally, *Observability* describes how visible the results of an innovation are to others (Sahin, 2006; Smerecnik & Andersen, 2011). The more obvious and easily the benefits and effects of an innovation are, the more likely it is that other organizations or end users are motivated to adopt to the innovation as well (Sahin, 2006). Positive effects of a sustainable innovation that demonstrates a high observability are, among others, reduced energy costs and improved environmental ratings (Smerecnik & Andersen, 2011).

Various studies prove that this framework can be effectively applied to the adoption of sustainable innovations and that it helps managers to develop strategies supporting the adoption and implementation of new sustainability initiatives (Johnson, 2015; Smerecnik & Andersen, 2011).

3 RESEARCH METHODOLOGY

3.1 The Case of Pirarucu Leather

The fashion industry finds itself in a challenging situation, as it is lagging behind other industries in terms of reconciling economic, environmental and social aspects. There remains a great need for improvement, as consumers increasingly expect sustainable practices and environmentally friendly products from brands and companies (Balchandani et al., 2023). Within the fashion industry, leather products in particular continue to be popular, as consumers prefer luxury goods that maintain their value over time, especially in times of economic uncertainty (Balchandani et al., 2023). For this reason, the author has focused on the fashion industry as a relevant sector for this research and therein, specifically on alternative leather materials, like e.g., Pirarucu leather.

3.1.1 Introduction to Pirarucu Leather

Pirarucu, scientifically known as *Arapaima gigas*, originates from the Amazon region and is the world's largest scaled freshwater fish. It can reach a size of up to three meters in length and a weight of up to 200 kilograms. Thanks to its immense size, the fish is used as the main source

of protein within the local and indigenous communities, but is also exploited for both national and international trade. Overfishing of this species has become a major problem, however, within Brazil, fishing of this fish within the natural reserve Mamirauá is strictly regulated and accompanied by a sustainable management system, whereby fishing is only allowed during dry season (Cortegano et al., 2017).

Within the fashion industry, the skin of the Pirarucu fish is used as an alternative to traditional, exotic leather and is classified as a luxury product (Global Green Solutions, 2024). The skin of the fish, which would otherwise be a mere waste product of the food industry, serves as the raw material for this specific leather production, making Pirarucu leather a unique and sustainable product that benefits both the environment and local communities (Global Green Solutions, 2024). Known for its softness, resilience as well as unique aesthetic qualities, the Pirarucu leather has become a preferred material for many design houses and fashion labels (Global Green Solutions, 2024). Rick Owens, Osklen and Burberry are some of those frequently using Pirarucu leather, combining luxury with sustainability to design shoes, handbags and garments (Appendix 1). Within this segment, one company stands out in particular: Nova Kaeru, a comparable small-scale company from Brazil, is the world's first 100% organic tannery, which is mainly engaged in the production of Pirarucu leather (Nova Kaeru, 2024). They have developed a process that ensures that the Pirarucu skin is treated without harmful chemicals such as chromium or heavy metals, while exclusively using natural oils and dyes (Nova Kaeru, 2024). Within their supply chain, they are considered pioneers in terms of environmental and social sustainability, not only by contributing to the preservation of the Amazonian ecosystem through zero deforestation and other initiatives, but also by ensuring greater economic stability in these regions through the fair and strictly monitored purchase of the fish skin (Global Green Solutions, 2024). Fishermen and breeders, as well as the entire indigenous and riverside communities in this area, are dependent on the sale of Pirarucu (Global Green Solutions, 2024). The sale of the fish skin, in addition to fish meat, provides an additional and essential source of income for these communities and ultimately a better quality of life, while safeguarding an endangered species and its environment (Global Green Solutions, 2024).

For these reasons, this paper will focus on Pirarucu leather in the context of the small-scale supplier Nova Kaeru, which by its own statement is responsible for 90% of the legal distribution of Pirarucu leather.

3.1.2 Pirarucu Leather in the context of Sustainable Innovation

Pirarucu leather serves as a suitable example to answer the research question and to illustrate the general role of small-scale suppliers in driving sustainable innovation within the global fashion industry. On the one hand, Pirarucu leather meets the definition of a sustainable innovation by Gupta et al. (2020) in that by transforming food waste into high-value and eco-friendly materials, it represents the development of a product that minimizes environmental and social harm while generating economic profit. Pirarucu leather therefore also fulfills the implementation of the TBL approach (Gupta et al., 2020). Furthermore, there is currently one notable supplier within the Pirarucu leather market that is driving sustainable innovation and practices. Nova Kaeru, considered a rather small-scale supplier within the global fashion industry, can therefore be used ideally to illustrate the role of these suppliers in the fashion industry and provide insight into the necessary arrangements and frameworks needed. Finally, through the use of Pirarucu leather by well-known international fashion labels, this example allows for a perspective and analysis of global fashion supply chains.

Therefore, the aim and reason for selecting the case of Pirarucu leather in the context of the small-scale supplier Nova Kaeru is to use a thoughtfully chosen example to explore the general role of such suppliers in terms of driving sustainable innovation in an already established and mature fashion industry, in which there remains a great deal of potential for sustainable development.

3.2 Sample Strategy

The sample for this research has been chosen using a mixture between purposive and convenience sampling techniques and therefore using a non-probability sampling method. Purposive or judgmental sampling is based on the researcher's competent assessment and selection of interviewees who can provide important and high-quality information related to the study (Etikan et al., 2016). In the context of this research, the selection criteria are as follows:

- 1) The interviewee is part of the global supply chain of Pirarucu leather or an external, independent expert (i.e., in field of sustainable textiles or SSCM).
- 2) The interviewee has been an integral part of an organization within the Pirarucu leather supply chain or an independent institute for 2 years or more.
- 3) The interviewee is, among other things, responsible for the development and promotion of sustainable innovations within said company.

Due to the comparatively limited number of potential interview partners, resulting from the niche market of Pirarucu leather and the special focus on a small-scale company from Brazil, the convenience sampling method has also been used. This implies the selection of interview partners based on availability and accessibility (Palinkas et al., 2015). For this reason, the researcher made use of her professional industry networks to identify suitable interview partners. Another reason for using these strategies is the limited timeframe and resources available to the researcher. In order to obtain differentiated views and avoid possible cultural biases, attention has also been paid to the geographical location of the participants.

A total of four participants directly involved in the global supply chain of Pirarucu leather as well as one independent expert in the field of sustainable textile materials and global supply chains has been identified. This again demonstrates the unique and comparatively small-scale nature of Pirarucu leather and its supply chain. Due to their different positions within the supply chain, as mentioned in chapter 2.3, the sample size enables a holistic and global overview of diverse stakeholders representing different perspectives along the Pirarucu leather supply chain. Appendix 2 provides a detailed overview of the interviewees, together with their role within the Pirarucu leather supply chain as well as other relevant details.

3.3 Data Collection Method

To answer the research question and find causal relationships regarding the role of small-scale suppliers in driving sustainable innovation, semi-structured, in-depth interviews have been conducted. The advantage of this research method compared to other data collection methods lies in the fact that it provides more detailed and specific information and allows for spontaneous questions that can vary across interviewees (Woods, 2011). Furthermore, Woods (2011) states that interviewees tend to feel more comfortable when having a conversation compared to filling out a survey.

