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Sustainability-Oriented Transition in Clusters: A Multilevel Framework from Induction

Aurora Carneiro Zen ¹, Bruno Anicet Bittencourt ², Jose-Luis Hervás-Oliver ^{3,4,*} and Ronald Rojas-Alvarado ^{5,6}

¹ School of Management, Federal University of Rio Grande do Sul (UFRGS), Washington Luiz, 855, Porto Alegre 90010-460, Brazil; aurora.zen@ufrgs.br

² Business School, Unisinos University, Av. Nilo Peçanha, 1600, Porto Alegre 91330-002, Brazil; banicet@unisinos.br

³ Management-DOE, Universitat Politècnica de València, 46022 Valencia, Spain

⁴ Industrial Engineering Department, Universidad de la Costa, Cl. 58 #55-66, Barraquilla 080001, Colombia

⁵ Departamento de Gestión Organizacional, Universidad ICESI, Cali 760031, Colombia; ronald.rojas@u.icesi.edu.co

⁶ Escuela de Ciencias Básicas, Tecnología e Ingeniería, Universidad Nacional Abierta y a Distancia UNAD, Cali 763532, Colombia

* Correspondence: jose.hervas@omp.upv.es

Abstract: The aim of this paper is based on understanding how sustainability-oriented transition occurs in clusters. This study focuses on both drivers and actors of that transition. Empirical results based on induction, using mixed-methods on the Serra Gaucha wine cluster in the South of Brazil, suggest that, at the micro-level, the mobility and adoption of knowledge about sustainability and individual awareness will support sustainability-oriented strategies as a new source of competitive advantage. Then, at the meso-level, collective actors' efforts towards sustainability in the cluster legitimize, disseminate and facilitate the adoption of new sustainable-oriented practices, creating a new cluster sub-identity (sustainability) compatible with the existing one. These actors utilize leading local firms in order to disseminate new practices and signal change in the territory. Lastly, macro-level governmental regulations, market pressures, and other environmental changes facilitate that clusters develop a collective-minded strategy towards sustainability.

Keywords: sustainability; clusters; collective actors; networks



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1. Introduction

In this study, our aim consists of understanding how to drive a cluster towards more sustainability-oriented practices, understanding key actors and their activities, along with the core drivers fostering change. This article is positioned in the cluster and industrial district literature [1–3], seeking to add knowledge on the sustainability dimension for clusters and clustered firms. The necessity of this study is based on the fact that there is scant literature on the understanding of sustainability transition in clusters [4,5].

Sustainability is one of the major current challenges in firms and regions around the world. Climate change, environmental degradation, economic inequities, social injustices, reduction of environmental impacts, changes in consumer behavior, and health issues motivate the regional agglomerations to rethink their actions and to introduce new sustainable practices. Sustainability also encompasses environmental, economic, and social aspects. It is widely understood that sustainability strategies in regions and networks must consider practices that seek social progress, effective protection of the environment, prudent use of natural resources, and lastly, maintenance of high and stable levels of economic growth and employment [6].

Academic researchers and policymakers are showing increasing interest in sustainable activities in industrial clusters [4]. More specifically, economic geographers and scholars from other business-related disciplines have made growing efforts to understand the role

of firms' sustainable strategies in clusters [5]. As regards clusters, however, scholars agree that sustainability-oriented transition in clustered firms can be complex due to the multiple objectives and stakeholders' motivation related to sustainable territorial development [4,7]. The question is, therefore, how to drive a cluster towards more sustainability-oriented practices. In this line of thought, this study addresses the following research questions: how does an industrial cluster promote a shift towards sustainability? What are the drivers of this process? How do we integrate and organize all the different cluster actors (i.e., firms, government, research institutions, unions, and representative institutions, etc.) for promoting sustainability?

Searching for answers, this study aims to understand how a cluster shifts towards sustainability, analyzing its drivers and the mobilization of actors in the process. We posit that different actors, both individual and collective ones, need to be aligned for a new path development towards sustainability in clusters. Such capacity of actors' orchestration refers to individual contributions throughout their collaboration [8,9], even acting as collective actors for fostering collective actions for shifting change in the region [10].

Empirically, we conducted a case study of the Serra Gaucha Wine Cluster in the South of Brazil, using mixed-methods based on documents, direct observation, and 38 in-depth interviews. The focal cluster is chosen for three main reasons: (i) it has a long trajectory of more than a century of activity; (ii) social and economic impact in the region and the country-level; and (iii) mainly, for undertaking ongoing shifts in the field of sustainability in recent years.

This study's findings point out that sustainability transition in clusters occurs among different actors and activities at different levels of analysis. Thus, results suggest that at the micro-level, the mobility and adoption of knowledge about sustainability and individual awareness will support sustainability-oriented strategies as a new source of competitive advantage. Then, at the meso-level, collective actors' efforts towards sustainability in the cluster legitimize, disseminate and facilitate the adoption of new sustainable-oriented practices, creating a new cluster sub-identity (sustainability) compatible with the existing one. These actors utilize leading firms in order to disseminate new practices and signal change in the territory. Lastly, macro-level governmental regulations, market pressures, and other environmental changes facilitate that cluster actors develop a collective-minded strategy towards sustainability. Overall, our insights suggest main actors and activities for cluster sustainability, considering clusters as a multilevel and multi-actor phenomenon.

After this introduction, Section 2 elaborates on the framework. Then, Section 3 presents the actors involved in the transition. Section 4 explains methodology and in Section 5 results are presented. Finally, Section 6 concludes.

2. Cluster and Sustainability Transition

As a multidimensional concept, sustainability builds upon economic, environmental, and social principles to foster societal well-being and prosperity. At the regional level, [4] argue that regional sustainable industry is all about creating the conditions under which firms can operate to make a sustainable contribution to society and the overall industrial activities within a given region. In this sense, the clustering of firms offers the opportunity to achieve simultaneously individual and collective benefits. These advantages are relevant for environmental, social, and economic actions.

Considering the sustainability-oriented transition of clusters, we point out that different levels of analysis, actors and aspects influence regional sustainable development. In general, there is a combination of commercial and regulatory pressures that are external to the businesses that guide environmental action. However, the literature also suggests that companies participate in voluntary environmental initiatives to: reduce costs or increase efficiency, avoid or delay regulatory action, gain competitive advantage and enhance or reinforce a positive image in the marketplace [11]. Recent studies identified technical (location, type of area, logistics support, etc.) and non-technical (public relations, community

involvement, market penetration, etc.) aspects that moderate the potential for sustainable development policy [12].

