

The Research Review of the Supply and Marketing Cooperatives and the Food Industrial Chain Resilience in Rocky Desertification Region

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Abstract: The characteristics of the academic circles research on the supply and marketing cooperatives and the food industrial chain resilience in rocky desertification region are multi-disciplinary and multi-angle research. The literature reviews and comments are made on relevant domestic and foreign research, which from the angles of two-dimensional efficiency of enterprise legal person and enterprise citizen of supply and marketing cooperatives, two-dimensional control of scientific and livelihood of rocky desertification, and the food industrial chain resilience in a specific time and region, and so on. Drawing on the essence of domestic and foreign research and learning the ancient and modern folk wisdom, combining the two-dimensional efficiency characteristics of supply and marketing cooperatives and the cause-and-effect chain of food industrial chain resilience in rocky desertification region, this paper holds that the rocky desertification region suits the specific time, region and "big food " restriction conditions for the supply and marketing cooperatives to exert two-dimensional positive efficiency. Then this paper concludes that the supply and marketing cooperatives are beneficial exploration directions to improve the food industrial chain resilience in rocky desertification region. The supply and marketing cooperatives play the value symbiosis advantage of "heter-organization+self-organization", make up for the congenitally deficient in the value endogenesis of rocky desertification region, which is beneficial to promote the positive evolution of the food industrial

chain resilience in rocky desertification region with market failure.

Key word: Supply and Marketing Cooperatives; Rocky Desertification Region; Food Industrial Chain Resilience; Efficiency

1. Introduction

China's rocky desertification land area of 72,000km², with decertified areas of small population density is different, rocky desertification areas are distributed in densely populated Yangtze River, Pearl River and other river basins, is the national average population density of 153.3%, is the rocky desertification areas of suitable population carrying capacity of 2.1 times [1]. The existence of environmental and income ecological position of the rocky desertification area double weak innate deficiency, to the rocky desertification fragile land traditional food (maize, sweet potatoes, etc.), not only exacerbate the deterioration of the rocky desertification, the formation of the rocky desertification and poverty causal chain, and yield tends to diminish, resulting in the resilience of the food industry chain in reverse evolution.

2. Overview of Supply and Marketing Societies and Food Chain Resilience in Rocky Desertification Areas

2.1 Supply and Marketing Agency

Supply and marketing societies (Cooperatives, full name of rural supply and marketing cooperatives), is a farmer as the main body, the masses voluntarily shareholding, engaged in agricultural production, supply of means of

living, sales and other services in the field of circulation of collectively owned commercial enterprise organizations. Corporate citizenship dimension, the correct layout of supply and marketing cooperatives, in the public welfare, help smooth the economic cycle of rocky desertification areas, "fishing", promote the integration of industries in rocky desertification areas, etc., with $1 + 1 > 2$ cooperative economies corresponding to the value of the symbiotic effect. In the dimension of enterprise legal person, supply and marketing societies play the role of "other organization + self-organization" resource coordination and the layout of the whole industrial chain in rocky desertification areas and have the advantages of enterprise economy of scale and industry economy of scope.

2.2 Resilience of the Food Chain

Food is the modern (broad) food that corresponds to the "Big Food" and "Big Agriculture" concepts, i.e., based on the traditional (narrow) food "grains", it is expanded to include all plants, animals and microorganisms that provide calories and protein. This means expanding the traditional "grains" to include all plants, animals, and microorganisms that provide calories and proteins. Considering the direction of food production and rocky desertification evolution in rocky desertification areas, the caliber of food is defined as the main food corresponding to plant food (traditional "five grains" with short life cycle and frequent plowing, such as cereals, corn, sweet potatoes, etc.) and the secondary food ("big food" with long life cycle and "a kind of hundred years of peace", such as mulberry silkworms, walnuts, chestnuts, etc.). "The food industry chain refers to the upstream agricultural supply chain.) Grain industry chain refers to the sum of different business activities such as upstream agricultural supply, seed technology and planting, midstream primary processing and deep processing of grain, and downstream purchase, storage, logistics and sales of grain. The resilience of the food industry chain refers to the value and robustness of the food industry chain, i.e., in the static environment, the food industry chain has the value of the upstream and midstream "grain accumulation" and the downstream "grain bag", as well as in