The interviews have been conducted online, through the video conferencing tools Zoom or Microsoft Teams. The duration of the interviews varies depending on the interviewee and ranges between 30 and 60 minutes, depending, among other things, on the questions that arose spontaneously as well as follow-up questions on specific topics. The interviews have been conducted in English, German or Portuguese and have been translated into English, if necessary, to ensure a uniform and accurate analysis. Each interview was recorded with Appendix 4 showing the individual transcripts of these interviews.

All interviews follow a guideline as shown in Appendix 3. The questions serve to determine the research question and follow the literature review and theoretical frameworks listed in Chapter 2 in a somewhat chronological order. Depending on the respective role of the interviewee in the global Pirarucu leather supply chain, individual questions may differ slightly, be omitted or added. Generally speaking, the set of questions is covering the following topics: Introduction, Interviewee's role in the global supply chain of Pirarucu leather, Sustainability practices within the company, Role of other relevant stakeholders within the supply chain of Pirarucu leather, Advantages and Challenges of Pirarucu leather, Advantages and Challenges of involving small-scale suppliers, Adoption Potential of Pirarucu leather and Closing. The questions are open ended and designed in a way that they do not lead the interviewee in any direction, encouraging the interviewees to illustrate their ideas and knowledge (Gioia et al., 2013). Despite the respective minor modifications, this guideline ensures that answers are comparable, that important theories are examined and that the research questions posed can be answered.

3.4 Data Analysis

The data analysis of this research is based on the Methodology for qualitative content analysis developed by Gioia et al. (2013), as it is considered a highly valued and recognized method within the academic literature (Graebner et al., 2012). This method aims to bring more rigor and transparency to inductive research and provides the researcher with a structured process for the verification and formation of new theories based on semi-structured interviews that serve to answer the research questions (Gioia et al., 2013).

In the first step, the transcribed interviews are analyzed and so-called *first-order concepts* are identified. These represent the most relevant findings of the interviews and are strongly based on the statements and lived experiences of the interviewees (Gioia et al., 2013). This process ensures that the statements and perspectives of the experts are incorporated right at the beginning of the analysis (Murphy et al., 2017). In addition, the inclusion of direct quotes ensures that potential biases on the part of the researcher are prevented (Gioia et al., 2013). During the next step, those first-order concepts are then grouped into *second-order themes*. In this phase, the researcher interprets the previously identified core statements and identifies commonalities and patterns that may not be apparent at first glance. This second clustering involves the use of more abstract concepts that are primarily based on the theoretical foundations of the literature review listed in Chapter 2. Contrary to the first stage, the focus

here lies not on the interviewee but on the researcher with her particular insights and knowledge (Gioia et al., 2013; Murphy et al., 2017). Finally, during the third and decisive step of the analysis, the previously formed second-order themes are assigned to so-called *aggregated dimensions* (Murphy et al., 2017). These dimensions form the core output of the analysis and are crucial for the formation of conclusive and substantial theories and results (Gioia et al., 2013). An important component of the Gioia Methodology is the visualization of the data structure by showing the transitions between the three dimensions, thus forming a systematic presentation of the results (Gioia et al., 2013)

4 FINDINGS

Following Gioia et al. (2013), a qualitative content analysis identified several themes and dimensions based on five semi-structured interviews, which have been methodically structured and presented in an Excel file (Appendix 5). Figure 1 provides a condensed visual presentation of the data, dividing it into the three hierarchical dimensions. In total, 176 first order concepts are determined, which are represented by direct quotes to ensure that the findings are based on the evidence provided in the interviews. Subsequently, these are categorized into 31 second order themes, which ultimately are summarized into five aggregated dimensions:

- 1) Ecological and Social Impacts of Pirarucu Leather
- 2) Market Dynamics and Consumer Perceptions of Pirarucu Leather
- 3) Role and Contribution of Small-scale Suppliers
- 4) Challenges and Barriers of Small-scale Suppliers
- 5) Success Factors and Necessary Arrangements

Hereby, each dimension and its respective subordinated themes reveal crucial information regarding the posed research questions, supporting the analysis of how small-scale suppliers drive sustainable innovation in global fashion as well as the arrangements and frameworks needed, all while using the example of Pirarucu leather. If relevant, information regarding the five aggregated dimensions is complemented by secondary data.

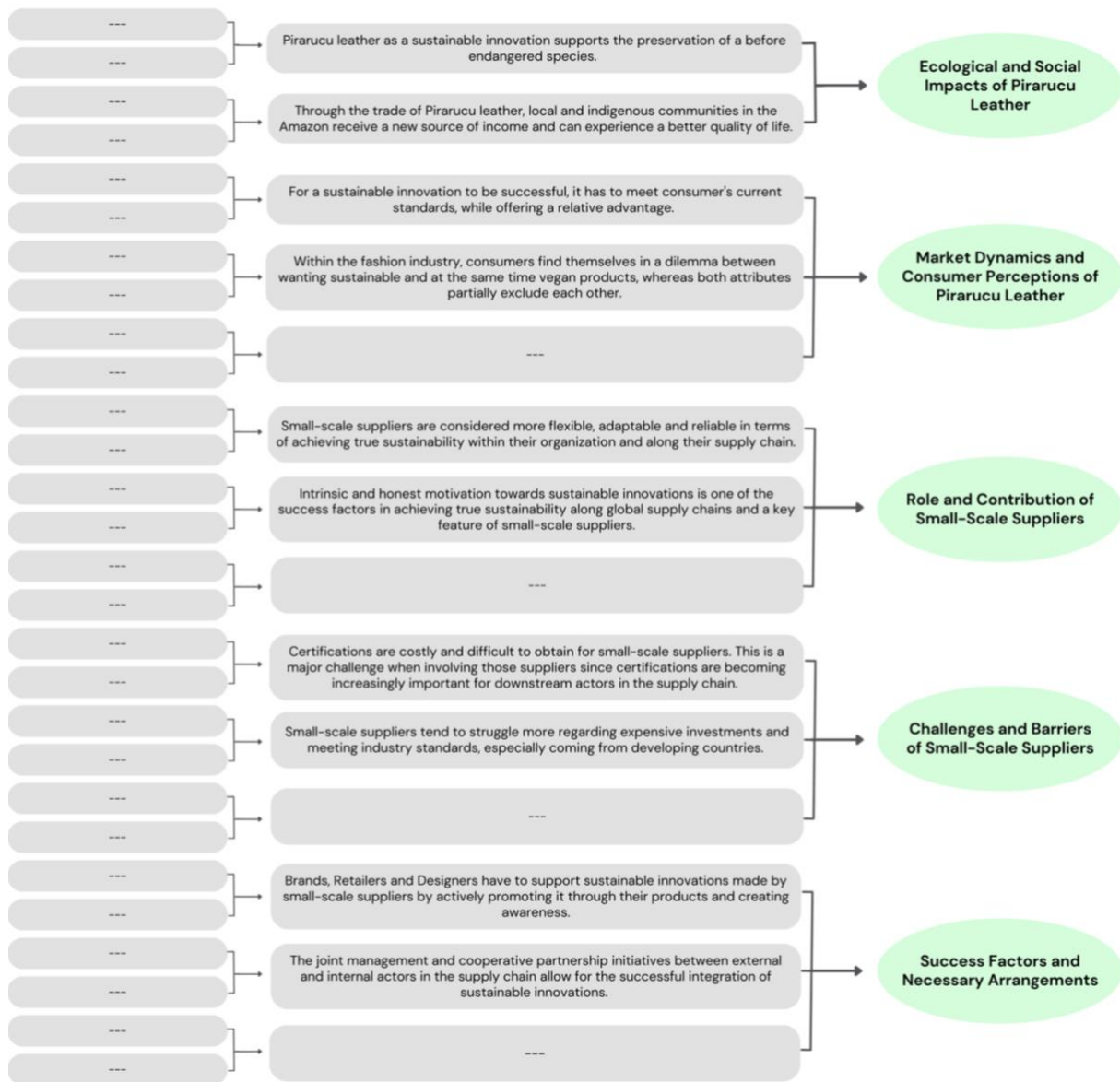


Figure 1: Overview of qualitative content analysis using Gioia's methodology (2013).

