

Article

An Exploratory Grounded Theory Approach: Unveiling the Impact Mechanism Model of Collaborative Dynamics between Green Production and Living

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Abstract: In response to the intensifying compression of resources and the environment associated with rapid industrial growth and increasing living standards, green production and sustainable living have developed essential facts for ecologically conscious progress. Despite the potential benefits of synergy, the complex relationship between green production and living organisms presents challenges that have not been thoroughly explored. This paper aims to fill this gap by proposing a comprehensive mechanism model that elucidates the collaboration between green production and life. Using comprehensive interviews and grounded theory procedures, this study, situated within the supply and demand context, precisely undoes the important basics and academic foundations of the synergy association between green production and living. The outcomes of this study disclose prominent insights: Firstly, collaborative perception, collective ability, and a cooperative atmosphere develop as substantial features with a significant effect on the synergy between green production and living, with resource environments having an indirect impact through their stimulus on synergy capacity. Secondly, the synergy efforts in green production and living, propelled by policy, social, and market environments, display characteristic features. Thirdly, the moderate perception of green production and living relationship is divided into the following four visible facets: educating a demand market for green supply, meeting green demand, catalyzing demand through green supply, and pushing supply through green demand. This paper proposes valuable recommendations, providing targeted policy designs and execution pathways for legislative entities looking for operative intercessions to adoptive collective activities in green production and living.

Keywords: green production; sustainable living; collaborative dynamics; supply and demand; grounded theory



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1. Introduction

As China advances its reform and open policies, the nation's industrial sector has experienced rapid development, but substantial resources and energy have been consumed, leading to a rapid increase in pollution and emissions, which has also caused enormous environmental pressure [1]. In addition, with the continuous improvement in people's living standards, the pressure on the resources and environment in China's consumption sector is also increasing [2]. In the trajectory of green development, the pursuit of ecologically sound practices emerges as a paramount concern, necessitating comprehensive efforts to address the intertwined challenges of industrial growth and consumption patterns.

The Fifth Plenary Session of the 19th Central Committee of the Communist Party of China has articulated an ambitious vision, aiming to "widely form green production and lifestyle by 2035" (p. 7) [3]. This objective has been enshrined as a pivotal goal within the overarching economic and social development framework during the 14th Five-Year Plan period, with a specific emphasis on achieving significant goals in the green transformation of production and lifestyle [3]. The subsequent report of the 20th National

Congress of the Communist Party of China reiterates this commitment, stressing the imperative to “accelerate the green transformation of development methods, implement comprehensive conservation strategies, develop green and low-carbon industries, advocate green consumption, and promote the formation of green and low-carbon production and lifestyle” (p. 51) [4]. The long-term aspiration of widely promoting green production and lifestyle imposes heightened demands on green development. This requires a concerted effort to advance the coordinated development of green production and lifestyle beyond achieving individual milestones in these domains [5].

However, what is the synergy of green production and living? And what are the factors that affect this synergy? At present, there is still a lack of targeted research on these questions. Taking the food industry as an example, on the demand side, with the improvement in living standards, people’s demand for food has shifted from being full to being nutritious and healthy, with a higher level of green demand [6]. On the supply side, in order to meet market demand, cater to national policies, and shape the image of green enterprises, enterprises pay more and more attention to the development of green food [7]. It can be argued that there is a synergy between green production and living. However, the majority of existing green food enterprises are decentralized and have not yet achieved large-scale, specialized, and intensive production. This has resulted in significant investments in R&D research and high production costs for green food [8]. In addition, the level of public awareness regarding green food labels is low, and there is a lack of social responsibility among enterprises. Furthermore, consumers’ actual purchasing power for green food is insufficient. All these factors hinder the synergy between green production and green living [9,10]. However, the research on green production and living collaboration is at the initial stage of concept discussion [11]. Currently, most studies unilaterally analyze influencing factors from either green production or green living perspectives without focusing on their synergy. There is a lack of comprehensive and systematic research on the influencing factors and mechanisms of synergy [12,13].

In the realm of sustainable business, companies engaged in environmentally friendly production play a crucial role as suppliers by offering eco-conscious products. On the other hand, the public plays a key role on the demand side by actively embracing green living practices and consuming sustainable products [14]. This interdependence creates a symbiotic relationship, where supply and demand closely influence each other, serving as a pivotal pathway to promote synergy between green production and green living [15]. However, despite the articulated goals and interconnected nature of green production and green living, significant challenges persist in realizing this synergy. A nuanced exploration of these challenges reveals the following critical insights:

Firstly, green production is an inevitable requirement and driving force for green living [16]. The green production level of enterprises has been continuously improved. By the end of 2023, the Ministry of Industry and Information Technology established 5095 green factories and promoted nearly 30,000 green products in China. However, the effective supply of high-quality green products and services is insufficient. Whether green food, energy-saving products, or green buildings, these products and services have insufficient advantages compared with traditional products and have not become the mainstream of essential consumer goods in terms of clothing, food, housing, or transportation [2]. Secondly, green living guides and drives green production [17]. With the improvement in living standards and upgrading of the consumption structure, green products with good environmental performance are increasingly favored by consumers [18]. However, extravagance, high energy consumption, and non-environmentally friendly consumption behaviors are still relatively common, and the potential for green domestic demand urgently needs to be stimulated [19]. Thirdly, green production and green living are interdependent and mutually influential, with a close supply–demand relationship between them [20]. However, there are significant differences between decision-makers on the supply and demand sides. And there is a lack of systematic institutional design for effective integration and transformation between supply and demand, resulting in a structural imbalance

between supply and demand, making it difficult for green production and green life to achieve coordinated development [21].

The synergy between green production and green living is a complex system engineering problem that faces both supply-side challenges and structural issues as well as demand-side bottlenecks and barriers. Systematic research is urgently needed. Based on the above background and findings, the following questions are raised: (1) How can the dimensions of green production and living collaboration be divided? (2) What are the key influencing factors of the synergy between green production and green living? (3) How do these influencing factors promote or hinder the synergy between green production and green living? Therefore, this research systematically and holistically investigates the synergy between green production and green living from the dual perspective of supply and demand. Based on grounded theory as a qualitative research method, this paper takes middle and senior managers in manufacturing enterprises as the research object, deeply explores the key influencing factors of green production and living collaboration, and constructs an influencing mechanism model.

This paper presents both theoretical contributions and practical significance. Firstly, in terms of its theoretical contribution, this study employs in-depth interviews with representative groups and applies the qualitative research methodology of grounded theory. This research systematically categorizes variables that influence the synergy between green production and living through this approach. Notably, this study identifies certain variable categories, such as the perception of a collaborative effect, information exchange ability, and demand conversion ability, which have received limited attention in prior research. Secondly, introducing the concept of “green production and living collaboration” constitutes a noteworthy theoretical advancement. Focused on the synergy between green production and green living from the perspective of supply and demand, this paper constructs an impact mechanism model for this synergy, thereby offering a foundation and reference point for subsequent scholarly investigations.

Moving on to practical significance, this research provides considerable guidance for the green transformation of manufacturing enterprises on the production side. By identifying and understanding the key variables that influence the synergy of green production and living, this research provides valuable insights for manufacturing entities seeking to align their practices with environmentally sustainable principles. In addition, this study provides practical guidance for consumers to adopt a green lifestyle in their daily activities. Finally, this research extends its relevance to the government level by providing insights for formulating effective intervention policies. The recommendations provided in this paper can help the government promote the coordinated development of green production and living by aligning policies with the imperative of sustainable and environmentally conscious practices. In summary, this study makes theoretical and practical contributions by providing a comprehensive framework for understanding and promoting the synergy between green production and green living.

This research is structured as follows:

Section 2: Literature Review, Section 3: Methodology and Data Description, Section 4: Category Extraction and Model Construction (Open Coding, Axial Coding, Selective Coding, Theoretical Saturation Testing, Validity Assurance), Section 5: Key Elements and Logical Relationships in the Model, and Section 6: Conclusions and Policy Recommendations (Main Conclusions, Theoretical Contributions, Policy Implications, Limitations and Future Prospects).

