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Circular Economy Initiatives: Strategic Implications, Resource Management, and Entrepreneurial Innovation in a Brazilian Craft Beer Ecosystem during the COVID Era

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Abstract: A new brewery is founded in Brazil every two days. Yet with climate change, drinking water is increasingly scarce. Previous studies have begun exploring the brewing industry, but an examination of circular economy initiatives in Latin America is lacking, particularly during the COVID era. This study analyzes strategic implications of circular economy initiatives, together with their role in the coevolution of the craft beer sociotechnical system in Brazil from a resource perspective during the COVID pandemic. Using a qualitative methodology based on analytic induction, 11 in-depth semi-structured interviews were carried out with key actors from the craft beer sociotechnical system in Guarapuava. For the content analysis, we triangulated the interviews with an analysis of 74 related documents. We found evidence of circular economy practices and sociotechnical transitions with the simultaneous coevolution of the system actors. Increasing rejection of the linear take–make–waste economy was observed as subject organizations largely adopted a regenerative model reducing operational waste. Hence, entrepreneurial innovation was apparently crucial for resource allocation during the COVID era. This work contributes to further understanding resource configurations in the circular economy, with practical implications for integrating sustainability into strategy, business models, and production.

Keywords: craft beer; coevolution; circular economy; sociotechnical system; strategy; resources; entrepreneurial innovation; COVID

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1. Introduction

According to the Ministry of Agriculture, Livestock and Supply, MAPA [1], beer activity has grown in Brazil in recent years. In this market, the so-called craft beer is highlighted in the segment. These are differentiated products, since they are produced on a smaller scale when compared to the mainstream industry. Craft beer has to focus on quality and innovation since the volume produced is less than that of industry major players. The production process is slow because fermentation and maturation happen naturally and there is no addition of chemicals introduced. Consequently, the selected products are considered to be of higher quality [2]. The master brewer, the individual who produces craft beer, monitors all stages of the production process and, at the end, analyzes whether the aromas and flavors of the final product are in accordance with the standards established in the Beer Judge Certification Program (BJCP) or the Brewers Association (BA).

In its 2020 report, the Brazilian Craft Beer Association, ABRACERVA [3], stated that craft breweries are responsible for the production of approximately 352 to 380 million liters per year in Brazil. The data presented by MAPA [1] show that, every two days, a new brewery is opened in Brazil, marking a rapidly expanding market. The numbers indicate that, in 2019, 1209 new craft breweries were registered in MAPA, a growth of 36% in relation to 2018, and the production of craft beer is growing between 30 and 40% annually. Brazil is the third largest producer of beer in the world with an approximate volume of 14 billion liters per year. The largest producers are China, with a volume of 48 billion liters per year, and the United States, with an annual production of 22.5 billion liters [3].

Considering the relevant growth of the craft beer market in Brazil, this study examines the craft beer ecosystem in Guarapuava region. Guarapuava is a city in central Paraná state, southern Brazil. The primary selection criterion was the existence of interacting actors in the system (local government, producers, suppliers, financial institutions, and production technology). Guarapuava has a developing craft beer market, with monthly production volume of approx. 75,000 L (900,000 L/yr., 0.9 ML/yr). Table 1 below shows the comparison of the micro/meso/macro regions production, in liters. The sector was formalized in 2017, through a partnership between the local government, the Secretariat of Agriculture and Tourism, and the newly created Guarapuava Craft Beer Producers Association (hereafter, ARTECERVA). The first artisanal brewery in the city started its operations in 2004, the second in 2014. Since then, the sector grew to eight microbreweries. This expansion is the result of a system that was formed concomitantly and that coevolves.

Table 1. Craft Beer Production.

Region	Craft Beer Production (Millions of Liters)
Guarapuava (Paraná, Brazil) [3]	0.9
Parana State (Brazil) [4]	9.6
Brazil [3]	380.0
Worldwide [5–7]	23,000.0

Source: the authors.

Within this context, a sociotechnical system was identified involving the collaborative union of people, technology, structures, and organizational processes, including the operational environment in which this occurs. In addition, this system is differentiated by a level of technical complexity designed to fulfill the functions society [8], which is the case in Guarapuava. In the same sense, Trist [9] states that improving one element of the sociotechnical system requires the improvement of other elements in the pursuit of maximum performance. Therefore, continuous improvement can affect all elements of this system. In this study, the improvement process was treated as coevolution, which according to Saviotti and Pyka [10], involves an interpretation of the concept of coevolution at the system level. For coevolution to exist the relationship of mutual interaction between different components should last for several time periods, giving rise to a sustained feedback loop. Thus, a system is made up of different and interactive components, whose coevolution occurs when two different components interact so that changes in one of them affect the others. Again, this is observed in the sociotechnical system of which ARTECERVA forms a key part.

The circular economy was linked to the coevolution of the sociotechnical system because the transition to the circular economy is the result of the involvement of all actors in society and their ability to link and create adequate patterns of collaboration. Such collaboration paves the path towards the search for continuous growth, demanding a rising flow of resources, since it aims to increase the resource use efficiency and to achieve a better balance and harmony between economy, environment, and society [11], highlighting the strategic implication of resources.

This clarifies the rationale behind the coevolution of the craft beer sociotechnical system in Guarapuava in terms of the scope of circular economy. Now we can shift our focus to the COVID era. Critical to the coevolution within the craft beer sociotechnical system during the COVID pandemic era are the strategic implications for the system's actors, particularly the producers and resource management practices adopted by the producers within technological niches, changing the sociotechnical configuration with the multilevel transition [12]. The stabilization and growth of an organization are related to its strategy and thereby to sustainable resource management [13]. Hence, responsible resource management is a factor of business sustainability, as well as a central component of the circular economy [14]. It was observed that in the COVID era all producers had a strategy of reducing resource waste, consistent with entrepreneurial innovation in the sense that each producer prioritized the most valuable resources in their production process and developed means to optimize those resource allocations [15].

Upon setting the COVID pandemic in the background and under the circular economy perspective, we examined the sociotechnical system of craft beer in Guarapuava from the coevolutionary approach, aiming to analyze strategic implications from resource management practices of the actors in the system. Entrepreneurial innovation played a key role in the process. We also found that circular economy initiatives are closely related to resource management and a sociotechnical transition present in the Guarapuava system. From this backdrop, our research question was: How does the coevolution of the sociotechnical system drive innovative circular economy strategic initiatives in light of the firm's resource management?

Our work contributes to the literature on sociotechnical coevolution, strategy, and resource management in several ways. First, it provides an applied view of multilevel transitions within the sociotechnical system, integrated with the coevolution of the actors in the system. Second, it contributes to deepening our understanding of resource relevance, optimization, and management within the scope of circular economy, providing practical evidence from a developing country during the COVID era. A potential practical contribution of the study is its pertinence of business strategy and entrepreneurial innovation in terms of implementing effective resource management practices, through the lens of coevolution of sociotechnical systems. Finally, to the best of our knowledge, no studies have explored the coevolutionary perspective of actors within the sociotechnical system under the circular economy umbrella, specifically addressing strategic implications for businesses and effective resource management.

2. Theoretical Background

In order to understand the coevolution within the craft beer sociotechnical system in Guarapuava, we integrate knowledge streams from disparate but related fields: the circular economy, sociotechnical system transitions, coevolution itself, strategy, resources management, and entrepreneurial innovation as depicted in Figure 1 below.

From Figure 1, the analysis of the sociotechnical transition occurs within the scope of the circular economy. The beer makers constitute the micro level of the sociotechnical system, and through entrepreneurial innovation and resource management they develop strategies that ultimately lead to the sociotechnical transition to the sociotechnical regime. Once the innovations are absorbed by the system, these evolve into the sociotechnical landscape. During the transition the actors in the system coevolve within the sociotechnical system.

2.1. Keystones of the Circular Economy

Our first knowledge stream is that of the circular economy. Conceptually, the circular economy pertains to the realm of sustainability [11] and aims at improving resource efficiency [12], maximizing materials lifecycles, and regenerating them at the end-of-life [15,16], in addition to a fostering a culture of reuse of resources and reduction of waste [17], including structural waste [18]. The circular economy can be defined as [19] (p. 4) "an economic system based on the reusability of products and product components, recycling of materials, and on conservation of natural resources while pursuing the creation of added value in every link of the system."

