



Review article

The development logic, scientific Connotation, and promotion path of rural eco-industries in China

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ABSTRACT

The rural industry is the foundation for promoting farmers' income and rural development, and adhering to the green development of the rural industry is the internal requirement for comprehensively promoting Rural Revitalization Strategy (RRS) in China. Firstly, the article explains the three aspects of China's rural eco-industries' development logic: the rural eco-industries have the historical inevitability of action under the Ecological Civilization (EC), academic rationality of development under the theory of urban-rural integration development, and strategic action under ecological poverty alleviation. Secondly, it establishes the six components of the Chinese rural eco-industries' scientific connotation: one guiding concept, three theoretical foundations, three development carriers, two practical paths, a 3*3 development model, and two fundamental goals. Thirdly, Suggestions to encourage the development of rural eco-industry in the three dimensions of "space, organization, and subject" from primary mode to advanced mode.

1. Introduction

The issues of agriculture, rural regions, and farmers (i.e., "three rural") have fundamentally impacted China's national growth and the lives of its for a long time. Moreover, the Report of the Communist Party of China's 19th Congress initially suggested the Rural Revitalization Strategy (RRS) as the overall framework for the operation of the "three rural" in the new age. The overall requirement of the RRS is to continuously expand the channels for farmers to increase their income and lead prosperous lives, according to the Strategic Plan for Rural Revitalization (2018–2022) published by the Central Committee of the Communist Party of China and the State Council of the People's Republic of China in September 2018. Therefore, the primary goal of the RRS approach is to increase farmers' income. Entering the stage of thoroughly advancing the RRS, the Chinese government has put a greater emphasis on ensuring the steady income development of farmers. Chinese President Xi underlined that "we should focus on industries to boost rural

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development" and "allow farmers to share more of the industrial value-added benefits" during the Communist Party of China (CPC) Central Committee's Rural Work Conference on December 26, 2021. The CPC Central Committee values rural industrial development's contribution to farmers' income. In the No.1 Central Document (N1CD) for 2022, agricultural and rural green development was added for the first time to the important theme "focused on industry to boost rural development." Suggesting that China must take the lead in the high-quality development of rural industries based on the idea that "lucid waters and lush mountains are invaluable assets." (i.e., "Two Mountains") in the next stage of development and construct a new model of rural development by highlighting the actual colors "ecological" and "green" in rural businesses. This new model will feature successful farmers and gorgeous natural surroundings.

Rural farmers depend primarily on agriculture for their livelihood; hence, agroecology is one of the industries that dominate ecology in rural areas (Li et al., 2021) [1]. In contrast, other eco-industries are more challenging to prove and develop due to their late start, shaky basis, and apparent heterogeneity (Meng & Wang, 2006) [2]. Therefore, agroecology was emphasized throughout the theoretical analysis of rural eco-industries. Environmental and food safety risks associated with industrial agriculture (Pimentel et al., 1973; Conway et al., 1998; Giri, 2006) [3–5] and concerns about the social and economic conditions of small farmers in the context of agricultural modernization are what gave rise to the research and practice of agroecology (Altieri, 1987, 2002; Conway, 1987) [6–8]. The origins of the term "agroecology" may be found in Odum's (1969) description of agroecosystems [9]. Later, Francis et al. (2003) and Gliessman (2006) broadened the meaning of "agroecology" to include food ecosystems as well [10,11]. According to Dumont et al. (2013) and Alexandre et al. (2021), agroecology should take into account the ecosystems of animal husbandry [12,13]. On the one hand, agroecology, in general, is an approach that builds semi-closed, resilient farming systems with high levels of environmental benefits based on ecological principles (Snapp, 2017) [14]. On the other hand, agroecology's specialized practices include cover crops, intercropping, crop and pasture rotation, forest pasture, integrated aquaculture, organic improvement, and minimizing or eliminating synthetic inputs (Bezner Kerr et al., 2023). [15]. In the 1980s, China confronted numerous ecological and environmental issues from intensive agriculture. Under the direction of agroecology, several ecological agricultural practices were implemented in rural areas, and theoretical research on the concepts and models of Chinese Ecological Agriculture (CEA) started to emerge (Ye, 1982; Ma, 1987; Li, 1998; Luo, 1999, 2009) [16–20]. Ye (2002) argues that including rural industries as a vital component of the ecological agriculture system separates Chinese Ecological Agriculture from the idea of agroecology in Western nations [21].

Currently, most of China's villages have only succeeded in eradicating absolute poverty. Moreover, the eco-industries, which sprang out of eliminating poverty and relied on regionally specific resources, are still in the early stages of active research, with new concepts and business models constantly developing. There has been an increase in research on rural eco-industries, mainly concentrating on their practice modes and practice route. According to practice modes, they consist of the ecological product value realization model (Liu et al., 2020; Zhang et al., 2022; Zhu et al., 2022) [22–24]; the "Two Mountains" model (Qiu et al., 2015; Weng et al., 2018; Dong et al., 2020; Rong et al., 2021) [25–28]; the primary models of industrial ecology and eco-industrialization (Feng et al., 2009; Wang et al., 2016; Zhang et al., 2020; Zhang et al., 2021) [29–32]. In terms of the practice route, it primarily entails the coordinated development of industrial ecology and ecological industrialization (Chen, 2019) [33], the mechanism innovation of "Lucid waters and lush mountains are invaluable assets" (Wang et al., 2017; Jiang et al., 2021; Tao et al., 2020) [34–36], Mechanisms for green poverty reduction (Zhang et al., 2019; Zhou et al., 2022), etc. [37,38].

The development of rural eco-industries is an effort made by China, the largest developing nation, to address ecological and environmental issues like climate change, food insecurity, and biodiversity loss. It is also one of the key ways to successfully address the challenges of farmers' income growth by extending their livelihood strategies. There needs to be more systematic discussions on the connotation, model, and improvement route of rural eco-industries, even though the current literature serves as a valuable source of reference relevance for this research. In this regard, sorting out the development logic of rural eco-industry at a theoretical level and systematically discussing its scientific connotation and promotion path is a helpful addition to eco-industries and agroecology theories. Additionally, it is of great practical significance to promote eco-industries in each village to enhance farmers' capacity for sustaining self-development by practicing the concept of "Two Mountains" and to provide sample experiences for rural eco-industries' development in similar regions of other developing countries.