2. Literature Review

2.1. Connotation and Influencing Factors of Green Production

Green production was initially proposed by the United Nations Environment Programme in 1989 and standardized in 1996. It aims to enhance the environmental quality of human life by widely implementing national environmental strategies in the production process and products. The ultimate goal is to increase ecological efficiency and minimize

environmental impact. Because of differences in institutional, environmental, and research perspectives, the definition of green production encompasses diverse characteristics. Relevant research mainly focuses on clean production, low-carbon production, circular production, sustainable production, and lean production [22,23]. From the perspective of efficiency, green production involves coordinating the interests of enterprises, consumers, and environmental ecology, as well as balancing economic, environmental, and social benefits [24]. In terms of application scope, green production starts from the green demand of consumers and covers the entire process of product research and development, production, packaging, and transportation, as well as consumption, use, and recycling [25]. Regardless of the perspective taken, it is clear that green production cannot be separated from green living. Some scholars have also conducted research on the influencing factors of green production in enterprises. From the internal perspective, resources and capabilities are crucial for green production. Sharif et al. (2023) emphasized that enterprises can control the impact of green behavior by dominating resources and capabilities [26]. Li and Lin (2023) discovered that technical capabilities have a positive impact on product green innovation [27]. In addition, the characteristics of managers have a significant impact on the choice of environmental strategy [28]. When making decisions regarding green production, enterprises tend to focus on the high-cost burden brought by the current situation, thus ignoring the long-term advantages brought by green technology [29]. From the external perspective, policies and regulations play a particularly significant role in enterprises' green production. Dzwigol et al. (2023) believed that reasonable government environmental regulations can effectively improve the overall green production level [30]. Benkhodja et al. (2023) found that green subsidies are positively correlated with green technology innovation [31]. Furthermore, Zameer et al. (2020) found that pressure from stakeholders (e.g., customers, suppliers, competitors) has a positive effect on green production [12].

Recently, there has been a growing scholarly interest in the influence of consumer factors on green production, indicating that green living plays a significant role in promoting green production. Baumer Cardoso et al. (2020) suggested that the increasing demand for eco-friendly products and services requires manufacturing enterprises to reconsider their management and operational strategies and transition towards green production [17]. Wen et al. (2020) discovered that consumer environmental responsibility can facilitate a cohesive supply chain between seemingly contradictory profit-seeking motives and environmental pressure [32]. Orsini et al. (2019) observed that as consumer low-carbon preferences increase, both supplier and manufacturer emissions reductions and supply chain system profits increase [33]. Ding et al. (2017) conducted an input–output analysis to examine the direct and indirect effects of household consumption activities on energy consumption in China from the perspective of consumer lifestyles, further exploring the relationship between household energy consumption and industrial energy consumption, as well as the energy-saving potential of lifestyle changes [34]. The acceptance of green products by consumers positively impacts green production by enabling companies to expand their production capacity and enhance the environmental performance of their products [35]. Additionally, aside from direct household sector energy consumption, people's consumption activities indirectly influence the energy consumption of various production sectors [36]. It is increasingly evident that green living plays a crucial role in promoting green production.

2.2. Connotation and Influencing Factors of Green Living

Research on green living was first conducted in the 1970s, focusing on reducing excessive consumption [37] and green values centered on material simplification [38]. Considering the rise in materialism and consumerism, some scholars have focused on the discussion of green consumption, believing that green living, represented by green consumption as a typical example, is a daily activity that reduces the use of natural resources and pollutant emissions while ensuring basic product demand and improving the quality of life [39], which concretizes green living in the consumption areas of clothing, food, housing, transportation, and use [2]. Furthermore, from the macro perspective of ecological

civilization and social development, green life is defined as a collection of all production and consumption processes that fundamentally value the harmonious coexistence of humans and nature; narrowly speaking, it refers to scientific, reasonable, and moderate green consumption methods [40]. Green lifestyle transformation is a comprehensive process from concept to behavior. Green living covers various aspects of life, such as clothing, food, housing, transportation, and tourism, focusing on rational, moderate, and economical green consumption. It includes circular links such as supply, packaging, procurement, and recycling and is closely related to green production.

Researchers have also investigated the factors that influence green living. In terms of consumers' own factors, Kamalanon et al. (2022) found that individuals' pro-environmental attitudes are positively related to sustainable lifestyles [13]. And Asif et al. (2023) found that green purchase intention is influenced by age, education, income level, and other consumer characteristics [41]. In terms of social and cultural factors, Jaiswal and Kont (2018) found that the intensity of social interaction plays an important role in residents' sustainable lifestyle decisions [42]. In terms of policy factors, Hong et al. (2021) suggested that environmental regulations and policy guidance can encourage the public to adopt a green lifestyle [43].

Some scholars have focused on the impact of supply-side factors on green living, specifically examining the role of green production in promoting green living. This includes considering factors such as the price and performance of green products, as well as environmental marketing. Liu et al. (2020) emphasized that the demand for remanufactured products is heavily influenced by their price and warranty coverage, which are indicative of their value and quality [44]. Yang et al. (2023) investigated strategies to capture the purchasing intention of environmentally conscious consumers through activities such as advertising design and product refinement [45]. Additionally, Veleva (2021) highlighted the important role entrepreneurs play in advancing sustainable lifestyles by addressing both environmental and social issues simultaneously [16]. It is insufficient to solely promote green attributes in order to drive most consumers towards a sustainable lifestyle. Instead, consumer behavior can be influenced by emphasizing product/service quality, time or cost savings, or social impact. Therefore, it is crucial to strengthen the involvement of enterprises in guiding both the supply and consumption of green products with the participation of multiple stakeholders. This should focus on public sectors including clothing, food, housing, transportation, and usage habits.

2.3. Green Production and Living Collaboration

In recent years, some scholars have begun to pay attention to the synergistic relationship between green production and green living. Wang et al. (2023) proposed that in the practice of building a socialist ecological civilization, a comprehensive and profound transformation of production methods, lifestyles, and production and living concepts is necessary [11]. Li et al. (2023) used carbon emissions as a specific indicator, considered lifestyle as the downstream of production methods, and proposed promoting the green transformation of production and living methods through reverse force and supply–demand linkage mechanisms [46]. Therefore, combining the two into a whole is the development trend in future research.

Some scholars have begun to study solutions to promote green production and life synergy from the perspective of guiding both supply-side and demand-side policies [20]. Zhou et al. (2022) suggested that the combination of demand-side management and supply-side structural reform can guide the green transformation of consumption [21]. Currently, research on government participation in green production and living has mostly focused on the issue of government subsidies for enterprise green production, with less attention paid to government subsidies for consumer green consumption [14]. According to Axon (2017), specific interventions can address various barriers to sustainable living and have a synergistic effect on production and living [47]. This also provides a basis for supply-side reform and demand-side management to promote the coordinated development of green

production and living. The two should be combined and guided through institutional arrangements to promote the coordinated development of green production and living.

Some scholars believe that the supply and demand situation of green products has an important impact on promoting the synergy of green production and living and achieving the sustainable development of a low-carbon economy. Fei et al. (2023) believed that the imbalance between supply and demand restricts the development of a green economy [48]. The widespread formation of green production and lifestyle requires coordinated efforts from both supply and demand, not only to consolidate the responsibility of producers but also to implement the responsibility of consumers [49]. Yang et al. (2022) proposed that the green transformation of production methods mainly involves the supply side, while the green transformation of lifestyles mainly involves the consumption side [20]. However, significant differences in the decision-making subjects between the supply and demand sides often lead to structural imbalances between the supply and demand sides, making it difficult for production methods and lifestyles to achieve synchronous green transformation [15]. Therefore, it is necessary to promote the coordinated development of green production and living through the linkage mechanism between supply and demand.