the dynamic environment of natural and man-made disasters and market failure, the food industry chain has the ability to sustain the value of people's livelihood or risk adaptability. The food industry chain has the ability to sustain livelihood value or the ability to adapt to risks under the dynamic environment of natural and man-made disasters and market failures. Specifically, this includes static resilience (value) indicators such as the upstream grain industry chain's hiding grain in the land (the foundation of grain production), hiding grain in technology (the potential for increasing grain production), the midstream's hiding grain in the production line (the potential for grain processing), and the downstream's hiding grain in the circulation network (the top and bottom of the grain and the regulation of the balance between supply and demand), as well as the static resilience (value) indicators of the food production capacity (self-sufficiency of raw grains and finished products), consumption (per capita possession of raw grains and finished products), circulation (per capita possession of raw grains and finished products) and distribution (per capita consumption of raw grains and finished products), based on international standards for food security. (per capita consumption of raw food and finished food products), distribution (reserves of raw food and finished food products), and other dynamic resilience (risk) indicators based on international standards for food security [2].

2.3 Supply and Marketing Societies and Food Chain Resilience in Rocky Desertification Areas

According to the authors' research, by the end of 2023, there were 29 supply and marketing societies at county level and above and about 400 grassroots supply and marketing societies in the rocky desertification areas. Compared with the rapid development until positive feedback of commercial enterprise citizens in the first-rich areas with convenient transportation, developed economy and smooth logistics, the development of commercial enterprise citizens in the rocky desertification areas with backward transportation, lagging economy and weak logistics is slow until negative feedback. The supply and marketing societies with the characteristics of commercial enterprise

citizens are the "stabilizers" of supply and demand that make up for market failures in terms of low-priced supply of agricultural materials, unified purchasing of primary agricultural products (mainly large foodstuffs), limited-priced sales of processed agricultural products, and terminal docking, fair-priced supply and marketing at special times of natural and manmade disasters in rocky desertification zones, and have the ability to promote the coordinated development of rocky desertification zones. It has the value of promoting the coordinated development of the rocky desertification area and the evolution of the resilience of the grain industry chain, such as positive externality. In the reverse evolution of the toughness of the food industry chain in the rocky desertification area, the farmers' shareholding, land trusteeship and public welfare subsidies of the supply and marketing cooperatives are able to guide the farmers to stop claiming traditional staple food (corn, sweet potato, etc.) that exacerbates rocky desertification from the fragile land of Karst (rocky desertification genes), and change to obtaining incomes from modern secondary food (mulberry silkworms, walnuts, etc.) that is resistant to rocky desertification and protects the soil, thus promoting the positive evolution of the toughness of the food industry chain in the rocky desertification area. At the same time, food for the people, food industry chain resilience needs to be rocky desertification area a chess, the supply and marketing society system not only has the economy of scale, scope of economic advantages of coordinating the resource allocation of the whole food industry chain, but also the three causes of the appropriate conditions, self-help + other help, multi-channel, multi-movement to enhance the resilience of the food industry chain.

3. Literature Combing on Supply Chain, Rocky Desertification, and Food Chain Resilience

There is a scarcity of literature related to supply and marketing societies and the resilience of the food chain in rocky desertification areas at home and abroad. In the following, independent literature is sorted out from supply and marketing societies, rocky desertification, and the toughness of food industry chain respectively.

3.1 Supply and Marketing Academic News

3.1.1 Literature on foreign supply and marketing societies

Cooperatives (generally translated as cooperatives abroad) model has a lot of experience and lessons to be learned in the international arena, and the relevant literature mainly includes two perspectives: (1) Cooperatives internal performance perspective. (i) return on net assets. Some researchers argue that the smaller the size of agricultural cooperatives in the United States, the greater the pressure of social responsibility exerted by stakeholders, and the lower the return on net assets of cooperatives; (ii) supply chain financial performance. Some researchers argue that the financial performance of Greek food producers' cooperatives has become better after the implementation of the short-food supply chain reforms, which is conducive to food localization reform, which benefits both local producers and consumers; (iii) financial objectives. Martínez et al. [3] modeled accounts receivable, profits, and financing for more than 10,000 Spanish food cooperatives and non-cooperatives and concluded that cooperatives are disadvantaged in their financial objectives and advantaged in their social objectives. (2) Cooperative External Profit and Loss Perspective. (i) externality efficiency. Some researchers modeled and compared the operational efficiency of Thai government-created food cooperatives with market-initiated grain enterprise alliances and concluded that food cooperatives are more inefficient in terms of both internal and externalities; (ii) externality capacity. Some researchers concluded that cooperatives created by the Indonesian agricultural sector and credit institutions have increased agricultural productivity and food-growing motivation; (iii) Externality barriers. Ada et al. [4] argued that there are barriers to the recycling cycle of agriculture-related resources-products in the supply chain of U.S. agricultural cooperatives in the digital era and analyzed the externality barriers to the cooperative supply chain in the context of circular economy policies.

