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Importance of Farmers' Awareness on Ecological Revitalization to Promote Sustainable Development

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Abstract: Implementing rural revitalization strategies requires understanding ecological revitalization, and improving farmers' ecological awareness is crucial for promoting ecological revitalization. China's rural ecological civilization construction is based on a theoretical foundation of Marxist ecological thought. This study examined the cultivation of ecological awareness among farmers in ecological revitalization using the literature, graphs, data statistics, and case analysis methods. A survey conducted in Gansu Province, in China, showed that more than 90% of people are satisfied with current ecosystem revitalization projects. The use of chemical fertilizer is decreasing every year, and the area of water-saving irrigation and soil erosion control has increased since implementing the Three-Year Action Plan for Rural Living Environment Improvement in 2018. The findings indicate the need for farmers to be more aware of general ecological concepts and economic development, and to participate more in ecological governance. Consequently, this study proposes policy measures such as strengthening ecological civilization ideological education, increasing investment in funds and technology, improving the relevant legal mechanisms to provide educational support for cultivating farmers' ecological awareness, creating a cultural atmosphere, and building a solid institutional guarantee. The study has valuable implications for policymakers, industrialists, and academicians informing the development of strategies and interventions to promote farmers' ecological awareness for rural ecological revitalization and sustainable development.

Keywords: ecological awareness; farmer knowledge; rural revitalization; education and training; sustainable development

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1. Introduction

Increasing urbanization has caused a shortage of labor resources in rural areas, which impacts the sustainable development of rural areas. To reduce the gap between urban and rural areas, the government of China introduced Rural Revitalization (RR) in 2015. Keeping a view on resource-exhausted cities, China adopted a "high-quality development" policy for the sustainable development in 2017. This policy is intended for a green transformation in its mode of development. China's notion of "ecological civilization" can be interpreted as an innovative framework for development and governance, grounded in political decision-making. The primary principles are environmental management, ecological restoration, and green development, which are markedly different from industrial and agricultural

civilizations [1]. A harmonious ecological environment is the foundation for implementing, and the sustained driving force for promoting, an RR strategy. As the world's largest developing country, rapid urbanization and rural industrialization significantly affected rural revitalization through environmental issues such as air pollution, food safety, water pollution, and ecosystem degradation [2,3]. Ecological problems have become an urgent challenge for rural construction in China [4]. Farmers are the sole decision-makers in their field [5,6], so enhancing farmers' ecological awareness is critical for effectively promoting the ecological revitalization of rural areas. In developing countries, such as China, farmers' low level of education and environmental awareness [7,8], as well as the limited technical level of grassroots organizers, significantly restrict their ability to participate in this. Therefore, considering the crucial role of raising awareness in the adoption of good agricultural practices, strategies to follow to achieve this goal have been suggested.

Previous studies on rural ecological environmental issues predominantly focused on causes, characteristics, governance methods, and generalizable research cases. Some studies focused on evaluating the current situation, problems, and related engineering technologies to solve ecological problems, starting from ecological factors such as water, soil, and atmosphere [9–11]. Additionally, previous studies discussed common problems and solutions in ecosystems at the macro level, such as macro policies, social management, and environmental regulations [12–14]. China has a vast territory, and problems with different regions' agricultural ecological environments inevitably vary. Therefore, previous studies examining the rural ecological environments in different regions have only explored feasible solutions suitable for local rural revitalization [15,16].

Several previous studies had beneficial discussions on rural ecological revitalization. However, the problem of insufficient attention paid to the ecological awareness of farmers in rural ecological revitalization persists. The key to rural ecological revitalization lies in individuals. The concept, attitude, and willingness of farmers to participate in rural ecological governance are directly related to the quality and effectiveness of rural ecological revitalization. Therefore, exploring ways to strengthen farmers' ecological awareness has become the primary task for effectively promoting rural ecological revitalization.

Research on knowledge graphs (KGs) is founded on theories including co-occurrence analysis, cluster analysis, and word frequency analysis in the bibliometric analysis method. It employs visualization analysis tools to examine the domestic and international literature data on the subject. By constructing diverse KGs, it can dynamically, clearly, and intuitively elucidate the research advancements, topics, and focal points within the subject area. KGs have become essential information frameworks that facilitate access, integration, and utilization of the extensive data being generated. KGs also function to encapsulate the knowledge acquired and utilized by contemporary machine learning techniques.

Based on the above, this study followed the theoretical logic of "posing, analyzing, and solving problems" and, based on the relevant literature, statistical data, and typical cases, combined with the current situation of rural ecological revitalization, studied the ecological awareness of farmers. The main objective of this study is to find the current status of rural ecological revitalization globally by using KGM. Other specific objectives include: (1) To find the problems with their causes by organizing the logical relationship between rural ecological revitalization and farmers' ecological awareness. (2) To provide policy recommendations to enhance awareness and provide guidance for rural ecological revitalization. The main contributions are summarized as follows: (1) This study visualizes the research on rural ecological revitalization by using the Knowledge Graph Method. (2) Discussion of the influence mechanism can help policymakers strategize the cultivation of farmers' ecological awareness, provide promising research directions for relevant studies, and promote academic progress in rural ecological revitalization. (3) The study has valuable implications for policymakers, industrialists, and academicians in developing strategies for interventions to promote rural ecological revitalization and farmers' ecological awareness.

2. Materials and Methods

This study applied the Knowledge Graph Method (MKD) to analyze the current global research status of farmers' ecological awareness in rural ecological revitalization, and conducted a comprehensive and objective analysis. The Web of Science (WOS) core database was selected as the data source, and the literature from 2018 to 2023 was retrieved. "Rural economy" and "rural economic environment" were used as keywords, and a total of 4233 related studies were found. Additionally, "farmers' ecological awareness" and "farmers' ecological civilization" were used as keywords, and 237 related studies were found. Therefore, regarding studies on rural ecological revitalization, studies on farmers' ecological awareness accounted for approximately 5.6%. Subsequently, VOSviewer was used as bibliometric analysis software, and the visual mutation detection function was used to analyze the research status.

Figure 1 presents a collaboration network diagram of the leading countries researching rural ecological revitalization.