2.4. Research Gap

The abovementioned achievements have enriched the theoretical system of green production and green living. However, there are still areas that require further expansion and deepening. Firstly, research on the synergy of green production and living is still in the initial stage of conceptual exploration, with relatively little focus on the influencing factors of synergy. Most existing research tends to concentrate on the factors affecting green production or green living separately, without delving into the synergy among them. There is a need for comprehensive and systematic studies to understand the influencing factors and mechanisms at play in achieving synergy between green production and living. Secondly, although there are numerous studies on green production, green consumption, environmental behavior, and other related areas of green production and living synergy, there is a lack of a mature variable category, measurement scale, and theoretical hypothesis specifically tailored for green production and life synergy. Thirdly, while research has been conducted on both guidance strategies for green production and promoting green living [30,43], there remains a gap in terms of guidance strategy research focused specifically on achieving synergy between green production and living. Furthermore, there is still a lack of comprehensive and systematic institutional design to promote this synergy. Therefore, from a supply and demand perspective, this article summarizes relevant research on the influencing factors of green production and green living, laying a solid theoretical foundation for exploring green production and living synergy.

3. Methodology and Data

3.1. Research Method

Scholars have conducted numerous empirical studies on green production, green consumption, environmental behavior, and other related fields [12,19,50]. However, in terms of green production and living collaboration, there are currently no mature variable categories, measurement scales, or theoretical assumptions. In addition, preliminary research found that respondents' understandings of green production and living synergy were also inconsistent. Therefore, it is not feasible to directly design a structured questionnaire without differences as a quantitative research method. Grounded theory has significant advantages over constructivist theory, which is recognized as the most scientific type of qualitative research [51]. Therefore, a qualitative research method based on grounded theory was adopted to conduct research on middle and senior managers or key employees of manufacturing enterprises in Jiangsu Province through open interviews in order to collect first-hand information and more effectively explore the impact mechanism of green production and life synergy. By adopting a theoretical sampling method, specific

respondents were selected according to the requirements of the analytical framework and conceptual development [52].

It is important to note that qualitative research necessitates respondents who possess a certain level of understanding and comprehension of the research problem, particularly given the systematic and holistic nature of green production and living collaboration. Therefore, for this study, middle and senior managers or key employees from manufacturing enterprises were selected as respondents. These individuals are typically young or middle-aged individuals with active thinking and a wealth of information. They play a crucial role as practitioners and driving forces in the green transformation and widespread formation of production and lifestyle. In striving towards long-term sustainability goals, these individuals not only shoulder the heavy responsibility of promoting green production but also need to effectively practice the responsibility of green living. They are the unity of producers and consumers. Additionally, they possess keen economic thinking, analytical abilities, and a relatively profound understanding of current market dynamics including supply–demand situations, issues, and policy trends in various government departments, especially the synergy of green production and green living. Therefore, selecting this group for research is representative and typical; it allows for comprehensive insights into the challenges faced in achieving synergy between green production and green living. Furthermore, it enables an exploration into key influencing factors along with their mechanisms for impact.

In addition, this study conducted field research in Jiangsu Province. As a major manufacturing and economic development province, Jiangsu has consistently prioritized the promotion of green transformation in the manufacturing industry in recent years. According to the 2022 green manufacturing list of the General Office of the Ministry of Industry and Information Technology, Jiangsu boasts 50 green factories, 3 green parks, 9 green supply chains, and 69 green products, ranking among the top in quantity nationwide. At the same time, Jiangsu Province is also one of China’s pilot cities for green buildings and has made significant progress in promoting green living. In 2022, the Implementation Plan for Promoting Green Consumption in Jiangsu Province was further formulated to comprehensively promote the development of green consumption in key areas. This includes accelerating improvements in green food consumption levels, encouraging the development of green and low-carbon clothing consumption, actively developing green and low-carbon residential consumption, and vigorously promoting green and low-carbon transportation consumption. Therefore, conducting research in Jiangsu Province is typical and can provide useful references for research in green production and living collaboration in other regions.

The overall framework of this article is shown in Figure 1.

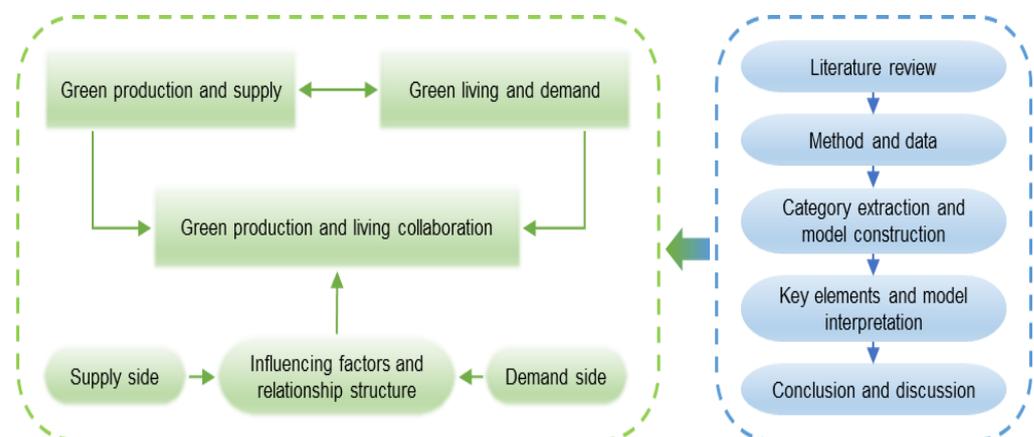


Figure 1. Overall framework diagram.

3.2. Data Sources

This study conducted a specialized survey on multiple manufacturing enterprises in Zhenjiang, Yangzhou, Huai'an, Lianyungang, Wuxi, Nantong, and other places through open interviews to gather first-hand information. The specific case information for each enterprise is presented in Table 1.

Table 1. Basic information on enterprises.

Number	Enterprise Name	Main Business	Interview Methods
R01	JTGC	Transportation construction	Personal in-depth interview
R02	YC	Food manufacturing	Personal in-depth interview
R03	TR	Pharmaceutical manufacturing	Focus group interview
R04	HD	Electric power	Focus group interview
R05	ZC	Modern agriculture	Personal in-depth interview
R06	PG	Bicycle manufacturing	Personal in-depth interview
R07	KL	Food manufacturing	Personal in-depth interview
R08	WQ	Food processing	Personal in-depth interview
R09	ZY	Packaging manufacturing	Focus group interview
R10	RCDF	Household manufacturing	Personal in-depth interview
R11	JJGY	Environmental protection	Personal in-depth interview
R12	AK	Chemical industry	Personal in-depth interview
R13	JL	Coating manufacturing	Focus group interview
R14	HL	Chemical industry	Personal in-depth interview
R15	XL	Environmental protection	Personal in-depth interview
R16	KSB	Shipbuilding	Personal in-depth interview
R17	JG	New energy	Personal in-depth interview
R18	JGRD	Papermaking	Personal in-depth interview
R19	YD	Textile and clothing	Personal in-depth interview

The survey was used to conduct in-depth interviews with participants in the following two forms: face-to-face and online interviews, combining individual in-depth interviews and focus group interviews. The sample size was determined based on theoretical saturation (Tie et al., 2019) [52]. A total of 27 one-on-one in-depth interviews were conducted, each lasting about 1 h. Additionally, four focus group interviews were conducted, with an average of 3 people per group, each lasting about 1.5 h. The comprehensive use of two methods can more effectively achieve interview objectives. One-on-one in-depth interviews provide respondents with ample time for reflection and expansion while also enabling reviewers to carefully observe their external expressions and internal psychology to gain a deeper understanding of their attitudes, emotions, and potential motivations towards green production and living synergy. On the other hand, focus group interviews guided by the host facilitate full discussion, mutual inspiration, and interactive stimulation among participants. This approach reveals the internal mechanism of green production and living synergy more comprehensively through divergent thinking modes.