3.1.2 Literature on domestic supply and marketing cooperatives

Domestic research related to supply and marketing cooperatives mainly covers three perspectives, such as efficiency, mechanism,

and service: (1) Efficiency perspective of supply and marketing cooperatives. (i) Technical and economic efficiency. Zhang and others conducted a comprehensive evaluation of the technical and economic efficiency of the supply and marketing cooperative system engaged in renewable resources operation in the Pearl River Delta region and concluded that the technical and economic efficiency of supply and marketing cooperatives' renewable resources operation is higher than that of enterprises; (ii) Operational efficiency. Zhao et al. concluded that food grassroots organizations and supply chain network systems can promote the improvement of supply and marketing societies' operational efficiency through two mechanisms: pure technical efficiency and scale efficiency; (iii) Total factor productivity. Yang et al. [5] argue that there is a lot of room to improve the static and dynamic efficiency of total factor productivity of grain wholesale in the supply and marketing society system. (2) Supply and marketing society mechanism perspective. (i) Mechanism design. Tang and others believe that we should start from the top-level design of the supply and marketing society system and mechanism and local experiments to solve the agricultural socialized service system and build a modern grain circulation system; (ii) Mechanism reform. Li and others put forward a strategic path of food to reform the market-type cooperative system of supply and marketing societies' institutions and mechanisms under the competitive environment of supply and demand imbalance; (iii) Operational mechanism. Xu and Jin explain the legitimacy mechanism, efficiency mechanism, appropriateness mechanism and cooperative development path for the operation and development of supply and marketing societies with the goal of saving water and increasing food. (3) Supply and marketing society service perspective. (i) Food and agriculture service system. Kong and others analyzed the grain and agriculture service system with land trusteeship as the core and put forward the path of relying on the scale of supply and marketing societies' services to realize the organic connection between grain and agriculture and modern agricultural development; (ii) Digital supply and marketing service system. Liu and others believe that we should integrate the food

industry chain resources through digital means, reconstruct the cooperative relationship between the agricultural, industrial and commercial sides of the supply and marketing societies, and improve the digital supply and marketing service system; (iii) circulation service system. Xi [6] believes that there is an urgent need to reconstruct the supply and marketing societies covering the county, township, and village levels of business network services, supply chain system services, and the circulation service system of downstream agricultural resources and upstream grain.

3.2 Academic Developments in Rocky Desertification

3.2.1 Literature on rocky desertification abroad

Foreign studies related to rock desertification and green development mainly include two perspectives: (1) rock desertification green governance perspective. (i) rocky desertification prediction. Valjavec et al. establish a time series of degraded karst depression evolution model to evaluate and predict the impact, trend and time of karst rocky desertification; (ii) rocky desertification blocking. González et al. study the attributes of the red soil in karst areas, geological geomorphology, conditions of use, and the ability to block karst rocky desertification; (iii) rocky desertification environment. Ellis et al. applied statistical models and social science methods, and proposed to strengthen the management of agroforestry and diversification of economic activities to optimize the rocky desertification environment; (iv) rocky desertification reversal. Geekiyanage et al. [7] overviewed the effects of soil, water and topographic factors on the ecosystem of rocky desertification areas, and proposed strategies for the conservation of biodiversity and the restoration of plant ecosystems. (2) Multiple green performance perspectives. (i) Green agricultural performance. It is believed that environment-friendly agriculture climate-adaptive agriculture can reduce poverty and soil degradation in rocky desertification areas; (ii) Green digital advantage. Fallahpour and others proposed a hybrid decision-making method that considers environmental standards and digital

technology to achieve green procurement and green digitalization in rocky desertification areas competitive advantage; (iii) green innovation performance. Mubarak et al. argue that open innovation in rocky desertification zone mediates the relationship between industry 4.0 technologies and green innovation performance; (iv) green supply chain performance. Lerman et al. [8] optimize the cost of external cooperation and the efficiency of internal operation through digital transformation to improve the performance of smart green supply chain management of cooperatives in rocky desertification zone.