The decision to adopt sustainable practices in their production process is determined by various drivers [13]. The distinction is generally made between internal and external drivers [14]. As internal drivers, we highlight the role of strategic and financial drivers to achieve a competitive advantage. External drivers refer to other factors, such as stakeholder pressure, compliance with regulations or consumer demand.

Sustainability is identified as a source of competitive advantage at firm and cluster levels, generating individual and collective benefits [11]. Grimstad & Burgess analyze the case of a Wine Cluster in Australia and the co-ordination of a collective actor to develop the project “greening Lovedale”, promoting sustainability as a source of regional identity and potential competitive advantage. Despite the individual obstacles towards sustainability, clustering participation can reduce costs, achieve scale economies and share knowledge. These advantages are relevant for environmental actions [11]. In this context, the competitiveness of clustered firms has a strong influence from collective actions and shared resources in a cluster [15–17]. In line with these previously mentioned scholars, we argue that collective resources enable a clustered firm to access resources that will positively influence competitive advantage and facilitate the sustainability-oriented transition at cluster level. The above-mentioned multilevel drivers are shown in Table 1.

Table 1. Multilevel Drivers for Cluster Sustainability Transition.

MICRO LEVEL Individual Actors/Firms	MESO LEVEL Sectorial/Collective Actors in Clusters	MACRO LEVEL Market Actors/Government/Environmental Changes in Regions/Countries
<ul style="list-style-type: none"> - Company’s own values and beliefs - Increased knowledge and awareness about the environment from company’s owners - The right thing to do - Sense of responsibility - Cost reduction - Pressure from employees - Attract employees - Strategic change 	<ul style="list-style-type: none"> - Collective actors’ actions - Pressure from local Associations and local community - Demand from business associations - Fear of bad regional reputation - Fear of environmental consequences 	<ul style="list-style-type: none"> - Government and Sectorial regulations - Pressure from customers - Environmental conditions required for accessing government grants - Environmental conditions required for private funding - Pressure from Climate Change (SDGs)

Source: own, based on [11,13,14].

Table 1 indicates the three levels of analysis of drivers for the sustainability-oriented transition in clusters. At the micro-level, firms as the unit of analysis, it is possible to perceive more individual and internal movements such as personal values, beliefs, and sense of responsibility for future generations. The micro-level also encompasses internal firm drivers, i.e., cost reduction, individual strategy and, pressure from employees. At this level, the access to knowledge about sustainability plays an important role for promoting an ethical choice based on personal values and concerns for the environment [13].

At the meso-level, we highlight demands from collective actors such as fear of bad regional reputation and pressure from local associations and the community. These collective actors (i.e., local/regional business trade associations, technology institutes, universities, cluster associations, etc.) have influence to legitimize new technologies and support the shift towards sustainability [10]. In line with [10,18], we also point out that collective actors can remove barriers to change, coordinate efforts, and act as brokers of new Sustainability-oriented institutional and technological processes. These collective actors also enable a collective understanding and shared vision about sustainability. Then, the close relationship between local/regional firms and other micro-level actors, can shape the local institutional context for the facilitation of the introduction of a new sustainability-oriented sub-identity. Some sustainable practices could ensure high environmental, social, and economic bene-

fits to the broader community, but only if adopted by a substantial number of clustered firms [14]. They reinforce the idea that collective actors play a key role in engaging clustered firms in adopting sustainable practices and changing their mindset towards a sustainability path for clusters.

At the macro level, there are general market demands and government requirements (i.e., government actors and regulations, consumer associations, large retail chains, distributors, public and private investors, etc.), as well as environmental changes that will force sustainable actions. Even in the context of weak or absent government actions and regulations concerning the environment, regional clusters can utilize the advantages of clustering to meet environmental goals [11]. However, we argue that the three levels of actors should be aligned to promote this change in the cluster.

3. Orchestrating Actors of Clusters towards Sustainability Transition

Industrial clusters are characterized by the interconnections between different actors in a delimited geographic area. The geographical agglomeration is a collective agent whose success depends on the network of relations with the end market and the development of an agglomeration image, regardless of the individual image of the clustered firms [19]. The cluster reputation comes from the synergy among firms, government, research institutions, unions, and representative institutions, etc. Interconnections and relationships between people and firms [20], a fact pervasive in clusters, require articulation and coordination of different actors and activities.

Orchestration refers to the ability to influence the evolution of a new business network, in which new technologies, products or business models can be commercialized, capturing and generating value for all participants [8,21]. As mentioned above, we argue that the sustainability-oriented transition of clusters requires a multilevel orchestration of actors and actions that encompass the development and coordination activities of the networks [22].

The orchestrator demonstrates different, important network activities [23], generally influencing the network design and how knowledge flows and relationships occur [24], monitoring and controlling new innovation practices [25]. The orchestrator needs to have a comprehensive view of the entire system, sharing the activities among the members and influencing their behavior [21].

More recently, the studies indicated the possibility of having more than one orchestrator in a cluster. However, understanding of that specific activity or function of orchestration is still limited. We know that the complexity and dynamism of the cluster constitute the existence of multilevel orchestrators in a given cluster. This leadership may be shared, and the different members may be organized without a defined hierarchy, spontaneously combining their resources and capacities to create and extract value from the network [25,26]. The skills and capabilities of individual and organization levels interact and affect each other in several ways in orchestrating a cluster [22]. Thus, it is possible to identify some processes from bottom to top and from top to bottom where the organizational level influences the levels of the groups or individuals and vice-versa.

To sum up, orchestration is a theoretical approach that focuses on organization and leadership in multiple actors' relationships [8,22,27,28]. Besides, several orchestrators with different functions can generate more value for organizations and networks [29,30] in dealing with the challenges brought about by the number and diversity of stakeholders [31]. The orchestrator can be a company [26], a university [32], a government [33], collective actors [9], technology institutes or local business associations [10,18]. The orchestration is dynamic and characterized by a multi-actor multilevel process, and orchestrators will articulate new processes and activities to build a path toward sustainability. We argue that the local actors' orchestration, both individual and collective, fosters a better sustainability-oriented transition of a cluster.

4. Methods and Information Sources

The study was developed under a qualitative approach. We have used a case study approach, a key instrument for gathering complex information [34,35], based on secondary data and in-depth semi-structured interviews. The theory-building research using cases typically answers research questions that address “how” and “why” in unexplored research areas. Our research achieved triangulation of data by posing specific questions to interviewees, engaging in discussion with experts in the industry and with policymakers, and comparing results with secondary data [36]. Another characteristic of the method is to perform a multifaceted investigation with data from different sources [37].