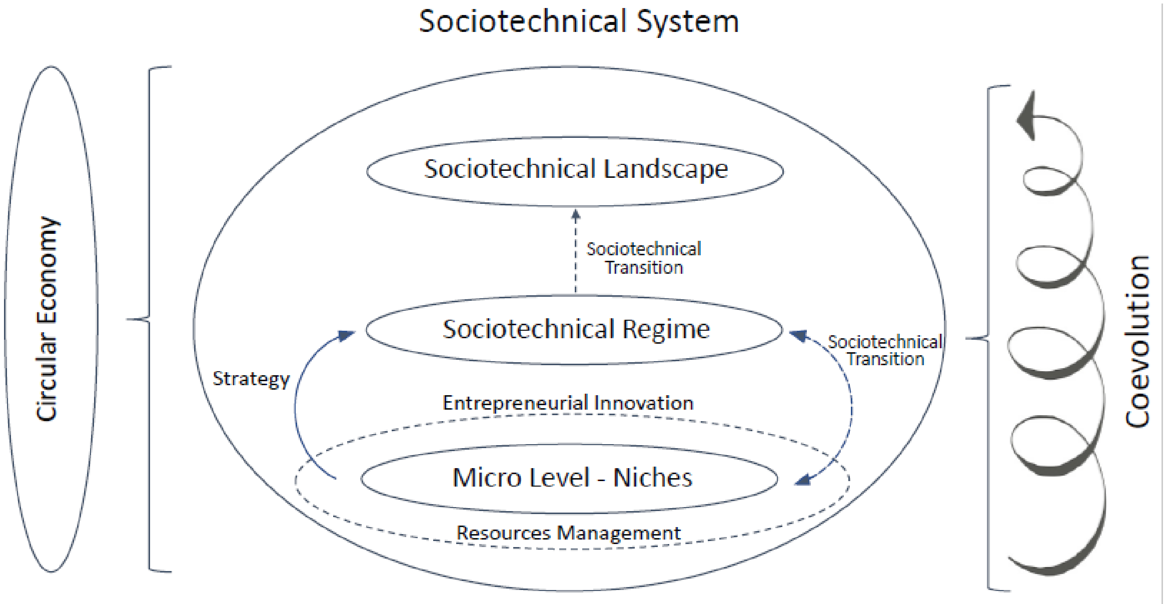

Figure 1. Theoretical Background–Knowledge Streams. Source: the authors. References: Circular Economy [11,12,16–35]; Sociotechnical System [13,36–50]; Sociotechnical Landscape [13,46,47]; Sociotechnical Regime [13,40,46,47]; Micro Level–Niches [13,46,48,49]; Sociotechnical Transition [40,42,49,50]; Strategy [18,19,51–61]; Sociotechnical Transition [40,42,49,50]; Entrepreneurial Innovation [25,62–70]; Resources Management [71–78]; Coevolution [36,40,79,80].

This study is therefore based on a wide understanding of circular economy, analyzing how organizations implement reduction, repairing, remanufacturing, and recycling of resources [20], addressing resource productivity [21]. From the sustainable future perspective, the importance of the transition from the linear economy towards the circular economy has been observed [22–26], together with economic growth [27], and policymaking for sustainable work [27–30]. However, some [31] pose criticisms of the circular economy, stating that it follows an ideological agenda and (p. 421) "emerges instead as a theoretically, practically, and ideologically questionable notion." Despite the criticism, the authors conclude with a pathway towards circularity based on solutions to actual problems, where the circular economy would be modest, concrete, inclusive, and transparent.

Digital technologies are another potential link to the circular economy [32], particularly the internet of things, artificial intelligence, and blockchain technology [33]. Nonetheless, it remains unclear which functions of digital technology are most effective to improve circularity [34]. In addition, industry 4.0 technologies and environment-related policies have been driving circular economy initiatives during the COVID era [35].

Finally, the circular economy is based on reducing the waste of resources through the design and implementation of products and processes for greater resource efficiency with circular flow involving reducing, recycling, reusing, redesigning, remanufacturing, and recovering [29,30], the 6Rs framework which we will draw upon in the analysis.

2.2. The Confluence of Sociotechnical Systems, the Multilevel Approach, and Coevolution

The sociotechnical system has four critical elements: institutional, social/cultural, organizational, and technological [36]. The institutional element involves policies, laws, rules, and regulations [37]. The social/cultural element refers to the different beliefs, norms, values, and practices that shape the actors' cognition and behavior [38,39]. The scarcity of resources and competition involve environmental changes [40]. Thus, (p. 46) "coevolution driven by environmental changes brings organizational changes", where the use of technology through human elements, social structures, and organizations, fulfills its functions [13]. These elements were analyzed from the multilevel perspective (MLP), an approach that debates social transformations for sustainability, with a focus on system transitions [13,40–45]. The MLP implies that a transition occurs within the sociotechnical system, at the micro, meso, and macro levels [13]. The micro level is where the technological niches are located, where innovation is born, and where firms operate. The meso level constitutes the sociotechnical regime, where the institutions, markets, industry, policies, culture, and science are located [13,39]. The macro level is the broad sociotechnical landscape that puts pressure on the regime level, creating windows of opportunity for novelty, and that cannot be influenced in the short-term [13], leading to long-term impact on the regime [46], made up of technologies, norms, rules, and institutionalized functions [47]. Cognitive, regulatory, and normative rules at the regime level provide stability during transitions [40].

At the niche level, experimentation and innovation occur that can be developed outside the immediate pressure of the regime [13]. Activities at niche level include: (1) formation of networks of actors for sharing knowledge and innovation; (2) learning, in which innovations are improved and sociotechnical structures invented, and (3) articulation and harmonization of visions and expectations in relation to the innovations or actions in question [48]. Thus, networks at the niche level are considered small, so over time it becomes necessary for actors to support the niche [46].

The sociotechnical system focuses mainly on the production and creation of knowledge and innovation [40,49] and is therefore well-suited to analyze the transition in the Guarapuava craft beer system. Transitions are multidimensional phenomena that can be studied from different angles by different disciplines [42] and are indicated for coevolution studies, as transitions integrate politics, technology, market, and culture [50] and lead to sociotechnical changes. The resulting actions influence the system's actors, engendering constant change and continuous evolution, or simply, coevolution [40]. At niche level, actors nurture alignment and development in multiple dimensions [47], corroborating with the coevolutionary approach.

Coevolution refers to the bilateral change of all components of the system [36,39]. From the production and consumption perspective, coevolution should integrate ecological economic thinking with the multilevel transition [79,80]. Therefore, in this study the craft beer sector is analyzed based on the coevolution of the socio-technical system from the MLP and the circular economy.

2.3. Strategy as the Propellant of Action

Strategy includes strategic implications for the actors within Guarapuava craft beer system, in particular for the producers. We view strategy as the maintenance of a firm's identity for continuity in strategic activity [51]. In addition, relatively few firms survive over the long-term as independent bodies [52], reinforcing the sociotechnical system and the coevolutionary transitional approaches. Strategy processes and strategy practice are intertwined in the same phenomena [53] and are central to the emergence of strategy in a firm [54]. In a coevolutionary system, within the MLP, strategy formulation is dynamic and emergent as the outcome of a learning process [55]. Emergent strategies are formulated and realized despite intentions and defined in terms of specific content [56], providing a possible explanation for the strategic implications derived from the MLP and coevolution of actors within the Guarapuava craft beer system.

Strategy and strategic implications are also analyzed from the circular economy 6Rs framework. Strategy is the restructuring agent of the take–make–dispose model involving all actors of supply chains [57], as well as the expansion agent that optimizes resources in firms [58]. The efficient use of resources shifts the paradigm of linear economy towards that of the circular economy [59]. This shift highlights the use of water, a resource particularly important to human survival and craft beer production.

The reduction of waste through less use of resources leads to reduction of emissions throughout the life cycle of a product [60] and involves a strategy to reuse products repeatedly over several cycles [29,30]. In this sense, recycling is a process of converting material that would be considered waste in new materials or products, that is, recovering materials for use in subsequent product life cycles [18] through redesign of products using recovered materials and resources, knowledge, and information for remanufacturing, reconditioning, and repairing products for reuse [61].

2.4. Strategic Relevance of Resource Management

Building on the theory of the growth of the firm [71], the resource-based view has been conceptualized as the firm's unique bundle of resources, which form the firm's potential for sustainable competitive advantage [71,72]. In order to achieve this state, the firm must acquire and control resources and capabilities that are valuable, rare, inimitable, and non-substitutable (VRIN) and have the necessary organizational structure to absorb and apply these. Sustainable VRIN resources are hard to attain [73]. These resources relate to the firm's core competencies [74] such as the capability to brew beer that has a particular taste composition or uses a more sustainable production or delivery process. They also form the basis of the firm's dynamic capabilities, which according to Teece, capture the firm's ability to adapt its particular resource configuration to the rapidly changing external environment [75]. This process requires the firm to sense changes in the environment, seize emerging opportunities and reconfigure its resources accordingly to meet the new contextual conditions.