4.1 Ecological and Social Impacts of Pirarucu Leather

As a sustainable innovation, Pirarucu leather embodies both ecological and social impacts. On the one hand, the use of Pirarucu leather supports the preservation of a before endangered species, the Pirarucu fish, which was under threat of extinction 20 to 30 years ago (PA). The commercial trade of its skin within the global fashion industry, among others, led to the establishment of a coordinated management program, guided by a local research Institute called Mamirauá in the Brazilian state of Amazonas (PA). Furthermore, being utilized as an exotic leather, Pirarucu leather is contributing to a broader species preservation. “That's the biggest

influence that Pirarucu leather has, is to replace materials, leathers from animals that are killed for their skins" (RL).

On the other hand, the use of Pirarucu leather in global fashion leads to an improved quality of life for local and indigenous communities, particularly fishermen and forest conservationists, in the Amazon region. The sale of the fish skin, in addition to the meat, not only generates additional income for these communities, but also a more liquid one, since "the skin, kilo by kilo, is more valuable than the meat" (PA). Apart from the direct contribution of the small-scale supplier Nova Kaeru, support towards these communities takes place through other actors within the supply chain, as one retailer emphasizes: "We are buying leather through Nova Kaeru and also, we are donating money. We bought nets for the villagers" (AR). Ultimately, this not only leads to an increased income, but also strengthens the community and "develops mechanisms of governance and protection of the territory" (AT). Therefore, Pirarucu leather plays a dual role in promoting both biodiversity and community well-being.

4.2 Market Dynamics and Consumer Perceptions of Pirarucu Leather

For a sustainable innovation to be successful, it has to somehow meet consumer's standards, while at the same time offering a relative advantage compared to current alternatives on the market. Especially classic consumers cannot be convinced with current sustainable leather material alternatives, such as apple or pineapple leather, as they are not really considered an alternative to current materials (BA). However, "there is a large proportion of people who are keen to choose sustainable alternatives but don't want to lower their standards" (BA), which is why it is important for the respective small-scale supplier in this case to emphasize the unique characteristics of Pirarucu leather. "The characteristics of the alternative, they don't have to be the same positive characteristics, so to speak, but there must be other positive characteristics elsewhere" (BA). However, awareness and adoption challenges persist, as Pirarucu leather remains relatively unknown among consumers and the general population (PA; AR).

Current market dynamics include stakeholder pressure and evolving regulations by governments and industries, driving big players to integrate sustainable innovations into their supply chains. Despite its positive social and ecological impacts, Pirarucu leather has specific characteristics, such as being heavy and not being able to replace comparable materials like crocodile leather in some cases (RL). This is also part of the reason why many designers and brands only use the material in capsule collections: "You have Givenchy, Dior, everybody, all

of those brands, they've used Pirarucu, but they use it in a collection. Then, five years later, they may use it again. It's not in their general assortment. It's not part of the portfolio" (PA). However, certain designers like Rick Owens are already using Pirarucu leather as a signature material, including it in every season (RL). Looking towards the consumer side, "it takes long time to make people aware and learn the new materials. As for now, Pirarucu, it's still a weird material for majority of the customers" (AR). Hereby, consumer education and testing are essential in overcoming wrong perceptions of Pirarucu leather, both regarding designers and direct clients as well as end consumers (PA). Positive word of mouth and direct experiences are key for breaking down the barriers of using fish skin as a sustainable leather (AR).

Furthermore, the adoption potential of certain sustainable innovations may depend on the respective market that they are being introduced to. In Brazil, where the Pirarucu fish is culturally significant due to its rich history, people are more aware of the product compared to markets in Europe and the United States, where Pirarucu leather is only growing gradually (PA). Furthermore, consumers in the fashion industry are finding themselves in a dilemma between wanting ecological and simultaneously vegan products, two attributes that until now often exclude themselves when referring to alternative leather products (BA). Therefore, in order to effectively position Pirarucu leather as a sustainable alternative in diverse markets, it is essential for small-scale suppliers to balance these complex market dynamics and consumer perceptions.

4.3 Role and Contribution of Small-Scale Suppliers

Small-scale suppliers play an essential role in terms of developing, implementing and driving sustainable innovation in global fashion supply chains. The findings suggest *six main characteristics* that distinguish these actors from larger suppliers and that can be identified as their key success factors in global fashion.

First, small-scale suppliers are being valued for their *motivation and patience when overcoming challenges*. They demonstrate the ability to persist through difficulties that may arise during the innovation process, which ultimately leads them to transform challenges into successful products. One interviewee states that "sometimes you just lack that innovative spirit to take the final step somehow. And that's where I see the advantage, especially with smaller suppliers and SMEs, because they are sometimes more likely to have this kind of motivation" (BA). In the beginning of the product development process of Pirarucu leather, there have been various

challenges and struggles, such as the lengthy procedure of teaching the slaughterhouses a new way to de-skin the fish, as people were used to buying the fish together with its skin (PA). However, thanks to their persistence, Pirarucu leather “became the main product. So today, in the leather side of the business, I think that 90% of what we do is Pirarucu” (PA).

Second, *intrinsic and honest commitment* is one of the success factors in achieving true sustainability along global supply chains and a key feature of small-scale suppliers. Downstream partners state that “one of the most important roles is to make actual sustainable practices, not only a speech” (RL). Small-scale suppliers like Nova Kaeru demonstrate this commitment continuously by balancing the challenges of being a relatively small business while maintaining a strong social focus (RL). This type of genuine care not only for the environment but also for their upstream suppliers, the local and indigenous communities in the Amazon region, distinguishes them from larger suppliers, with one retailer expressing: “I’m willing to buy from Nova Kaeru maybe a bit more expensive leather, but I’m glad to do it because they care” (AR). Partners can sense that the business is not only focusing on monetary profits but also on overall social and ecological wellbeing (AR). This intrinsic motivation is deeply embedded in the DNA of small-scale companies, leading them to drive sustainable innovation in global fashion (BA).