The case analyzed is the wine cluster of Serra Gaúcha in Brazil. The cluster has existed for more than a century, and it has followed different evolutionary paths. We select this case for its relevance in the Brazilian wine industry and its relevant and ongoing transition towards sustainability. Over the past ten years, the cluster has shown a prominent shift towards adopting some sustainability-oriented practices. Its importance as a cluster is also emphasized by the fact that it represents around 85% of the wine industry in Brazil [38]. In this cluster there are many vineyards, more than 60 wineries linked to several wine-oriented associations and around 18 institutions (e.g., public labs) and organizations (e.g., trade associations) connected to education, research, production and professional consultancy, all of them devoted to wine.

In the wine industry, sustainability-oriented practices have gradually increased over the last decade [13,39]. The wine producers are pressurized by sustainability issues aimed at reducing gas emissions and the use of water, land, pesticides and energy [40,41]. In this context, sustainability-oriented practices are also necessary because of the high degree of competitiveness in the globalized wine sector, along with consumers’ and policy makers’ demands and awareness of new sustainability practices in wine production [13,42,43].

The study has been developed following a qualitative and inductive approach on a case study. Cases are key instruments for gathering complex information [34,35]; we have used mixed-methods (based on analysis of secondary data and in-depth semi-structured interviews), addressing “how” and “why” the sustainability transition occurs [35]. The interviewees included companies, experts in the industry and policymakers. This combination of different informants facilitated triangulation of data. We also utilized secondary data, following methodological recommendations for different sources of data [36,37].

Thus, we carried out data collection primarily covering the previous ten years to understand the cluster’s evolution through different historical moments where sustainability was present. A series of documents (ranging from 2009–2021) were analyzed to collect detailed information about the history of the wine cluster (academic surveys, reports about the sector, information gathered on firms and institutions websites). In addition, we performed 38 in-depth interviews with local actors and organizations involved in the cluster (i.e., representative of the Brazilian Institute of Wine, research centers, institutions of training, consultants, experts, members of the association of producers, and entrepreneurs). The semi-structured interview script sought to explore the background of the cluster and the organizations and the interactions and the articulations performed throughout that trajectory, addressing sustainability-oriented activities especially. The interviews lasted an average of around 1 h for each informant (during 2018–2021). See Table 2 for more details.

Table 2. List of the Interviewees.

Code of Interviewee	Type of Organization	Interviewee Position	Year of Interview
INT1	Cooperative Winery A	Director	2018
INT2	Cooperative Winery B	Technician	2018
INT3	Winery C	Technician	2009
INT4	Winery D	Manager	2018
INT5	Winery E	Manager	2018
INT6	Winery F	Manager	2018
INT7	Winery G	Director	2018
INT8	Winery H	Enologist	2018
INT9	Winery I	Enologist	2018
INT10	Winery J	Director	2018
INT11	Winery K	Director	2019
INT12	Association A	Director	2009
INT13	Association B	Director	2018
INT14	Association C	Director	2018
INT15	Association D	Director	2018
INT16	Association E	Associate	2018
INT17	Association F	Office worker	2018
INT18	Association G	Associate	2019
INT19	Representative Organization	Director	2018
INT20	Representative Organization	Director	2019
INT21	Tourism Institution	Office worker	2018
INT22	Educational Institution	Professor	2018
INT23	Oenology Institution	Director	2018
INT24	Research Institution	Researcher	2019
INT25	Research Institution	Researcher	2018
INT26	Professional Representation	Manager	2018
INT27	Business Support Institution	Consultant	2018
INT28	Union	Director	2018
INT29	Government	Office worker	2018
INT30	Association B	Director	2019
INT31	Winery G	Director	2019
INT32	Winery J	Manager	2019
INT33	Oenology Institution	Director	2019
INT34	Representative Organization	Manager	2019
INT35	Representative Organization	Director	2019
INT36	Representative Organization	Expert in Sustainability	2021
INT37	Educational Institution	Professor	2021
INT38	Winery L	Owner	2021

Regarding chronology, we asked open questions that focused on understanding the cluster's trajectory and evolution paths (e.g., describe the cluster's trajectory? What were the recent highlights and drivers of the cluster's history? What are the main characteristics of the cluster? How are the actors organized? How are the local networks arranged?). Lastly, interviews with direct questions related to sustainability drivers and transition were conducted [32]:

“How do you define sustainability in the wine sector? How do you assess the stage of sustainable development in the Serra Gaúcha cluster? What sustainability initiatives do you know of? Who are the main actors involved in this movement? Which companies and/or organizations would you highlight for this specific purpose? Is there any collective action between the actors in the cluster for shifting towards sustainability-oriented practices? If so, could you describe these initiatives? How does the exchange of information between the actors about sustainable actions and practices in winery occur? What are the main difficulties for the dissemination of sustainable practices in the Serra Gaúcha cluster? How could sustainability be inserted into the cluster's theme and purpose?”

The data analysis is based on an integral transcription of the interviews, codifying this information for subsequent analysis and discussion using the axial coding procedure. Data triangulation among different sources of data was utilized in order to identify the consistency of the data and, thus, implement the validation of findings [44].

Qualitatively, the transcribed data was coded and analyzed [45], deciphering data from interviews and secondary data into first-order concepts. Interviews and secondary data were analyzed in parallel, relating also the analysis with the collection process for the sake of better isolation of concepts. Then, clustering these concepts into second-order or higher-order themes, we proceeded by identifying concepts and mechanisms by open coding.

5. Results

The Serra Gaúcha Wine Cluster is responsible for more than 85% of the wine production in the country [38], counting on the presence of the leading institutions of the sector. Italian immigrants had an essential role in the wine activities in Serra Gaúcha, situated in the south of Brazil. The beginning of wine production was restricted to family and friends. However, in the first decades of the 20th century, the cluster had increased production, and some families developed a wine business. In 2018, the cluster employed 43.96% of all workers and 44.77% of all wineries in Brazil, classified within the National Economic Activity Register—“Production of Wine” in Brazil [46]. In the Serra Gaúcha Wine Cluster, “vitiviniculture has become the main economic activity in the region [. . .] it is an identity symbol of the region, it characterizes and represents the winegrowers, descendants of Italian immigrants” [46], (p. 4719).