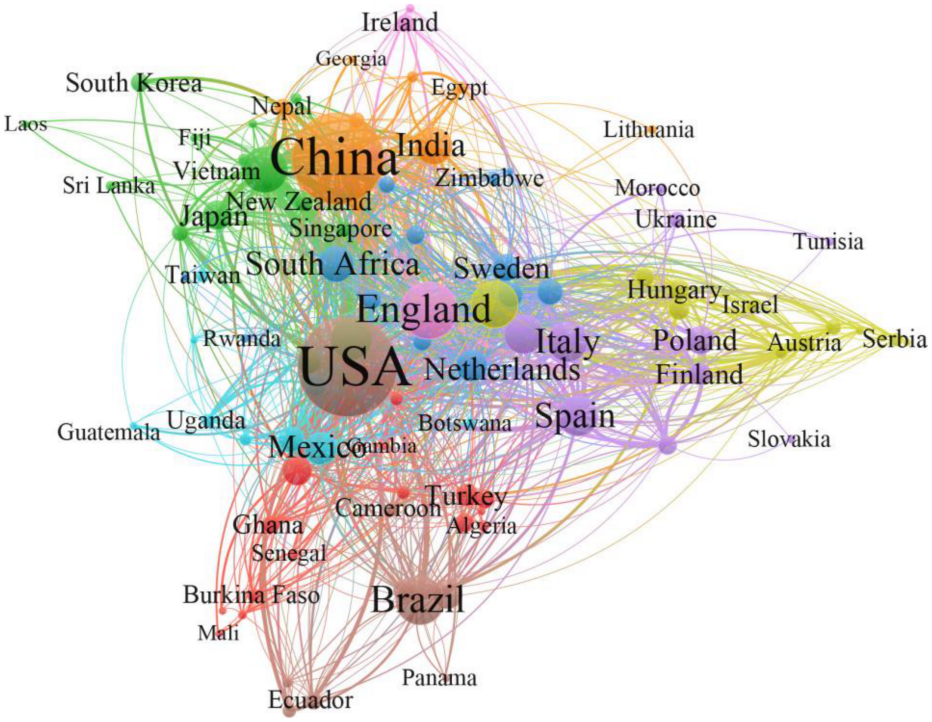

Figure 1. Collaborative networks analysis between countries.

The countries where the researchers were located were predominantly the USA, China, and England, accounting for 24.26%, 20.43%, and 8.07%, respectively, whereas the proportion of those from other countries was 47.24%. The colors of the bubbles represent different countries, and the size of the bubble represents the number of publications, with the larger the bubble size, the more studies published. The line connections represent inter-regional cooperation, with the thicker the connection, the higher the cooperation intensity, and the more connections, the more tightly the regions cooperate. The countries with outstanding research in this field are mainly developed countries with developed socioeconomic production or developing countries in a rapid development stage. Such countries give more importance to the study of rural ecology than other countries. According to the statistics, China's publication volume in rural ecology research accounts for approximately one-fifth of the total. As shown in the collaborative network graph, its density is only second to that of the United States, indicating that China's research level in rural ecology is at the forefront of the international community. Research [17] found overall development status relatively stable with signification spatial variations in an RR study in 30 regions of China. Compared with developed countries, China's rural ecological environment has improved and entered

a relatively stable state, and China's rural ecological revitalization is undergoing a profound developmental revolution. Figure 2 presents the relationship between various keywords in the literature on ecological awareness among farmers.

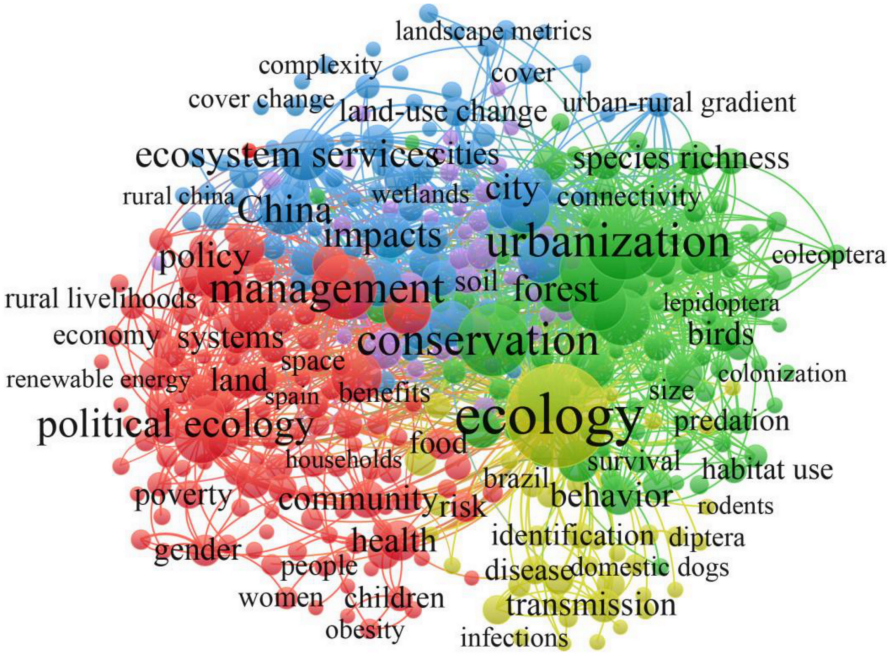

Figure 2. Co-keywords network analysis.

The main keywords included "farmers", "conservation", "management", "ecosystem services", and "agriculture". Currently, academic studies on farmers' ecological awareness include why it is necessary to shape their ecological values, conduct surveys, and summarize their ecological awareness. The Co-Keyword Network analysis elucidates the interrelation of knowledge components, concepts, technologies, and methodologies within the specific research, assisting researchers in recognizing emerging trends and under-explored domains.

Farmer satisfaction with rural ecological construction data were collected from the Gansu blue book: *Analysis and prediction of public opinion in Gansu* (2024) [18]. From May–October 2023, a research team carried out surveys on 14 cities, and some counties, townships, and villages in Gansu Province. The survey summary was predominantly conducted using questionnaires, analyzing the current situation, problems, and influencing factors of farmers' ecological awareness from different perspectives and proposing corresponding countermeasures. Originally, they collected 15 aspects of opinion, but only the data related to farmer ecological awareness were reanalyzed in this study. To show the progress of the RR program, we adopted the data of water-saving irrigation areas and fertilizer usage during project period from the Gansu blue book [18].

3. Results

3.1. Development History of Cultivating Ecological Awareness Among Farmers

3.1.1. International Context

The study of ecological awareness includes the concept of cultivating farmers' ecological awareness. The American scholar Leopold first proposed the term "ecological consciousness": "Without ecological consciousness, obligations beyond self-interest are just empty talk, so the problem we face is to expand the scale of social consciousness from humans to the Earth (nature)" [19]. Later, Soviet scholar Kirusov officially proposed the concept of "ecological consciousness", and defined it as "the sum of subjective points, theories, and emotions that reflect the mutual relationship between society and nature in terms of the optimal solution to social and natural relationship problems based on the

specific possibilities of society and nature" [20]. With attention being paid to ecological awareness issues after the 1980s [21], ecological villages emerged and prospered as a branch of conceptual communities. Gilman [22] believed that an ecological village is "a settlement with all of its characteristics on a human scale. Within the settlement, human activities do not damage the natural environment. They are integrated into it, supporting healthy human development and sustainable development in the future" [23]. The Global Ecological Village Network (GEN) states that "an ecological village is a concept, tradition, or urban community that integrates sustainable development elements such as economy, nature, culture, and community through local autonomous participation in design, thereby promoting social progress and ecological regeneration". Dissimilar to the construction of ecological villages in China, the ecological village movement in the West appears to be a post-industrial phenomenon and more of a social trend of pursuing an ideal lifestyle [24].