In the case of Brazilian craft beer, resources include not only financial capital, human capital and networks, technology, etc., but knowledge of how to produce and market beer in a more sustainable way, that is, knowledge of the circular economy (reuse, recycling, etc.) and of the sociotechnical system as a whole (e.g., institutions, culture, etc.). This is in line with the knowledge-based view of the firm [76]. From this perspective, the brewing company executives' managerial capabilities to integrate these resources provides a form of sustainable competitive advantage for the firm, placing human beings and their experience and leadership skills at the center of firm success, in the cockpit. The nature of the highly competitive beer industry in Brazil and low initial barriers to entry arguably force firms to explore specialization and to self-reflect on their resources and core competencies, their defining strengths. Together, these concepts imply that a firm's quantity and quality of resources are critical to their firm performance and survival. Further, stakeholder management, business ethics, and issues management are in and of themselves valuable firm resources, when in place [77].

Along these lines, a previous study on sustainability and the resource-based view finds that textile firms in India and Pakistan make strategic use of resources via focus on environmental management and safety management within the framework of quality management [78]. However, the move of the firms observed towards sustainability seems motivated not only by national emergencies regarding pollution (e.g., toxification of rivers, air quality concerns), but by Western retailers for textiles that are increasingly demanding a minimal level of sustainability among textile (and particularly, clothing) manufacturers in Asia. Hence, the motivation for the use of resources towards sustainable production can differ enormously by industry and geographic location.

For the Brazilian craft beer producers examined here, stakeholder coordination plays a critical part in the move towards sustainability as well, and while pollution concerns could also be a motivation here, supplier pressure is not a major factor, but rather intrinsic motivation of the executive teams and their corresponding value/belief systems seem to play a more important role.

2.5. Entrepreneurial Innovation

Entrepreneurs must constantly innovate in dynamic environments dominated by risk and uncertainty [62]. To cope with that, a specific skill set is needed, particularly in the context of circular economy. Firms should use circular economy specific skills for circular innovation driven by external factors, as internal factors commonly pose barriers to innovation [25]. Therefore, combining factors facilitating entrepreneurship with factors stimulating innovation is essential in ecosystems [63]. Also important is combining the ecosystems territorial approach, as in Guarapuava, with the complex (co) evolutionary umbrella [64].

Entrepreneurial innovation has its focus on radical innovation and is driven by the co-creation and evolution with the ecosystem [65]. Within the multilevel approach, entrepreneurs contextualize innovation through narratives, where contexts moderate the availability of opportunities and/or the viability of creations [66,67]. Hence, the continuous search for innovation opportunities, or "effectuation", is essential for innovation [68].

In developing economies, the cooperation of enterprises with triple-helix agents (enterprise–university–government) to obtain knowledge and resources confirms the increase of innovation performance through R&D cooperation [69]. In addition, environmental strategy, entrepreneurial innovation, and entrepreneurial orientation influence the environmental performance and energy efficiency of firms [70], contributing to the coevolution process.

3. Data and Methods

In this study, we adopt the research paradigm of analytic induction, hereafter AI [81,82]. In this method, authors begin with tentative knowledge of a phenomenon or an initial framework based on preexisting knowledge of theory and empirical findings and go on to test this pre-existing understanding based on findings from qualitative data. Beginning with an initial set of questions, qualitative data is gathered and iteratively examined and collected, following the principle of the hermeneutic circle, until theoretical saturation is reached. The semi-structured interview questions flow from the initial framework and may evolve during the research process. The resulting data is systematically coded along the lines of the framework allowing this to be supported, refuted, or in some cases, extended.

This research logic is used to guide data collection and analysis and to organize the presentation of findings [82] (p. 84): "Its objective is causal explanation, a specification of the individually necessary and jointly sufficient conditions for the emergence of some part of social life. AI calls for the progressive redefinition of the phenomena to be explained". Authors have invoked AI in an attempt to conduct more rigorous qualitative analyses and to bridge the qualitative–quantitative divide [83]. Examples of such work in management and entrepreneurship literature include Bansal and Roth's [84] model of ecological responsiveness, Busch's [85] work on organizational adaptation to disruptions of the natural environment (e.g., climate change) and Hoffmann, Trautmann, and Hamprecht's [86] analysis of regulatory uncertainty, investments, and resources.

In this study specifically, we depart with an initial understanding of the co-evolution of sociotechnical systems, the circular economy, and the role of resources in the management of organizations and strategy and, based on this, crafted an initial theoretical framework (see Figure 1) and an accompanying set of interview questions (translated from Portuguese by a dual native speaker).

Since this paper aims at analyzing how circular economy initiatives contribute to the coevolution process of the sociotechnical system and its strategic implications for resource management in the sociotechnical system for craft beer production in Brazil through the lens of analytic induction, we follow a two-stage research design, in which (1) the sociotechnical system is first analyzed in order to uncover the key actors and circular economy initiatives in the system; these are then (2) qualitatively examined using both semi-structured interviews and secondary documents. The level of analysis is that of the actors in the sociotechnical system and the unit of analysis is circular economy initiatives among Brazilian craft beer producers in Guarapuava.

For the first stage of the research, the analysis of the coevolution of the sociotechnical system, we followed the model of Gaziulusoy and Brezet [36], which entails examining the system under observation (the craft beer industry in Gurapuava) according to the following key components: institutional, social/cultural, organizational, and technological. According to the authors, the coevolution in the sociotechnical system is the result of mutual changes in these system components. In order to analyze the circular economy initiatives that contribute to this coevolution process, we rely on the 6Rs model of Jawahir and Bradley [29] and Kirchherr, Reike, and Hekkert [30] which break the circular economy down into six key features: reusing, recycling, redesigning, remanufacturing, reducing, and recovering resources, which we systematically explore in this industry. The first phase of the research design results in two categories of analysis and their subcomponents summarized below in Table 2.

Table 2. Categories of Analysis.

Categories of Analysis		**Dimensions of Analysis**
Coevolution of the sociotechnical system	Institutional	Policies, laws, agreements, strategies, and plans businesses must follow
	Cultural/Social	Consumer, values, beliefs, market influence changes
	Organizational	Individual changes resulting from the business community or unions and partnerships
	Technological	Resulting from products or services, technological regime, or infrastructure
Circular economy, strategic implications, and resource management	Reduce	Reduce the use of resources
	Recycle	Conversion of material that would be considered waste in new materials or products
	Reuse	Reuse of products or components as a whole
	Redraw	Redesign the next generation of products, which would use components, materials, and resources recovered from the previous life cycle
	Remanufacture	Reprocessing products already used for restoration purposes
	Recover	Collection of products at the end of the use stage for use in subsequent product life cycles

Source: The authors.

Table 3 below depicts the beer producers in the Guarapuava system and provides details about the individual cases in order to facilitate comparison and understanding. Specifically, the table provides information on the volume and types of beer produced by each firm.

Table 3. Overview of Craft Beer Producers in the Guarapuava System.

Producers	**Insertion in the Craft Beer Sector**	**Business Formalization**	**Business Type**	**Volume/ Month (liters)**	**Beer Styles**
Producer 01	2012	2019	Industry	10,000	Pilsen, Weiss, Belgian Pale Ale, IPA, Stout, Session, Fruit Beer of Guabiroba
Producer 02	2016	2017	Industry and emporium for the commercialization of beer from all producers	4000	Orange Beer, Yerba Mate Beer, Coffee Beer, IPA, Zero Alcohol, Passion Fruit Mango Beer, Fruit Beer, Strawberry Hibiscus Beer, Belgian, Dark Beer, Cocoa Beer, Brown Ale, Wine Beer, Red Ale
Producer 03	2014	2019	Brewpub	10,000	American and Belgian School, German Pale Ale, IPA, Red Ale, Ris, Weiss, Pumpkin Ale, Trappist Single, Belgian Dubbel, Saison, Barley Wine, Purpura Sour, Pilsen, Witbier
Producer 04	2004	2004	Industry and restaurant with typical German food	20,000	Traditional Pilsen, German Pilsen, Red Lager, Pale Ale, Dark Beer
Producer 05	2014	2016	Industry	5000	Pilsen, Vienna Lager, Weizen, Citrus Pale Ale, Ra IPA

Table 3. *Cont.*

Producers	Insertion in the Craft Beer Sector	Business Formalization	Business Type	Volume/Month (liters)	Beer Styles
Producer 06	2008	2015	Beer production, beer shop with several brands, and snack store	6000	Pilsen, IPA, Sour Beers, American Pale Ale
Producer 07	2000	2014	Industry and store for consumption and commercialization	15,000	Helix, Bohemia Pilsen, Bock, Trippel, Bubbler, Red Large, Witbier, Weiss, IPA, and American Pale Ale
Producer 08	2016	2019	Beer production and snack store	5000	Carrier and Porter, Porter with Coffee, Vanilla and Fruit

Source: the authors.