The Brazilian wine industry has four phases or historical periods [47]. The first is the implantation of vitiviniculture in Serra Gaúcha, from the 19th century to 1920. Then, from 1930 to 1960 there was a diversification of wine products and an improvement of the wines. From 1970 to 1990 the third phase was marked by the cultivation of wine-producing vines and the production of fine wines. Finally, after 2000, there began a period of certification and identity of Brazilian wines. Besides these four phases proposed by Tonietto (2003), we argue that, in the last decade, the Cluster of Serra Gaúcha began a sustainability-oriented transition as a new phase.

5.1. The Paths of Development of the Cluster

The viticulture activity of Serra Gaúcha started after 1875 as a result of Italian immigration. The immigrants brought with them the seeding of the vine and the expertise of grape cultivation for the region of Serra Gaúcha [48]. “The Italian immigrant had in his veins and practices the habit of cultivating and producing wine. With this, when he settled in the new

land, he started to seek conditions to carry out winemaking.” [48], (p. 60). However, the trade of wine was kept small-scale until 1920.

During the 1930s, the production increased to supply a market that reached other states of the country [49]. Due to the growing pressures of the unions and the sanitary legal demands, the craft production of wine and grape-related products became more complicated. After the 1930s, the first cooperatives of wine with the capacity of competing with the private vineyards were constituted [50]. The cooperatives proved to be important economic agents since the growing local producers’ association, and the cooperatives, could produce large volumes and set prices low enough to control the market. The cooperatives also served as an alternative to small local producers to market their grapes at fairer prices, encouraging the production of the small grape farmer.

After 1940, agricultural activity started being replaced by industrial activity, as part of national policy. Industrialization attracted new workers and diversified production. A series of technical changes happened in this period to improve the quality of production of the wines and the organizational structure of the vineyards [50]. The period after 1950 saw the emergence of representative organizations such as Sindivinho, in 1948, Fecovinho in 1952, and UVIBRA, in 1967. Those entities have worked, promoting the objectives of vineyards and cooperatives, and they had strong relevance in the development of the region [51]. Another important actor emerged—the School of Viticulture and, later, Oenology [51]. For a long time, it was the only one in the country. The School of Oenology increased the breadth of knowledge, which spread in the region, increasing the number of qualified professionals, who had been scarce, and had mostly been foreigners (Interview 23, Interview 33).

During the 1970s, the arrival of multinationals meant a need for productive, technological, and market updates for the local producers. The multinationals implemented policies and actions aimed at quality gains in grape production, encouraging new varieties of French wine grapes. The new players, focused on cultivars, traded at a higher price, with more advanced productive and industrial practices and better technology that guaranteed higher quality and efficiency (Interview 9, Interview 15, Interview 26, Interview 20). The initial shock to the old routines did not occur immediately; national wineries were forced to adapt to these new routines and technologies brought by foreign wineries [45].

Another significant shock to the Brazilian wine industry was the economic plan, called Color Plan, at the beginning of 1990. The Color Plan aimed to open the market, reduce the import tariffs, and create Mercosul in 1991. Consequently, new competitors joined the Brazilian wine market; first Germany, then Argentina, and Chile. Most of the multinationals, including those located in Serra Gaúcha, left Brazil for countries with a lower cost of production. In that period, some local producers of grapes decided to be integrated and became producers of wine to provide a market for their product (Interview 34). Thus, the opening of the market in 1990 strongly impacted the cluster with a high ease of entrance of international wines, especially coming from other countries of Mercosul. On the other hand, the French paradox brought a cultural change that encouraged the consumption and the production of red wine and the migration to sparkling wine as a significant part of the grape production for white wines.

Many collective initiatives and innovations to improve the quality of wine and the region’s reputation started after the 2000s, particularly the production of sets of wines and the substitution of the bombardment conduction system for the gravity system and the systems of automatic control of temperature and reassembly [52]. The innovations in distribution covered the expansion of the internal and external markets. In 2002, the Program Wines from Brazil (nowadays “Wines of Brazil”) was created by IBRAVIN to promote Brazilian wine in the international market. That Program is a network of vineyards whose goals are to encourage the consumption of Brazilian wine globally and prepare the Brazilian producers to export (Interview 35). Besides that, the representative entities obtained the possibility of inclusion in the tax system called “Simples Nacional” which simplifies taxes for the sector. Another important innovation of marketing was the denomination of origin “Vale dos

Vinhedos” in 2002, the first one in Brazil. Since 2012, the vineyards of Vale dos Vinhedos have had a Denomination of Origin (DO), with more restrictive rules to produce grapes and wines. In this context, there was “a new phase of national vitiviniculture, marked by the search for the territorial characteristics of wine. This movement was led by EMBRAPA, a research institution that brought together professionals from the sector, wineries, producer associations, and professional associations in order to obtain this achievement. Therefore, a new phase began in Brazilian vitiviniculture, that of geographical identification” [53].

As a new path of this cluster, we identified new challenges related to sustainability transition. In the wine industry, the adoption of sustainability practices has gradually increased over the last decade [13]. The sustainability-oriented transition is reinforced by the high degree of competitiveness, consumer awareness, and legal requirements regarding sustainability (Interview 36; Interview 37 and Interview 38). In the context of the Serra Gaúcha Wine Cluster, most producers still consider sustainability as a cost and a legal obligation (Interview 36 and Interview 37). However, there is a new generation with new ideas and new ways to conduct a wine business. Thus, Interview 38 points out:

“It is young people who are discovering the path to sustainability, new organic, biodynamic practices.”

(Interview 38)

The first movements to sustainability-oriented transition in the cluster began with small and independent producers. Their motivation was their beliefs and values. Nevertheless, some large companies also started to adopt sustainability practices (Interview 38). Since the beginning of the 21st century, there was a conceptual expansion in the Brazilian wine industry, including organic, biodynamic, natural wines and double pruning or inverted cycle of the vine [54]. This expansion encompassed essential changes in wine production, especially in the management of the vineyard. In the next section, we will discuss the drivers and actors of transition in the Serra Gaúcha wine cluster.

5.2. The Drivers and Actors in Sustainability-Oriented Transition of Clusters

The drivers to cluster sustainability-oriented transition encompass three levels: micro, meso and macro. At the micro-level, we identified a group of wine producers motivated by their values and beliefs. In addition, the cluster has a growing group of producers engaged in the natural wine movement (Interview 38). Another point is the increased knowledge about sustainability in the cluster. The School of Viticulture and Oenology has incorporated sustainability practices in their vineyard courses. Interview 37 exemplified: “Last year they partnered with a vineyard to apply sustainable production techniques and showed better results with reduced costs.” After these courses, many students maintain the exchange of knowledge on social networks. This exchange is still very informal but engaging more and more people each year. Another source of knowledge was a postgraduate program on biodynamics in São Paulo. The Program has not focused on viticulture; however, many producers incorporated some practices in their vineyards after joining the Program.