During the interview, we obtained consent from the participants to record the interviews and organized the recorded materials after the completion of the interviews. This resulted in a total of over 240,000 words of interview records. We randomly selected 2/3 of the interview records (18 in total, including 10 personal in-depth interviews and 3 groups of 8-person focus group interviews) for coding analysis and model construction. The remaining 1/3 of the interview records (9 in total, including 5 personal in-depth interviews and 1 group of 4-person focus group interviews) were reserved for theoretical saturation testing. The basic information on the participants is presented in Table 2. The participants were mainly between 40 and 50 years old. The percentages of bachelor's and master's degrees were 33.33% and 48.15%, respectively. Furthermore, all participants were middle and senior managers of manufacturing enterprises.

Table 2. Basic information of participants.

	Characteristic	No. of Participants	Percentage
Gender	Male	19	70.37%
	Female	8	29.62%
Age	31–40 years old	6	22.22%
	41–50 years old	13	48.15%
	51 years old or older	8	29.63%
Level of Education	Associate degree or below	5	18.52%
	Bachelor’s degree	9	33.33%
	Master’s degree or above	13	48.15%
Position	Senior manager	17	62.96%
	Middle manager	10	37.04%

4. Category Extraction and Model Construction

This study adheres to the principles of grounded theory and develops a theoretical model through the open encoding, spindle encoding, and selective encoding of text materials [53]. The model is continuously reconsidered and compared during the encoding process, continually refined, and revised.

4.1. Open Coding

Open coding involves the initial conceptualization of the original interview data, sentence by sentence. It also includes further extraction of conceptual categories from a large number of initial concepts. In the conceptualization process of this study, in order to reduce the researchers’ personal biases, prejudices, or influences, the initial concepts were explored as much as possible from the interviewees’ original words. In the categorization process, the initial concepts were compared and classified in several rounds, before being condensed into the initial categories. Because of space limitations, an example of open coding is shown in Table 3.

Table 3. Open coding example (part).

Initial Category	Initial Concept	Primitive Statement
Information exchange capability	Channels for consumers to access information related to green production and living	R02 Nowadays, it is relatively convenient to access information related to green production and living, but some older people have limited channels for obtaining such information, which also hinders their transition towards adopting more sustainable practices. R05 The local government has implemented cloud farming or intelligent farming, allowing for the real-time supervision and monitoring of the entire production process within enterprises. For example, if ammonia nitrogen levels exceed the standard, an automatic alert will be sent via a mobile phone, and the farming process will be transparent to consumers.
	Enterprises transmit green product information to consumers	R03 The enterprise utilizes green labels and indicator component labeling on product packaging to inform consumers about the environmental impact of the product. R07 The company has developed brochures, as well as created pages and videos on WeChat and TikTok, in order for salespeople to effectively communicate information about popularization to consumers.
	Enterprises engage in market research to investigate consumer demand	R09 Our company conducts in-depth research by immersing ourselves in the actual customer environment to understand their pain points and develops products that address their needs. R10 Every year, during various holidays such as May Day and National Day, our company’s leaders are required to conduct market research, including the R&D team sinking to the sales end to understand frontline needs.

Table 3. Cont.

Initial Category	Initial Concept	Primitive Statement
Publicity and education	Government's publicity and guidance for enterprises to implement green production	R06 In order to effectively promote and guide policy implementation, it is necessary to provide guidance and training for enterprises after the policy has been released, as they may be unsure of how to proceed. R11 Following the introduction of a new policy, it is advantageous to allow relevant enterprises to provide technical guidance through publicity.
	Government conducts publicity and education on green living for the public	R07 It is also crucial to educate and raise awareness among students, and many schools are currently implementing various beneficial activities. R18 With continuous government publicity and education, as well as collaborative efforts, public awareness of waste classification has been steadily increasing. Through proper guidance, individuals can develop an understanding of the importance and gradually adjust their living habits.
	Insufficient promotion of green policies	R01 If there is a lack of publicity and inadequate public awareness regarding green production and living, the effectiveness of the policies will be compromised. R09 The promotion of these policies aimed at guiding green lifestyles is insufficient, and many individuals have been adequately exposed to these policies.
Green production enthusiasm	Green production can conserve energy, reduce consumption, and lower production costs	R02 The transition of enterprises from utilizing diesel to natural gas represents a low-carbon process with higher efficiency and lower costs. R18 Despite the relatively substantial initial investment, the overall cost for enterprises is diminished throughout the green production process.
	Green transformation of the entire supply chain	R05 Green production enterprises should design products based on the need of customers, encompassing the entire value chain from supply chain to production, sales, and the choice of the whole business model. It is essential for upstream and downstream enterprises to support each other to achieve a green supply chain from its resources. R10 We conduct internal audits of our upstream supplier annually, with a focus on selecting partners that align with our company's environmental protection system. We have implemented an evaluation system for new suppliers and are committed to not engaging with unqualified partners.
	Green production enhances corporate reputation	R13 For instance, the implementation of green factories and cleaner production not only impacts the production of our enterprises but also reflects the corporate image. R15 Engaging in green production can significantly enhance the credit credibility, image, and social responsibility of the enterprise.
Green demand can be met	Green demand is fulfilled through customization and interaction with enterprises	R02 The overall green supply in society is insufficient, but individual green needs can still be met through personalized customization and the co-creation of green value. R07 If one wants to eat green food, it is possible to customize it at a higher cost and control the sourcing of ingredients for environmental friendliness, which enables satisfaction through personalized customization.

Table 3. Cont.

Initial Category	Initial Concept	Primitive Statement
Green demand can be met	Enterprises have the capability to manufacture green products to satisfy consumer demand	R06 When exporting abroad, we will adhere to the high environmental standards set by the European market by minimizing the use of non-environmentally friendly materials in our production processes and utilizing green packaging as much as possible. R10 In response to consumer demand for green products, other factors such as functions, prices, quality, performance, post-purchase support services should also be considered. It is important to compare these aspects with traditional products rather than solely focusing on environmental protection.
	Current green supply can meet the green living demand of consumers	R09 From my perspective, it is relatively easy to purchase necessary green products or services needed in daily life. R19 I believe there is currently a substantial supply of green products available in various aspects including food, clothing, housing, and transportation on the market.

4.2. Axial Coding

Axial coding aims to discover and establish potential logical connections between independent categories and to develop the main category and its subcategories. In this study, different categories were categorized based on their interrelationships and logical order at the conceptual level, with 19 subcategories and seven main categories, as shown in Table 4.

Table 4. Main categories formed by axial coding.

Main Category	Corresponding Category	Category Connotation
Collaborative cognition	Collaborative relationship understanding	Enterprise managers' understanding of the synergy between green production and green living
	Subjective responsibility consciousness	Enterprise managers, as producers, are committed to corporate social responsibility; as consumers, they also recognize the importance of environmental responsibility
	Collaborative effect perception	Perceptions of enterprise managers on the synergy between green production and green living
Collaborative ability	Information exchange ability	Enterprises provide consumers with channels to obtain information on green products; consumers have the ability to identify this information
	Demand conversion ability	The ability of enterprises to transform consumer demand into green products
	Value co-creation ability	The ability of enterprises and consumers to jointly create green value
Policy environment	Policy support	The government actively guides and promotes the coordinated development of green production and living
	Publicity and education	The government actively promotes and educates enterprises and the public about green production and green living
Market environment	Green consumption tendency	Consumers are increasingly focusing on the environmental attributes of products and showing a growing inclination towards purchasing green products
	Green production enthusiasm	The enthusiasm of enterprises for green production continues to increase
	Green product economy	Green products offer economic benefits, reasonable prices, convenient use, and functional performance that can meet demand

Table 4. Cont.

Main Category	Corresponding Category	Category Connotation
Social environment	Regional green atmosphere	The region generally creates an environmentally friendly green atmosphere
	Social Green Trust	Consumers have confidence in green products in the market, and enterprises have confidence in the government long-term support for green development
Resource conditions	Technical resources	The level of green production technology, research and development funds, technical personnel, and production equipment of the enterprise
	Knowledge resources	Enterprises' green production knowledge and consumers' green product knowledge
Green production and living collaboration	Green demand can be met	Enterprise green products can meet consumers' needs
	Green supply has market demand	Green products produced by enterprises are recognized by the market
	Green demand promotes supply	Consumers' green demands promote enterprises' supply of green products
	Green supply stimulates demand	Enterprises actively update green products to stimulate consumer demand for green products

4.3. Selective Coding

In the stage of selective encoding, it was important to further analyze the connection between the core category, the main category, and other categories to develop a theoretical framework. By conducting further investigation of these main and auxiliary categories, as mentioned earlier, the typical relational structures of this study's main categories were determined, as shown in Table 5.