As the biggest beneficiaries of the Industrial Revolution, the early-developing Western countries have faced severe ecological and environmental problems, which promoted the ecological civilization enlightenment of rural residents and ecological civilization construction practices in rural environments in those Western countries (Figure 3). Simultaneously, it has important implications for China's rural ecological revitalization and the cultivation of farmers' ecological awareness. For example, the rural environment in the UK is characterized by its historical charm and humanistic sentiment, which are closely related to its advanced rural environmental protection concepts, environmentally friendly rural planning and design, sound rural environmental protection system, and the participation of environmental organizations, such as the UK Rural Protection Association [25]. Since their emergence in the mid-to-late 20th century [26], American ecological villages underwent decades of development, gained a wealth of ecological experience, and have had a broad impact [27]. Influenced by early concept communities, ecological villages value the compatibility of the ecological environment and good support for local culture with the goal of sustainable development and forming a bottom-up, self-organizing way of life. Germany implemented two significant measures to promote the development of rural areas: land consolidation and village reform. Through these two measures, urban-rural equivalence can be achieved [28], and public participation and other principles are followed to guide rural community residents to spontaneously improve their quality of life, promote their sense of responsibility and internal development, stimulate synergies, and enhance their overall efficiency [29]. Through its modernization, Japan was constrained by resource scarcity and environmental conditions. Consequently, Japan started building a circular society earlier, and continued to pay attention to issues such as agricultural and rural modernization. Therefore, Japan utilizes the development of ecological agriculture as its core and vigorously supports the development of "environmentally friendly agriculture" through laws, technologies, policies, and other aspects. By establishing development models, such as "rationalization of agricultural land retention" and "collective farming", Japan promoted the joint participation of Government, enterprises, civil society organizations, farmers, and other stakeholders, ultimately achieving good results in intensive and large-scale utilization of agricultural land and realizing the circular utilization of rural resources [30]. Regarding water resource management in Egypt, it has gone through three main phases: in the first phase, farmers relied on water lifting techniques and watershed irrigation systems to allow the floodwater stored during the Nile floods to be transported to the farmland through canals, i.e., the seasonal management of irrigation using the floodwaters; in the second phase, as a result of the explosive growth of human activities, the construction of the Suez Canal, the signing of the Sultan's agreement concerning the Nile, the construction of the Aswan High Dam, etc., were completed, followed by the issuance of the first water resources plan by the Egyptian Government in 1978; and in the third phase, in response to the realization of the sustainability of water resources, the Egyptian Government enacted the promulgation of legal provisions such as the Drainage and Irrigation Law, the Sewerage Law, the Environmental Law, and the Farmers' Participation Law, i.e., the integrated management of water resources in the context of the transboundary basins [31]. Furthermore,

developed countries started the development of similar rainwater management systems earlier than China. For example, the US controls rainfall runoff and maintains the ecological sustainability of water quality through concepts and methods such as Best Management Practices (BMPs), Low-Impact Development (LID), and Green Infrastructure (GI); Australia uses the Water-Sensitive Urban Design (WSUD) system to mitigate flood risk; the UK adopted the Sustainable Drainage Systems (SUDS) system to promote the regional water cycle, increase surface water utilization, reduce surface water harvesting, and minimize flooding. Germany uses aquatic plants to create a microbiologically enriched, sponge-effect purification pond [32].

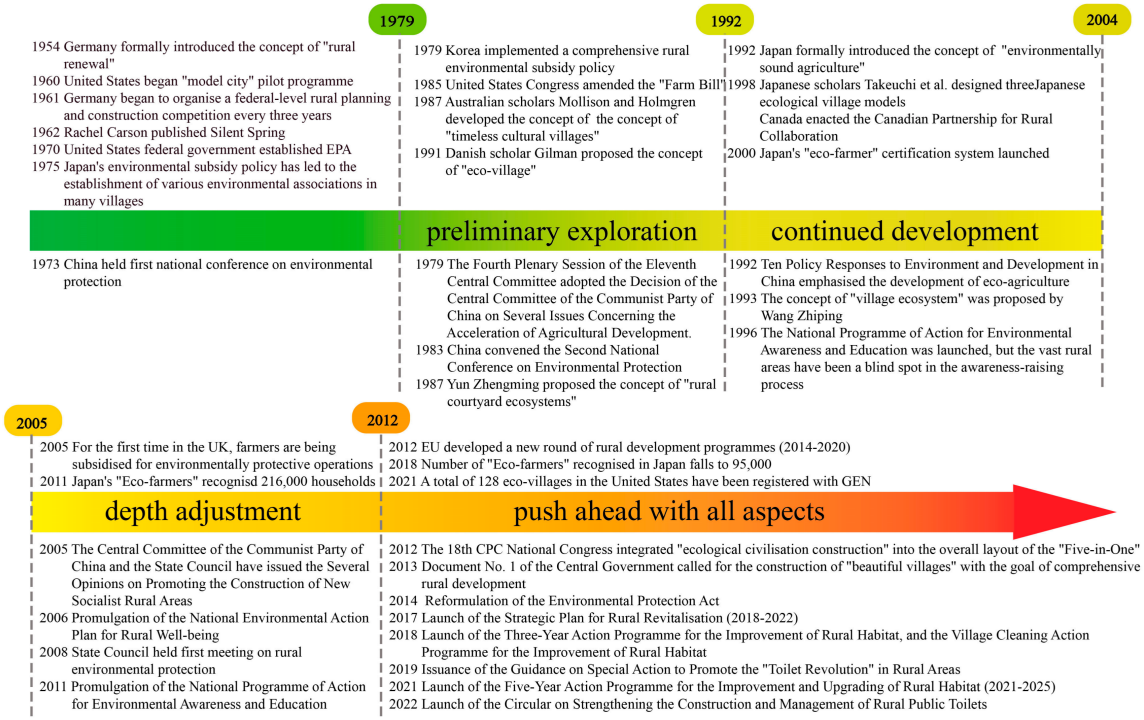

Figure 3. Comparative historical development of rural ecological civilization in China and other countries.