3.2.2 Domestic literature on rocky desertification

Domestic research related to rocky desertification and green economy mainly includes two perspectives: (1) scientific type rocky desertification comprehensive treatment perspective. (i) Scientific design. Ouyang and others put forward the macro-planning and top-level design of rocky desertification management, Li and others promote a variety of arbor-irrigation-grass species combination of seedlings, afforestation technology to promote the benign cycle, Wang and others put forward the viewpoint of rocky desertification comprehensive management that water is the core and soil is the focal point; (ii) ecological comprehensive management. Zhang and others put forward the insights of ecological compensation in rocky desertification area, green technology, rocky desertification factor analysis, karst carbon sink and restoration, etc.; (iii) Harmony between man and land. Feng and other researchers studied the comprehensive management of rocky desertification and ecological compensation, the synergistic mechanism of social and ecological system to solve the contradiction between people and land, and Long et al. [9] put forward the application strategy of the comprehensive management technology of rocky desertification to promote the harmony between people and land. (2) People's livelihood-type comprehensive management of rocky desertification perspective. (i) Cooperative development. Wang and others put forward the viewpoints of east-west collaborative development in rocky desertification areas, cooperation in public welfare projects, coordination of cooperative

interests, and innovation of supply and marketing society mechanisms; (ii) ecological enrichment. Yang and others carry out research on ecological enrichment mode in rocky desertification area, innovation of rock-resistant industry, ecological revitalization strategy, and path of supply and marketing cooperatives; (iii) Ecological agriculture. Xiong et al. [10] research on rocky desertification areas to develop the combination of agriculture, forestry and animal husbandry, grain, mulberry and fishery composite, planting, raising, plus integration and other diversified ecological agricultural system model.

3.3 Academic Dynamics of Grain Chain Resilience

3.3.1 Literature on the resilience of the food chain in foreign countries

Foreign studies related to the resilience of the food industry chain mainly include two perspectives: (1) Cooperatives support food supply perspective. (i) cooperatives support food security. Zeweld et al. used a two-stage model to derive that rural cooperatives in Ethiopia have a positive impact on household food security and poverty reduction; (ii) cooperatives promote food supply. Oba et al. argued that the inclusiveness of food cooperatives in Turkey for food producer and consumer groups is conducive to the realization of a social justice and equal food supply system; (iii) Cooperatives reduce food risk. Lawangen et al. [11] examined the contribution of village-level cooperatives in Thailand in reducing disaster risk and food ration risk, mainly through the provision of assistance services such as food grants, loans, and so on to cooperative member households. (2) Food supply chain resilience perspective. (i) supply chain resilience definition. relying on the food supply chain resilience literature review, Stone et al. define resilience as the ability to maintain the core functions of the food supply chain and adapt to changing conditions based on a food security focus; (ii) supply chain resilience enhancement. Mishra et al. use a case study approach to contextualize a framework for analyzing the food supply chain during the New Crown epidemic and proposed to enhance food supply chain resilience through cooperative collaboration, coordination, and inputs; (iii)

Supply chain resilience capacity. relying on the dynamic capacity theory, Ali et al. [12] modeled and analyzed how knowledge management practices and risk management culture can stimulate the dynamic capacity of food supply chains when cooperatives face food supply chain risks.