Next, in the second research phase, we conducted qualitative interviews with the actors in the system. Specifically, a total of 11 semi-structured interviews were conducted in the timeframe from July–August of 2020 (summarized in Table 4 below) and hereafter transcribed. The interviews with the micro-brewers (all small businesses with 10 employees or less and revenues of under 1 million USD) and surrounding actors (e.g., from the industry association of which the brewers are all part) lasted between approximately 60 and 120 min each (for a total of about 16 h) and were conducted in the cities of Guarapuava and Entre Rios, both in the region of Paraná State, Southern Brazil.

Table 4. Overview of Semi-Structured Interviews.

Sociotechnical System Actor	Interviewed Role	Interview Code	Gender	Age	Interview Duration (HH:MM)	Occupation
Association of Craft Beer Producers of Guarapuava	President	P1	F	55	1:20	University Affairs Technician
Caminhos do Malte Project	Coordinator	C1	F	52	2:00	Businesswoman, responsible for tourism projects.
Craft Beer Producers	Producer 01	P1	M	46	1:00	Producer of Mushrooms and Craft Beer
	Producer 02	P2	F	45	1:15	Entrepreneur and Craft Beer Producer
	Producer 03	P3	F	40	1:20	Professor, Entrepreneur and Craft Beer Producer
	Producer 04	P4	M	56	1:25	Entrepreneur, Rural and Craft Beer Producer
	Producer 05	P5	M	40	1:30	Rural and Craft Beer Producer
	Producer 06	P6	M	40	1:15	Entrepreneur and Craft Beer Producer
	Producer 07	P7	M	45	1:35	Milk Producer, Craft Beer Producer and Entrepreneur
	Producer 08	P8	M	40	1:55	Entrepreneur, Rural and Craft Beer Producer
Provider	Business Unit Manager	F1	M	40	1:20	Entrepreneur, Rural and Craft Beer Producer

Source: the authors.

We successively coded the transcripts using the QDA software package Atlas TI and used the theoretic framework as a guide to structure the themes in the data, which allowed us to see if and how these concepts are present in the cases and context examined. Finally, in order to triangulate our findings following Bardin [87], we supplemented the interview transcripts with a total of 74 secondary documents related to the activities of the companies and Brazilian craft beer industry. The documents include laws, decrees, a manual for requesting business registrations, as well as rules and regulations on tax procedures. These provided us with a holistic picture of the predominant rules and regulations both guiding and restricting activity in this industry that could affect resource allocation and the nature of competitive strategy.

4. Results

Our findings follow the structure of our categories of analysis, that is, we first present the results on the coevolution of the sociotechnical system and its components, and next the results on the circular economy, strategic implications, and resource management.

4.1. Coevolution of the Sociotechnical System

From the field research, we observed that organizational and technological elements influence and are influenced by socio/cultural and institutional elements [88]. Two government bodies are responsible for defining the microbreweries regulations: the MAPA, Ministry of Agriculture, Livestock, and Supply, and the Secretariat of Finance. Within this context, policies are formalized and can be conceptualized as key elements of the institutional structures of sociotechnical systems [38] and must be updated regularly and be easy to interpret.

The actors within the sociotechnical system, on the one hand, act based on rules and on concrete actions in local practices [44], and on the other hand, rules configure the actors. In this study, we observed that the institutional elements analyzed at the niche level actually belong to the socio-technical regime and both exert pressure on and are pressured by the niches. Therefore, there is a direct relationship between institutional elements that goes beyond the observation made by the authors. A relationship with the landscape is also observed as the landscape directly affects the niche. Refer to Table 5 below for evidence on institutional elements coevolution.

Culture and the stage of maturity of organizations' business models can influence the adoption of circular economy practices [89,90]. Institutional arrangements and social-cultural structures determine the direction of change in organizational and technological components in general [37]. We identified in the producers' discourse that the coevolution of the social/cultural elements in the sociotechnical system occurs in two scales; the first is at the consumer level, while the second is at the market level (see Table 5 below for illustrative quotes from the interviews).

The landscape level is the broader context in the sociotechnical system, which influences the dynamics of niche and regime [48]. Institutional and social-cultural changes precede and influence organizational changes [37]. In addition, the organizational elements of the coevolution of the sociotechnical system sought to identify the individual changes or those resulting from a business community, unions, and partnerships [37]. At the organization level, we identified that producers recognize the need for change in their businesses., particularly in management end technology. A need for change in products was not observed as producers followed a product style guide. The exception is in taxation, because specific sets are necessary to market to all audiences at niche level. Hence, niches are crucial for transitions because they provide the basis for systemic change [44]. Evidence on organizational coevolution is provided in Table 5 below.

For this study's purposes, technology sought to identify elements resulting from products or services, from the technological regime or infrastructure [37]. In this context, technology is used by managers to improve their access to resources [11]. In addition, technology expands the range of resources to managers. We observed that technological changes are continuous, and the dynamics between the niche, regime, and socio-technical landscape levels collaborate for the coevolution of the system. Evidence is provided in Table 5.

Table 5. Coevolution of the Sociotechnical System: Evidence on Key Findings.

Theoretical Grounds	Evidence from the Interviews
	Institutional Dimension
[1,37,38,44,88]	P2 on institutional coevolution, "authorization filing request occurs simultaneously with the industry registration request filing. Laws were set to regulate the market and guarantee the quality of the product and are constantly updated through normative instructions with a 365-day period for adjustments." [sic]. P2 additional evidence on institutional coevolution, "The laws come from above, and must be obeyed, then it changes. It is a permanent adaptation, you are always adapting to the environment, there is no way to escape" [sic].
	Cultural/Social Dimension
[37,89,90]	P1, at consumer level, "You know your clientele, and that's how it is, at the moment it's trial and error, you're going to launch a new product and you're going to put it on the market. The [customer] response is immediate, in a month you already know if that product of yours, the product will be produced again, or if you are going to give up and make a new recipe, change your recipe profile. The customer dictates which style of beer sells the most, which is the best, best of all, customers are becoming beer experts. There's a guy I know who knows more about beer than I do and doesn't make it, he just drinks it" [sic]. P1, at market level, "nowadays, not only beer, but anything and everything that says crafted, special, family made, or similar denominations, has a quite large demand. The vast majority go after it out of curiosity" [sic]. P5 additional evidence at market level, "People still attribute craft beer as extreme, or very different, beers. This has changed a lot, but it depends on the person's income as well" [sic]. P2, within the religious context, "at church parties we started with zero alcohol draft beer, we had the idea of zero alcohol to serve customers who like craft beer, but couldn't drink with alcohol, but we only do it on demand" [sic].
	Organizational Dimension
[37,44,48]	P8, on management, "there is always something to change, as we were released by the map not so long ago, the pandemic has already come, our business has been affected, [. . .] We need this pandemic to pass so that we can begin to have a real sense of our business" [sic]. F1, on suppliers' bias, "the cooperative has sought to communicate with the microbrewery market, as a supplier, not only of inputs, but also of solutions, technology, and knowledge to add value to the product and retain customers" [sic]. F1 goes further," International Technical Congress, lasting 15 days in 2020, where the lectures were online, which can become a trend in the Brazilian market" [sic] P5, on relationships with the public sector, "the local government is a partner, the *Caminhos do Malte* [Malt Ways] project by the Secretariat and the Agriculture and Tourism Secretariat itself, the Association never really existed, [. . .] the local government can help us through the Association. If you are member, you can participate in the events of the local government" [sic].
	Technological Dimension
[11,37]	F1, on offering product, production, and management technology, "raw material that leads to better results, where there is a whole research technology in the background. Today we have an experimental brewery, where the breweries can come to test their products, test our products, and test new recipes" [sic]. P4, on production and management technology, "the factory is already more technological, it is not so artisanal. We have all the production equipment and always leave it at the same level" [sic]. P3, on technological changes at niche level, "Each technology that comes will shake you, sometimes it takes you a while to understand, how it works, but they are technologies that help a lot, I mean technologies even for product use, even in sales, now we have the internet channel for sale, we didn't have it before, they change the dynamics of the thing, they are allies, they take us out of comfort, so we can experiment with them" [sic].

Source: the authors.

4.2. Circular Economy, Strategic Implications, and Resource Management

The analyses conducted in this category were those from the 6Rs framework, that is, reuse, recycle, redesign, remanufacture, reduce, and recover, at the microsystem level, involving actions related to products, businesses, and consumers [30,31].

In the craft beer system in Guarapuava, we observed several actions for resource enhancement and optimization [61]: production process redesign, reuse of resources (mainly water and yeast), reduction of use, recovery of resources, and product collection at the end of the use stage [30]. Those actions were of strategic relevance given their implications on the operation, production, and sales of the craft beer makers, and entrepreneurial innovation was the driving force moving the craft beer makers forward in their business endeavors.

Furthermore, according to the interviewees' reports, the knowledge of the equipment, the production process, the technology of the raw material, and the material used for bottling are essential to the reduction of necessary resources, as well as resource reuse, recycling, and recovery, consistent with the circular economy framework [30,31]. Table 6 provides evidence on circular economy practices, its strategic implications, and resource management at niche level.