The rest of this article is structured as follows: Section 2 is the Development logic of rural eco-industries. Section 3 is The scientific connotation of rural eco-industries. Section 4 is The promotion path of rural eco-industries. Section 5 is the Conclusion.

2. Development logic of rural eco-industries

Historical, theoretical, and practical logic are used to describe the inevitability, rationality, and strategy of the expansion of rural eco-industries, which is a necessary foundation for further understanding the scientific connotation of rural eco-industries.

2.1. Historical logic: the inevitability of the development of rural eco-industries under Ecological Civilization (EC)

Traditional farming is the backbone of the country and the solid material foundation of Chinese culture. It has persisted for 3000 years in the historical development of the Chinese nation. It has given rise to ecological thinking patterns such as Confucianism's "Access to natural resources must be following the laws of climate change and the growth and development of plants and animals," Taoism's "Act on the laws of nature.," Mohism's "Food is not only a requirement for humans to survive, but it is also a substance used by the king to nourish himself and his subjects." Legalist's "Only when people have enough food will they understand etiquette, and only when people are materially wealthy and adequate will they understand honor and shame." etc. These ecological ideas about farming can be seen as the essence of traditional Chinese agriculture. They demonstrate the most peaceful and pure interaction between man and the environment under the sustainable agricultural farming model of the unity of heaven and man and the ecological ethics of the

rulers, who see agriculture as the root of the country. The fact that Chinese civilization has survived and thrived is also a result of traditional Chinese agriculture, which upholds the notion of following nature. Therefore, traditional Chinese civilization is an agricultural civilization [39]. The development of agricultural production in China advanced with the logic of industrial production during the 1990s, along with the promotion of globalized capital and the mature development of the oil industry in Western developed nations. As a result, the value of the economic function of industrial agriculture was maximized, which brought about a concentration of issues like agricultural non-point pollution, food safety, and rural decline. At the same time, the country delivered abundant resources to the city because agriculture performs non-economic services with positive externalities; they cannot be compensated for their value through market transactions under the competitive market economy mechanism. When markets and governments fail, agriculture’s ecological, social, and cultural roles are swept away in the industrial and agricultural growth wave. As a consequence, the agricultural ecology is going to alter in the era of industrial agriculture.

In November 2012, the report of the 18th Party Congress incorporated the comprehensive implementation of EC into China’s Five-sphere Integrated Plan, opening a new era of eco-civilization construction of socialism with Chinese characteristics. Utilizing the N1CD from 2013 to 2022, Fig. 1 shows the critical policy evolution of rural eco-industries’ growth within the new age of the socialist eco-civilization building with Chinese characteristics and the strategic keywords of the two time periods before and after the RRS. From Fig. 1, the Chinese government has deepened its understanding of the value of agriculture and rural areas by promoting the construction of EC in rural areas. Meanwhile, China’s rural industries’ development in this period faces two significant new features. Firstly, the emergence of new industries and businesses in the country has dramatically expanded and enriched the connotation of agriculture. With the rapid development of China’s economy and the increase in people’s income level, urban residents have begun to pay attention to food safety and high quality. The demand for ecological agricultural products of "San Pin Yi Biao " (i.e., Pollution-free agricultural products, green food, organic products, and agricultural products geographical indication products) has become increasingly prosperous. At the same time, it started to create new needs for agricultural production, going from the need for eco-agricultural goods to the need for eco-services like rural tourism, farming experiences, leisure, and relaxation. The phenomenon has led to the emergence of new industries and new businesses in the county, such as rural tourism, leisure agriculture, recreation tourism, etc. In 2019, China’s leisure agriculture and rural tourism received 3.09 billion, an increase of nearly four times over 2012 [40]. Since COVID-19 spread worldwide, it has become much harder and riskier to travel long distances overseas or between provinces.

At the same time, the huge domestic demand for leisure and recreation tourism has slowly crept into the country. From January to October 2021, China’s rural tourism received 1.85 billion visitors, an increase of 43.4% year-on-year [41]. Secondly, rural eco-industries’ development meets the demand for multifunctional value realization in agriculture. In September 2018, the Central Committee of CPC and the State Council issued the plan of RRS (2018–2022), which takes the continuous broadening of farmers’ income avenues and the realization of prosperity as the landing point of the overall requirements of the RRS. However, one of the most important aspects of boosting farmers’ income is emphasizing and exploiting the multifunctional value of agriculture. Agriculture’s ecological, social, and cultural functional values have been unrealized since industrial civilization. However, the economic function has been rewarded with value through market transactions; farmers at the lower end of the agricultural chain can only earn a lower income, resulting in a still large income gap between urban and rural residents.

One study concluded that the deal value of agroecological value in China in 2015 was 68.16 trillion yuan, which was 11. 2 times the economic value of agriculture in that year [42]. Even by itself, agriculture’s ecological role is significantly more valuable than its role