3.1.2. Chinese Context

China's exploration and practice of rural ecological civilization construction and farmers' ecological awareness cultivation began after the reform and opening up (Figure 3). Throughout history, China's rural ecological civilization construction was based on Marxist ecological thought as the theoretical foundation. "Learning Marx refers to learning and practicing Marxist ideas on the relationship between humans and nature" [33]. The relationship between humans and nature is the primary one that human survival and development must face and is an unavoidable issue in any era. Since its inception, Marxist theory has been striving to solve the problem of correctly handling the relationship between humans and nature. Marx proposed that humans and nature are dialectically unified, emphasizing the need to respect the laws of nature. Marx's ecological criticism of capitalist agriculture is essential to his ecological thinking. Additionally, he criticized the destruction of the agricultural ecological environment through capital rationality: "The spirit of capitalist production hoping to obtain immediate monetary benefits is contradictory to agriculture, which supplies all the living conditions that humanity will continuously need for generations to come" [34]. Such a realization reflects the highly integrated theoretical research and practical exploration of ecological civilization construction, forming a Chinese paradigm for developing contemporary world ecological civilization. From a rural perspective, farmers' ecological awareness is an effective way to solve rural ecological problems and an inevitable

requirement for building a new socialist countryside. From the farmers' perspective, their ecological awareness is needed to improve quality and cultivate modern farming.

3.2. Farmers' Ecological Awareness

3.2.1. Achieving Results

Ecological agriculture has become an international trend in recent decades. Farmers in developed countries have relatively mature ecological education, and resource-saving and environment-friendly agricultural models have been well developed in developed countries. For example, Israel's water-saving, environment-friendly, sustainable, ecological, precision, and facility agriculture models. Sweden utilizes farmer associations to promote rural development and improve the services and operational models of the regional skiing tourism industry. Japan is implementing the "Village Building Movement" to safeguard the interests of farmers and rural areas. By popularizing ecological and agricultural technology education among villagers, the integrated development of rural and agricultural areas is promoted, the realization of urban–rural linkage development and modern governance is accelerated, and the successful experience of Eurasian Ma Village to promote the "One Village, One Product" movement is used nationwide in Japan. Similarly, the UK implements a village town model, with typical planning representatives such as the Howard Rural Urban Plan and the Greater London Plan. Its core aim is to strengthen the development of small towns, fully consider the needs of villages and farmers, and jointly plan to develop new towns. South Korea promotes the "New Rural Construction and Development Movement", guided by the Government with farmers as the main body, and based on promoting comprehensive rural and regional development with the overall goal of improving efficiency, while gradually changing the role of the Government, unleashing the enthusiasm and initiative of farmers, and comprehensively supporting rural development.

With the improvement in China's rural economic level, farmers' quality of life has also improved. Some individuals have begun reflecting on their behavior. Gradually, they have realized that the quality of the surrounding ecological environment is closely related to their living standards. Therefore, they are increasingly eager to enjoy fresh air, clean water sources, safe food, and beautiful environments. Public environmental awareness is constantly increasing, and a harmonious situation where everyone participates in ecological environment protection is being formed. Since implementing the Three-Year Action Plan for Rural Living Environment Improvement in 2018, gratifying changes have been observed in farmers' environmental and health concepts, and the quality of life has generally improved. This was reflected in two aspects: farmers' increasing recognition of rural ecological governance and the gradual strengthening of their awareness of ecological environment protection. For example, according to Gansu Province's data statistics [18], in a survey on the satisfaction of farmers with rural ecological construction, more than 60% of the respondents expressed satisfaction with the local ecological environment, drinking water safety, air quality, garbage recycling, treatment, and others. More than 90% of the respondents expressed satisfaction with the current implementation of ecological construction, and the vast majority fully affirmed the recent efforts made by the Gansu Province in ecological governance and rural environmental protection (Figure 4A). By increasing environmental protection publicity, conducting education and training, commending advanced personnel, creating ecological festivals, and enhancing public participation, various provinces and regions on the Qinghai–Tibet Plateau gradually popularized the concept of an ecological civilization that respects, conforms to, and protects nature. This awareness program gradually replaced the traditional concept of "relying on mountains to eat mountains, relying on water to eat water" with the new concept of "green mountains and clear waters are mountains of jewels, also ice and snow are mountains of gold and silver" [35]. Xizang continued to conduct activities such as the "food conservation" and the "Clean Your Plate Campaign" to enhance urban and rural residents' awareness of water and electricity conservation, and green life gradually became a social fashion for Xizang individuals [36]. In addition, according to official data from the National Bureau of

Statistics (source: National Bureau of Statistics), farmers' agricultural production activities gradually show a "green" background. The use of agricultural fertilizers and plastic films has been decreasing annually. In contrast, soil erosion control and water-saving irrigation areas are constantly expanding (Figure 4B,C). The "Five Modernizations" of straw utilization in China is accelerating, and the comprehensive utilization rate of straw in China reached 87.6% in 2020; the comprehensive utilization rate of straw in many areas has significantly exceeded the national average. From 2019 to 2021, the straw collection, storage, and processing capacity of Longzhou County, Fujian Province, increased from 20,000 tons to 150,000 tons. This increment indicates that the majority of farmers have significantly enhanced their modern concepts, are actively participating in the construction of rural ecological civilization, are increasingly identifying with China's ecological governance and that individuals are beginning to pursue new civilized lifestyles, such as green, scientific, and healthy lifestyles, and that villages, as a habitat for agricultural livelihoods and rural landscapes, are deeply rooted in nature, and integrate various elements centered on the villages into a cohesive ecological system [37].