Third, small-scale suppliers are characterized through their *innovative spirit*, in this case by turning a byproduct from the food industry into a valuable, high-quality leather. Even before its foundation, the company “starts already with the idea of doing it differently” (PA) and with a respective mentality that “to be profitable, you can be profitable in different ways” (PA). This innovative approach has been awarded many times internationally and hence, has been recognized by different actors in the supply chain (PA; AR). The director of Nova Kaeru furthermore expresses: “When we showed up with Pirarucu, although we were perhaps the smallest stand in the show, it was perhaps the most crowded one, because people were curious to know the product” (PA), which demonstrates how small-scale suppliers can lead the way in driving sustainable product innovation.

Fourth, small-scale suppliers are considered more *flexible, adaptable and reliable in terms of achieving true sustainability* within their organization as well as along their supply chain. This allows them to quickly adjust to new challenges and opportunities and therefore surpassing larger businesses regarding the ability to implement sustainable practices, as one distributor

notices: "I think because they are small, they have much more flexibility to adapt and to exercise true sustainability compared to a big company" (RL). Furthermore, this flexibility can also be seen in the context of social responsibility, as small-scale suppliers, in this case, are naturally using traditional, non-polluting practices and supporting local communities (RL). This form of commitment enhances their reputation and effectiveness along the global supply chain (PA).

Fifth, small-scale suppliers not only promote environmentally but also *socially responsible products, processes and management practices*, which play an increasing role in global fashion. This side of the TBL is often being neglected by big players, especially in the fashion sector. However, in the case of Pirarucu leather, the small-scale supplier ensures the well-being of its employees and those involved in upstream supply chain activities and "they keep trying to find different ways to keep improving that" (RL). Those social practices for example include the support of women as well as addressing and educating about sexual misconduct (RL).

Finally, small-scale suppliers can be defined as leaders in terms of *pushing sustainable innovations and practices* along the global supply chain. This even leads to them setting benchmarks within the industry that are being imitated by larger retailers and brands (PA). When taking the perspective of the small-scale supplier Nova Kaeru, that is being analyzed in the case of Pirarucu leather, the director even states: "Our contribution is small relative to the contribution of the people in the Amazon who are actually far ahead of us and of the brands as well in terms of a sustainable way of living with nature" (PA). This underlines the existing learning effect small-scale suppliers bring to their downstream partners. Nova Kaeru's exclusive L.I.V.E. process enables the company to be the world's first 100% organic tannery (Nova Kaeru, 2024), with the process being adopted by companies like Louis Vuitton or Hermes, some 15 years later than the small-scale supplier (PA). Therefore, the role and contribution of small-scale suppliers lies in inspiring positive imitations and pushing an entire industry towards more sustainable practices.

4.4 Challenges and Barriers of Small-Scale Suppliers

The findings suggest *five main challenges* regarding the involvement of small-scale suppliers and Pirarucu leather as a sustainable innovation in global supply chains.

First, given its characteristic of being a natural byproduct of the food industry, *the quantity of a sustainable innovation like Pirarucu leather is limited* in order to guarantee the protection of

the species and ensure long-term sustainability. As a result, the small-scale supplier “cannot really afford to have another market because the demand would then be much greater than the ability to supply” (PA), restricting the growth potential of the firm. Furthermore, the Pirarucu remains an important food source within the local Amazonian market where it originates, causing local research institutes to worry: “We want to value the product, but we don't want to stop supplying the state either, because we know the demand of the population for this product” (AT). This leaves small-scale suppliers with less room for expansion, with the question remaining: “Can I cover what my customers demand of me, i.e., a certain production volume, and at the same time remain sustainable” (BA)?

Second, one of the key challenges that can be broadly applied to small-scale suppliers within the global fashion industry, is *obtaining necessary certifications*. However, these are becoming increasingly important for downstream actors in the supply chain, yet they are costly and difficult to acquire, especially within the leather industry (PA). “In a matter of a few years, it will be impossible to sell, to even approach, even if you have the best product in the world, the most sustainable one, if you don't have the certification from a third party” (PA). This leads to major complications for small-scale suppliers regarding their ability to compete in global markets (RL). However, having a trustworthy seal has a significant influence on the purchasing behavior of that product, making it indispensable to obtain certificates in the future (BA).

Thirdly, small-scale suppliers tend to struggle more regarding *expensive investments* as well as *meeting certain industry standards*, particularly coming from developing countries. Especially within the luxury fashion industry, it is essential to meet the quality standards of big brands and designers (BA). Small-scale companies face challenges in promoting themselves internationally in the global fashion industry, beginning with language barriers, informality and lack of structured business practices, such as providing proper samples for brands and designers (RL). Furthermore, expensive investments in machinery present an obstacle, as it is harder for small-scale suppliers to scale such operations effectively (AR). Talking about small-scale suppliers in general, one downstream retailer states: “You really like these people. You love their ideas. You want to help them. And you realize they're not there yet. That's the biggest challenge” (AR).

Fourth, when looking at sustainable product innovation in general, *sustainable textile materials like Pirarucu leather are more costly than their non-sustainable counterparts*. The rise of fast

fashion aggravates this state by “killing very good companies with very big sustainable practice in terms of social practices as well” (RL), as those relatively small-scale businesses are not able to compete on price alone. While positively contributing on a social and environmental level, sustainable practices struggle to match the cost-effectiveness of regular practices. “All our materials have a much higher cost than the normal material. All of them. Not only Pirarucu” (RL), illustrates the challenge of scaling sustainability.

Finally, within the case of Pirarucu leather, a *potential value distribution challenge appears*, as the research institute criticizes the fair value distribution between raw material suppliers, meaning the local Amazonian communities, and other actors in the global supply chain (AT). While the trade in Pirarucu leather has generated unprecedented additional income for the fishing communities, the value of the end product does not stand in comparison to the return received by the raw material producers (AT). To minimize risks and motivate the communities, one interviewee emphasizes: “I think that if we can break this abyss that exists between the end product, the customer, and the producer, I think it minimizes the risks, because you have a more equitable distribution of the values along the chain” (AT). This may ultimately lead to more municipalities, in addition to the 22 existing ones, joining the Mamirauá Institute’s management program. Since the fishing of Pirarucu is only possible under the supervision of said program, an improved value distribution can, among others, solve the first challenge mentioned in this chapter by generating more raw materials to satisfy greater demand.

4.5 Success Factors and Necessary Arrangements

Aligning with the previous two chapters, there are certain factors and mechanisms that guarantee the successful integration of sustainable innovation through small-scale suppliers as well as minimize potential risks and challenges. This chapter is sub-divided into *seven key success factors*, derived from the specific case of Pirarucu leather, along with *five main arrangements* to be followed by major actors involved in the global supply chain.

The seven key success factors can be classified as follows: Close and transparent relationships, extensive networks and partnerships, unique sustainable products, open dialogue and collaboration, partnerships with local, joint management initiatives, and sustainability throughout the entire production process. *Close, trusted and sincere relationships* between small-scale suppliers and their distributors, retailers and end customers are crucial for the success of implementing Pirarucu leather as a sustainable innovation in global fashion.

Scheduling visits to one's respective company and providing firsthand insights into the production process and sustainable practices are examples of building trust and transparency (AR). This is particularly important in the context of global supply chains.