3.3.2 Literature on the resilience of the domestic food industry chain

Domestic studies related to the resilience of the food industry chain mainly include three perspectives: (1) The perspective of food security in rocky desertification areas. (i) Population and food security. However, Wen and others believe that the ecological and economic system of "arable land-labor force-population-food" in the rocky desertification area is balanced, which is conducive to Guizhou's food security; (ii) arable land and food security. He and others analyzed the coupling of rocky desertification, arable land pressure and food security in karst mountainous areas and concluded that rocky desertification management is a key factor to reduce the pressure on arable land and improve food security; (iii) Spatio-temporal and food security. Wang et al [13] put forward the spatial and temporal changes in the sowing area of grain crops in the rocky desertification area of Southwest China, the factors affecting it, and the spatial and temporal "fit" countermeasures to ensure food security. (2) Food supply chain resilience perspective. (i) Digital countryside and food system resilience. Hao and other modeling analysis of the impact of digital village construction on the resilience of the food system, that rural digital financial and digital service platform construction on the resilience of the food system to promote the effect is significant; (ii) innovation path and food supply chain resilience. Tao pointed out the strengthening of the food supply chain resilience of the basic stability, technology integration, financial support, supply and marketing society support and other innovation path; (iii) digital economy and food supply chain resilience. Wang et al. [14] relying on the deep integration of the digital economy and supply and marketing society food supply chain, put forward the role of digital economy empowered food supply chain resilience path and policy orientation. (3) Food security perspective in specific time and space. (i) The new crown epidemic and food security.

Relying on the integration of domestic and international resources, Zhang and others analyze the risks and countermeasures facing China's food security under the century of change and the new crown epidemic; (ii) Russia-Ukraine conflict and food security. Relying on the effective utilization of two domestic and international markets and two resources, Zhao and others put forward the fluctuation of the world food market and China's food security countermeasures under the Russia-Ukraine conflict; (iii) Specific events and food security. Wang et al. [15] analyzed the impact and countermeasures of specific events such as rocky desertification and desertification and the international situation on China's food security risk from multiple aspects of production, consumption and distribution.

4. A Review of Research on Supply Chains, Rocky Desertification, and Food Chain Resilience

The academic research on the resilience of the food chain between supply and marketing societies and rocky desertification areas is characterized by multidisciplinary and multifaceted interventions: research on ecology, industry and agricultural science, and research on the resilience of the food chain between supply and marketing societies, rocky desertification and the food chain, and so on. The research on the three foreign subject terms is limited to the issue of supply and marketing societies and food security, and rocky desertification is an independent literature that is not related to each other. Domestic association studies are limited to food security issues in rocky desertification areas, and supply and marketing societies are independent literature unrelated to each other. Due to interdisciplinary reasons, the existing research has "threefold and three light": (1) the perspective of supply and marketing societies focuses on the internal and external efficiency of supply and marketing societies and is lighter than the resilience of the food industry chain in rocky desertification areas. From foreign research, we get the economic value (efficiency) of supply and marketing societies in the dimension of enterprise legal person such as economy of scale and economy of scope, and from domestic research, we get the social value (efficiency) of supply and

marketing societies in the dimension of enterprise citizen such as public welfare and dual-carbon, which provides two-dimensional value (efficiency) for supply and marketing societies to influence the resilience of the food industry chain of rocky desertification area. (2) The perspective of rocky desertification focuses on the science of rocky desertification and people's livelihood management and is lighter than the research related to supply and marketing cooperatives and food production capacity. From the foreign research, we get the economic governance methods in the dimension of enterprise legal person such as green governance of rocky desertification and scientific blocking, and from the domestic research, we get the social governance methods in the dimension of enterprise citizen such as the causal chain of rocky desertification poverty and people's livelihood governance, which provide two-dimensional value (governance) ideas for the supply and marketing societies in rocky desertification area to influence the resilience of grain industry chain. (3) The perspective of food chain resilience focuses on food security and supply chain resilience and is lighter than the research related to supply and marketing societies and rocky desertification. From foreign research, we get the economic value (micro toughness) of supply and marketing societies in the supply chain, industry chain optimization and other dimensions of enterprise legal person of the people in the cooperative game of food industry chain, and from domestic research, we get the social value (macro toughness) of supply and marketing societies in the supply chain and industry chain community of interest in the supply chain, industry chain optimization and other dimensions of corporate citizenship, which provides two-dimensional value (toughness) for the resilience of the food industry chain and the related impacts of the supply and marketing societies in the rocky desertification area.) essence [16].