During the analysis process, we also observed that remanufacturing, a component of the 6R framework [30,31], was not carried out due to the need for additional investment and/or the formalization of other business beyond the main branch of the company. Based on field research, literature, analysis, and data triangulation in order to answer our research question, we created Figure 2 below, identifying initiatives at the micro, meso, and macro levels.

Table 6. Circular Economy, Strategic Implications, and Resource Management: Key Findings.

Theoretical Grounds	**Evidence from the Interviews**
	Reuse, Recycle, Redesign, Remanufacture, Reduce, and Recover (6Rs) Dimensions
[1,30,31,37,61]	P3, on strategic implications of reusing, redesigning, and reducing resources, "When we set up the factory, water was one of the first [resources] that we needed to optimize in the production process, when it is sent for cooling. So, we put cold water to cool the hot must. One of the things we did was to create a long water box, for this water that comes in cold and comes out hot, we return it to the box, because in the process we reuse it for beer production. Water was what we thought most, we have some taps of hot water for cleaning, we don't spend energy heating, we have the box, there are some streamers that keep it warm" [sic]. P1, similarly on strategic implications of reusing, redesigning, reducing, and recovering resources, "Optimization of water consumption, even for the sake of final effluent, optimization of input, also of electrical energy, not only electrical energy, but energy as a whole, our boiler is firewood, we try to optimize, compile, we are creating a kind of calendar to optimize all of these resources. We managed to optimize raw materials, readjusting, and making a recipe look good, with less product and for that, you need to know your process and your machines, so you can optimize production, producing more with less. Machine optimization is one of the factors that adds more gain, so you can decrease the cost of production. These actions directly lead to a cost reduction" [sic]. P4 on redesigning and reducing resources, "with standardized processes, you reduce the malt, before we milled the malt and put it into production without counting how much it yielded or how much was lost, now I manufacture the same volume with less malt, reduce purchase, cost" [sic]. P4, further on redesigning and adding on recovering resources, "over time we have been able to optimize our process, because there is one thing, inside a factory beer, you find another factory, when you optimize processes, a bad grind gives you a loss of 2 to 5% on the final product" [sic]. P4 on reusing resources (beer growler), "I take it back, for every 10 empty packages it takes one full, I do the process of washing, sterilizing, sanitizing and filling beer again" [sic]. P3 on reusing, recycling, and recovering resources, "each brewer informs MAPA how they do it [*product collection process at the end of the use stage is for use in subsequent product life cycles*], and MAPA analyzes whether they approve it or not. Producers send a picture of the equipment, components they are using and quantities. I had to adopt peracetic acid" [sic]

Source: the authors.

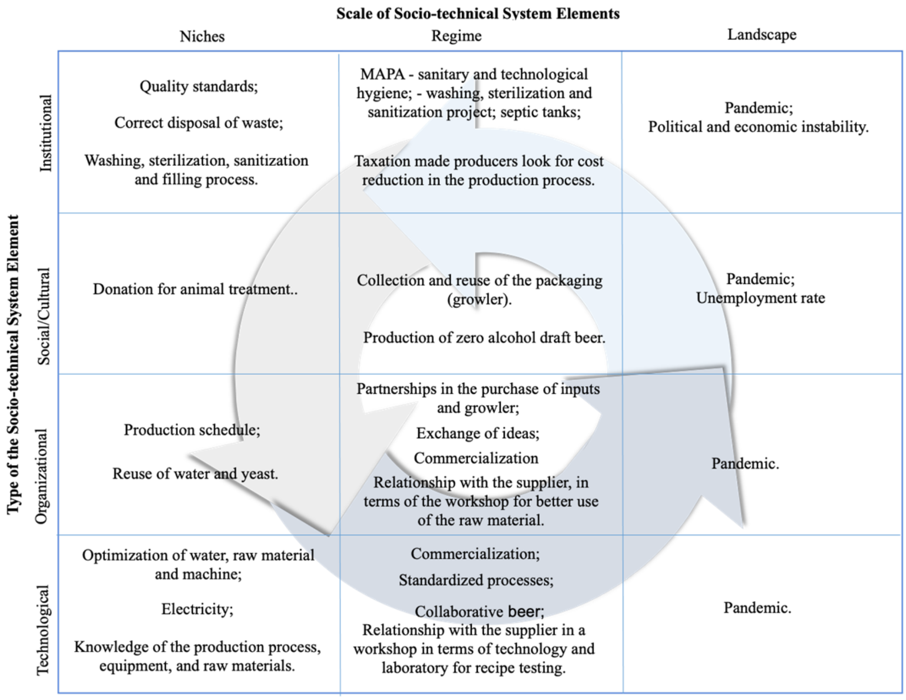

Figure 2. Circular economy initiatives that contribute to the coevolution of the Guarapuava sociotechnical system. Source: the authors, adapted from Gaziulusoy and Brezet [21], Geels [9], and Carstens and Cunha [30].

This model intends to show the circular economy initiatives that contribute to the coevolution within the sociotechnical system. From the analysis, we observed that the circular economy initiatives institutional elements are determinant for the other elements (cultural/social, organizational, and technological). The social/cultural elements respond to both the institutional elements and the demands of the environment. The same occurs with the organizational elements, where we observed that in addition to meeting the circular economy requirements, actors develop strategies to optimize resources in terms of cost reduction. We also observed a direct relationship between the organizational and technological elements.

4.3. Comparison to Other Studies

While screening Web-of-Science and Google Scholar for similar studies, we were not able to find studies compiling the same knowledge streams adopted in this research project, that is, the circular economy and sociotechnical transition, coevolution, resource management, strategy, and entrepreneurial innovation in a craft beer sociotechnical system or ecosystem. However, we did identify a small number of studies developed under the scope of the circular economy and craft beer production for comparison. Out of the scarce eight articles found, five were not peer-reviewed and therefore were not considered. Two of the three remaining studies were conducted in Brazil, and one was in the same region as our project (Southern Brazil). The third study was done in the U.K. Table 7 below compares and contrasts the three studies at the local, national, and international levels. All three studies address circular economy practices and two are qualitative. Interestingly, the second study finds no evidence on remanufacturing.

Table 7. Comparison to other studies in related fields.

Comparison Item	**Comparison Study**		
	Regional Level (Southern Brazil)	**National Level (Brazil)**	**International Level (UK)**
	Feasibility of a Bio-refinery for Conversion of Brewers' Spent Grain [91]	Modernization Principles in Circular Economy Practices [92]	Distribution Logistics to Reduce the Environmental Footprint [93]
Research method	Quantitative (Monte Carlo method)	Qualitative (multiple case studies)	Qualitative (multiple case studies)
Coevolution of the sociotechnical system	Coevolution was not directly addressed. Coevolutionary inferences can be made on the supply chain of craft beer production.	Clear for the technological component, where technology is essential to strengthen production	Coevolution was not directly addressed. Coevolutionary inferences can be made on transportation logistics, packaging suppliers, and craft beer makers
Circular Economy–6R framework	Evidence on resource waste transformation, implying in resource reutilization.	Companies studied have pursued the adoption of circular economy practices. No evidence found on remanufacturing	Evidence on reuse (bottle return), redesign (packaging type), and reduce (transport load and handling costs)

Source: the authors.

5. Discussion

This article studied the craft beer sociotechnical system in Guarapuava from a combined perspective of four theoretical approaches, the coevolution of the sociotechnical system, the circular economy, business strategy, and resource management. The objective was to analyze the circular economy initiatives that contribute to the coevolution process of the sociotechnical system and the strategic implications from resource management that impact actors in the system for craft beer production.

Significant insights emerged from the interviews and from the analysis developed in the course of this investigation, which time frame comprised the COVID era. Drawing on the theoretical backdrop and the analytical framework adopted in the study, the findings from field research and document analysis allow us to reach meaningful conclusions, which we present here. First, regarding our research question, we found that the coevolution process of the sociotechnical system indeed drives innovative circular economy strategic initiatives [13,19,20,25,27,39,41–44]. In this process, we found that the firms' resource management plays a role [14,15,73,77]; however, out of the six Rs [29,30] we could only find support for five Rs. Reduction, recycling, reuse, redesign, and recovery of resources were abundantly found in the system, particularly within producers at niche level [21,22,24]. Hereby, entrepreneurial innovation played a key role in propelling actors' strategic actions [25,51–53,56,63–66].

Craft beer makers adopt resource optimization strategies in their operations [15,73,78] to meet demands from the sociotechnical environment [13,40–44], at niche (micro) level, from customers and from the market, regime (meso) level, from technology and institutional demands, and landscape (macro) level, from the broad sociotechnical landscape [40–44]. Thus, we understand that a transition between the elements of the sociotechnical system occurs within the circular economy perspective [36,42,50]. This dynamic can be understood as coevolutionary from the niche, regime, and landscape levels [13,25,39–44,50].