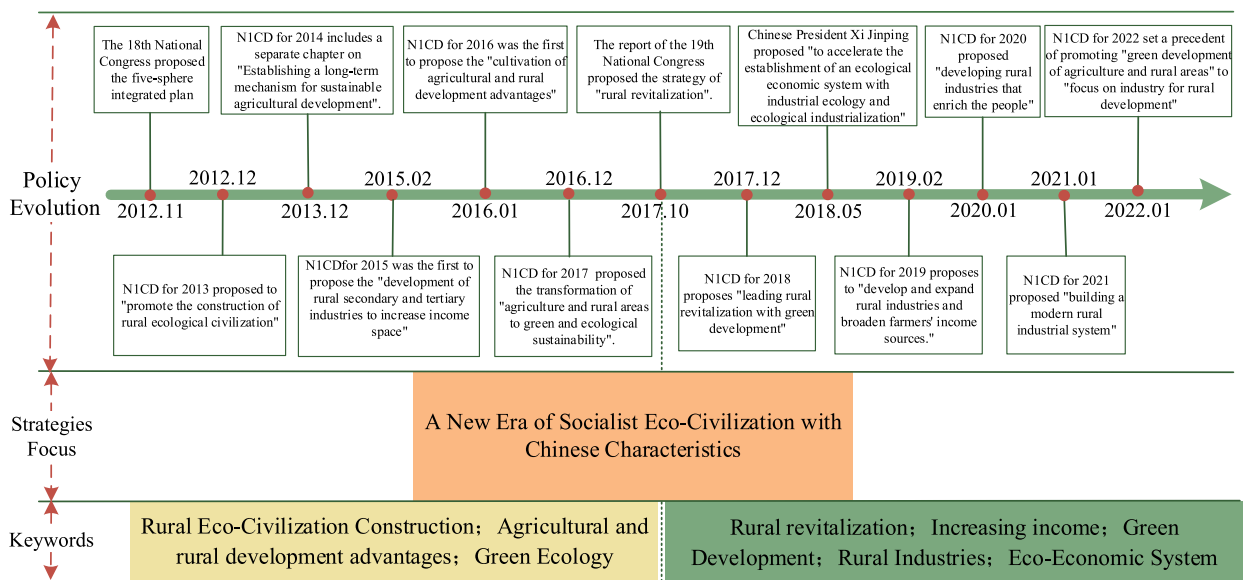


Fig. 1. Policies related to the development of rural eco-industries in the new era of socialist EC construction with Chinese characteristics.

in food production. If agriculture's ecological, social, and cultural contributions are valued for what they are, it will revitalize the nation and increase farmer income. As mentioned earlier, rural industry under EC expands the boundaries of agricultural connotation. Rural eco-industries can enhance the value of agricultural products in terms of ecological and cultural heritage by creating brands. It can realize the value of agricultural ecological, social, and cultural functions by providing services such as rural tourism, farming experience, and recreation and wellness. It can obtain ecological compensation through ecological restoration and protection projects to guarantee the realization of the value of agricultural non-production functions [43]. Therefore rural eco-industries are one of the inevitable development modes of rural industry under EC. It can help realize the multifunctional value of agriculture and increase farmers' income.

2.2. Theoretical logic: the academic rationality of rural ecological industry development under the theory of urban-rural integration development

In the mid-nineteenth century, the outbreak of the Industrial Revolution brought about a radical change in urban-rural relations in capitalist countries. Based on this phenomenon, Marx and Engels summarized the general rule of urban-rural ties, that is, the relationship between urban and rural goes through the trend of "integration"- "opposition" -"integration." They argue that urban-rural relations were initially integrated because, in the medieval period, laborers were small producers and privately owned the means of production. The products produced by the peasants were only for their consumption or that of the feudal lords; thus, "exchange is limited, the market is small, the mode of production is stable, the place is isolated from the outside world, and the place is unified within itself." It is expressed as "Milk in the country and guilds in the city." The emergence of the capitalist mode of production has further promoted the division of labor in various fields. The first division of labor was the "separation of urban and rural areas." i.e., the "urban-rural dichotomy" in which the urban areas dominated the rural areas economically [44]. As we all know, the degree of output must correspond to the relations of production. The economic linkages between cities and the nation will alter once the communist system is in place to accommodate the demands of socialist production. By uniting the nation's cities and rural areas, it will be possible to stop industrial production from contaminating the air, water, and land and lessen the risk that pollutants cause to people's health [45]. The critical thesis of Marx and Engels on the theory of urban-rural integration reflects that the inherent interaction mechanism between productive forces and relations of production determines the urban-rural relationship. Therefore urban-rural relationship should be an interdependent and mutually constraining relationship of unity of opposites. The era of industrial civilization, mainly characterized by industrialization and urbanization, has given rise to the problems of unbalanced urban-rural development in China, such as urban prosperity and rural decline and urban involution while rural hollowing out. Since entering the era of EC, the unbalanced development of urban and rural areas and the unbalanced and insufficient development of rural agriculture and farmers are still the most significant shortcomings of the modernization of socialism with Chinese characteristics.

On May 14, 2020, the meeting of the Standing Committee of the Political Bureau of the CPC Central Committee proposed to "establish a development pattern in which domestic economic cycle plays a leading role while international economic cycle remains its extension and supplement." The 14th Five-Year Plan initiative to accelerate the construction of a "dual circulation" development pattern indicates that China has entered a new development pattern stage of domestic and foreign markets can boost each other, with the domestic market as the mainstay. The domestic cycle in the "dual circulation" in the leading position is the foundation and guarantee of the international cycle and the Party Central Committee in response to the impact of external uncertainties in a far-sighted manner. *Domestic circulation* is a multidimensional and complex system with numerous multilevel and intersecting small circulations [46]. Among them, the economic cycle between urban and rural regions, in particular, is the most fundamental relationship and a noticeable coming together. The specific manifestations are urban-rural dichotomies such as a high urban-rural industrial fence, large urban-rural income gap, the coexistence of oversupply and undersupply of agricultural products, low rate of return of agricultural production factors, and reluctance of production factors to go to the country. According to the general law of urban-rural relationship development, we should face up to the dialectical relationship between urban and rural areas, reposition the value of urban and rural areas, smooth the urban-rural economic cycle through integrated development of urban and rural economies, and provide the necessary support for building a new development pattern of "dual circulation." The high-quality integrated development of the urban-rural economy not only needs to break the institutional barriers of the urban-rural industrial division of labor based on vigorously promoting the modern industrialized construction and bring into play the long-term mechanism of bringing the country with the city and promoting agriculture with the industry [47], but also needs the country to explore an industrial model suitable for local development, support the vigorous development of rural productivity through the revitalization of rural industries, and provide a positive feedback mechanism to promote the interaction of resources, factors, and products in the urban and rural area. The Chinese country is an ecological sponge society with a spatial interface that hosts trillions of dollars of ecological resources (ER) [48]. ER refers to green water, green mountains, local culture, fresh air, strategic resources with multifunctional properties, and the most incredible wealth in the country. Based on the rich ER in the local area, the total excavation of rural ecological industries with regional characteristics is a critical development path to break the dual structure of urban and rural areas under EC. Promoting the economic cycle of urban and rural areas and the domestic cycle is strategically essential.