Table 5. Typical relationship structure of the main category.

Typical Relationship Structure	Connotation of Relationship Structure
Collaborative cognition → green production and living collaboration	Collaborative cognition is the demonstration of enterprise managers' understanding, perception, and environmental responsibility awareness of the relationship between green production and green living collaboration, based on the dual identities of producers and consumers. It has a direct impact on green production and living collaboration.
Collaborative ability → green production and living collaboration	Collaborative ability is the ability of enterprises and the public to promote the collaborative development of green production and living. It has a direct impact on green production and living collaboration.
Collaborative ability → green production and living collaboration	The collaborative environment is the external environment in which green production and living collaboration are located, and it has a direct influence on green production and living collaboration
Resource conditions → collaborative ability → green production and living collaboration	Resource conditions are the indirect influencing factors of green production and living collaboration, which indirectly influence green production and living collaboration by influencing collaborative ability

Based on the typical relationship structure mentioned above, this study categorizes the core category as "influencing factors and mechanisms of green production life synergy" and constructs an impact mechanism model of green production life synergy based on this, as shown in Figure 2.

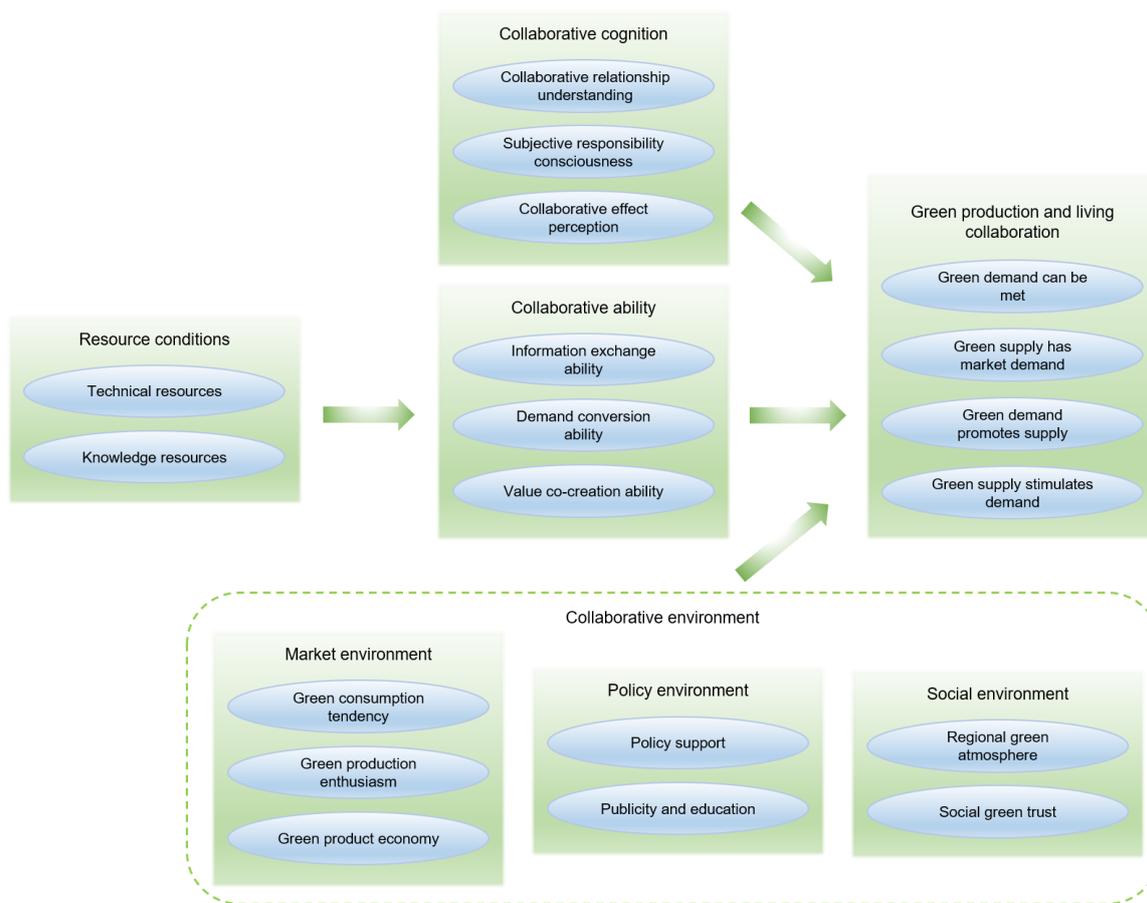


Figure 2. Impact mechanism model of green production and living collaboration.

4.4. Theoretical Saturation Test

In this study, a theoretical saturation test of the constructed model was conducted by randomly selecting one-third of the reserved interview records. This included five personal in-depth interview texts and one group of four-person focus group interview texts. The results indicated that no new main or secondary categories or relationships were obtained. These findings are consistent with the conceptual model of green production and living collaboration, leading to the conclusion that the above model is theoretically saturated.

4.5. Validity Assurance

Furthermore, as stated by Tellis (1997), triangulation was conducted on the information gathered from the interviews [54]. Initially, each author independently reviewed all interview records to verify their validity and prevent the inclusion of potentially ambiguous data in the database. Then, each author compared and confirmed their analysis results with the findings of other authors to achieve a common interpretation of the information. Finally, triangulation was carried out on all collected data [55]. A framework for establishing initial concepts, initial categories, and main categories was investigated.

4.5.1. Reliability Test

In order to test the reliability of the coding, the seven main categories obtained by theoretical coding were tested by calculating the coding consistency of coders. Since there are three coders in the coding process, V1, V2, and V3 are used to represent the concepts coded in each category, where $V1 \cap V2 \cap V3$ represents the intersection of concepts in each category and $V1 \cup V2 \cup V3$ represents the union of concepts in each category. The former is divided by the latter to measure consistency, as shown in the following formula.

$$\text{Coefficient of Consistency} = \frac{V1 \cap V2 \cap V3}{V1 \cup V2 \cup V3}$$

A coding consistency exceeding 0.8 is considered to be an acceptable level of reliability, indicating that the results obtained by the three coders are generally consistent [56]. The consistency coefficients of the seven main categories were as follows: 0.88, 0.82, 0.88, 0.86, 0.92, 0.85, and 0.90. As a result, the encoding results passed the reliability test.

4.5.2. Validity Test

In this paper, the content validity rate (CVR) proposed by Lawshe (1975) was utilized to assess the validity of coding results [57]. The calculation formula is as follows:

$$\text{CVR} = \frac{n_e - N/2}{N/2}$$

where n_e represents the number of coders whose concepts are consistent with the measured categories and N represents the total number of coders. If the concept is consistent with the measured category, the value of CVR is positive. When all coders think the concept is appropriate, $\text{CVR} = 1$; when all coders think that the concept is inappropriate, $\text{CVR} = -1$. In this way, we measured the CVR values of the 103 concepts and 19 categories obtained in the open coding. After calculation, we found that the CVR for 97 concepts and 19 categories was 1, and the CVR for the remaining 6 concepts was 0.33, which is positive, indicating that the coding results of this study have good content validity.

5. Key Elements and Model Interpretation

5.1. Collaborative Cognition

Cognition refers to the acquisition of knowledge through psychological activities, which is the process of people's cognitive activities [45]. Collaborative cognition in this article refers to the understanding of the collaborative relationship between green production and living, the perception of the effects of green production and living collaboration, and the sense of responsibility for the environment formed by enterprise managers from their dual identities as producers and consumers, through their understanding of the relevant knowledge of green production and living collaboration.