Another important conclusion was the existence of a direct relationship between the landscape level of the sociotechnical system and the niche level, without the regime level [13,41,42,79,80], reinforcing that our theoretical contribution goes beyond the isolated analysis at each level or the analysis of the relationships between the levels [13,40–44]. In addition, on the one hand, we identified that niches operate under pressure from other levels in the system [13,40–44,47,50], as in the case of the craft beer system and MAPA and

Secretariat of Finance regulations. On the other hand, the niche level exerts pressure on the regime, leading to structural changes [37,38,46].

Expanding on this, from the field research, we observed that the considered theoretical approaches (Figure 1) are related and mutually dependent. In the sociotechnical system for craft beer production in Guarapuava, institutional components are determined by MAPA, as it regulates and audits the establishments, sets quality and hygiene standards, specifies labels, fillings, sanitization of packaging, and product registration. The Secretariat of Finance also carries institutional components as it reinforces the taxation rules. In addition, we found that there are both laws and normative instructions that promote the standardization of the sector. However, complicating elements are present, such as the lack of clarity regarding the laws, regulations, and tax rules, as well as frequent changes is the regulatory environment, which can pose a challenge to incumbents.

In the social/cultural analysis, as suggested by the literature on sociotechnical transitions e.g., [13,40,42], we found a direct and close relationship between producers and consumers in Guarapuava and that this affinity influences consumers, producers, and the overall market. We found that consumers have the power to influence product types (e.g., the type of craft beer), leading producers to adjust their production to serve consumers and to incorporate market demands, leading to organizational and technological changes. At the organization level, changes are clearly taking place regarding management, production, and the sustainability of the business and production process, while at the technology level, changes are predominantly occurring at the level of production and resource management. A lack of adequate management was observed, since among the interviewees, only two had business management background.

Considering the 6Rs model [29,30], we found that transitions occur in terms of circular economy initiatives through optimization, recycling, reuse, and recovery of resources, leading to major strategic implications for producers. Brazilian craft beer producers are developing and implementing strategies to maximize resource efficiency, and strategy execution demands technology for effective implementation. The examined system shows that technology is also closely related to operations, as production must comply with MAPA standards and improve processes, manage raw materials, and adopt a production agenda that incorporates the reuse of resources, in particular, water and yeast. Malt is also an essential resource, but cannot be reused, as all sugars are extracted in the production process, and sugar is also a key component in craft beer production.

Process improvements refer not only to technological innovations, but also to the integration of several organizational systems and their subsystems [40]. In this regard, we observed that the circular economy initiatives are largely integrated within the sociotechnical system. Therefore, it is possible to identify circular movements where the elements are interconnected and dependent. In terms of organization, we observed that changes are individual and occur according to the need and the determinations from the environment. Partnerships among beer producers occur for the exchange of information, the purchase of raw materials and, to a certain extent, for joint production and mutual revenue generation (which can be seen as a big picture win–win scenario for producers).

We found that relationships with the suppliers are strictly commercial. The fact that suppliers are also associated with ARTECERVA, in partnership with the local government and the Secretariat of Agriculture and Tourism, allows suppliers to participate in events organized by the local government and *Caminhos do Malte* (Malt Ways) project. Events also aim at leveraging regional tourism, following a route for visits to the craft breweries. In addition, there is no need to be ARTECERVA member to participate in events promoted by the local government. Authorization could be simply through public notice. Regarding tax incentives, there are none from the local government. However, according to interviewee C1, this is in part “because the brewers did not ask” [sic]. This implies the craft beer industry in Guarapuava is relatively self-sufficient and profitable.

The *Caminhos do Malte* (Malt Ways) project was suspended during the COVID pandemic, as well as local government events. However, according to C1, partnerships were sought with restaurants to offer craft beer to consumers, even with partial or restricted operation. Finally, our study shows that when pursuing circular economy initiatives, membership in local industry associations such as ARTECERVA can bring institutional contributions to producers in terms of exchanging information and practices, professional development, events, and mutual collaboration in responding to changes in the legal and regulatory environments and meeting customer and market demands.

Our study also has limitations. First, the research was conducted in a particular sociotechnical system, under the circular economy perspective. It may therefore not fully generalize to other sociotechnical systems in other industries or in developed countries, though we would expect similar findings for other beverage sociotechnical systems where similar institutions reign (e.g., language and culture, taxation, government support). Second, while we have addressed multi-level collaboration between actors within the sociotechnical system, intra-level transitions (e.g., between beer producers) were not further explored, which we leave to future research.

This article marks only a first step towards the analysis of the coevolution of the socio-technical system in the multilevel perspective as applied to the circular economy, considering strategy and resource management. For future research, it is suggested to expand this scope to other larger and more developed craft beer systems or even other sociotechnical systems in other countries or regions.

6. Conclusions

Overall, our study adds further and complementary qualitative evidence to the uncovered comparison studies [91–93], expanding the scope of the investigations towards other related knowledge streams, namely the sociotechnical transition perspective, coevolution, strategy, resource management, and entrepreneurial innovation. We hope that our findings will contribute to further research at the confluence of one or more of the above-mentioned areas we explored. It is imperative that organizations and society in general keep a very close eye on the social, environmental, and economic sustainability of production activity. This work provides inputs in this direction. Our future depends on our immediate actions and successful circular economy initiatives depend on the inner workings of and firms' understanding of their role in the sociotechnical system. Efficient resource management can act as an important step towards creating a better world, and we hope that more industries will adopt the circular economy paradigm and see Guarapuava and other such systems as role models.

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References

1. Ministério Da Agricultura, Pecuária e Abastecimento, MAPA (Ministry of Agriculture, Livestock and Supply). Available online: https://www.gov.br/agricultura/pt-br (accessed on 12 August 2022).