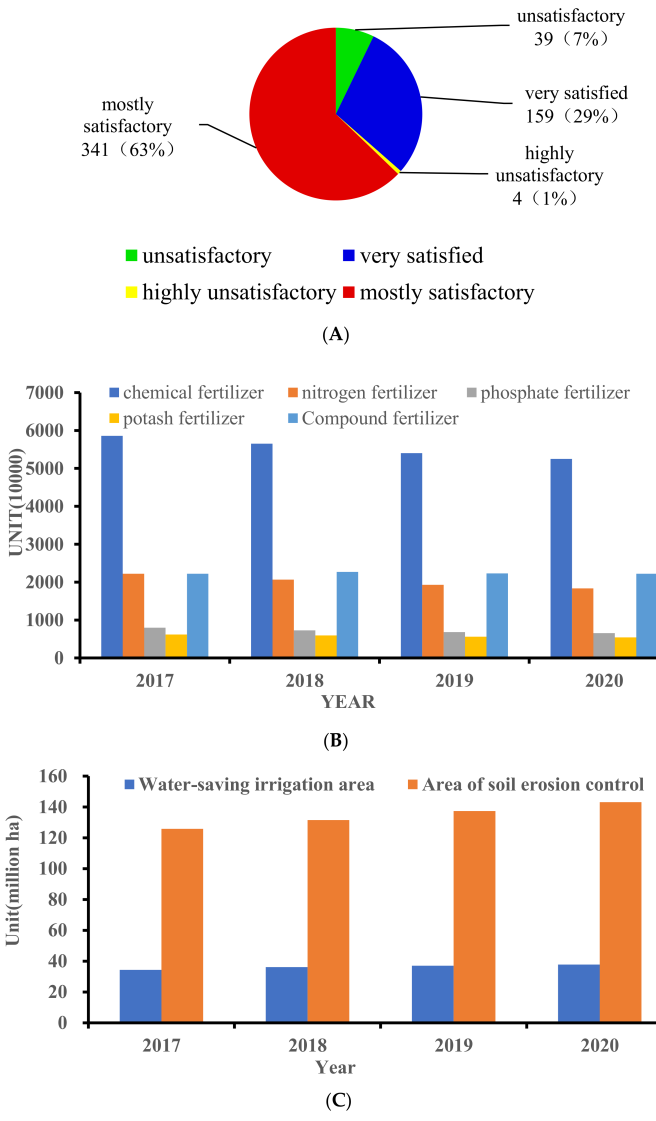

Figure 4. Results from the survey by Gansu Province's data statistics [18]. (**A**): People's satisfaction with "ecological livability" (strengthening the management of rural environmental problems and promoting a favorable rural ecological environment); (**B**): Changes in agricultural applications of fertilizers; (**C**): Water-saving irrigation and soil erosion control.

3.2.2. Problem Analysis

- Awareness of ecological ethics and moral qualities among farmers.

"Human beings are the bearers and subjects of social development. The level of human quality directly determines the role of humans in economic and social development to a certain extent, and even affects the speed of human historical development" [38]. With the development of Western society and individuals' understanding of ecological issues, laws and regulations regulating farmers' ecological and ethical behavior awareness emerged, establishing the legal foundation for the ecological ethics education of Western farmers. Religion is a highly influential social force in Western society that provides ecological ethics education to farmers. Through religious activities, rural areas subtly integrate relevant ethical principles and norms into farmers' production and life practices, enabling them to internalize and externalize ecological morality in their hearts and actions. Thus, ecological knowledge and agricultural technology education are highly valued in developed countries. For example, science education in American kindergartens includes guiding children to "understand the material world" and "understand various natural forces and their mutual influences". Since the 1960s, all counties in the United States established at least one agricultural cooperative extension education office, which stipulates that secondary agricultural vocational education should provide students with comprehensive knowledge of agricultural production and soil protection, selection and improvement of livestock and crops, production of agricultural products, application and improvement of agricultural machinery, farm management and furniture maintenance, storage and sales, and other knowledge and skills. Such knowledge and skills enable students to learn how to effectively utilize various resources to develop agricultural production and become modern agricultural laborers and technicians. In France [39], in addition to regular agricultural and forestry schools, ecological agriculture knowledge education and training for farmers includes environmental protection, forest maintenance, land improvement, agricultural management, agricultural services, and agricultural tourism. Narayanamoorthy conducted a two-season study in four irrigation villages in the Pudukkottai region of Tamil Nadu, India, to explore the correlation between farmers' education levels and rice productivity. A binary analysis indicated that the group of farmers with higher education levels (receiving more than five years of school education) had a higher input–output ratio than the group of farmers with lower education levels (receiving less than five years of school education) [40]. According to a survey by Arcury [41], no significant correlation was observed between environmental awareness and knowledge when individuals had a low level of environmental understanding. However, the growth of environmental knowledge can change individuals' attitudes toward the environment, which can manifest in their behavior, and environmental knowledge and attitudes can affect the formulation of environmental policies. Martin et al. [42] proposed that inner emotions and ecological knowledge significantly affect ecological behavior and are independent; emotional components have better predictive power for ecological behavior than cognitive components. With the acceleration of industrialization and urbanization, Western society eliminated the dual urban–rural structure, and most rural areas completed the transformation to cities or urban areas, with farmers becoming urban or urban residents. Previous studies on the psychology and behavior of residents in mainstream Western economics have reference significance for the study of ecological ethics and moral issues of farmers in China.

Over the past 40 years of China's reform and opening up, an undeniable fact is that the urban–rural gap remains significant. Owing to the limitations and backwardness of the farmers' cultural levels, many groups break free from the constraints of social morality due to petty personal gains. These groups still exhibit typical small-scale farming ideas such as self-interest, exclusivity, and isolation in production and life. They often pay attention to the material needs of individuals and families and exhibit a mindset of "interests belong to themselves, environment belongs to everyone", focusing on ecological awareness. They may consider phenomena such as cutting trees and flowers, garbage littering, sewage flowing horizontally, and poultry manure littering to have nothing to

do with them. "The root cause of an ecological crisis is not a technical problem, but a disorder in the thinking, vision, and value priority order inherent in individuals' minds in an industrialized society" [43]. A previous study selected 200 villagers from a village in Gansu Province and surveyed the reasons for the problems in rural living environment improvement [18]. The vast majority of the villagers believed that the reasons for the problems of rural habitat improvement were multiple, including the lack of awareness of the masses, the lack of financial support, the lack of technical conditions, the poor natural conditions, and the lack of attention from the local government, and the reason that ranked first was 'Lack of awareness among the masses', with 72.5% of the villagers interviewed agreeing that villagers' lack of awareness of the environment is one of the reasons for the problems of rural habitat improvement. Currently, the vast rural areas of China face the dual task of economic development and ecological governance, and such contradictions are very prominent. Although it is well-known that "green mountains and clear waters are like mountains of gold and silver", when there is a conflict between the two, the short-sighted behavior of focusing on mountains of gold and silver still exists. In some rural areas of China, particularly remote and underdeveloped areas, farmers are eager to achieve material wealth growth as soon as possible. Coupled with their weak cultural foundation, they often exhibit more utilitarianism in production and life, leading to a certain degree of bias in understanding policies such as "green mountains and clear waters are like mountains of gold and silver", which unconsciously damages the rural environment.

- Insufficient motivation for farmers to participate in rural ecological governance.