Collaborative relationship understanding refers to the comprehension of the synergistic relationship between green production and green living by enterprise managers, considering both the perspectives of producers and consumers. The analysis of interview results reveals that respondents' understanding of this synergistic relationship encompasses three main aspects. Firstly, it is believed that green living is dependent on green production, serving as a prerequisite and essential condition for green living. The achievement of green living relies on the realization of green production. As mentioned in R02, "Where green living cannot exist without green production, as everyone's living depends on products or services provided by enterprises". Secondly, it is assumed that green production is closely interwoven with green living, representing both the application scenario and source of demand for green products. Taking R07 as an example, "Green living serves as an application scenario and source of demand for green products; thus companies must design products based on customer needs and usage scenarios". Thirdly, it indicates that there exists a close supply–demand relationship between green production and green living. For example, R16 stated that "For enterprises, green production is the supply side, while green living is the demand side. They are interdependent and mutually influencing supply–demand relationships".

Subjective responsibility consciousness refers to the psychological experience and characteristics of producers actively implementing green production and assuming social green responsibilities. Simultaneously, consumers actively undertake corresponding obligations such as resource conservation and environmental protection, contributing to their responsibilities. In the R&D and production process of R05 enterprises, it is advisable

to assume social responsibility and adopt a more ethical and environmentally friendly approach. This is because by assuming social responsibility towards different stakeholders, enterprises can obtain a good production and operation environment conducive to improving their competitiveness. From a consumer perspective, as environmental pollution and resource shortages continue to be highlighted, an increasing number of consumers realize the impact of their behavior on the environment and resources. Individual green responsibility cognition refers to consumers' understanding and perception of whether they should be responsible for protecting the environment and conserving resources. For instance, R10 asserted that in recent years, there has been a rapid increase in people's environmental awareness and sense of responsibility.

Collaborative effect perception refers to the direct impression obtained by enterprise managers of the objective fact regarding the collaborative development of green production and living. For example, a green production and life collaboration will promote long-term sustainable development and the formation of a competitive advantage for green enterprises, meet public green needs, and solve environmental problems. In the interview with R13, it was stated that "After the implementation of green production and green living, including our environmental remediation and emission standards, we have seen significant improvements in the entire environment over the years". Additionally, R01 also mentioned that "The synergy between green production and living needs to make people feel firsthand that this is a good thing, so that they can see and touch it, not just something lofty and ethereal. It is necessary to make people feel that living environment are greener than before, there are more blue skies and white clouds, and less air pollution, so they will be more receptive to the green policies. Consumers concerned about pollution issues have a positive attitude towards the environment, leading to green consumption behavior". Therefore, this study suggests that the perception of green production and green living synergy among enterprise managers is a key factor affecting the realization of synergistic development in enterprises.

5.2. Collaborative Ability

The collaborative ability of enterprise groups can be defined as the capacity to create value and gain a competitive advantage through the coordination and development of resources via management activities within specific environmental conditions. This study's assessment of collaborative ability encompasses information exchange ability, demand transformation ability, and value co-creation ability.

Information exchange ability refers to the ability of enterprises and consumers to exchange information on green living needs, green production supply, and other aspects. Specifically, from the perspective of producers, this is demonstrated by the capability of enterprises to conduct market research, explore consumer needs, and disseminate information on green technologies, products, and services to consumers. From the consumer perspective, it is manifested as the public's ability to effectively provide feedback on the demand for green living and green products to enterprises. Additionally, it includes access channels for obtaining information on green technologies, products, and services offered by enterprises, as well as the ability to identify relevant information. As mentioned in R02, "it is now more convenient to obtain information related to green production and green living, but some older people have limited channels for accessing such information, which hinders their transition towards a greener lifestyle". This sentiment was supported by R07, who stated "We have developed brochures, as well as created pages and videos on WeChat and TikTok, in order for salespeople to effectively communicate information about popularization to consumers". Another interviewee, R10, mentioned that "Every year, during various holidays such as May Day and National Day, our company's leaders are required to conduct market research, including the R&D team sinking to the sales end to understand frontline needs". It can be observed that the diversification of information exchange channels helps enhance the realization of green production and living synergy in enterprises. In addition, it should be emphasized that although consumers have envi-

ronmental awareness, they do not have sufficient ability and knowledge accumulation to identify whether a product is truly environmentally friendly. This prompts companies to consider how to showcase green products better and achieve collaborative development of green production and living.

Demand conversion ability refers to an enterprise's capacity to integrate existing knowledge with newly acquired and digested knowledge during its development process, thereby facilitating daily work processes. In the context of this study, demand conversion ability specifically pertains to an enterprise's effectiveness in converting consumers' demand for green products into a supply of such products. This involves the transformation of consumer demand information related to green products obtained by enterprises and its application in the design, research and development, production, upgrading, and transformation of green products. Ultimately, this supports the achievement of synergy between green production and living. As highlighted in the interview with R10, "We conducted authoritative research on the health hazards posed by kitchen fumes to housewives. We investigated customers' actual scenarios to understand their pain points and developed our products based on these insights. Last year, we developed a product called Healthy Cooking Space".

On the one hand, traditional products are being upgraded and transformed to align with consumers' green preferences. For example, R06 stated that "In response to consumers' desire for sustainable living, upgrades and transformations are being implemented for certain products in order to meet the demand for eco-friendly options". On the other hand, enterprises are upgrading and transforming green products based on consumers' non-environmentally friendly preferences such as price, function, and performance. As mentioned in R09, "Consumers may not explicitly express their need for eco-friendly options but instead prioritize functionality and performance. It is essential for businesses to incorporate sustainability into their product development process by leveraging technological advancements to meet consumer demands".

Value co-creation ability refers to the joint capacity of enterprises and consumers to create value, specifically demonstrated by consumers fully utilizing their own knowledge reserves in green practices and actively participating in the design, production, and other aspects of green products within enterprises. As stated in the interview with R05, "the crab farming volume is very large, and the customer specifically requested to participate in our process of formulating plans and manufacturing products, and customize the products according to their requirements". This highlighted that enterprises should not only focus on groups with direct economic interests but should also shift from market orientation to stakeholder orientation. Stakeholder management should be utilized to address green strategy problems, identify valuable stakeholders' behaviors, and emphasize the interaction and learning abilities among stakeholders and enterprises [58].

5.3. Collaborative Environment

As a crucial external factor in promoting green production and living synergy, the collaborative environment encompasses three main aspects as follows: policy environment, market environment, and social environment.

The policy environment is divided into policy support, publicity, and education. Policy support involves the government's encouragement and support of the green transformation of production and living for enterprises and the public. Through the implementation of guiding policies, incentive policies, and mandatory policies, it effectively guides and promotes the collaborative development of green production and living. R02 mentioned that "National policy is forward-looking with strategic goals, leading the production and lifestyle step by step in a guiding process". Additionally, R03 stated that "Our factory was relocated to restore the ecology, for which we were rewarded with 600,000 yuan by the government. We also received other financial support for energy-related technology". However, there are still shortcomings in the corresponding supporting policies for public green living. Taking R10 as an example, "Policies mostly focus on technology subsidy sup-

port at the production end, with few supporting subsidy policies at the consumption end". Institutional pressure has received widespread attention in environmental management. It has become a key external driving factor for enterprises to engage in environmental activities, indicating that institutional pressure can significantly impact corporate environmental strategies [59]. Compulsory policies also exert significant influence, as mentioned in R04, "Environmental protection policy puts a lot of pressure on us, with strict requirements and increasing penalties. For example, the discharge of sewage, wastewater, and exhaust gases must be within the national limits, within the policy indicators, and cannot exceed them".