Furthermore, having a *huge network of different actors* that are either directly or indirectly involved in the supply chain, together with joint projects and partnership approaches, can be seen as a key success factor for sustainable innovation. Indirectly involved actors include NGOs and environmental state authorities, among others (PA). These networks have the advantage of bundling expertise and resources, which drives innovation and can ultimately lead to reduced costs for all actors involved (BA). "The amalgamation of the various players, i.e., that you don't act as a single player, but that everyone somehow comes together in a cooperative" is regarded essential in promoting sustainable innovation along the entire supply chain (BA).

Another key success factor in global fashion consists of offering a *unique and incomparable sustainable innovation*. The ability to provide products that are not available elsewhere and that encompass a specific degree of specialization gives small-scale suppliers a competitive advantage (BA). Pirarucu leather, for example, is being processed without harmful chemicals, making the process exclusive as "99% of tanneries are using chrome" (AR). This unique selling point helps small-scale suppliers to attract environmentally conscious consumers and enables them "to survive in the global supply chain" (BA).

Moreover, *open dialogue and finding compromises* through common goals and partnerships across supply chain partners are essential for the successful implementation of sustainable innovations. "It's always the compromise and to find the right solution to make it happen, to make everybody happy" (AR). Therefore, communication and collaboration across the supply chain is key for achieving sustainability goals.

Partnerships with local institutes, such as the Mamirauá Research Institute in the case of Pirarucu leather, are crucial for guaranteeing both economic and social responsibility. These actors provide valuable insights into local practices and "provide technical advice to fishing communities and also to urban fishermen who want to do Pirarucu handling" (AT). Hereby, the geographical location of such institutes plays an important role, as "the expertise of local actors as a benefit is actually one of the most important points when doing such projects" (BA). The success is proven by the fact, that the territories guided by the Mamirauá Research Institute

display a high quantity of Pirarucu fish, while the ones that are not profiting from said management practices have a scarcity of this resource (AT). Furthermore, through the involvement of various associations, Nova Kaeru guarantees that benefits reach fishing families directly, resulting in the social project to consist of more than 1.000 families (Nova Kaeru, 2024).

Joint management and cooperative partnership initiatives between external and internal actors in the supply chain allow for the successful integration of sustainable innovations. Those multi-stakeholder initiatives involve both global players as well as local actors from the outset in order to ensure a comprehensive approach towards development efforts (BA). In the case of Pirarucu leather, “the success is in the management as a whole”, bringing together various stakeholders to work towards common goals (AT).

Finally, when considering sustainable product innovations like Pirarucu leather, it is essential to ensure that the *entire process and the management practices surrounding the development and creation are sustainable* as well. This implies using eco-friendly methods from the beginning to the end of the production process (PA). With Nova Kaeru, “the company was set up using an organic process. So, everything we do would have to follow the lead of this process” (PA). This mentality underscores the importance of alignment between product, process and management sustainability. As said by the director of Nova Kaeru: “Pirarucu came to us with a history of sustainability, which was larger and richer than ours. So, everything matches. It became the right process, with the right product, with the right origin” (PA). This applies not only to small-scale suppliers, but also to downstream retailers (AR). The process and management practices evolving around the production of a sustainable product are key to ensure long-term success and integrity of sustainable product innovations (PA). In the example of Nova Kaeru, the small-scale supplier aims to demonstrate its commitment to sustainability through solely sourcing solar energy by 2027 (Nova Kaeru, 2024).

For small-scale suppliers to fully unfold their potential, five arrangements have been identified that are said to be followed by major actors of the supply chain, such as distributors, retailers, brands and designers. First, *brands, retailers and designers have to support sustainable innovations* made by small-scale suppliers by actively promoting them through their products and hence creating consumer awareness. Talking about a long-term Brazilian retailing partner, the director of Nova Kaeru states: “They believed in the product in the same way that we

believed in the skin" (PA). Having influential design figures, such as Rick Owens in the case of Pirarucu leather, significantly boosts the acceptance of such innovations (PA). By integrating sustainable materials into their collections and educating consumers, these key players can drive demand and support small-scale suppliers (RL). The relationship between those actors and small-scale suppliers "goes both ways. They are providing us with material, and we are using their materials and promoting them as well" (AR), hence fostering consumer awareness and acceptance.

Second, by *setting norms and educating small-scale suppliers*, downstream supply chain actors support the development of sustainable innovation. This implies both providing guidance on sustainable practices as well as ensuring that small-scale suppliers comply with necessary standards (AR).

Third, distributors play an essential role in *connecting small-scale suppliers with the global fashion industry* by helping them with necessary documentations and facilitating the distribution of materials, among other things. "We have stock here from Nova Kaeru to quickly supply Pirarucu to many of these countries in the EU and abroad as well, because Pirarucu specifically requires special documentation", states one distributor, thereby illustrating the logistical and technical support provided by these supply chain actors (RL). As a result, materials like Pirarucu leather can be obtained by smaller firms as well, thus guaranteeing the accessibility of sustainable innovations to everybody (RL).

Fourth, as mentioned in the previous chapter, acquiring certification poses a major challenge for small-scale suppliers. Hence, for sustainable innovation to happen and to be successful across the whole supply chain, *retailers, distributors, manufacturers and designers have to support small-scale suppliers regarding the requirement of certain standards*. "If a brand wants to use leather and somehow promote it or would like to incorporate it into its own collection, then of course it has to make sure that the certificates are there and perhaps best of all also make sure or support the small suppliers so that certain seals are there" (BA). Therefore, in terms of meeting industry standards, downstream actors are playing a pivotal role "in influencing and supporting the small suppliers in the best possible way, because that's also in their own interest" (BA). In the case of Pirarucu leather, those actors have helped shaping the small slaughterhouses in the Amazon region to achieve certain standards in order maintain credible and assure the sustainability of the whole supply chain (PA).

Fifth and lastly, another important role of designers and brands is to *ensure that sustainable innovations like Pirarucu leather are being used with minimal environmental impact*. This involves the combination of Pirarucu leather together with other sustainable materials when developing the final goods (AR). One retailer describes his role as “to produce these bags with the minimal environmental impact to make sure that they're producing at the right cost without jeopardizing design aesthetics” (AR). This step is crucial for securing sustainability from the beginning to the end, offering true sustainable innovations to the end consumers.

5 DISCUSSION

This research investigates how small-scale suppliers contribute uniquely to sustainable innovation in the global fashion industry and delves deeper into specific frameworks that define its successful integration within the whole supply chain. The findings both align with and extend existing literature and concepts such as sustainable innovation, SSCM, stakeholder engagement as well as the diffusion of innovation, leaving small-scale suppliers and other players within the global fashion industry with new managerial insights.

5.1 Theoretical and Managerial Contributions

The ecological and social impacts of Pirarucu leather highlight its position as a sustainable product innovation (Harsanto et al., 2023). Through the preservation of endangered species, improving the livelihoods of local communities as well as generating profits, Pirarucu leather fully aligns with the TBL approach, encompassing economic, environmental and social goals (Gupta et al., 2020). Therefore, the specific case of Pirarucu leather supports existing literature by proving that green innovations can lead to positive outcomes for both the environment and the society (Kusi-Sarpong et al., 2019; Yang & Lin, 2020). Furthermore, it adds to literature by demonstrating that the development of green innovation can not only reduce environmental and social impacts, but that it can ultimately improve the well-being of people and the planet beyond what would be achieved in its absence. This is underlined by the fact, that the commercial trade of Pirarucu skin has partially led to coordinated management programs, contributing to an increased fish population of 427% over the past ten years (Nova Kaeru, 2024).