Rural construction cannot be separated from agricultural development because economic support and agricultural development require relevant agricultural policies and laws to ensure that developed countries mature. For example, although the United States is an immigrant country with more than 200 years of history, its agricultural regulations are comprehensive. As early as 1862, the US Department of Agriculture positioned agriculture as the national economy's foundation for manufacturing and commerce. Since Roosevelt's New Deal in the 1930s, agricultural support and protection policies in the United States gradually became complete and comprehensive after decades of development [44]. Various levels of government in Germany implement economic policies and legal measures to protect and develop agriculture in rural areas. First, to provide comprehensive assistance policies and financial and tax subsidies, such as establishing a specialized policy bank—the German Agricultural Pension Bank—to provide financing channels for agricultural enterprises. If enterprises invest in expanding their scale, reducing costs, or introducing environmental protection equipment, the Government should provide subsidies and loans [45]. Second, comprehensive and extensive tax incentives, such as tax exemptions for agricultural businesses and motor vehicles, are recommended. Although the percentage of agricultural tax in the national tax revenue is not high, the percentage of agricultural investment in the national budget is higher than the percentage of agricultural tax in the national tax revenue, which indirectly reflects the importance of agriculture.

The reason for Chinese farmers' insufficient participation in rural ecological governance is the need for more institutional mechanisms of grassroots ecological governance in rural areas. First, the governance model involving multiple stakeholders remains imperfect, with problems such as the unclear responsibilities of investment entities, difficulty entering social forces, and insufficient mobilization of the masses. Grassroots governments have become the sole entities. Due to the lack of subjectivity and unchanged attitudes among farmers, many villagers have a mentality of "waiting and relying on demand" [46]. The Government often takes over too many responsibilities, while farmers are predominantly bystanders and passive, often in a state of marginalization and detachment. Second, the communication and feedback mechanisms between rural grassroots organizations and farmers should be improved. The degree of information openness and transparency in rural ecological governance could be higher, and better communication channels hinder farmers' active roles, dampening their enthusiasm to participate in rural ecological governance [47]. Third, problems with rural ecological supervision and punishment mechanisms are evident,

such as overly formalized supervision, insufficient punishment, and insufficient deterrence, which cannot effectively constrain farmers' non-green behavioral activities. For example, reducing carbon emissions from agriculture can reduce the risk of land droughts [48]. The government of Yongding District of Zhangjiajie City, Hunan Province, has included the environmental protection work into the scope of official performance assessment, established the joint conference system of environmental protection and strengthened the publicity of environmental protection, thus improving the rural ecological environment of Yongding District and significantly enhancing the people's awareness of environmental protection. Up to now, the region has built 1 national-level ecological town with beautiful environment, 12 provincial eco-towns, 22 provincial eco-villages, and 66 municipal eco-villages [49]. However, an incomplete legal system for rural ecological revitalization also leads to insufficient motivation for farmers to participate in rural ecological governance. First, a certain degree of lag is evident in rural environmental legislation, and the cultivation of ecological awareness among farmers needs to have policy systems. Additionally, problems in constructing the environmental legal system, such as "emphasizing technical norms over ethical norms and emphasizing legal enforcement over moral self-discipline", are evident, and no rules and regulations have been established to guide the shaping of ecological values for farmers. Furthermore, the specific institutional norms for farmers to participate in rural ecological governance are "missing" [50]. Second, sound agricultural ecological compensation systems are lacking. Currently, most rural farmers are more concerned about material living issues and should pay more attention to environmental issues. Although ecological compensation policies, such as returning farmland to lakes and forests, have been implemented in precision poverty alleviation, these relatively broad regulations only apply to some rural areas, and need a comprehensive and unified standard system. Third, the regulatory mechanisms must be unified. Cultivating rural ecological ethics is a highly complex systematic task involving rural production practices, rural cultural construction, and farmers' daily lives and consumption patterns. It is not a single institution or department; however, it requires the joint attention and collaborative cooperation of various administrative departments, rural communities and families, and civil society organizations. The Ministry of Ecology and Environment, the Ministry of Finance, the Ministry of Agriculture and Rural Affairs, and the Bureau of Rural Revitalization have their plans. A clear definition of departmental power is not conducive to improving the implementation efficiency of rural ecological revitalization [51]. For example, the ecological and environmental protection of rivers and lakes requires the participation of departments and personnel responsible for cleaning work, the participation of pollution treatment monitoring personnel, the supervision of the prohibition and restriction of animal husbandry, and the supervision of anti-electricity, explosions, and toxic fish by the fishing administration. However, in cultivating ecological ethics, there must be more communication and coordination among various departments; a lack of overall correlation, and closure and fragmentation, indicates insufficient coordination and symbiosis among governance entities [52]. In 2018, in Guangxi Province, the Yulin city fu cotton district's government formed an action plan for water pollution prevention with control of the constitutional rules as the basic basis, around the "sewage, pool, collector, returning" governance process to redesign the collective selection rules. In the government, market and farmers cooperate with each other. At the same time, in the rural fu cotton area, they realized the effective allocation of biogas slurry resources and also obtained the good environmental governance effect [53].

- Farmers have a short-sighted view concerning the development of rural ecological economies.

Currently, the ideological education system for cultivating ecological awareness among Chinese farmers is not yet perfect, mainly manifesting in the lack of theoretical studies on ecological civilization issues, the backwardness of teacher–team construction, the insufficient excavation and promotion of rural ecological cultural resources, and the low attention of some grassroots party organizations, party members, and cadres to ecological education.

Such deficiency resulted in most farmers having a short-sighted view of the development of the rural ecological economy and needing to change their fixed thinking, production, and lifestyle fundamentally. The ecological agriculture education and training models for farmers in foreign countries can be summarized into three main models: the East Asian, Western European, and North American models (Table 1) [54]. Current ecological and moral governance methods in rural China are singular and exhibit closure and fragmentation characteristics. The primary manifestation is that some units or departments often promote ecological ethics governance based on their own requirements. Most of such promotions are made with limited effort, predominantly through radio and television, banner displays, and the distribution of promotional materials. These ecological moral governance methods, which remain in verbal preaching, often need help to realize the seriousness of ecological problems. Owing to their inability to deeply understand the detailed rules and specific operational methods of ecological environment protection, some farmers, even if they developed environmental awareness, do not know how to start protecting the ecological environment. Consequently, the effectiveness of ecological and moral governance was low [55]. In vast rural areas, particularly underdeveloped areas, many farmers are satisfied with the status quo and are self-sufficient. They need to recognize the significant ecological and economic benefits of the abundant natural resources in rural areas and have specific knowledge reserves, funds, and technological conditions. Therefore, they are unable to take the initiative, or lack the enthusiasm or creativity to upgrade traditional agriculture and industry in a green way. Agricultural producers need the correct understanding of ecological agriculture. If they fail to understand the benefits and concerns of ecological agriculture, they will fear the risks of transformation, and worry regarding whether policies can play a protective role. Thus, their polarity and importance are significantly reduced.

Table 1. Agro-ecological education and training models for farmers abroad.