On the other hand, the policy environment also includes publicity and education. This is specifically demonstrated through government efforts to actively promote and popularize policies, knowledge, and technologies related to green production and sustainable living to both enterprises and the public. The government also engages in corresponding publicity and education activities with the aim of achieving the collaborative development of green production and living. As R01 stated, "Promotion is very important, and the aroma of wine is also afraid of deep alleys. Some people have access to a wide range of information channels, but older individuals have limited access to information. Therefore, promotional efforts can play a significant role in introducing new concepts". However, there are still certain shortcomings in the government's promotion and education. In terms of green living, as mentioned in R09, "These guiding policies for green living are not well publicized, and some individuals have not been exposed to these policies". In terms of green production, as stated in R06, "Many times after the new policies are introduced, enterprises do not know how to implement them. If there were mechanisms for guidance and training, or if relevant enterprises provided technical guidance through publicity efforts, it would benefit each enterprise".

The market environment encompasses a growing trend towards green consumption, an increasing enthusiasm for green production, and the development of a green product economy. Green consumption tendency refers to consumers' growing attention to the environmentally friendly characteristics of products and their willingness to purchase green products. As highlighted in R08, "When living standards are getting higher and higher, people are more accepting of green products and manufacturing methods, and they are willing to spend extra money on purchasing green products". Furthermore, there is a rising enthusiasm for green production among enterprises. As the demand for green consumption continues to increase, businesses are showing greater interest in implementing energy conservation and consumption reduction measures to achieve sustainable development within their supply chains and industrial chains. For instance, R10 emphasized that "Green production enterprises should design products based on customer needs throughout the entire value chain, from supply chain to production, manufacturing, sales, and selection of business models, supporting upstream and downstream enterprises, and achieving overall sustainability within the supply chain". This further enhances the image and reputation of the enterprise and better reflects its social responsibility. Additionally, the concept of a green product economy pertains to the reasonable pricing, convenience of use, and functional performance offered by green products compared with the non-green alternatives within the same category. This ensures that consumers find value in their investment when choosing environmentally friendly options over non-green ones. For example, R03 highlighted that "Cost-effectiveness is a primary consideration for ordinary people when choosing between energy-saving lamps (which may have higher upfront costs but offer long-term electricity savings) versus regular lamps".

The social environment can be subdivided into the following two main components: the regional green atmosphere and social green trust. As an important component of the entire social environment, enterprises should assume certain social responsibilities to meet social expectations and respond to changes and improvements in social expectations in a targeted manner. In organizational psychology and environmental psychology, the psychological atmosphere is considered an important situational factor affecting individual attitudes and behaviors [60]. The regional green atmosphere in this study refers to the local

public and enterprises fully embracing green production and living, thereby creating an environmentally friendly society. For example, R02 emphasized that “Without improvement in people’s quality, government efforts are futile. It is challenging to implement policies due to lack of compliance from individuals; for example, many shared bicycles are abandoned in fields leading to resource wastage. Ultimately, enhancing people’s quality will have a positive impact on these aspects”.

Another crucial aspect of the social environment is social green trust, which encompasses consumers’ confidence in green products available on the market as well as enterprises’ reliance on long-term government support for sustainable development. Research reveals that consumers currently lack trust in green products, mainly because of deficiencies in the certification system and standardization process. For example, R15 indicated insufficient trust from the public regarding various organic product certifications or green production certifications, while R01 mentioned that it discontinued to use of green labels because of numerous counterfeit products. However, some companies have also made efforts in green product certification. Taking R10 as an example, “Company has obtained ISO9000 and 14,000 environmental system certifications, including green product certification, 3C environmental label certification, antibacterial certification, and so on. Only with these foundations can there be future applications such as applying for a green factory”.

5.4. Resource Conditions

The resource-based theory states that a company’s tangible and intangible resources play a crucial role in gaining a competitive advantage [61]. This study specifically categorizes resource conditions into technical resources and knowledge resources. Technical resources are essential for enterprises to enhance efficiency and reduce energy consumption, encompassing the green production technology level, corresponding research and development funds, technical personnel, production equipment, etc. As mentioned in R01, “The implementation of new technologies, materials, and processes has made green production in enterprises more systematic and standardized”. Some companies have also integrated their technological resources. For example, R10 emphasized that “Our company integrates air source heat pumps with solar energy technology to form dual tree coupling technology. This means that when the weather is favorable, solar energy can be utilized for heating purposes; whereas during unfavorable weather conditions, air source heat pumps can be employed to drive the system, significantly enhancing energy efficiency”. The integration of technological resources not only enables enterprises to efficiently acquire more valuable technological assets but also expands their resource boundaries.

The knowledge resources in this study specifically refer to the knowledge of green production, green products, green living, and related policies and regulations owned by enterprises and the public. Knowledge resources can promote performance improvement in enterprises and are crucial for their development. For example, R08 stated that “If enterprises do not have a sufficient understanding of professional knowledge, they do not know how to transform, innovate, or research and development”. Based on the interview, it can be seen that consumers’ green knowledge reserves need to be improved, as mentioned in R15, “As an environmental worker, I am very familiar with the soil conditions in China, so I can determine whether the product is green and healthy based on information such as origin and production process. But most consumers are unaware of this knowledge”. In addition, R05 stated that “When production enterprises implement the green standards of a certain industry, consumers’ understanding of green products is lagging, and it is generally discovered that there are problems with this product through national sampling and other means afterwards”. This further reflects that only when consumers have more green knowledge can they better supervise the green production of enterprises.

5.5. Green Production and Living Collaboration

In the 1970s, Hermann Haken proposed the concept of synergy based on multidisciplinary research and gradually formed and developed it into an emerging discipline [62]. Synergy originates from ancient Greek, meaning coordination and cooperation, and is an important branch of systems science theory. Existing research has primarily focused on discussing regional collaborative development from a macro perspective. This study explores the synergy between enterprise green production and consumer green living. Based on interview texts, it was found that the synergy between green production and living mainly includes meeting green demand, creating a market for green supply, promoting supply through green demand, and stimulating demand through green supply.

On the one hand, “green demand can be met” is exemplified by the ability of enterprises to supply green products and services that meet consumers’ environmentally friendly living needs. For instance, R09 stated that “As for me, some green products or services that are needed in daily life can be purchased”. On the other hand, enterprises have the capacity to develop green technologies and manufacture eco-friendly products in order to satisfy consumers’ green preferences. Taking R06 as an example, “When exporting to foreign markets, due to the stringent environmental requirements, we will reduce the use of non-environmental materials during production and prioritize the utilization of sustainable packaging”. However, in situations where meeting green demand proves challenging, it becomes imperative to enhance communication channels between consumers and businesses. As indicated by R02, while the overall green supply in society is still insufficient, personalized customization and collaborative efforts for creating green value offer avenues for fulfilling individualized green needs.

“Green supply has market demand” refers to the market’s recognition of green products produced by enterprises, which are more popular than non-green products. On the one hand, enterprises need to conduct thorough market research and identify consumers’ needs and preferences in order to gain a competitive advantage and explore opportunities in the green market. For example, R10 stated that “Even if your product is good, it is useless not to be recognized in the market. Therefore, we have conducted market and industry research over the past two years to access market demand. As a result, our enterprise has become more competitive and has received more orders from the market”. On the other hand, enterprises need to accurately target specific consumer groups and promote green supply and demand synergy by matching target consumer groups with green product services. This will help promote green production and living collaboration. For instance, R02 pointed out that “Starting from raw materials, the entire production process is green. As a result, the price of crystal meat produced is three or four times higher than before. While general consumer acceptance may not be high, there still exists a niche green market that caters towards high-end consumers”. Enterprises can provide green products tailored specifically for this consumer group; therefore, it is crucial to effectively position this particular segment of the market.

“Green demand promotes supply” refers to the phenomenon where consumers’ green preference can stimulate an increase in the quantity, quality, and variety of green products offered by businesses. This, in turn, encourages a positive cycle of promoting the synergy between green production and living. As mentioned in R10, “It is advisable that not only actively develops, designs, and produces green products for consumers, but also ensures that other aspects such as functionality, pricing, quality, and support services are on par with or surpass traditional products”. In addition, enterprises can enhance the supply of green products by thoroughly investigating and analyzing consumers’ green needs across various sectors including clothing, food, housing, and transportation. For example, R01 noted that some consumers are willing to pay a premium for customized green products such as sourcing organic food or insisting on using purely natural dyes in their clothing.