The wineries had to adopt some practices due to the legal requirements and government regulations as a meso-level driver supported by collective actors. At the meso level, in 2017, the Brazilian Institute of Agricola Research—Grape and Wine (Embrapa Uva e Vinho, hereinafter Embrapa) developed the Integrated Production of Grapes for Processing (PIUP) and a booklet of good practices of wine production, including food safety and sustainability practices (Manual BPF, 2017). The PIUP is a voluntary adherence system that enables certification of high-quality wines and juices based on sustainability. The system prioritizes food safety by monitoring insects and mites, pests and diseases, prioritizing safe methods, with correct use of agrochemicals, focusing on sustainability, increased profitability, and making the producer more competitive in economic scenarios of globalization and demanding markets in quality.

Participation in the Program additionally produces other benefits for producers, as it covers principles of environmental sustainability, allowing the adjustment of conduct with environmental legal requirements [55]. Furthermore, from the consumer perspective, PIUP

guarantees the reduction of contamination risks, whether chemical (residues of pesticides, mycotoxins, nitrates, and others), physical (soil, glass, metals, and others), or biological (waste, bacteria, fungi, and others). In the Serra Gaúcha Wine Cluster, the development of the PUIP Program lasted from 2010 to 2015 and had five experimental plots, also called demonstrative units, located in different municipalities: Flores da Cunha (Luiz Argenta Winery); Caxias do Sul (cooperative member of Vitivinícola Aliança); Garibaldi (supplier of Tecnovin); Farroupilha (Perini Winery) and Gramado (Ravanello Winery).

In 2017, Embrapa also developed a guide to support wineries in the implementation of PIUP [55]. The booklet (Manual BPF, 2017) compiled the experiences of the wineries in the PIUP, coordinated by Embrapa and with the participation of collective actors in the Brazilian wine industry (e.g., producers' associations). This booklet mobilized many actors in the cluster and followed as reference Normative Instructions No. 05/2000 and No. 17/2015, from MAPA and RDC No. 275/2002, from ANVISA. The development of this booklet was the first step in the cluster to promote a collective action to improve grape quality and wine production based on food safety and sustainability practices. It is noticed that, just as occurred with the Denomination of Origin (DO) movement, Embrapa plays the role of articulating the different actors in the cluster for the transition to sustainability-orientation.

However, organic wines production does not allow the use of any chemical pesticides. To achieve this, some Brazilian wineries, such as Don Giovanni Winery, use the Thermal Pest Control (TPC) technology in the vineyards, which markedly reduces the use of agrochemicals (Dardeau, 2020; Franciosi, 2017). Organic certification is also a concern of a group of wineries, especially as regards grape juice. Currently, we identified two certifications on the label of some grape juices from the Serra Gaúcha. The first one is the standard certification process through the stamp "Brazil Organic Products" since 2013. The second one came from the mobilization of prominent producers and cooperatives to obtain an independent certification by EcoCert Brazil. However, the EcoCert Certification has a high cost for small producers (Interview 36).

We also identified some wineries engaged in biodynamic production. Biodynamic wines must have the following requirements, according to the formulation of the Biodynamic Institute (IBD Certifications): each vineyard must be an integrated individuality; the producer must have soil conservation practices; not using chemical fertilizers and synthetic pesticides (only natural control products are allowed); assume nature conservation practices; practice social responsibility at work; apply biodynamic homeopathic preparations, which increase the vitality of the environment, plants, and the final product; do not make use of transgenic products. In addition, biodynamic production integrates animals into the process as they exercise control of weeds and insects and fertilize the soil, promoting the balance of the ecosystem [54].

Among the wineries in this process, we highlight Don Giovanni, a small winery with an annual production of around 120 thousand liters. In search of sustainability, Don Giovanni started, in 2014, tests on its vineyards using biodynamic management. In this system, grape production does not use pesticides or synthetic fertilizers. In contrast, natural products and organic compounds produced on the property are used. Another critical point is to understand that the search for sustainability is a long-term process. In the case of Don Giovanni, it needed the process of conversion of vineyards. Therefore, it is a slow, learning process towards sustainability [56].

The customer's awareness is another crucial driver to sustainability-oriented transition at the macro level. Some wineries have already faced pressure from the international market to adopt sustainable practices and changed their discourse (Interview 38). A highly relevant fact: organic, biodynamic, and natural tendencies, with their demands, have greatly provoked traditional producers. In this sense, techniques commonly adopted in the conventional process have been altered. Volumes of chemical pesticides and SO₂ have been reduced, among the traditional ones, by the teaching of 'nature's person.' We have already found several conventional producers using wild yeast, reducing SO₂, and adopting other approaches, always influenced by the experiences of nature's person [54]. These changes

could be the first step to a collective sustainability strategy as a competitive advantage for the cluster. According to our case study, multiple orchestrators can be seen throughout its transition to sustainability.

We highlight the role of the first wine producers who sought outside knowledge about organic and biodynamic wines and brought the concept to the region. From this, the School of Viticulture and Oenology had the role of disseminating and training on sustainable production practices. There is also the important role of wineries, such as Don Giovanni, a pioneer in the appropriation of this knowledge, thus becoming the main reference in terms of sustainability. Besides developing sustainability programs in the wine sector, Embrapa, as an important collective actor in the cluster, articulated different actors based on this theme. Finally, there are the certifying institutions that ensured an alignment between the practices carried out.

Regarding orchestration process to sustainability-oriented transition, at the beginning, we noticed that some wineries developed spontaneous actions. However, at meso level, we identified the role of Embrapa to orchestrate wineries and government regulations for developing the booklet of Integrated Production of Grapes for Processing (PIUP) and disseminating best practices in wine production.

5.3. Multilevel Orchestration to Sustainability-Oriented Transition in Clusters: A Framework Proposition

Clusters are considered a network of the interaction of different actors in a geographical concentration. The networks are a consequence of combining the existing and new knowledge of several companies, and their limits, to create exclusive products, services, and processes, depending on the market's current needs [25]. We argue that the current challenge for clusters is to build paths towards sustainability; however, this transition process is complex [7]. Therefore, we present a multilevel orchestration framework of actors and three propositions to explain the sustainability transition.

Results suggest the existence of a framework towards sustainability in clusters. First, the individual actor should be aware of sustainability and develop new knowledge about the topic. According to Interview 38, most people don't have a clear vision of sustainability. The producer also adds:

"It is a philosophy of life that involves different pillars; those who only see it as a commercial reason do not have much hope of it working."