2. Prestes, D.N. Desenvolvimento Tecnológico de Cervejas Com Matérias-Primas de Importância Regional (Technological Development of Beers with Regional Importance Raw Materials). Ph.D. Thesis, Universidade Federal de Pelotas (Federal University of Pelotas), Pelotas, Brazil, 2019.
3. Associação Brasileira De Cervejaria Artesanal, ABRACERVA (Brazilian Craft Beer Association). Available online: https://abracerva.com.br (accessed on 20 October 2020).
4. Folha de Londrina. Available online: https://www.folhadelondrina.com.br/economia/pandemia-derruba-faturamento-de-cervejarias-em-80-2996528e.html (accessed on 19 August 2022).
5. Fortune Business Insight. Available online: https://www.fortunebusinessinsights.com/industry-reports/craft-beer-market-100736 (accessed on 19 August 2022).
6. Fortune Business Insight. Available online: https://www.fortunebusinessinsights.com/beer-market-102489 (accessed on 19 August 2022).
7. Statista. Available online: https://www.statista.com/statistics/270275/worldwide-beer-production/#statisticContainer (accessed on 19 August 2020).
8. Wu, P.P.; Fookes, C.; Pitchforth, J.; Mengersen, K. A framework for model integration and holistic modelling of socio-technical systems. *Decis. Support Syst.* **2015**, *71*, 14–27. [CrossRef]
9. Trist, E. *The Evolution of Socio-Technical Systems*; Occasional Paper; Ontario Quality of Working Life Centre: Toronto, ON, Canada, 1981; p. 67.
10. Saviotti, P.P.; Pyka, A. On the co-evolution of innovation and demand: Some policy implications. *Revue de l'Ofce* **2012**, *124*, 347–388. [CrossRef]
11. Geissdoerfer, M.; Savaget, P.; Bocken, N.M.P.; Hultink, E.J. The circular economy—A new sustainability paradigm? *J. Clean. Prod.* **2017**, *143*, 757–768. [CrossRef]
12. Ghisellini, P.; Cialani, C.; Ulgiati, S. A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *J. Clean. Prod.* **2016**, *114*, 11–32. [CrossRef]
13. Geels, F.W. Technological Transitions as evolutionary reconfiguration process: A multi-level perspective and a case-study. *Res. Policy* **2002**, *31*, 1257–1274. [CrossRef]
14. Czainska, K.; Sus, A.; Thalassinos, E.I. Sustainable Survival: Resource Management Strategy in Micro and Small Enterprises in the Rubber Products Market in Poland during the COVID-19 Pandemic. *Resources* **2021**, *10*, 85. [CrossRef]
15. Golinska-Dawson, P.; Werner-Lewandowska, K.; Kosacka-Olejnik, M. Responsible Resource Management in Remanufacturing—Framework for Qualitative Assessment in Small and Medium-Sized Enterprises. *Resources* **2021**, *10*, 19. [CrossRef]
16. Kouhizadeh, M.; Zhu, Q.; Sarkis, J. Blockchain and the circular economy: Potential tensions and critical reflections from practice. *Prod. Plan. Control* **2019**, *31*, 950–966. [CrossRef]
17. Mattos Nascimento, D.L.; Alencastro, V.; Quellas, O.L.G.; Caiado, R.C.G.; Garza-Reyes, J.A.; Rocha-Lona, L.; Tortorella, G. Exploring Industry 4.0 technologies to enable circular economy practices in a manufacturing context: A business model proposal. *J. Manuf. Technol. Manag.* **2019**, *30*, 607–627. [CrossRef]
18. Kristoffersen, E.; Blomsmab, F.; Mikalefa, P.; Lia, J. The smart circular economy: A digital-enabled circular strategies framework for manufacturing companies. *J. Bus. Res.* **2020**, *120*, 241–261. [CrossRef]
19. Potting, J.; Hekkert, M.; Worrell, E.; Hanemaaijer, A. *Circular Economy: Measuring Innovation in the Product Chain*; Policy Report; PBL Netherlands Environmental Assessment Agency: The Hague, The Netherlands, 2017.
20. Barreiro-Gen, M.; Lozano, R. How circular is the circular economy? Analysing the implementation of circular economy in organisations. *Bus. Strategy Environ.* **2020**, *29*, 3484–3494. [CrossRef]
21. Blomsma, F.; Brennan, G. The Emergence of Circular Economy: A New Framing Around Prolonging Resource Productivity. *J. Ind. Ecol.* **2017**, *21*, 603–614. [CrossRef]
22. United States Government. *The Circular Economy as a Concept for Creating a More Sustainable Future*; Hearing before the Committee of Environment and Public Works, United States Senate; U.S. Government Publishing Office: Washington, DC, USA, 2021.
23. Imoniana, J.O.; Silva, W.L.; Reginato, L.; Slomski, V.; Slomski, V.G. Sustainable Technologies for the Transition of Auditing towards a Circular Economy. *Sustainability* **2021**, *13*, 218. [CrossRef]
24. Sohal, A.; Nand, A.A.; Goyal, P.; Bhattacharya, A. Developing a circular economy: An examination of SME's role in India. *J. Bus. Res.* **2022**, *142*, 435–447. [CrossRef]
25. Eisenreich, A.; Füller, J.; Stuchtey, M. Open Circular Innovation: How Companies Can Develop Circular Innovations in Collaboration with Stakeholders. *Sustainability* **2021**, *13*, 13456. [CrossRef]
26. Haezendonck, E.; Van den Berghe, K. Patterns of Circular Transition: What Is the Circular Economy Maturity of Belgian Ports? *Sustainability* **2020**, *12*, 9269. [CrossRef]
27. Hysa, E.; Kruja, A.; Ur Rehman, N.; Laurenti, R. Circular Economy Innovation and Environmental Sustainability Impact on Economic Growth: An Integrated Model for Sustainable Development. *Sustainability* **2020**, *12*, 4831. [CrossRef]
28. Korhonen, J.; Honkasalo, A.; Seppälä, J. Circular economy: The concept and its limitations. *Ecol. Econ.* **2018**, *143*, 37–46. [CrossRef]
29. Jawahir, I.S.; Bradley, R. Technological elements of circular economy and the principles of 6R-based closed-loop material flow in sustainable manufacturing. *Procedia Cirp.* **2016**, *40*, 103–108. [CrossRef]
30. Kirchherr, J.; Reike, D.; Hekkert, M. Conceptualizing the circular economy: An analysis of 114 definitions. *Resour. Conserv. Recycl.* **2017**, *127*, 221–232. [CrossRef]

31. Corvellec, H.; Stowell, A.F.; Johansson, N. Critiques of the circular economy. *J. Ind. Ecol.* **2022**, *26*, 421–432. [CrossRef]
32. Chauhan, C.; Parida, V.; Dhir, A. Linking circular economy and digitalization technologies: A systematic literature review of past achievements and future promises. *Technol. Forecast. Soc. Change* **2022**, *177*, 121508. [CrossRef]
33. Huang, L.; Zhen, L.; Wang, J.; Zhang, X. Blockchain implementation for circular supply chain management: Evaluating critical success factors. *Ind. Mark. Manag.* **2022**, *102*, 451–464. [CrossRef]
34. Liu, Q.; Hoffman Trevisan, A.; Yang, M.; Mascarenhas, J. A framework of digital technologies for the circular economy: Digital functions and mechanisms. *Bus. Strategy Environ.* **2022**, *31*, 2171–2192. [CrossRef]
35. Khan, S.A.R.; Ponce, P.; Thomas, G.; Yu, Z.; Al-Ahmadi, M.S.; Tanveer, M. Digital Technologies, Circular Economy Practices and Environmental Policies in the Era of COVID-19. *Sustainability* **2021**, *13*, 12790. [CrossRef]
36. Gaziulusoy, A.I.; Brezet, H. Design for system innovations and transitions: A conceptual framework integrating insights from sustainability science and theories of system innovations and transitions. *J. Clean. Prod.* **2015**, *108*, 558–568. [CrossRef]
37. Markard, J.; Suter, M.; Ingold, K. Socio-technical transitions and policy change–Advocacy coalitions in Swiss energy policy. *Environ. Innov. Soc. Transit.* **2016**, *18*, 215–237. [CrossRef]
38. Fuenfschilling, L.; Truffer, B. The structuration of socio-technical regimes: Conceptual foundations from institutional theory. *Res. Policy* **2014**, *43*, 772–791. [CrossRef]
39. Kompella, L. A Co-evolution Framework towards Stable Designs from Radical Innovations for Organizations Using IT. *J. Technol. Manag. Innov.* **2019**, *14*, 44–58. [CrossRef]
40. Geels, F. Understanding system innovations: A critical literature review and a conceptual synthesis. In *System Innovation and the Transition to Sustainability: Theory, Evidence and Policy*; Elzen, B., Geels, F.W., Green, K., Eds.; Edward Elgar Publishing: Cheltenham, UK; Northampton, MA, USA, 2004; pp. 9–47.
41. Geels, F.W. Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective. *Technol. Forecast. Soc. Change* **2005**, *72*, 681–696. [CrossRef]
42. Geels, F.W. Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Res. Policy* **2010**, *39*, 495–510. [CrossRef]
43. Geels Frank, W. The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environ. Innov. Soc. Transit.* **2011**, *1*, 24–40. [CrossRef]
44. Geels, F.W. Socio-technical transitions to sustainability: A review of criticisms and elaborations of the Multi-Level Perspective. *Curr. Opin. Environ. Sustain.* **2019**, *39*, 187–201. [CrossRef]
45. dos Santos Carstens, D.D.; da Cunha, S.K. Challenges and opportunities for the growth of solar photovoltaic energy in Brazil. *Energy Policy* **2019**, *125*, 396–404. [CrossRef]
46. Vähäkari, N.; Lauttamaki, V.; Tapio, P.; Ahvenainen, M.; Assmuth, T.; Lyytimaki, J.; Vehmas, J. The future in sustainability transitions: Interlinkages between the multi-level perspective and futures studies. *Futures* **2020**, *123*, 102597. [CrossRef]
47. Rip, A.; Kemp, R. *Technological change: Human Choice and Climate Change*; Battelle Press: Columbus, OH, USA, 1998; Volume 2, pp. 327–399.
48. Verbong, G.; Geels, F.W. The ongoing energy transitions: Lessons from a sociotechnical, multi-level analysis of the Dutch electricity system (1960–2004). *Energy Policy* **2007**, *35*, 1025–1037. [CrossRef]
49. Mohr, B.J.; Dessers, E. Designing from a socio-technical systems perspective. In *Designing Integrated Care Ecosystems: A Sociotechnical Perspective*; Mohr, B.J., Dessers, E., Eds.; Springer International Publishing: Cham, Switzerland, 2019; pp. 25–48. [CrossRef]
50. Kemp, R.; Loorbach, D.; Rotmans, J. Transition management as a model for managing processes of co-evolution towards sustainable development. *Int. J. Sustain. Dev. World Ecol.* **2007**, *14*, 78–91. [CrossRef]
51. Burgelman, R.A. A Model of the Interaction of Strategic Behavior, Corporate Context, and the Concept of Strategy. *Acad. Manag. Rev.* **1983**, *8*, 61–70. [CrossRef]
52. Burgelman, R.A.; Grove, A.S. Let chaos reign, then rein in chaos-repeatedly: Managing strategic dynamics for corporate longevity. *Strateg. Manag. J.* **2007**, *28*, 965–979. [CrossRef]
53. Burgelman, R.A.; Floyd, S.W.; Laamanen, T.; Mantere, S.; Vaara, E.; Whittington, R. Strategy processes and practices: Dialogues and intersections. *Strateg. Manag. J.* **2017**, *39*, 531–558. [CrossRef]
54. MacKay, B.; Chia, R.; Nair, A.K. Strategy-in-Practices: A process philosophical approach to understanding strategy emergence and organizational outcomes. *Hum. Relat.* **2021**, *74*, 1337–1369. [CrossRef]
55. Mintzberg, H.; Ahlstrand, B.; Lampel, J.B. *Strategy Safari: The Complete Guide through the Wilds of Strategic Management*, 2nd ed.; Pearson Education: North York, ON, Canada, 2008; pp. 183–240.
56. Mintzbeg, H.; Waters, J.A. Of Strategies, Deliberate and Emergent. *Strateg. Manag. J.* **1985**, *6*, 257–272. [CrossRef]
57. Borrello, M.; Caracciolo, F.; Lombardi, A.; Pascutti, S.; Cembalo, L. Consumers' Perspective on Circular Economy: Strategy for Reducing Food Waste. *Sustainability* **2017**, *9*, 141. [CrossRef]
58. Stewart, R.; Niero, M. Circular economy in corporate sustainability strategies: A review of corporate sustainability reports in the fast-moving consumer goods sector. *Bus. Strategy Environ.* **2018**, *27*, 1005–1022. [CrossRef]
59. Viles, E.; Santos, J.; Arevalo, T.F.; Tanco, M.; Kalemkerian, F. A New Mindset for Circular Economy Strategies: Case Studies of Circularity in the Use of Water. *Sustainability* **2020**, *12*, 9781. [CrossRef]