5. Conclusion

In the causal chain of rocky desertification and food chain resilience, the inherent insufficiency of endogenous rocky desertification genetic value is the primary cause, and the predatory solicitation of karst fragile land with low ecological carrying

capacity is the secondary cause, which synergistically results in the reverse evolution of the resilience of the food chain in rocky desertification areas. Drawing on the essence of domestic and foreign literature and the wisdom of ancient and modern folklore, analyzing the two-dimensional efficiency of supply and marketing societies to promote the symbiosis of food value in the rocky desertification area and influence the causal chain of the resilience of the food industry chain, the following conclusions can be drawn.

5.1 The Two-dimensional Efficiency of Supply and Marketing Societies Determines Their Suitability for Time-specific, Region-specific, and Crop-specific Resource Allocation

While the foreign literature affirms the economic efficiency of the corporate dimension of cooperative enterprises, the domestic literature specifies the social efficiency of the civic dimension of supply and marketing cooperative enterprises. The need for supply and marketing cooperatives to maintain both corporate economic efficiency and civic social efficiency is only appropriate for positive resource allocation efficiency within the constraints of a specific time, such as emergencies, a specific region, such as an inherently underdeveloped area, or a specific crop, such as "big grains".

5.2 Limitations in the Rocky Desertification Areas Corresponding to the Specific Time, Area, and Crop that Correspond to the Positive Efficiency of Supply and Marketing Societies

Existing literature and scientific evidence and ancient and modern folk wisdom show that the cultivation of traditional foodstuffs such as maize, sweet potatoes and peanuts in rocky desertification areas requires annual ploughing, and that man-made disturbances exacerbate soil and water erosion (vertical leakage) and the deterioration of rocky desertification. The planting of ecological mulberry, walnut, chestnut and other "big food" that can take root in the seams is conducive to realizing the positive evolution of the resilience of the food industry chain in the rocky desertification area. The social efficiency of the citizenship dimension of supply and marketing cooperatives is suitable for the period of

correcting the reverse evolution and promoting the positive evolution in the rocky desertification area. The genes of rocky desertification cause the causal chain of poverty, and the traditional food causes the artificial catalyst for the deterioration of rocky desertification. Supply and marketing societies can give full play to the advantage of value symbiosis of "other organization + self-organization", make up for the inherent shortcomings of value endogenous in rocky desertification areas with value symbiosis, and promote the positive evolution of resilience of the food industry chain in rocky desertification areas. Ecological value-oriented ecological mulberry, walnut, chestnut and other "one hundred years of peace" anti-rock "big food", relying on social value-oriented supply and marketing society carrier for ecological industry integration, is the theoretical research direction of three-dimensional enhancement of the resilience of the food industry chain in rocky desertification areas.

5.3 Supply and Marketing Societies are a Practical and Exploratory Direction to Enhance the Resilience of the food Chain in Rocky Desertification Areas

The rocky desertification area has more people and less food, more rocks and less soil, more mountains and less fields, and the toughness of the food industry chain is significantly lower than the national average. The area of rocky desertification area is 72,000km², with a resident population of 12 million. Karst landscape covers an area of 1.2 million km², with a resident population of 220 million. The relocation type ecological migration can only "give fish" to the resilience of the food industry chain in the rocky desertification area. The surplus to make up for the shortage of transfer payments to the rocky desertification area food industry chain resilience can only "grant fish" for a while. The author's long-term personal experience in the production and marketing of food in rocky desertification areas in the past two decades, literature research and field research show that the supply and marketing societies' supply (corresponding to the upstream food industry chain of hiding food in technology, hiding food in the ground and the middle-stream food production line, i.e., upstream business and the industry chain of "wide accumulation of food")

and sales (corresponding to the downstream food industry chain of hiding food in the production line) can only "give fish" in one corner. The two sub-systems of supply and marketing cooperatives (corresponding to the downstream of the grain industry chain, i.e. the downstream business corresponding to the industry chain's "grain bag") have positive impacts on all the links of the grain industry chain upstream, midstream and downstream. It is conducive to the "other organization + self-organization" of supply and marketing societies to realize the symbiosis of the "fishing" value of the resilience of the food industry chain in rocky desertification areas and promote the positive evolution of the resilience of the food industry chain in rocky desertification areas.

Fund Project

This study is supported by National Social Science Foundation Program of China "The Study on the Impact of Global Value Chain Digitization on the Agricultural Industrial Chain Resilience of China" (22BJY035).

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