2.3. Practical logic: strategic development of rural eco-industries under ecological poverty alleviation

Managing ecological poverty traps has long been an important issue for countries worldwide. In 2010, the State Council released the National Plan for Main Function Areas, which defines critical ecological function areas as "areas where enhancing the ecological capacity of ecological products is a top priority." More than 60% of the 25 critical ecological function area counties are poor counties,

of which the percentage of poor counties in the ecological function areas of soil and water conservation, biodiversity maintenance, wind and sand control, and water conservation is 85.94%, 85.35%, 65.28%, and 37.41% in that order [49]. The data showed that the correlation coefficient between the average ecological vulnerability index and the poverty index of 14 concentrated contiguous particular hardship areas in China is as high as 0.817 [50]. The high spatial overlap between poor and ecologically functional areas is called the "ecological poverty trap." The reason is that poor people living in environmentally vulnerable locations have no choice but to depend on natural resources for their livelihoods. Overusing inappropriate land for agriculture and careless agricultural practices further drive them into poverty. The downward spiral of "more ecologically fragile-poorer" ultimately leads to a spatial ecological poverty trap (Narloch & Bangalore, 2018) [51].

For managing the ecological poverty trap, Chinese President Xi's early discourse wisdom solution on poverty alleviation in poor areas. Comrade Xi, the vice-secretary of the Fujian Provincial Party Committee, visited Barracks Village in Xiamen City on October 16, 1998, and said that "we should green the forest, conserve the ecosystem, allow the villagers to produce more tea and fruits, and vigorously increase agriculture and forestry" [52]. On August 24, 2005, Comrade Xi, who was then secretary of the Zhejiang Provincial Party Committee, wrote in his column "Zhijiang New Language" in Zhejiang Daily that "if these ecological advantages transform into ecological, economic advantages, such as ecological agriculture, ecological industry, ecological tourism, etc., then green mountains and clear water are equivalent to mountains of gold and silver" [53]. In his address at Nazarbayev University in Kazakhstan on September 7, 2013, President Xi said, "We desire not just mountains of gold, but also green. If we must choose between the two, we would rather have green than gold."

Moreover, in any case, green maintains are themselves gold mountains" [54]. From the protection of the environment and the development of eco-industries to the transformation of ecological advantages into ecological and economic advantages and then to the realization that clear waters and green mountains are as valuable as mountains of gold and silver, President Xi's understanding of escaping the ecological poverty trap is deepening and sublimating from "what to do" to "how to do it." Since the 18th Party Congress, the Chinese government has placed poverty eradication in a prominent position in the country's governance. In 2018, the National Development and Reform Commission and six other ministries and commissions issued the Ecological Poverty Alleviation Work Program (Development and Reform Agricultural Economy [2018] No. 124), which intended to solve the problem of poverty caused by ecology. Ecological poverty alleviation emphasizes the organic combination of ecological protection and poverty reduction. It is a sustainable poverty alleviation model with Chinese characteristics that improve the ecological service function of poor areas and achieves multi-dimensional income generation for people experiencing poverty through the implementation of ecological restoration and protection projects, the development of ecological industries, and other ecological reproduction methods. Ecological poverty alleviation fully absorbs the Marxist ecological philosophy. It is a theoretical sublimation of President Xi's EC thought, guided by the scientific development concept and centered on the "two mountains" concept. In addition to providing the necessary material support for impoverished areas to realize the transition from a passive blood transfusion to an active blood-making economic development mode, rural eco-industries are a significant factor in luring foreign investment, elements, and talent to the nation. Under the guidance of the "Two Mountains," many impoverished areas have encouraged the development of ecological industries with a variety of modes, such as ecological tourism, ecological recreation, ecological forestry, ecological breeding, etc., in the aggressive implementation of an ecological poverty alleviation strategy, which has laid a necessary material foundation for victoriously overcoming poverty.

3. The scientific connotation of rural eco-industries

3.1. The connotation of eco-industries

Up to now, there is no uniform definition of the term "eco-industries" in academic circles. In the 1960s, Carson (1962) first published *Silent Spring*, which aroused people's attention to the ecological environment. Ayres (1969) pioneered the concept of "industrial metabolism," which refers to the collection of physical processes that transform raw materials, energy, and labor into economic output and waste [55]. Frosch and Gallopoulos (1989) further developed the study of "industrial metabolism" by simulating the metabolic processes of living organisms. They proposed an "industrial ecosystem" with high efficiency of industrial energy consumption, low pollution of waste discharge, and a good recycling of waste water [56]. In the late 1970s, the trend of ecological deterioration in Chinese rural agriculture emerged, and under the influence of industrial ecosystem theory, Ye (1982), Ma (1986), and Luo et al. (1987) opened up research on ideas related to ecological agriculture based on the real needs of agroecological transformation in China. Based on the objective fact that ecological technology and ecological engineering applied in various industries, Li (1998), Wang et al. (2001), and Chen (2008) expanded the connotation of eco-industries from eco-agriculture to eco-agriculture, eco-industry, and eco-services. This paper compares the definitions and models of eco-agriculture, eco-industry, eco-services, and eco-industries to better distinguish the relevant concepts involved in eco-industries by combining the existing research literature, as shown in [Table 1](#).

3.2. Definition of the connotation of rural eco-industries

Compared with eco-industries, the connotation of rural eco-industries must understand from two levels. First, what is the country, and second, the connotation of rural eco-industries.

(1) What is the country?

In China, the country has been part of the local administrative system since ancient times. Since the Qin Dynasty promoted the

Table 1
Comparison of concepts and classifications related to eco-industries.

Related Concepts	Definition	Classification
Eco-agriculture	It refers to a sustainable development model that actively adopts an eco-friendly approach to comprehensively enhance the service functions of agroecosystems (Luo, S.M. et al., 1987) [57], where the eco-friendly approach contains the meaning of both the technical system of ecological agriculture and ecological engineering [58].	Eco-agriculture, eco-forestry, eco-livestock, eco-fishery, etc.
Eco-industry	It refers to the integrated industrial production embodiment of circular production and intensive business management developed by applying modern technology modeled after the ecological process of material and energy circulation in nature (Lu, W., 2014) [59].	Eco-manufacturing industry, eco-construction industry, eco-chemical industry, etc.
Eco-services	It refers to reflecting the ecological concept in the facilities, means, and channels of the service, as well as being ecologically sound in the course of service so that consumers can establish the concept of green consumption and environmental awareness (Shen, M.H., 2009) [60].	Eco-tourism, eco-design, eco-finance, eco-logistics, eco-information, etc.
Eco-industries	It refers to network-based and evolutionary industries organized according to the principles of ecological economics and the laws of knowledge economy based on the carrying capacity of ecosystems, with efficient economic processes and harmonious ecological functions (Wang et al., 2001) [61].	Eco-Agriculture, eco-Industry, eco-Service