“Green supply stimulates demand” means that as green production technology and products advance, consumer demand will also increase. For example, R10 stated that “the country’s policy promotion of green production aims to upgrade consumption habits.

As products are iterated and updated, consumers tend to choose new over old ones". However, it is challenging for consumers to consciously change their lifestyle habits, making it necessary to control products from the source. As emphasized in R04, "If only green products are available in the market, consumers will turn to them". Therefore, a rich and high-quality supply of green products will further stimulate the transformation of consumption towards sustainability.

5.6. Explanation of Logical Relationships

This study conducted a rooted analysis based on interview data and developed an impact mechanism model of green production and living collaboration, incorporating key elements such as collaborative cognition, collaborative ability, a collaborative environment, and resource conditions. The logical relationship among the elements is as follows:

(1) Collaborative cognition (understanding of collaborative relationships, awareness of subject responsibility, and perception of collaborative effects) serves the internal psychological attribution of green production and living synergy. The existing research indicates that individuals' knowledge of the environment forms a crucial foundation for engaging in green behaviors such as resource conservation and environmental protection. Through the in-depth interviews and empirical research conducted in this article, it was found that collaborative cognition significantly promotes the synergy of green production and living; however, the two are not entirely consistent. The intensity, source, and structure of cognition may all affect its consistency.

(2) Collaborative ability (information exchange ability, demand transformation ability, and value co-creation ability) is a prerequisite for promoting green production and living collaboration. The development of collaborative ability is closely linked to one's own resource conditions (technical resources, knowledge resources). By enhancing collaborative abilities, the connection between green production and sustainable living can be strengthened through improved interaction between enterprises and consumers. This in turn promotes the coordinated development of green production and sustainable living. It is important to recognize that resources form the foundation of capabilities, and only by further cultivating and developing collaborative capabilities based on sufficient resource conditions can we effectively promote the synergy of green production and sustainable living.

(3) The collaborative environment (policy environment, market environment, and social environment) is an external influencing factor of green production and living synergy. The green production and living synergies driven by three different environments have distinct characteristics. Policy-driven synergy refers to the introduction of relevant policies, regulations, and standards by the government to guide enterprises and the public in adopting environmentally friendly production and lifestyle practices. This promotes the collaborative development of green production and living through normative, leading, and strongly binding measures. Market-driven synergy refers to promoting the production and consumption of green products through market pricing mechanisms, competition mechanisms, etc., with a focus on value orientation, competition orientation, and innovation orientation. Society-drive synergy refers to the transformation of non-environmentally friendly production and lifestyle practices by enterprises and individuals. This is driven by the overall green atmosphere within society to promote the collaborative development of green production and living. It emphasizes social consensus and social voice guidance and focuses on public participation with strong immateriality aspects.

(4) According to the level of autonomy, green production, and living collaboration can be divided into the following three groups: passive, receptive, and active. Firstly, passive synergy refers to the passive formation of green production and living collaboration within a collaborative environment shaped by policy, the market, and society. Secondly, receptive synergy internalizes the subject's ideology and focuses on adaptive collaboration in cognitive processes. Thirdly, building upon the first two categories, active synergy represents proactive green production and lifestyle collaboration after further developing synergistic capabilities.

6. Conclusions and Policy Recommendations

6.1. Conclusions

This study utilizes grounded theory to construct an impact mechanism model elucidating the synergy between green production and living. The systematic exploration reveals key elements and theoretical underpinnings in this context. This research identifies three pivotal elements—collaborative cognition, collaborative ability, and a collaborative environment—that significantly influence green production and living collaboration. Furthermore, it uncovers that resource conditions indirectly impact this collaboration through their influence on collaborative ability. This study discerns distinct characteristics in green production and living collaboration, propelled by the policy environment, market dynamics, and social influences. Moreover, the intricate concept of green production and living collaboration is deconstructed into the following four discernible components: meeting green demand, establishing a demand market for green supply, propelling supply through green demand, and stimulating demand through green supply. These findings collectively contribute to a comprehensive understanding of the intricate dynamics underpinning the synergy between green production and living.

6.2. Theoretical Contributions

The theoretical contributions of this study are notably significant for several reasons. Firstly, in contrast to previous research predominantly relying on quantitative methods such as scale design and large-scale surveys, this study employs qualitative research methods for exploratory research. By conducting interviews with representative groups and applying grounded theory techniques, our approach facilitates a comprehensive categorization of relevant variables influencing the synergy between green production and living. Unique variable categories, including perceived synergy, information exchange ability, and demand conversion ability, emerge as noteworthy contributions that have been scarcely explored in prior studies.

Secondly, whereas past research often focused solely on either green production or green living and their respective influencing factors, this study integrates both realms to investigate their synergy. By examining the interplay between green production and green living from the supply and demand perspective, this research delves into the factors affecting their synergy, culminating in the construction of a mechanism model illustrating the impact of green production and living synergy.

Thirdly, this research introduces the variable “green production and living collaboration” as a novel conceptual category distinct from both green production and green living. Positioned from a supply and demand standpoint, its core essence lies in fostering the coordinated development of green production and green living through a dynamic balance between green consumption demand and green product supply. This conceptual innovation adds depth to understanding the intricate dynamics inherent in the synergy between green production and living.

6.3. Policy Implications

The managerial implications derived from this study offer targeted policy recommendations and implementation pathways for the government to intervene and promote synergy between green production and living effectively. Firstly, it is advisable to develop focused guidance policies addressing the collaboration between green production and green living. Coordinated policies on both the supply and demand sides are essential, requiring synchronization between green production policies and green living policies. Policy design should not be exclusively concentrated on either the supply or demand side but should be orchestrated to facilitate synergy. Concurrently, active public engagement, education initiatives, and enterprise guidance and training activities should be undertaken to ensure effective policy implementation through diverse media channels such as television and the internet.

Secondly, the government should enhance its oversight of the green market. Establishing a unified green product standard, certification, and labeling system is recommended, accompanied by a stringent evaluation of the capabilities and qualifications of green product certification and testing institutions. This measure aims to instill green trust in the public. Leveraging digital regulatory measures like “cloud-based planting” and “intelligent breeding” can ensure real-time monitoring and automatic warnings throughout production.

In the short term, government support policies can incentivize the production and consumption of green products. This includes providing subsidies to consumers, manufacturers, and distributors to encourage their purchase, production, and circulation. However, while effective in the short term, this intervention strategy is costly. For long-term stability and sustainability, the synergy between green production and green living must rely on the endogenous driving force of consumer consciousness and producer initiative for autonomous operation. This entails enhancing the attributes of green products, improving production efficiency, reducing production costs, and enhancing the functionality and performance of green products to meet economic and usage needs. Additionally, promoting the green transformation of the entire industry chain is crucial. This involves internal design and research to development, production, and sales. Government initiatives should encompass a full industry chain layout, creating a green supply chain and comprehensive design and transformation for the industry, particularly focusing on front-end enterprises.

6.4. Limitations and Future Prospects

While this study addresses certain gaps in the existing literature, it is not without limitations, which open avenues for future research in this domain. Firstly, the data utilized in this study are exclusively derived from China. Given the potential influence of different research settings and sample characteristics on findings [63], future research endeavors could consider expanding the scope by incorporating samples from other emerging economies. This would provide a comparative perspective to explore the trajectory of coordinated development in green production and living.

Secondly, this study’s collaborative impact mechanism model of green production and living is grounded in a small sample of in-depth interviews and qualitative research. The reliability and validity of this model remain untested on a larger scale. Future research should aim to conceptualize the factors within the model, develop measurement scales, and employ large-scale questionnaire surveys to validate the relationships between variables embedded in the model.

Furthermore, integrating and coordinating diverse intervention strategies to maximize synergy necessitates in-depth theoretical verification and empirical testing rooted in interdisciplinary backgrounds. Future studies could delve into this aspect, offering a comprehensive understanding of how various intervention strategies can synergize effectively to promote the collaboration between green production and living.

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