Furthermore, the research identifies market dynamics and consumer perceptions as crucial for the successful adoption of sustainable innovations like Pirarucu leather, aligning with Roger's Diffusion of Innovation Theory. The findings support existing literature by verifying the

theory's five main characteristics as essential for the successful implementation of a sustainable innovation (Sahin, 2006; Smerecnik & Andersen, 2011; Johnson, 2015). The relative advantage of Pirarucu leather is given through its positive social and environmental impacts compared to current leather materials. In terms of complexity, although Pirarucu leather can largely be used like conventional leather, its special characteristics, such as being relatively heavy, mean that it cannot fully replace existing alternatives, thereby partially missing this dimension (Sahin, 2006). Furthermore, the study reveals that testability and observability are critical components of overcoming potential biases regarding Pirarucu leather within the global fashion industry, both by brands and consumers. Through testing the material in capsule collections and educating the consumers, the small-scale supplier is able to gain more trust and confidence towards the new innovation (Sahin, 2006; Johnson, 2015). Furthermore, the findings add to current literature by stating that sustainable alternatives have to meet certain consumer standards, but don't have to be fully compatible as long as the innovation encompasses another relative advantage. Finally, the study reveals the role of culture in shaping the adoption potential of a sustainable innovation, with Brazil showing a higher awareness and acceptance of Pirarucu leather compared to markets in Europe and the USA, due to its cultural and historical significance. Therefore, market-specific strategies are essential for managers of small-scale businesses.

Regarding the role and contribution of small-scale suppliers, this research identifies six main characteristics that distinguish these actors from larger suppliers. Within the literature, a comparatively wide gap persists with regard to the distribution of roles and the role of small-scale suppliers within the global fashion industry, making the findings of this dimension largely complementary to existing research. Firstly, small-scale suppliers are valued for their motivation and patience when overcoming challenges during the development of sustainable innovations, supporting the literature on the importance of motivation and persistence in driving sustainable innovation (Cheng, 2020). Secondly, their intrinsic and honest commitment towards the broader concept of sustainability is identified to be a key success factors of those actors. This type of internal driver goes beyond top management commitment, as identified by Yang & Lin (2020), and aligns with the concept of intrinsic motivation as a main driver for sustainable innovation (Gupta et al., 2020). Furthermore, this genuine dedication towards both social and ecological wellbeing aligns with Stakeholder Theory, specifically the normative approach, emphasizing that companies should serve the interests of all stakeholders involved (Gibson, 2000; Parmar et al., 2010; Sajjad et al., 2015). The findings suggest that this intrinsic motivation

is deeply embedded in the DNA of small-scale suppliers, which can distinguish them from larger firms, hence extending current literature towards sustainable innovation. Thirdly, their innovative spirit differentiates small-scale suppliers within the global fashion industry, making them an important player in terms of driving sustainable innovation across the whole supply chain. This finding is somewhat consistent with current literature, which suggests to consider suppliers as innovation partners rather than just sources of material (Cheng, 2020; Lintukangas et al., 2019). Fourthly, flexibility and adaptability enable small-scale suppliers to quickly adjust to new challenges and opportunities, particularly in terms of implementing sustainable practices. This adds to current literature by showing that this adaptability extends to social responsibility, where small-scale suppliers use traditional, non-polluting practices and support local communities, such as in the case of Pirarucu leather. Fifthly, small-scale suppliers are driving sustainable innovation with an increasing focus on socially responsible products, process and management practices, aligning with SSCM literature on the importance of maximizing social welfare and profit, while minimizing the environmental impact (Gupta et al., 2020; Zhou et al., 2020). Finally, small-scale suppliers are considered leaders in pushing sustainable innovation and practices along the global supply chain, setting benchmarks within the industry and leaving downstream actors imitating those processes, thus supporting the idea of using suppliers as a source of green knowledge (Cheng, 2020). This complements to the findings of Todeschini et al. (2020) by adding the involvement of small-scale suppliers as a key to achieve holistic sustainability in an entire industry.

Moreover, the findings suggest five main challenges regarding the involvement of small-scale suppliers and Pirarucu leather as a sustainable innovation in global supply chains. First, limited supply of Pirarucu leather, being a byproduct of the food industry, adds to current literature by illustrating the natural constraints that some sustainable innovation entail in order to avoid overexploitation of natural resources. Second, small-scale suppliers in global fashion face the challenge of acquiring costly certificates that are being demanded by end consumers and downstream supply chain actors. However, literature defines the incorporation of such consumer expectations in line with compliance measures as key success factors for sustainable innovations (Rese et al., 2022). Third, expensive investments and comparably high industry standards from the luxury fashion sector pose a challenge towards small-scale suppliers, leaving industry decision-makers to rethink these norms in order for small players to scale and compete internationally and hence continue driving sustainable innovation. Fourth, the analysis finds that sustainable innovations, more precisely product innovations regarding textile materials like

Pirarucu leather, are more costly than their non-sustainable alternatives. This aligns with current SSCM literature by underlining the aspect that companies must often pursue conflicting goals when integrating sustainability into their supply chain (Gupta et al., 2020). Finally, in the case of Pirarucu leather, the findings suggest some value distribution challenges within the global supply chain. However, literature states that to effectively integrate sustainable innovations into a supply chain, the relative perception of fairness among all supply chain partners plays a pivotal role (Zhou et al., 2020). Therefore, findings indicate managers to implement equitable value distribution methods to ultimately motivate local communities and ensure the overall sustainability of the global supply chain.

Finally, the success factors and necessary arrangements defined throughout the analysis align with the principles of Sustainable Innovation, SSCM, Stakeholder Theory and Supplier Engagement. The findings support the point, that an interactive collaboration between supply chain partners, characterized by long-term relationships and trust, is key for establishing sustainable innovations across the entire supply chain (Yang & Lin, 2020). The case of Pirarucu leather highlights that the multistakeholder approach, meaning involving different actors such as local research institutes and local Amazonian communities, is essential for ensuring the success of sustainable practices in supply chain management (Lui et al., 2017). Adding to current literature, the geographical location of the external actors plays a decisive role, as they have far better insight into the local conditions as well as a cultural connection to sustainable practices. The supply chain of Pirarucu leather is characterized by joint management practices and cooperative partnerships, marked through open dialogue and compromises. This aligns with the managerial implications stated by Deloitte (2023), emphasizing businesses to adjust towards strategic, long-term and multi-dimensional thinking while using partnerships. Regarding the types of sustainable innovations, Pirarucu leather fits in the category of being a product innovation, specifically a material innovation (Harsanto et al., 2023). The findings suggest, that rather than approaching sustainable innovation in the context of one of the three defined categories, it should be implemented throughout all three dimensions. In the case of Pirarucu leather, the product itself but also the process and organizational structure surrounding it is both socially and environmentally sustainable by e.g., guaranteeing a chemical-free production process and establishing a corporate culture characterized through respect towards local communities, women and the environment. Finally, when looking at the necessary arrangements and roles of other key stakeholders surrounding the small-scale suppliers, the findings complement current literature defining these actors as drivers, facilitators or inspectors

(Siems et al., 2023; Sajjad et al., 2015). The case of Pirarucu leather highlights the role of distributors in supporting small-scale suppliers by facilitating the acquisition of necessary certificates as well as the allocation of materials, while brands and retailers have to promote sustainable product innovations by actively incorporating the materials in their designs and thus spreading consumer awareness. Research institutes provide necessary knowledge about local and traditional practices (Siems et al., 2023; Sajjad et al., 2015). While literature argues that the focal companies, hence the retailers, designers and brands, are responsible for driving sustainable practices within the supply chain and educating the supplier, the findings propose that in the case of Pirarucu leather, it is rather the small-scale suppliers that push sustainable innovations and practices downstream the supply chain, serving as a role-model towards a sustainable shift in the global fashion industry. Therefore, the analysis suggests that small-scale suppliers should be seen as drivers of sustainable innovation, while downstream actors act as facilitators, ensuring that framework conditions are met, which ultimately leads to an efficient implementation of sustainable innovations globally.