county system, the country has referred to the system of sub-county administrative organizations. Villages, marketplaces, and towns constitute the main form of rural China [62]. Of course, the country does not only represent basic units in an administrative sense. According to the origin and development of Chinese agriculture, people adopted a more tranquil way of life after entering the age of agricultural civilization. They began utilizing the land as their primary production source for farming and other forms of production. They established villages where they thrived and lived, ultimately giving rise to the country as a settlement type [63]. Clearly, the country, as a spatial structure, serves to assure both productivity and life for farmers and nurture the environment. In addition, because the country's residents produce and live in the same geographical space, as well as the continuity of the ancestral lineage, they have a commonality in production, life, and ecology. Even under the impact of modernization and urbanization, the country still retains its relative independence and characteristics [64], an expression of Chinese agricultural civilization and an important carrier of Chinese traditional culture.

(2) The connotation of rural eco-industries

According to the development logic of rural eco-industries and related literature, the connotation of rural eco-industries should include the following six elements (Fig. 2):

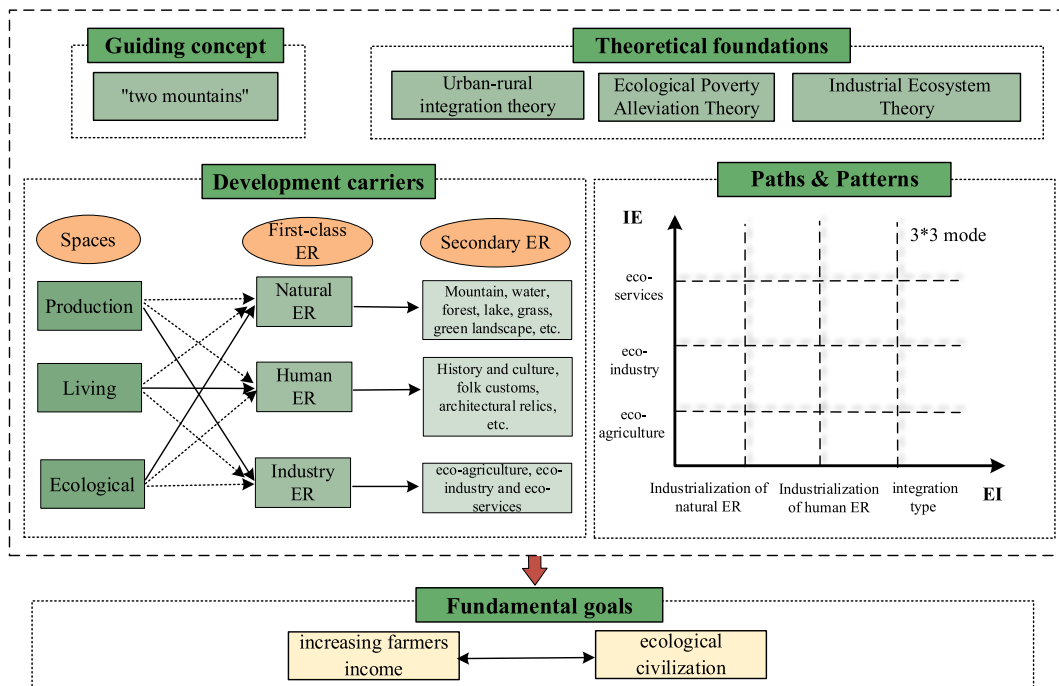


Fig. 2. The connotation of rural eco-industries.

- i. Follow one guiding concept: The development of the rural ecological industry is one of the most important ways to alleviate poverty ecologically, and the guiding concept is "Two Mountains."
- ii. Based on three theoretical foundations: The development of rural eco-industries is not only a strategic choice for correctly resolving China's antagonistic relationship between urban and rural areas, but it is also a concrete expression of a sustainable poverty alleviation model with Chinese characteristics, as well as an essential component of industrial ecosystem theory. Thus, its theoretical foundations include Urban-rural integration theory, Ecological Poverty Alleviation Theory, and Industrial Ecosystem Theory.
- iii. Reliance on three development carriers.: That is, the ecological resources (ER) of the production, living, and ecological spaces (PLES) in the country, including the natural ER, human ER, and industrial ER. "Rural" as the term for "eco-industries" restricts eco-industries to the spatial field of rural areas. Further, based on human activities, rustic space can be divided into production, living, and ecological spaces [65]. Regarding the distribution of ER in each space, the production space mainly consists of industrial ER, including ecological agriculture, ecological industry, and ecological services. The living space primarily consists of human ER, which can reflect the lifestyle, values, and cultural traditions of residents, including historical culture, folk customs, architectural relics, etc.; the ecological space mainly consists of natural ER, including not only the unmodified landscape by humans, such as forest, field, lake, and grass, etc. but also the natural ecological landscape after human processing, such as the beautiful scenery along the river and the green landscape formed by the ecological protection and restoration project. As the PLES in the country interpenetrates and influences each other, there is not only one dominant ecological resource in one type of space but also multiple ER. For example, the production space dominated by industrial ER also carries natural ER and human ER (See "development carrier" in Fig. 2.).
- iv. Implementation of two practice paths: According to the previous review of the connotation of eco-industries, it is easy to find that early articles understood the connotation of eco-industries from the perspective of industrial ecology (IE) based on the industrial ecosystem theory, which is an effective model for green upgrading of traditional industries, emphasizing on enhancing the efficiency of resource absorption and waste metabolism through green technology in the industrial production process, or by using ecological engineering to simulate ecosystem principles and maintain ecosystem service functions, ultimately achieving both environmental benefits and economic benefits. Since the beginning of EC, the Chinese government has innovatively combined ecological protection with poverty alleviation and put forward the ecological poverty alleviation strategy, using the concept of "Two Mountains" to guide the development of ecological industries in poor areas. The ecological industries in the context of ecological poverty alleviation are essentially ecological industrialization (EI), i.e., taking rural ER as the main production factor for industrial development, the value of ER will be preserved, multiplied, and realized through socialized production, market-oriented operation, and integrated development, to finally achieve the purpose of ecological protection and farmers' income increase [66]. Therefore, from the perspective of the practical path, the connotation of rural eco-industries should include both IE and EI. At present, China has achieved victory in the fight against poverty and stepped from the elimination of absolute poverty to the normalized management of relative poverty and comprehensive promotion of an RRS. Improving rural ER's added value and realization capacity will effectively increase farmers' income and boost the country's capacity for endogenous growth. The present growth of rural eco-industries concentrates on the promotion of EI. Implement a 3*3 development model. The model of rural eco-industries distinguishes according to the principle of practical path. "Paths & Patterns," in Fig. 2, shows the 3*3 development mode of rural eco-industries, with the horizontal axis indicating EI and the vertical axis indicating IE. Regarding EI, it mainly consists of the industrialization of rural natural ER, rural human ER, and the integration type. The industrialization of natural ER is turning resource advantages into industrial values, such as the assetization of ER, the capitalization of ecological assets, and the marketization of ecological products and services [67]. The industrialization of human ER is the process of developing and using human ER to promote EI, referring to turning human and ecological advantages into industrial development factors, most of which are cultural and ecological tourism. The integration type refers to the integrated industrial development of rural natural ER and human ER, such as ecological recreation tourism, ecological tourism, etc.; regarding IE, reference to existing research mainly includes models of eco-agriculture, eco-industry, and eco-services. Some villages with better ER endowment and the ability to develop ecological industrialization and industrial ecology simultaneously have the opportunity to form a multifaceted integrated development model, which represents in Fig. 2. Of course, some villages may also have a superposition of multiple integrated development models, and the rural eco-industries have characteristics of integration, clustering, and scale development.