(Interview 38)

This point is related to the confusion about cluster sustainability [4]. Therefore, the next step in the transition would be to understand the concept of sustainability, considering its different pillars (economic, social, and environmental). Interview 37 exemplifies the difference between the stages when it mentions that previously the actors in the cluster did not even know what sustainability meant. However, it is now in the discourse of many of them, even though they still do not carry out sustainable practices.

We can see that the awareness of sustainability and understanding the concept are directly related to the micro-level of the cluster: people. It is possible to identify personal values and beliefs, knowledge about the environment, and the desire to do the right thing, influencing the other levels of the cluster [11].

"The more traditional producer still has more resistance; however, the new generation is more oriented towards sustainability and has been demanding more sustainable products and practices."

(Interview 36)

As the next steps in this sustainability-oriented transition, we identified the compliance with legal requirements and implementation of sustainable practices. The recognized importance of sustainability-related topics has produced studies about the efficiency of public policies, private industrial performance, and environmental performance determinants [57]. In addition, several International Organizations, such as the European Union

(European Commission, 2017) and the OECD, [58] have introduced ecological issues into their programs and goals. In the wine industry, the International Organization of Wine (OIV) has been involved in sustainability since 2014. According to Interview 36, sectorial and government actors are demanding more sustainable wine production practices.

In parallel to the legal requirements, we observed some isolated sustainability movements in the cluster taking place in large wineries and producer cooperatives, such as the production of organic juices, biodynamic wines, and integrated production certifications. We understand that there is already a direct relation with the meso-level. It is possible to observe that the advance to this level is due to different motivations: (i) ethical philosophy of producers, (ii) market opportunities, and (iii) legal pressures. Therefore, the main drivers are cost reduction, brand positioning, fear of reputation loss, pressure from groups, and legal requirements.

The following elements on this path are related to the current transition to a more sustainable cluster and implementing a collective strategy. Thus, the collaboration between the actors and sustainability is a strategy and competitive advantage for the region. We assume that all stakeholders must search for ways to develop sustainability for the Region [13]. According to Interview 38, the cluster has already shown collaboration in constructing other paths, such as obtaining the certification of Designation of Origin (DO). Considering the three levels, we identified the existence of actors still in the initial stages of this sustainability-oriented transition process.

“When there is a challenge, the actors collaborate [. . .] the problem is that they are still focused only on the economic dimension of sustainability. [. . .] The cluster will be sustainable when the different actors perceive it as a competitive advantage strategy.”

(Interview 38)

As regards the main actors and drivers at the macro-level, we highlight market actors, such as customers, investors, international agencies, and commercial partners. The interviews pointed out that the change in other clusters will also influence the transition in the wine cluster of Serra Gaucha:

“There are some other clusters in the world (as in the United States—Napa Valle, in South Africa—Stellenbosch, Australia—Adelaide Hills) and in Brazil (São Francisco Valley/Northeast) that are already founded with an orientation towards sustainability; if we don’t change soon, we will be left behind.”

(Interview 37)

Based on the elements and levels of a cluster’s sustainability transition, we realized that it’s not a linear process with isolated actions. In other words, it is a dynamic process with multilevel actors and can start spontaneously at different levels. In the Serra Gaucha Wine Cluster, we observe a spontaneous movement from individual actors to disseminate knowledge and sustainable practices. At a micro-level (individual actors), an orchestration oriented to the mobility of knowledge among actors becomes necessary. It refers to the sharing, acquiring, and implementing of knowledge within the network between the actors involved and the combination of this specialized knowledge for co-creation [28]. It started with researchers, winemakers, and entrepreneurs enthusiastic about sustainable viticulture practices. Then they shared the knowledge obtained with other actors. We highlight educational institutions offering courses focused on sustainability for winemakers, the fraternities of organic and biodynamic juice, and wine producers with meetings to discuss sustainable practices and lectures promoted by entrepreneurs trained outside the cluster. As suggestions for new activities, there is the sharing of knowledge among the actors, the attraction and selection of partners for the cluster, and the promotion of actions aimed at sustainability [8,28]. According to Interviewee 38, as people learn about sustainable concepts and practices, they will realize their importance. We recognize that the orchestration of knowledge between the individual actors directly influences the sustainability-oriented transition. From this, we arrive at the first proposition of the paper:

Proposition 1. *At the micro-level, the mobility and adoption of knowledge about sustainability and individual awareness will support sustainability-oriented practices strategies.*

Regarding the meso-level, collective actors facilitate the appropriation of sustainability in practices. The appropriability can be through instruments such as practices, products, processes, patents, copyrights, and trademarks [8]. The point is to guarantee the generation of value and results for the network [28]. In our case, we identified collective actors that conform to this dimension: the government's inspection sectors with legal requirements, research institutions with the sharing of new practices and products and wineries, cooperatives, and association with carrying out sustainability experiences.

"The certifications and the positive result of larger wineries with sustainability inspire other organizations to experiment."

(Interview 36)

As key orchestration activities, legitimizing and building trust among organizations is suggested, as well as extraction of value created by innovations and encouraging sustainable practices [8,28]. Interviewee 38 also reinforces that as pioneer wineries in sustainable practices realize the value generated, other wineries are inspired. Therefore, we see different actors that encourage organizations to comply with legal requirements and develop sustainable practices. Thus, orchestration, at the meso-level, is related to legitimacy and appropriability of sustainable innovations.

Collective actors legitimize change and build a new sustainability-oriented identity. In this sense, the collaboration facilitates the change based on a shared vision and the appropriability of sustainable innovations. Hence the second proposition of the paper.

Proposition 2. *At the meso-level, the collective actors' efforts towards sustainability in the cluster legitimize new sustainable-oriented practices and support sustainable practices' appropriability.*

At the macro level, the orchestration also includes the external events and market actors, such as consumers, suppliers, investors, etc. The orchestration activities become necessary to ensure the alignment of the cluster actors towards sustainability. In the Serra Gaucha Wine Cluster, although we observed a spontaneous movement of individual actors to disseminate knowledge and sustainable practices, there were few collective efforts to articulate all actors and levels. Different actors have participated in the orchestration at each level. However, we still did not identify leaders to articulate the three levels to develop a collective strategy. According to Interview 36:

"There is a lack of leaders to articulate isolated sustainability actions."