5.2 Limitation and Further Research

The conducted analysis of semi-structured interviews and the corresponding findings deliver answers to the research questions presented and provide valuable insights regarding the role of small-scale suppliers in driving sustainable innovation within the global fashion industry. Nevertheless, the study entails several limitations, that simultaneously form the basis for directions to future research.

On the one hand, the study is based on a single case best practice example: Pirarucu leather and the small-scale supplier Nova Kaeru. Although this example provides knowledge-enhancing and relevant insights regarding the research questions, it also limits the generalizability of the analyzed findings for the entire fashion industry. Due to the specific characteristics of Pirarucu leather and the particular supply chain entailed, the findings may not be entirely transferable to other sustainable innovations or other small-scale suppliers. After all, in the fashion industry in particular, the allocation of roles largely depends on the specific supply chain (FashionUnited, 2022). For this reason, future research should concentrate on other sustainable innovations, such as other product or process innovations, as this allows for a comparison regarding the role of small-scale suppliers in global supply chains. Furthermore, the researcher recommends expanding future studies by increasing the number of interview partners from different supply

chain perspectives. This will allow for better confirmation and supplementation of existing theories as well as better analysis of the collective impact between these actors on sustainability.

In addition, given the niche market of Pirarucu leather and the restricted timeframe, this study only involves a limited number of interviews. Although attention was paid to ensure that each interviewee covered a different stakeholder role in the global supply chain, this nevertheless might result in the findings not covering the full range of perspectives. Along with this lies the limitation that the researcher was unable to interview the local Amazonian communities of fishermen due to technical, cultural and linguistic reasons. However, the latter represent an important stakeholder group along the global Pirarucu leather supply chain, as their opinions are crucial for a comprehensive understanding of the social impacts of such sustainable innovations. Future studies should therefore aim to analyze a broader range of small-scale suppliers, both across industries and regions, in order to gain a more comprehensive understanding of the various factors influencing sustainable innovation and to gain further insights across different contexts.

Moreover, although efforts were made to minimize potential researcher bias through the inclusion of direct quotes, there remains a risk of this effect to influence the findings and corresponding conclusions. This subjectivity is a general disadvantage when using qualitative research methods, even if they allow for enriching insights (Noble & Smith, 2015).

Finally, this research primarily uses qualitative data as well as secondary material which may lack objectivity and generalizability compared to quantitative data. Therefore, the researcher suggests to incorporate methods such as surveys for future research to complement the qualitative findings of this study as well as to deliver more objective and statistically significant conclusions.

6 CONCLUSION

This research examines the integral of small-scale suppliers in driving sustainable innovation across global supply chains in the fashion industry, focusing on the specific case of Pirarucu leather. Through an in-depth qualitative analysis of semi-structured interviews, supported by secondary data, several key findings were identified that provide insights into the contributions, challenges and necessary framework conditions of small-scale suppliers. The findings underline

the essential role of small-scale suppliers in implementing and fostering sustainable practices along the entire supply chain. Pirarucu leather, as a specific example, demonstrates how a byproduct of the food industry can be transformed into a high-value and sustainable material with the help of small-scale suppliers. This particular innovation benefits not only the environment, but also creates social welfare by providing an additional income and improving the quality of life of local communities in the Amazon region.

In order to successfully establish sustainable innovations from small-scale suppliers in the global fashion industry, various success factors have been defined. Hereby, close and transparent relationships between supply chain partners, networks and partnerships with both global and local actors as well as an overall approach towards sustainability throughout the whole production process are of particular importance. Compared to larger players, small-scale suppliers show a comparable high intrinsic motivation as well as an innovative spirit, which leads to them setting benchmarks to downstream actors and hence boosting sustainable practices throughout the entire supply chain. Despite the immense potential of small-scale suppliers and their respective sustainable innovations, the research highlights a series of challenges. High costs and the difficulty of obtaining required certifications as well as the inability to meet certain industry standards are among the most crucial ones. Moreover, sustainable materials are generally more costly than similar, non-sustainable alternatives, which tends to hamper their broader adoption.

The managerial implications of this research are explicit: For sustainable innovation to prosper, a collaborative effort among all stakeholders in the supply chain must be followed. This implies that distributors, retailers, brands and designers must act as facilitators by providing support towards the identified challenges and by actively promoting sustainable innovations, as they are able to raise consumer awareness and adoption.

In summary, small-scale suppliers can be considered key drivers in terms of promoting sustainable innovation in global fashion. When overcoming potential challenges as well as encouraging their unique characteristics, these actors significantly contribute to the industry's holistic transformation towards sustainability. The results of this research represent a valuable and enriching foundation for further research and managerial strategies aimed at enhancing the role of small-scale suppliers in global sustainable development.

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8 APPENDIX

8.1 Appendix 1: Pirarucu Leather in the Luxury Fashion Sector





Rick Owens for Rihanna

VOGUE



8.2 Appendix 2: Overview of Interviewees

#	Interviewee Name	Identification Code	Company	Position	Years of Experience	Duration (in min)	Geographical Location	Position within Supply Chain
1	Paulo Amaury	PA	Nova Kaeru	Director	12	60	Brazil	Supplier/ Manufacturer
2	Ana Cláudia Torres	AT	Mamirauá Research Institute	Coordinator of Sustainable Fishing Program	15	30	Brazil	Research Institute
3	Rodrigo Lopes	RL	Global Green	Commercial Director	17	45	Netherlands	Distributor
4	Alex Ravikovitch	AR	Piper & Skye	Vice President of Sourcing and Production, Manufacturing Operations	20	50	USA	Retailer/ Brand
5	Berat Arici	BA	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	Specialist assistant	2	60	Germany	Independent Researcher

8.3 Appendix 3: Interview Guideline

8.3.1 Interview Guideline Nova Kaeru

- Please briefly introduce yourself and your current occupation.
- Can you provide an overview of your involvement in the fashion industry's supply chain, particularly in relation to the use of Pirarucu leather?
- Can you walk me through how your company features sustainability into its supply chain management practices, specifically when it comes to sourcing materials like Pirarucu Skin?
- Can you describe any specific initiatives or partnerships aimed at improving the sustainability of your supply chain?
- What factors have motivated your organization to explore sustainable alternatives, such as Pirarucu Skin, within the fashion industry's supply chain? What are some challenges you may have faced?
- In what ways do you believe small-scale suppliers contribute uniquely to sustainable innovation efforts within the global fashion supply chain?
- What are some challenges that may appear when engaging small-scale suppliers in sustainable practices and innovation efforts?
- How do you perceive your role and responsibility in promoting sustainable innovation with the global supply chain of Pirarucu?
- How do you perceive the role and responsibility of other key players involved in the global supply chain of Pirarucu (e.g., Manufacturers, Suppliers, Retailers, Customers, etc.) in promoting sustainable innovation?
- How would you rate the adoption potential of sustainable innovations like Pirarucu Skin within the fashion supply chain?
- Do you have any other comments or is there anything else you would like to share on this topic that we haven't covered yet?