According to the analysis of prior literature, there is no unified classification standard for rural eco-industries. Based on 187 typical examples of "two mountains" practice and innovation in China, this study combines the meaning of rural eco-industries. It proposes the primary model of rural eco-industries from practice paths like IE and EI. County-level administrative units are the primary research objects. At the same time, a detailed summary of the features, routes of implementation, and specific regions of the primary models is provided (Table 2).

- v. Achievement of two fundamental goals. According to the landing point of the RRS under China's EC, the essential purpose of developing rural eco-industries is to realize farmers' income increase and EC.

In conclusion, rural eco-industries is an eco-industry system based on the concept of "Two Mountains." It uses the ER of rural PLES as the development carrier, translates the value of ER through EI, and creates a rural green cycle through IE to ensure the country has an excellent ecological environment. Ultimately, farmers' incomes and rural EC go up, which is a win-win situation.

Table 2
The main modes, main features, implementation routes, and specific regions of rural eco-industries in China.

Practice Path	Main modes	Main features	Implementation routes	Specific regions
Industrial Ecology	Eco-agriculture	Based on the local climate, geography, and resource endowment, this mode may effectively integrate the ecological, economic, and social advantages of agricultural systems, and "resource matching, environment friendliness, and food safety" are maintained throughout time.	(1) relying on speciality agriculture - technology introduction - building green brands - industry chain extension and expansion; (2) organic agriculture - leading enterprise cultivation - product research and development - green brand cultivation - industry integration; (3) ecological recycling industry - integration of speciality agriculture with secondary and tertiary industries - integration of the agricultural, commercial, cultural, and tourist sectors; (4) ecological recycling agriculture - integration of agriculture and tourism - integrating tourism and culture - establishing culture and tourism brands.	Anji in Zhejiang Province; Yuexi in Anhui Province; Mengyin in Shandong Province; Hani Terraces Heritage Area in Yunnan Province; Dalishu Village in Liaoning Province; Dajao County in Yunnan Province; Pinggu District in Beijing City; Henan-Mongolian Autonomous County in Qinghai Province; Wensu in Xinjiang Uygur Autonomous Region
	Eco-industry	This mode is based on local resource endowment (minerals, electricity, water power, etc.) or industrial bases, featuring clean production, recycling, resource conservation, and coupled symbiosis.	(1) traditional industrial greening and transformation - construction of a novel industry system with unique characteristics - diversified development of green industry; (2) traditional industrial upgrading (informationization, greening and intelligence) - integration of industry and tourism - clustering of industrial, cultural, and tourism; (3) ecological treatment industrial cluster development with a reduced carbon footprint - high-quality industrial ecological park building - dividends for low-carbon technology released.	Jiawang District in Jiangsu Province; Huaping in Yunnan Province; Dawukou District in Ningxia Province; Huocheng in Xinjiang Province; Longgang District in Guangdong Province; Nanshan District in Guangdong Province
	Eco-services	It mostly consists of eco-tourism and modern service sectors that provide useful services to eco-agriculture and eco-industry with low-carbon and recycling features.	(1) industrial transformation - ecological protection - scenic spot development - brand building - multi-industry integration; (2) theme tourism - industry clusters - integration of agricultural tourism, cultural tourism, and industrial tourism; (3) tourism ecology - cultural ecology - recreation ecology - ecological product branding.	Fanggan Village in Jinan City; Jingyuan in Ningxia Hui Autonomous Region; Yongding District in Hunan Province; Longsheng Autonomous County in Guangxi Zhuang Autonomous Region; Jiuzhaigou in Sichuan Province; Jindong Management District in Hunan Province; Good Luck Corner in Shandong Province; Gaochun District in Jiangsu Province
Ecological industrialization	Industrialization of natural ecological resources	The development and preservation of natural ecological resources are prioritised, as well as the realization of value via effective industrial organisation and management.	(1) ecological resources identification - special cultivation and farming - brand building - integrating agriculture and tourism - industrial integration; (2) ecological restoration and treatment - environmental recompense - industrial transformation - regional public brand; (3) ecological restoration and treatment - ecological restoration and treatment - green industrial system driven by "cooperative+/"leading enterprise+/"company + base + farmers"; (4) ecological protection and governance - dominant resources - recycling agriculture - integrated development of three industries; (5) revitalization of ecological resources - "two mountain banks" - "government + market"/community-based economic cooperatives - "digitalization+"; (6) ecological restoration and treatment - scenic spot creation - scientific and technological innovation - integrated development of three industries.	Jingzhou Miao and Dong Autonomous County in Hunan Province; Mulan Creek Basin in Fujian Province; Zixing in Hunan Province; Tonggu in Jiangxi Province; Seyhanba Mechanical Forestry Farm in Hebei Province; Youyu in Shanxi Province; Sihong in Jiangsu Province; Yili Ecological Demonstration Area in Inner Mongolia Autonomous Region; Changting in Fujian Province; Chishui in Guizhou Province; Liuba in Shaanxi Province; Jingde in Anhui Province; Babusha Forestry in Gansu Province; Yaozhihe Village in Hubei Province
	Industrialization of human ecological resources	The preservation and development of human ecological resources, as well as the realization of value via industrial organisation and management, are prioritised.	(1) ecological governance and protection - cultural resources utilization and development - brand building - integration of cultural and tourism - integration of agricultural and tourism; (2) human ecological resources - tourism project construction - "government + enterprise +	Datong Village, Liwu New District, Mentougou District in Beijing Province; Dadong Village, in Tibet Autonomous Region