Training Modalities	Type of Application	Country	Main Features
East Asian model	Cultivated land per capita is lower than the world average, and the scale of landholding operations is smaller.	Japan, Korea	Government-led, national legislation to guarantee multi-level, multi-directional, and multi-objective education and training for farmers at different levels and types of training
Western European model	Agricultural production with the family farm as the central business unit	UK, France, Germany	Organic combination of government, schools, research institutions, and agricultural training networks to educate and train farmers through various forms of general, vocational, and adult education.
North American model	Mechanized farming and large-scale agricultural production	USA	Constructing an agricultural science and education system, with agricultural colleges as the mainstay, will help realize the organic combination of agricultural education, agricultural research, and agricultural technology promotion, thereby improving farmers' overall quality.

4. Discussion

Increasing farmers' ecological awareness is an essential factor in achieving rural area ecological revitalization. To find solutions, while adhering to the principles of government leadership and farmer subjectivity, the ideological foundation of ecological awareness

of farmers can be strengthened through ecological education. Ecological awareness can be deepened through ecological practice. Laws and regulations also play a crucial role in ensuring the sustainable development of the rural economy to enhance the ecological awareness of farmers.

4.1. Government Leadership

First, ecological awareness adheres to the principles of government leadership and farmer-centeredness. There is a logical coupling and a mutual promotion relationship between grassroots party organizations and rural ecological revitalization (RER). They are manifested as follows: the former is the vanguard force of the latter, providing guidance and organizational support; the latter is an effective way to consolidate the former's leadership position, effectiveness, and cohesion. The Government's primary responsibility is to cultivate ecological awareness among farmers. The Government's role is uniquely important and authoritative in this regard. A higher level of ecological value than the public, a higher level of ecological moral self-discipline, and a higher level of ecological consciousness are inevitable requirements for grassroots governments. The Government should shoulder the primary responsibility of ecological "good governance", implementing an ecological administration, achieving ecological transformation of its functions, improving innovation capabilities, and strengthening public service capabilities in the ecological field. As the "masters" and the main body of RER, the vast number of villagers should exert their intelligence and talents, accepting and practicing ideological values and moral norms to meet the requirements of the ecological civilization era. They can achieve this through self-learning, social education, civil consultation, and self-reflection, and enhance their ecological awareness.

4.2. Farmer Centered Education

Second, ecological civilization education should be strengthened for farmers, and green production and lifestyle should be promoted. Green production will increase healthier food and ensure food security. Cultivating ecological awareness among farmers should focus on imparting ecological knowledge to them while stimulating their ecological moral emotions, forging their ecological moral will, and guiding and strengthening their ecological moral behavior [56]. The ecological ideological education of farmers should follow the "agriculture as the foundation" and "ensuring material foundation" principles, which cannot be separated from the material needs of farmers, fully respecting their pioneering spirit. Attention should be paid to popularizing ecological ideological education, attempting to be as straightforward as possible, and environmental educational content that is close to farmers' actual production and lives should be identified. The forms of education should be diverse. Thus, television's role in rural environmental publicity and education should be fully utilized. Usually, livelihood programs are more popular among farmers, such as the "Life Online" program of Qingdao TV Station, which includes "Environmental Protection Tips" that teach farmers environmental protection measures and methods related to production and life. This form of publicity and education is more intuitive, and farmers can understand and learn as soon as they read it [57]. Additionally, the exemplary role of some models and local elites can be utilized to create an ecological and cultural atmosphere, stimulate farmers' enthusiasm, inspire them, form resonance, improve their understanding, to learn, to emulate, and to improve their ecological literacy. Furthermore, considering the construction of green production and lifestyle as the starting point, farmers' enthusiasm and initiative to participate in ecological agriculture should be enhanced. First, the green transformation of agricultural production should be promoted, which will ensure socioeconomic security as well as food security. Rural areas should strengthen the promotion of green technologies, promote efficient resource utilization, and provide ecological agricultural training for farmers. Furthermore, water conservation, energy-saving technologies, and biogas production technologies should be tailored to the local conditions [58]. In addition, to assist in building a green lifestyle by establishing a long-term mechanism to

change traditional consumption patterns, farmers' education on green consumption can be strengthened, and they can be provided with concrete green consumption methods and products [59].

4.3. Investment and Industrialization

Capital investment should be increased to promote green industrialization and the industrial ecology of rural areas. The effectiveness of a rural ecological economy is related to the cultivation of ecological awareness among farmers, and it is necessary to increase investment in rural agricultural development continuously. A diversified investment mechanism led by government investment, supplemented by farmer support, and operated by social enterprises should be established to increase urban support for rural areas, improve funding guidance policies and flexible enterprise loan policies, reduce loan interest rates, increase tax exemption and compensation efforts, and extend repayment periods. By introducing a diversified, competitive mechanism into rural ecological revitalization, the construction of ecological agriculture infrastructure can be intensified, and modern scientific and technological means can be comprehensively utilized. By integrating agricultural production, industrial development, and protection of natural resources into an ecological, economic system with ecological industrialization as the main body, an agricultural production system with a reasonable layout can be established, regional characteristic agricultural products can be created, their value can be increased [60], brand effects can form, and economic benefits can be achieved, concerning the virtuous cycle and unity of ecological and social benefits [61]. For example, rural ecological resources can be utilized to combine ecological environment governance, green landscapes, and infrastructure renovation. Average variable cost (AVC) theory is used in rural tourism studies to determine rural landscape quality and economic viability [62]. Therefore, ecological service industries such as farmhouse entertainment and catering, tourism and leisure, sports, and health and elderly care can be developed. An industrial system that integrates rural industries such as ecological agriculture, ecotourism, and leisure and recuperation can be established, forming ecological and economic advantages for rural revitalization. For example, the Qinling region's development systems include infrastructure projects, tourism, and agricultural expansion [63]. Consequently, China can draw on good development theories and the experiences of foreign countries. Based on the local resources of each country, combined with creative thinking and logic, foreign countries can integrate agriculture with creative elements, such as technology and traditional culture, expand agricultural functions, increase agricultural added value, and develop traditional agriculture into a modern agricultural model that integrates production, leisure, ecology, and technology (Table 2).

Table 2. Summary of eco-creative agriculture development in various other countries.