60. Dieterle, M.; Schäfer, P.; Viere, T. Life cycle gaps: Interpreting LCA results with a circular economy mindset. *Procedia CIRP* **2018**, *69*, 764–768. [CrossRef]
61. Hernández, A.E.B.; Lu, T.; Beno, T.; Fredriksson, C.; Jawahir, I.S. Process sustainability evaluation for manufacturing of a component with the 6R application. *Procedia Manuf.* **2019**, *33*, 546–553. [CrossRef]
62. Lungu, A.E. Comparative Analysis of Entrepreneurial Innovation Factors in 25 National States. *ANDULI* **2022**, *21*, 55–73. [CrossRef]
63. Laceta, J.M.; Könnölä, T. Fostering entrepreneurial innovation ecosystems: Lessons learned from the European Institute of Innovation and Technology. *Innov. Eur. J. Soc. Sci. Res.* **2021**, *34*, 475–494. [CrossRef]
64. Scaringella, L.; Radziwonb, A. Innovation, entrepreneurial, knowledge, and business ecosystems: Old wine in new bottles? *Technol. Forecast. Soc. Change* **2018**, *136*, 59–87. [CrossRef]
65. Autio, E.; Kenney, M.; Mustard, P.; Siegele, D.; Wright, M. Entrepreneurial innovation: The importance of context. *Res. Policy* **2014**, *43*, 1097–1108. [CrossRef]
66. Garud, R.; Gehman, J.; Giuliani, A.P. Contextualizing entrepreneurial innovation: A narrative perspective. *Research Policy* **2014**, *43*, 1177–1188. [CrossRef]
67. Ghorbel, F.; Hachicha, W.; Boujelbene, Y.; Aljuaid, A.M. Linking Entrepreneurial Innovation to Effectual Logic. *Sustainability* **2021**, *13*, 2626. [CrossRef]
68. Guerrero, M.; Urbano, D. The impact of Triple Helix agents on entrepreneurial innovations' performance: An inside look at enterprises located in an emerging economy. *Technol. Forecast. Soc. Change* **2017**, *119*, 294–309. [CrossRef]
69. Khalid, N.; Salykova, L.; Capar, N. The Contribution of Environmental Strategies, Entrepreneurial Innovation and Entrepreneurial Orientation in Enhancing Firm Environmental Performance and Energy Efficiency. *Int. J. Energy Econ. Policy* **2020**, *10*, 282–288. [CrossRef]
70. Znaniecki, F. *The Method of Sociology*; Farrar and Rinehart: New York, NY, USA, 1934.
71. Penrose, E.T. *The Theory of the Growth of the Firm*; John Wiley: New York, NY, USA, 1959.
72. Barney, J.B. Firm resources and sustained competitive advantage. *J. Manag.* **1991**, *17*, 99–120. [CrossRef]
73. Miller, D. An asymmetry-based view of advantage: Towards an attainable sustainability. *Strateg. Manag. J.* **2003**, *24*, 961–976. [CrossRef]
74. Hamel, G.; Prahalad, G.K. *Competing for the Future*; Harvard Business School Press: Boston, MA, USA, 1994.
75. Teece, D.J.; Pisano, G.P.; Shuen, A. Dynamic capabilities and strategic management. *Strateg. Manag. J.* **1997**, *18*, 509–533. [CrossRef]
76. Grant, R.M. Toward a knowledge-based theory of the firm. *Strateg. Manag. J.* **1996**, *17*, 109–122. [CrossRef]
77. Litz, R.A. A resource-based-view of the socially responsible firm: Stakeholder interdependence, ethical awareness, and issue responsiveness as strategic assets. *J. Bus. Ethics* **1996**, *15*, 1355–1363. [CrossRef]
78. Savino, M.M.; Shafiq, M. An extensive study to assess the sustainability drivers of production performances using a resource-based view and contingency analysis. *J. Clean. Prod.* **2018**, *204*, 744–752. [CrossRef]
79. Foxton, T.J. A coevolutionary framework for analysing a transition to a sustainable low carbon economy. *Ecol. Econ.* **2011**, *70*, 2258–2267. [CrossRef]
80. Kallis, G.; Norgaard, R. Coevolutionary ecological economics. *Ecol. Econ.* **2010**, *69*, 690–699. [CrossRef]
81. Robinson, W.S. The logical structure of analytic induction. *Am. Sociol. Rev.* **1951**, *16*, 812–818. [CrossRef]
82. Katz, J. Analytic Induction. In *International Encyclopedia of the Social and Behavioral Sciences*; Smels, J., Baltes, P.B., Eds.; Elsevier: Oxford, UK, 2001; Volume 1, pp. 480–484. [CrossRef]
83. Hammersley, M.; Cooper, B. Analytic induction versus qualitative comparative analysis. In *Challenging the Qualitative-Quantitative Divide: Explorations in Case-focused Causal Analysis*; Cooper, B., Glaesser, J., Gomm, R., Hammersley, M., Eds.; Continuum/Bloomsbury: London, UK, 2012.
84. Bansal, P.; Roth, K. Why companies go green: A model of ecological responsiveness. *Academy of management journal* **2000**, *43*, 717–736. [CrossRef]
85. Busch, T. Organizational adaptation to disruptions in the natural environment: The case of climate change. *Scand. J. Manag.* **2011**, *7*, 389–404. [CrossRef]
86. Hoffmann, V.H.; Trautmann, T.; Hamprecht, J. Regulatory uncertainty: A reason to postpone investments? Not necessarily. *J. Manag. Stud.* **2009**, *46*, 1227–1253. [CrossRef]
87. Bardin, L. *Análise de Conteúdo. (Content Analysis)*, 3ª Reimpressão da 1ª ed.; Edições: São Paulo, Brazil, 2016; Volume 70.
88. Edmondson, D.L.; Kern, F.; Rogge, K.S. The co-evolution of policy mixes and socio-technical systems: Towards a conceptual framework of policy mix feedback in sustainability transitions. *Res. Policy* **2019**, *48*, 103555. [CrossRef]
89. Urmee, T.; Md, A. Social, cultural and political dimensions of off-grid renewable energy programs in developing countries. *Renew. Energy* **2016**, *93*, 159–167. [CrossRef]
90. Sehnem, S.; Ndubisi, N.O.; Preschlak, D.; Bernardy, R.J.; Santos, S., Jr. Circular economy in the wine chain production: Maturity, challenges, and lessons from an emerging economy perspective. *Prod. Plan. Control* **2019**, *31*, 1014–1034. [CrossRef]
91. Colpo, I.; Rabenschlag, D.R.; de Lima, M.S.; Martins, M.E.S.; Sellitto, M.A. Economic and Financial Feasibility of a Biorefinery for Conversion of Brewers' Spent Grain into a Special Flour. *J. Open Innov. Technol. Mark. Complex.* **2022**, *8*, 79. [CrossRef]

92. Sehnem, S.; Jabbour, A.L.B.S.; Conceição, D.A.; Weber, D.; Julkowski, D.S. The role of ecological modernization principles in advancing circular economy practices: Lessons from the brewery sector. *Benchmarking: Int. J.* **2021**, *28*, 2786–2807. [CrossRef]
93. Morgan, D.F.; Styles, D.; Lane, E.T. Packaging choice and coordinated distribution logistics to reduce the environmental footprint of small-scale beer value chains. *J. Environ. Manag.* **2022**, *307*, 114591. [CrossRef] [PubMed]