(continued on next page)

Table 2 (continued)

Practice Path	Main modes	Main features	Implementation routes	Specific regions
	Integration	It encompasses the industrialization of ecological natural resources as well as ecological human resources.	cooperative" operation - integration of cultural and tourism. (1) villagers' life tourism - life scene scenic - cultural resources tourism transformation - industry's "government + mass + market" coalition - integration of cultural and tourism; (2) ecological protection and management - "cultural resources +" industry - special cultivation and farming - cultural tourism and agricultural tourism integration; (3) natural ecological resources - special cultivation and farming - deep development of industrial chain - branding operation- cultural ecological resources - ecological tourism - cultural tourism integration of agricultural and tourism; (4) ecological restoration and protection - ecological product brand cultivation - scenic spot building - industry-tourism integration; (5) ecological restoration - cultural connotation mining - "leading enterprises +" - scientific and technological innovation -brand building - convergence of speciality industries.	Wangxia in Hainan Province; Jinggangshan in Jiangxi Province; Jinxiu Yao Autonomous County in Guangxi Zhuang Autonomous Region; 161 Regiment, Ninth Division in Xinjiang Production and Construction Corps; East Helan Mountain Wine Industrial Park in Ningxia Hui Autonomous Region; Middle Horqin Right Wing Banner in Inner Mongolia Autonomous Region

4. The promotion path of rural eco-industries

The above definition of the connotation of rural eco-industries makes it easy to find that its connotation involves core elements such as development carrier, practice path, and development focus. They correspond to the core elements of rural eco-industries, such as "What is the basis for development?" "How to develop?" "Who will develop?" These ideas provide an alternate approach for promoting rural eco-industry development and relate to the spatial resources, organizational forms, development issues, etc. We can gradually promote rural eco-industries from primary mode to advanced mode through the three dimensions of "space, organization, and subject" (Fig. 3).

4.1. Relying on ER of rural PLES and promoting rural eco-industries by category

From the local perspective, it is the primary consideration of how to promote rural eco-industries based on local resource endowments to realize the value of ER. From a regional point of view, the most important thing is to help rural eco-industries based on local resources so that the value of these ecological resources can be seen or even maximized. The ER of each village differs according to its geographical position, as does the historical development potential. For example, the eastern coastal region of China finished Rural Industrialization in the mid to late 1990s; moreover, the development of various industries in the country has become an organic part of the local economic development and has the advantage of fostering the EI. As the coastal areas are more urbanized and market-oriented, the ER of the PLES in the country has favorable conditions for value transformation, so the eco-industries can be developed by revitalizing the ER and through EI. For some villages with rich natural landscapes and historical deposits, it can focus on cultivating models such as ecological humanistic tourism, eco-tourism, eco-tourism & eco-tertiary industry.

In contrast, most of China's villages—or roughly 80% of all—are primarily found in the central and western regions, without exceptional natural resources, remote from urban growth zones, and predominantly engaged in traditional agricultural production [68]. These villages have facilities for growing crops and providing homes for farmers. Through the use of green technologies or ecological engineering, it may support the ecological transformation of agriculture and enhance the effectiveness and quality of supply based on assuring the self-sufficiency of crops. At the same time, a part of the country with conditions can promote the industrialization of eco-agriculture by improving the construction of modern service infrastructure and creating characteristic humanistic landscapes. Considering the development of rural eco-industries via *trans*-regional governance in ecologically fragile villages by performing ecological preservation and restoration, ecologically vulnerable places in the upstream have a considerable spillover impact or positive externality on the downstream region, but they do not obtain market-based advantages. The downstream area can subsidize this value through ecological compensation, and the upstream region will then operate the ecological compensation part as eco-industries in a market-oriented way. On the other hand, since ecological protection and restoration projects help to improve the quality and stability of ecosystems in ecologically fragile areas and also have particular ornamental value, they have the advantage of developing the industrialization mode of natural ecological resources.

4.2. Orderly promotion of EI and IE

As the practical path of rural eco-industries, EI and IE are both different and interrelated. First and foremost, the heart of EI is transforming PLES value in rural areas, which is also the focus of current rural eco-industries practice. It is the key to raising farmers' income and enrichment under the new stage of fully supporting the RRS. In the process of promoting EI, it is necessary to facilitate the industrialization of ER and branding of ecological products in the country by clarifying the property rights of the collective economy as a guide, supported by new production and management modes such as "company & farmers," cooperatives and associations, and guaranteed by technology and talents [69]. Secondly, IE focuses on the organic cycle of elements within the industrial ecosystem through green upgrading of production technology, which requires the introduction of green technology or ecological engineering to

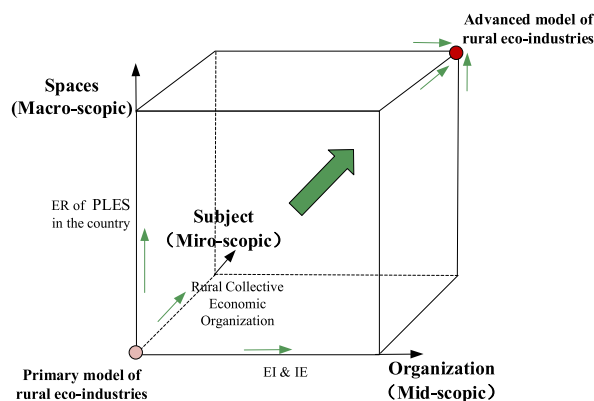


Fig. 3. Promotion path of rural eco-industries.

realize the development of a vertical production process of recycling, intensification, and greening. Since IE improves production efficiency while leaving space for natural ecosystems to recover and reuse, it is the basis for EI to realize again. At the same time, EI needs to be preceded by IE, which is the guarantee and path to consolidate and transform the achievements of IE [70].