8.3.2 Interview Guideline Mamirauá

- Could you please introduce yourself briefly and share your current role within the Mamirauá Research Institute and your involvement within the use of Pirarucu Skin?
- How do you perceive the integration of Pirarucu Skin into the global fashion industry's supply chain, and what role do you believe it plays in promoting biodiversity conservation and sustainable development in the industry?
- Can you provide insights into the collaborative efforts between the Mamirauá Research Institute and stakeholders in the fashion industry (Manufacturers, Suppliers, etc.) to explore sustainable alternatives such as Pirarucu Skin?
- Can you describe any specific research projects or initiatives undertaken by the Mamirauá Research Institute aimed at supporting the sustainable management and conservation of Pirarucu populations, considering its significance as a source of sustainable material for the fashion industry?
- How do you perceive the role and responsibility of key stakeholders, such as fashion manufacturers, suppliers, retailers, and consumers, in driving sustainable innovation and supporting the use of Pirarucu Skin within the fashion supply chain?
- What are some potential socio-economic and environmental impacts associated with the increased demand for Pirarucu Skin within the fashion industry, and how do you address these challenges?
- From your expertise, what practical recommendations or advice would you offer to stakeholders in the fashion industry, particularly regarding the sustainable sourcing and utilization of materials like Pirarucu Skin, to ensure the long-term conservation of biodiversity and sustainable development in the Amazon region?
- How do you collaborate with local communities and indigenous groups in the Amazon region to ensure their involvement and benefit from initiatives related to sustainable materials like Pirarucu Skin within the fashion industry's supply chain?
- Can you share any success stories or notable achievements of the Mamirauá Research Institute in promoting sustainable innovation and biodiversity conservation through collaborations with the fashion industry?
- Do you have any other comments or is there anything else you would like to share on this topic that we haven't covered yet?

8.3.3 Interview Guideline Global Green

- Please briefly introduce yourself and your current occupation.
- Can you provide an overview of your involvement in the fashion industry's supply chain, particularly in relation to the use of Pirarucu leather?
- Can you walk me through how your company features sustainability into its supply chain management practices, specifically when it comes to sourcing materials like Pirarucu Skin?
- Can you describe any specific initiatives or partnerships aimed at improving the sustainability of your supply chain?
- What factors have motivated your organization to explore sustainable alternatives, such as Pirarucu Skin, within the fashion industry's supply chain? What are some challenges you may have faced?
- In what ways do you believe small-scale suppliers contribute uniquely to sustainable innovation efforts within the global fashion supply chain?
- What are some challenges that may appear when engaging small-scale suppliers in sustainable practices and innovation efforts?
- How do you perceive your role and responsibility in promoting sustainable innovation with the global supply chain of Pirarucu?
- How do you perceive the role and responsibility of other key players involved in the global supply chain of Pirarucu (e.g., Manufacturers, Suppliers, Retailers, Customers, etc.) in promoting sustainable innovation?
- How would you rate the adoption potential of sustainable innovations like Pirarucu Skin within the fashion supply chain?
- Do you have any other comments or is there anything else you would like to share on this topic that we haven't covered yet?

8.3.4 Interview Guideline Piper & Skye

- Please briefly introduce yourself and your current occupation.
- Can you provide an overview of your involvement in the fashion industry's supply chain, particularly in relation to the use of Pirarucu leather?
- Can you walk me through how your company features sustainability into its supply chain management practices, specifically when it comes to sourcing materials like Pirarucu Skin?
- Can you describe any specific initiatives or partnerships aimed at improving the sustainability of your supply chain?
- What factors have motivated your organization to explore sustainable alternatives, such as Pirarucu Skin, within the fashion industry's supply chain? What are some challenges you may have faced?
- In what ways do you believe small-scale suppliers contribute uniquely to sustainable innovation efforts within the global fashion supply chain?
- What are some challenges that may appear when engaging small-scale suppliers in sustainable practices and innovation efforts?
- How do you perceive your role and responsibility in promoting sustainable innovation with the global supply chain of Pirarucu?
- How do you perceive the role and responsibility of other key players involved in the global supply chain of Pirarucu (e.g., Manufacturers, Suppliers, Retailers, Customers, etc.) in promoting sustainable innovation?
- How would you rate the adoption potential of sustainable innovations like Pirarucu Skin within the fashion supply chain?
- Do you have any other comments or is there anything else you would like to share on this topic that we haven't covered yet?

8.3.5 Interview Guideline Expert

- Could you please introduce yourself briefly and share your current role within sustainable supply chain management, particularly in relation to the fashion industry?
- Can you provide insights into how sustainable practices, such as the utilization of sustainable materials (e.g., Pirarucu Skin as an alternative to traditional leather), are integrated into today's supply chain strategies within the fashion industry?
- How do/can organizations incorporate sustainability into its supply chain management practices, specifically concerning the sourcing and utilization of sustainable materials like Pirarucu Skin?
- Can you describe any specific initiatives or partnerships aimed at improving the sustainability of a company's supply chain?
- What factors have motivated organizations to explore sustainable alternatives, such as Pirarucu Skin, within the fashion industry's supply chain? What are some typical challenges that may occur?
- From your perspective, how do smaller-scale suppliers contribute uniquely to fostering sustainable innovation within the global supply chain of the fashion industry?
- What are some challenges that may appear when engaging small-scale suppliers in sustainable practices and innovation efforts?
- In your opinion, what role and responsibility do the key stakeholders, such as manufacturers, suppliers, retailers, and customers, have in driving sustainable innovation within the fashion supply chain?
- How would you rate the adoption potential of sustainable innovations like Pirarucu Skin within the fashion industry and its supply chain?
- From your expertise, what practical ideas or advice would you offer to small-scale suppliers in promoting sustainability throughout global supply chains (*especially within "mature" industries like the fashion industry*)?
- Do you have any other comments or is there anything else you would like to share on this topic that we haven't covered yet?

8.4 Appendix 4: Interview Transcripts

Interview Transcripts can be accessed through the following link:

[Interview Transcripts Dissertation Franziska Stapper](#)

In case of difficulties, please contact the researcher: s-fstapper@ucp.pt.

8.5 Appendix 5: Qualitative Analysis

The detailed qualitative analysis can be accessed through the following link:

[Analysis of Semi-structured Interviews according to Gioia et al. \(2013\).xlsx](#)

In case of difficulties, please contact the researcher: s-fstapper@ucp.pt.