(Interview 36)

However, analyzing previous paths of the cluster, it was observed that in the case of obtaining the Denomination of Origin (DO), this movement was led by the collective actors (research institution and by the producers' associations). The drivers to stimulate DO strategy were the wine tourism practices in the region, the impoverishment of the soil due to unsustainable actions, and pressure from international consumers. Based on this experience in the DO of the cluster, the interviewees highlight that the collective actors can orchestrate this strategic change. However, they still do not realize the importance of this issue to maintain a regional competitive advantage.

"Collective strategies are difficult. It is only in crisis that they come together to get things done. However, entrepreneurship is the strongest element in the cluster. When they perceive this need, they will know how to work together. If they need to be sustainable, they will be more sustainable."

(Interview 36)

Currently, some actors understand the importance of sustainability to the region and changed their discourse about it. We identified sustainability actions at each level, but

there is a lack of alignment between actors in different levels, incentives for collaborative sustainability actions and a collective strategy based on sustainability as a competitive advantage. These orchestration activities can be performed by collective actors in the meso-level (i.e., producer associations, representative entities, government agencies, or research institutions), as in the DO in the Serra Gaucha Cluster. The cluster trajectory indicates that collective actors will have the ability to orchestrate the different levels and actors. Finally, we present our third proposition.

Proposition 3. *Considering the governmental regulations, market pressures, and environmental changes, cluster actors should be engaging and orchestrated to develop a regionally collective strategy to generate a regional competitive advantage based on sustainability.*

Eventually, we summarized in Table 3 the 14 first-order codes, labeling them in the same way (meaning) as our informants use them. Then, these concepts were collapsed into second-order themes on the basis of similarities (i.e., axial coding). The three overarching dimensions are related and equivalent to the stated propositions: (1) Proactive adoption of new knowledge (micro-level); (2) Collective Actors to legitimize and diffuse new practices (meso-level); (3) Inter-cluster collaboration for regions (macro-level). See Table 3.

Table 3. Summary of the final data structure and codes.

First-Order Concepts	Second-Order Themes
"People are unaware of the concept of sustainability" "The focus of entrepreneurs is only on the economic pillar". "It is necessary to disseminate knowledge about sustainability actions". "When people know examples and discover sustainable practices, they appropriate them" "There is an opportunity to develop green and organic products"	At the micro-level, individual awareness and adoption of knowledge about sustainability is required Theme: [Proactive adoption of new knowledge]
"Training for sustainable practices is not available" "There is a need to exchange and diffuse experiences about more sustainable production" "The importance of collective actions that generate engagement of wineries in sustainability" "Collective actions to legitimize new practices"	At the meso-level, the collective actors' efforts towards sustainability in the cluster legitimize new sustainable-oriented practices and support sustainable practices' appropriability Theme: [Collective Actors to legitimize and diffuse new practices]
"The sustainable practices in clusters are individual and isolated in regions" "The emergence of sustainable wine tourism in the region demands that wineries should adapt to consumer demands" "It is necessary that the region organizes itself to improve its reputation" "The legal and governmental demands require that wineries act in a more sustainable way" "Other wine regions in Brazil and around the world are already aligned with the SDGs"	At the macro-level, clusters should be engaging and orchestrated to develop a regionally collective strategy to generate a regional competitive advantage based on sustainability Theme: [Inter-cluster collaboration for regions]

Figure 1 shows our propositional framework of Multilevel Orchestration to Sustainability-oriented transition in the cluster.

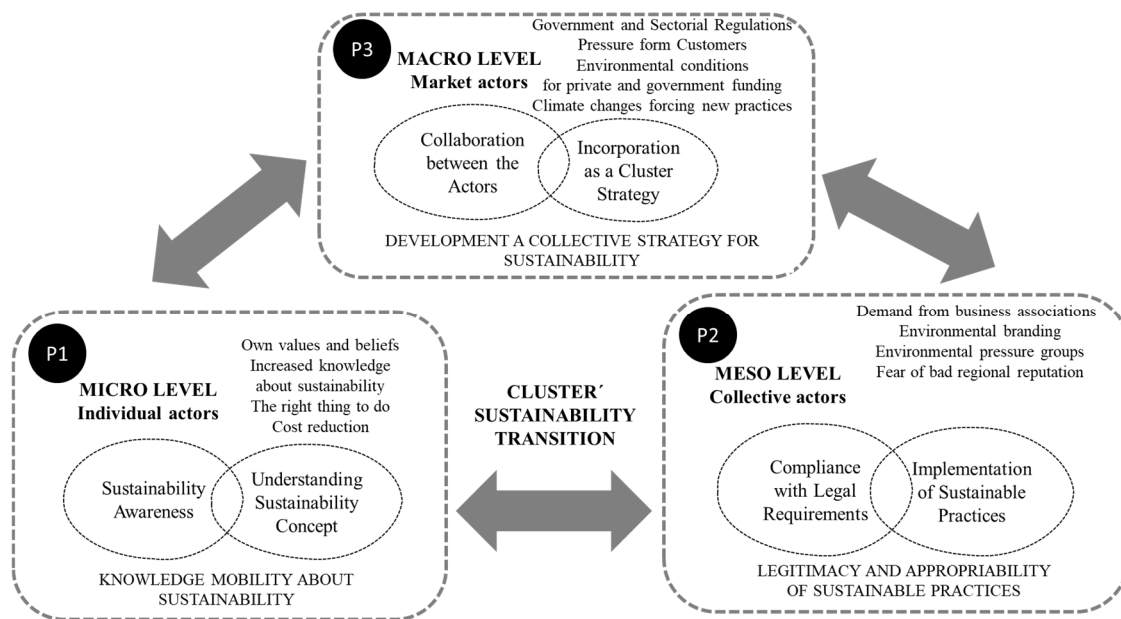


Figure 1. Multilevel Orchestration to Sustainability-oriented transition in Cluster.

This framework argues that the sustainability-oriented transition in clusters depends on multilevel actors and actions. Nevertheless, it is a dynamic process based on the interaction of these actors and actions. At the micro-level, we identified the efforts of individual actors to improve the awareness and the understanding of sustainability. In addition, these actors mobilize knowledge in small groups of producers. At the meso-level, there are some collective actions to promote compliance with legal requirements and implementation of sustainable practices. Therefore, the collective actors also contribute to the legitimacy and the appropriability of sustainable practices. Finally, the third level (macro), external pressures will influence the incorporated sustainability as a cluster strategy.