Consequently, the coordinated development of EI and IE may not only promote the construction of the ecological and economic system but also serve as a crucial instrument for drawing urban technology, money, and other resources to the country, promoting urban-rural development integration and integrating into the domestic cycle. Based on the features and advantages of local resources, the country should rationally distribute the development of its ecological industries. There is a need to strengthen ecological protection and construction and drive the industry's ecological transformation with innovation, greening, and digitalization. At the same time, it is vital to make the most of both the market-driven and government-directed roles to ensure that green mountains and clean water turn into mountains of gold and silver in an orderly way. Thus, rural regions may accomplish comprehensive ER development and the integrated development of rural industries and gradually improve the institutional mechanism of technological innovation, capital to the country, talent attraction and cultivation, etc.

4.3. Organized governance of rural collective economy to ensure rural eco-industrial development

The rural collective economy is an essential intermediary in promoting EI. As the carrier of rural eco-industries development, the ER of rural PLES is structured resources stuck in the rural space and needs help to divide easily. Their ownership belongs to farmers and rural collectives. For example, farmers have the right to own land and house bases. While other spatial ecological resources, such as rivers, wastelands, and landscapes, are owned by rural collectives and have the general characteristics of non-competition and non-exclusivity. The overall and public characteristics of rural spatial ER make it simple for the industrial income to be "hitched" by the elites under the basic agricultural situation of "Small farmers in a big country" [71].

In contrast, farmers and rural collectives can only partially receive the benefit, which contradicts the development goal of rural eco-industries. Since the suitable property boundary of the rural collective economy according to geography, it has unparalleled advantages as the representative of the owner of the ER of rural PLES. It implies that rural collectives may combine disparate ER into one and use them three-dimensionally. As a result, it is feasible to lower the higher transaction costs brought on by information asymmetry on the one hand while still leaving the industry's advantages directly to farmers and rural collectives on the other. Moreover, the rural collective economy offers clear geographical and organizational advantages for enhancing the development potential and organization of small farmers and constructing a social support system for small farmers [72]. Therefore to better play the intermediary role of the rural collective economy in promoting EI. Firstly, it is essential to consider all of the local circumstances and resource endowment to innovate and explore the collective economy organization mode suitable for local development, to improve the endogenous development capacity of the rural collective economy, and the ability to coordinate the development of rural eco-industries. Secondly, it is crucial to firmly practice the concept of "two mountains," deepen the reform of the rural collective property rights system according to local conditions, and innovate the revenue model of communal land, assets, and resources to enhance the value space of rural collective resources [73]. Thirdly, consolidate and cultivate the talent team for growing the rural collective economy. Including strengthening the skills training of village cadres in management, operation, and technology to provide support for village cadres to serve the collective economy better, as well as try to absorb returning talents, veterans, and wealthy leaders into Rural Party and Village Committee, to consolidate further the ability of collective economic organizations to lead farmers to increase their income.

5. Conclusion

As a significant contributor to sustainable development, China actively promotes EC and green growth. This paper discusses the development logic, scientific connotation, and promotion path of the rural eco-industries, extending research on the theoretical foundation of China's rural ecological industry. Moreover, it will help develop rural ecological industries across the country. From the perspective of the promotion path of rural eco-industries in China, it is essential for attaining high-quality growth of China's rural industries and raising farmers' income, as well as a fundamental necessity for China's sustainable development. Rural eco-industries is an eco-industry system based on "Two Mountains." It uses the ER of rural PLES as the development carrier, translates the value of ER through EI, and creates a rural green cycle through IE to ensure the country has an excellent ecological environment. Ultimately, farmers' incomes and rural EC go up, which is a win-win situation.

In the age of eco-civilization, the Chinese government has issued many policies for developing rural industries and several practices implemented nationwide. It has sparked the development of several new industries and business models in rural areas, meeting the requirements of realizing the multi-functional value of agriculture and promoting the increase of farmers' income. Combining top-down and bottom-up strategies must work together as a vital precondition to promote the orderly growth of rural eco-industries. In addition, this article put forward the promotion path of rural eco-industries through the three dimensions of "space, organization, and subject." However, since rural areas in China have a variety of resource endowments, geographic locations, and development foundations, each village must rationally prioritize the growth of rural eco-industries based on the unique qualities and benefits of its resources. To support the expansion of the rural eco-industries, institutional innovation from the introduction of technology, money flowing to the countryside, and talent introduction must be energetically pushed.

Meanwhile, since the growth of the rural eco-industries depends on the promotion of the rural collective economy, we can strengthen the development capacity of the rural collective economy from the following three aspects:

- the innovation of the collective economy organization mode

- the reformation of the rural collective property rights system
- the consolidation of the talent team

Despite the article's contribution, it inevitably has certain limits. First, as this study aims to provide a theoretical framework for China's rural eco-industries, it focuses on the definition and model of rural ecological industries from a theoretical standpoint. In the meantime, we attempt to compare and explain the traits, implementation routes, and specific geographic regions of particular examples matching the 3*3 model of rural eco-industries. Future studies will thoroughly review the organizational patterns and efficiency of different schemes. It will help assess different types of rural eco-industries' regional variations in inappropriateness and efficacy. Second, the rural eco-industries in China are still in the process of realistic exploration. Therefore, in addition to the three aspects of "space, organization, and subject," future research may delve deeper into the improvement route by merging practical difficulties. Resolving the difficulty in developing a specific rural ecological industry is also an essential component of future research by introducing research data and the execution of empirical tests.

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Data availability statement

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Abbreviations

RRS	Rural Revitalization Strategy
EC	Ecological Civilization
ER	ecological resources
EI	ecological industrialization
IE	industrial ecology
PLES	production, living, and ecological spaces
CPC	Communist Party of China
N1CD	No. 1 Central Document

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