Nations	UK	France	German	Netherlands	Japan
Paradigm	Leisure Agricultural Tourism	Environmental and ecological benefits	Social life function	High-tech foreign exchange earning	Multifunctional enrichment
Specificities	Combination of primary and tertiary industries, idyllic "agriculture + tourism" innovation	Field crop-based, large-scale specialized farm production, highlighting agro-ecological functions	Breaking down urban-rural boundaries, diluting the urban-rural divide, and protecting the agro-ecological environment	High technological content, advanced production methods, and excellent technical knowledge	Localization, self-reliance, creativity, and nurturing of talented people with a spirit of challenge
Business Entity	Personalized and specialized small farms	Large farms	Family farms	Field Crop and Horticultural Production Farms	Government-led to drive village areas

Table 2. *Cont.*

Nations	UK	France	German	Netherlands	Japan
Government Support	Grants to farmers for projects to improve tourism facilities in rural areas	Provision of various types of financial support, such as low-interest loans for agriculture, emergency grants for agriculture	One-stop shop for agricultural cooperatives, tax incentives, subsidy policies, and creative agriculture programs agreed directly between farmers and relevant government departments	Implementation of a series of nationally appropriate macro-controls and guidance	Government-led, with incentive policies in place, with the Government playing a significant role in advocacy, publicity, and promotion.
Forms of Enumeration	Rural leisure activities combining folklore, production activities, festivals, etc.	Use of agriculture to reduce pollution, specialized farms to provide urban landscapes and recreational areas	Leisure tours, experience tours, and specialty tours for citizens' farms and holiday farms	Greenhouse industry, industrial production, soilless culture, and other technologies	One Village, One Product, Urban Vegetable Garden, Beautiful Countryside
Angle	Market innovation with an emphasis on integrated development	Conceptual innovation and the pursuit of eco-efficiency	Market innovation with a focus on integrated development	Product innovation, highlighting the power of science and technology	Industrial innovation with an emphasis on integrated development

4.4. Legal Reforms

Finally, it promotes constructing a rural ecological legal system and improves the regulatory and ecological compensation mechanisms. With changes in the rural ecological environment, some laws have become incompatible with the practical requirements of rural ecological revitalization. Therefore, modifying, deleting, and abolishing such incompatible laws and establishing new laws and regulations is necessary to enhance their pertinence, feasibility, and timeliness. First, legislators should go deep into rural areas, targeting the characteristics of rural life, combining the production and lifestyle of farmers, and, based on the issues of rural ecological governance, formulate local regulations that correspond with the development characteristics of rural production and the living habits of farmers to achieve the ecological content of legislation and ensure that the ecological rights of farmers are legally protected. Learning, promoting, and implementing these laws and regulations promotes the recognition and strengthening of farmers' ecological, moral awareness, emotions, will, and behavior [64]. Second, ineffective law enforcement should be removed at the source, the discretionary power of environmental protection law enforcement should be regulated, and the fines imposed on farmers should be unified to reduce illegal facts and the degree of ecological damage caused. Adopting the "fault-tolerant mechanism and moderate tolerance" principle would allow them to make occasional mistakes, actively persuade them to reject the "one size fits all" supervision behavior and provide farmers with a gradually adaptive fault-tolerant space. Third, ecological courts should be established to improve environmental supervision. Township governments should release relevant ecological environment information promptly, make the information more open and transparent, and accept the public opinion supervision of the vast rural population. Based on the actual situation of local rural areas, rural environmental legal education can be performed through popularization, simplicity, and daily life, rural legal libraries can be built, farmers can be encouraged to learn relevant knowledge consciously, the assistance role of environmental associations, government departments, professional lawyers, and other groups can be increased. Farmers should be allowed to express their environmental demands legally, reasonably, and orderly. Additionally, the ecological compensation mechanism

should be improved. According to the fairness principle of "whoever benefits compensates, whoever damages pays", farmers should receive reasonable and timely compensation for the ecological benefits of "positive externalities" in agricultural ecological production.

Through the cooperation of education, economy, law, and system, a scientific and systematic pattern of cultivating farmers' ecological awareness can form (Figure 5), promoting the transformation of farmers from "economic individuals" to "ecological individuals" and the sustainable development of rural environments, improving the quality of China's rural ecological civilization construction, and encouraging rural revitalization with the help of green ecological revitalization. Ecological revitalization supports sustainable economic development, ecology, society, and food security. Additionally, it can establish a solid foundation for the rejuvenation of the Chinese notion and contribute to the United Nations' Sustainable Development Goals.

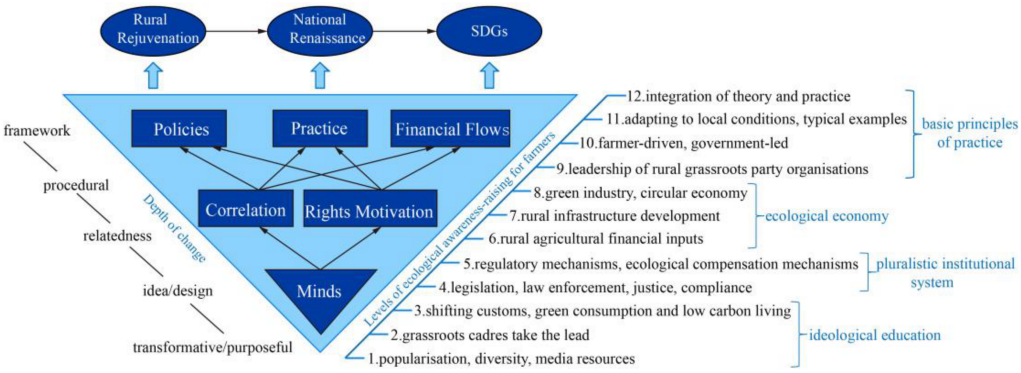

Figure 5. Farmers' Ecological Awareness Incubation System.

5. Conclusions

The revitalization of rural ecology is the "ecological" and "sustainable" driving force that promotes sustainable development in rural areas. Raising farmers' ecological awareness is fundamental to cultivating ecological ethics and morals and building a long-sighted view toward developing rural ecological economies. Data from Gansu Province shows the effectiveness of rural revitalization. More than 90% of farmers feel they are satisfied with the ecological construction work. Water efficient areas are increasing and the use of chemical fertilizers is decreasing while the use of organic fertilizer like straw is increasing. Such revitalization works definitely improve the rural environment and help to promote sustainable development. Farmers need more motivation to participate in ecological governance. However, the promotion of rural ecological revitalization requires scientific guidance. The scientific ecological value of farmers is the "ideology" of rural ecological revitalization, which is an inevitable requirement for realizing the rejuvenation of the Chinese notion. Also, a value guide for every Chinese individual to realize the "Chinese Dream". Therefore, by addressing various aspects, such as adhering to the principle of government leadership and farmers as the main body, strengthening ecological civilization education for farmers, increasing notable fund investments, and improving relevant laws and regulations, the shortcomings of the current rural ecological civilization construction can be addressed. Farmers' awareness of ecological civilization can be improved, and "ecological farmers" can be cultivated for rural ecological revitalization. Which ultimately drives toward sustainable development in rural socio-economy and the nation's food security.

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