6. Conclusions

This paper investigates how a cluster shifts towards sustainability, analyzing the main mobilization of actors and activities activated in the process. Overall, we try to find out how a cluster shift towards sustainability occurs. In doing so, we attempt to fill the gap in the cluster literature about understanding the black box of sustainability transition in a cluster, presenting a framework and three propositions that explain actors and activities of the multilevel orchestration to construct this new path.

Findings suggest that, at the micro-level, the mobility and adoption of knowledge about sustainability and individual awareness will support sustainability-oriented strategies. This means that firms need to adopt new sustainability practices in their routines, reconfiguring new capabilities (access to certifications, training, adoption of new standards, etc.). More than a profit-oriented action, sustainability-oriented capabilities should be understood as a new source of competitive advantage. Second, at the meso-level, the collective actors' efforts towards sustainability in the cluster legitimize and disseminate new sustainable-oriented practices and support sustainable practices appropriability, creating a new cluster sub-identity (sustainability) compatible with the existing one. Third, at the macro-level, governmental regulations, market pressures, and other environmental changes, should make it possible for cluster actors to develop a collective strategy to generate a regional competitive advantage based on sustainability.

Therefore, according to our results, it is necessary to stimulate firms' actions toward sustainability (e.g., training activities for biodynamic viticulture, awareness of the sustainability concept), facilitating the adoption of new sustainability-oriented practices at firms, such as new processes and methods, accessing sustainability-oriented certifications, training employees for sustainability, etc. These activities permit the creation of new

sources of advantage. Thus, firms' proactivity in sustainability-oriented transition should be considered strategic and part of the future competitive advantage. In this context, our findings reinforce extant literature. At the micro-level, the findings show that both internal and external drivers matter when implementing sustainability, but internal drivers stand out [13]. Therefore, ethical choices appear to be the most important internal drivers. In this line of thought, our results highlighted the importance of mobility of knowledge about sustainability at the micro-level. This knowledge will support ethical choices for sustainability in the clustered firms' strategy.

At the meso-level (cluster collective actors and networks), we point out that the creation of new legal requirements and standards, regarding the dissemination of sustainable-oriented practices (certifications, new processes, etc.) can facilitate firm turnaround. These actions from collective actors enable a collective understanding and shared vision about sustainability in the cluster. The legitimacy and close relationship between collective actors (e.g., research centers) and local firms can shape the local institutional context for the facilitation of the introduction of a new sustainability-oriented sub-identity, legitimized as a new way of doing things in the territory.

Actors promoting these changes (collective actors, such as research and transfer institutes, Embrapa in this case, or local business associations) have to create and disseminate new sustainability-oriented practices (e.g., product certifications) and legal requirements in order to create the new context for firm compliance. Considering the meso-level, the results of [11] pointed out the obstacles to environmental action due to a lack of resources, and a lack of know-how among clustered firms. In this sense, collective actors have a key role in coordinating activity and providing dissemination of best practices.

Our results are also aligned with [10,18], indicating that collective actors in the investigated cluster (e.g., Embrapa) can legitimize, coordinate efforts, and act as brokers of new sustainability-oriented institutional and technological processes. Our results also reinforce the concept that the efforts of collective actors contribute to the stabilization of cluster networks towards sustainability practices and strategies. According to [3], stabilization means that all the ties that can bring information, ideas and reciprocity between such actors are well established, and constitute a dense network.

Concerning the 'effects' on sustainability-oriented transition, stabilization is consistent with a relatively high level of reconfiguring new capabilities for sustainable practices. It is very important to stress that collective actors utilize leading firms to promote change in their networks. Using the demonstrative units from the PUIP at leading firms (e.g., Perini Winery), change is legitimized by advanced local firms and best practices are subsequently diffused. Those leading firms participating in the demonstrative units, will subsequently promote change and diffusion of new practices within their own networks, contributing to supporting legitimization of new sustainability-oriented practices in the focal cluster.

Lastly, at the macro-level (market actors, government and environmental changes), the external pressures (e.g., international and national distributors demanding higher sustainability standards, consumers' associations for sustainable products, etc.) will generate collaboration and adaptation of sustainability as a cluster strategy.

Our findings present several contributions to the sustainability and clusters literature by discussing this intertwined and complex under-researched process of cluster transition into sustainability. Overall, we present implications for theory and practice. The first contribution is related to having identified the main actors and activities for the adoption of sustainability practices in clusters, presenting the different yet related three themes and how they, as a system, influence the process of transition towards sustainability in a cluster context, confirming literature [11,14]. The second contribution is based on the necessity to organize the orchestration of the process [29], trying to activate all actors and activities in the same direction and thus harmonizing the complexity of the multiple objectives and stakeholders' motivation related to sustainable territorial development.

Thus, this study contributes to the cluster and industrial district literature [2,16] by extending knowledge on the sustainability transition of clusters and districts. In addition,

our results also reinforced the importance of collective actions for cluster transformations through collective actions, such as the demonstrative units for PUIP [10,18]. These demonstrative units or technology demonstration platforms are collective actions that legitimize the shift towards sustainability, introduce the new sub-identity in the territory and diffuse best practices, signaling the change and how to achieve it. This is of capital importance in clusters and industrial districts, where companies learn more by imitation (from others) than by interaction (with others) [59]. Therefore, collective actions by collective actors provide contagion and foster imitation, constituting crucial activities for a sustainability-oriented shift. As observed, collective actors utilize leading local firms in order to disseminate new practices and signal change in the territory. This occurs because leading actors orchestrate the local networks.

As regards practice, our study is insightful. As managerial implications, the paper explains that the sustainability-oriented transition in clusters occurs from an active engagement of individuals and firms adopting new knowledge related to sustainability. Proactive attitudes and strategies are required: training, collaboration, investments and active search strategies to access information and knowledge on the topic are capital. Also, collaboration with collective actors and participation in collective actions will result in better access to sustainability-oriented knowledge. For policymakers, collective-based initiatives (eco-labels, dissemination of best-practices to the territory, pilot projects to demonstrate new technology or processes) should be promoted and financed. Also, active initiatives from innovation policies should aim at linking collective actors and clusters in regions to the co-creation of macro-level initiatives (i.e., active participation in sustainability-oriented regulations and standards, etc.).

This study is not free of limitations. Specifically, we highlight the use of a single case study to explore the transition to sustainability, therefore, generalizations need to be cautious. For future studies, we suggest the comparison between clusters at different stages of sustainability. For instance, comparing Serra Gaucha to Napa Valley in the United States. In addition, studies that deepen the identified steps and drivers can be very useful. Finally, we also suggest carrying out a cross-country study to validate the three levels of influence, especially the role of the macro-level in this transition.

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