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Social Landscape Optimization of Towns and Villages at the County Level by Developing a Compound Ecological Capital System

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Abstract: The development of the social landscape of towns and villages at the county level in China currently lacks sustainability and urgently needs to be optimized. By developing a compound ecological capital system, the optimization of the social landscape will be an important process. Based on the dialectical relationship between landscape production and landscape sustainability, a theoretical framework is proposed as a paradigm of landscape structure. By highlighting the culture base and life proposed in ecosystem services (ES) described in the common international classification of ecosystem services (CICES) methodology, we propose a new social landscape order. We used Hequ County, Shanxi Province, China as the study case, evaluating the ecology level of social capital by gravity. In this paper, four types of optimization approaches for social landscape structure are proposed: completing urbanization (urbanized approach), shaping social landscape (prioritized development approach), protecting nature (scale-controlled approach), and increasing agricultural landscape (migrated and merged approach).

1. Introduction

For towns and villages, landscape or capital usually refers to physical space. The collection of landscape resources constitutes the compound capital of towns and villages, including natural capital, economic capital, and social capital. The specific landscape attributes mainly include natural landscape, economic landscape, and social landscape. The connotations of the term "social landscape" are the most weighted, directly expressing whether the human–land relationship in a given place is healthy or not. Indeed, the history of human development is essentially the transformation history of physical space. Social landscape, which is the most comprehensive of the abovementioned landscape forms, includes physical space, political system, cultural facilities, values, living situations, and production activities.

Since ancient times, Chinese people have advocated harmony between man and nature. In farming civilization, in which there is an equal relationship between urban and rural landscape, the rural landscape is very healthy in terms of both natural and social ecology. With the rapid spread of industrial civilization in China, the most profitable economic base generally determines the superstructure of industry, and thus, rural status and landscape have declined rapidly. The natural ecology collapsed first, such as natural resources being over exploited, and the use of large quantities of pesticides in order to increase agricultural production. Then the social ecology started to disappear, posing the greatest threat to rural sustainability. We propose that it is necessary to construct the compound ecological capital to reshape the social landscape structure. Why? Since the founding of the People's Republic of China,

towns and villages at the county level have been at the bottom of the power pyramid, while capital is often distributed unequally by power, so rural areas are always marginalized. In the urban–rural dual system, rural social structure was seriously separated, and numerous social ecological problems have recently emerged in various ways. This is because, with the natural environmental pollution and natural resources shortage in rural areas, capitalists could not carry the reproduction of space, so they withdrew. Then, rural infrastructure and living environment took a turn for the worse, and the permanent population lost a lot, causing rural traditional culture to break and the social landscape to decline (Figure 1). All these deteriorating landscapes demonstrate that social structure in rural areas is extremely distorted in terms of economic development, and therefore a comprehensive development model needs to be constructed urgently—the compound ecological capital in towns and villages.

Figure 1. Evidence of the decline of social landscape: with rural population loss, a classroom in a former primary school has become a horse stall.

So, how does the construction of compound ecological capital affect the social landscape in towns and villages? Firstly, the new social landscape order is constructed. Then, we analyze social capital, which drives the formation of the social landscape, and evaluates its ecology level. Finally, according to the differences in the ecological attributes possessed in different towns and villages, we propose the approaches for optimizing the social landscape.

1.1. From Space Production to Landscape Production

Henri Lefebvre's theory of "production of space" [1] was proposed in 1991. In this theory, he affirmed the complex attributes of space, because he viewed the superposition of nature, society, and economy in the same space. Following Lefebvre, David Harvey [2] and Edward Soja [3] further developed the theory of production of space, and they asserted that people should firstly conduct an attributes analysis of a given space before engaging in economic acts or social activities in that space. In this paper, we draw lessons from the critical thoughts and space theories of the aforementioned scholars. Considering the phrase "town and village landscape", which holds connotations of society, culture, economy, and so on, we chose the term "landscape" to replace the term "space" at the county level, directly identifying the capital reproduction process as landscape production. Landscape production in rural areas puts an emphasis on sociology, and rural areas are heterogeneous, dynamic, and dystopic [4]. As a link between the rural and the urban, the production of rural landscapes involves not only spatial elements in relation to the natural and ecological landscapes, but also puts an emphasis on "people-oriented" principles and conditions, such as public services and participation rate in social activities [5]. We are of the opinion that landscape production in rural areas could avoid social instability and the loss of local traditional culture caused by urban capital, and thus provide greater social benefit [6].

1.2. From Sustainable Livelihoods to Compound Ecological Capital

In the development of towns and villages, sustainable livelihoods have played a major role in recent years. In 1992, the United Nations Conference on Environment and Development introduced the concept of sustainable livelihoods into the agenda of action, advocating that sustainable livelihoods should mainly improve the livelihood of the poor from the perspective of development. At present, the sustainable livelihoods analysis framework from the United Nations Development Program (UNDP) is the most widely used [7], emphasizing the impact of the external environment and intervention on sustainable livelihoods. Sustainable livelihoods are the goal of development, not the starting point or path of it. Sustainable livelihoods represent the pursuit of certain goals, prohibiting failure, while compound ecological capital takes the possibility of rural development based on its capital condition, and the possibility of development is forecast via capital evaluation. Thus, villages and towns may be allowed to continue to develop and grow or may be merged or restricted. Construction of compound ecological capital does not make local development the sole goal. Ecological evaluation can provide a more moderate possibility for many ecologically fragile or economically resource-deficient areas; therefore, it can be referred to broadly as sustainable livelihoods.

1.3. Eco-Economy and Ecological Social Structure

Eco-economics has benefits for sustainable urban construction, so Stossel proposed an evaluation approach of an urban capital–sustainability index assessment [8]. Sustainable economic theory is based on the participation of social force, which means that, from the perspective of human capital investment, public awareness of ecological threats and comprehensive coordination of social systems are the basis for eco-economy [9]. Sustainable economic development is not only a continuous dynamic process but also the construction process for power promotion [10], and social structure and production organization should make adaptable adjustments.

Recent research on social ecology has mainly focused on the protection and utilization of nature, culture, and society, and scholars have adopted one-way dimension analysis methods, such as measuring the patch area or recognizing different shapes, to analyze social structure [6,11–13]. Social ecology involves methodical concepts, and through social hierarchy—the role of ecosystem patterns in spatial scales—social ecology can improve the sustainability of the whole ecosystem [14].

2. Theory

2.1. Social Landscape in Deterioration

Due to the inferior position of towns and villages in the national economic system of China, the landscape, including physical spaces and traditional culture in rural areas, used to be the cheap raw materials in production [15]. As a result, the deterioration of the landscape structure in towns and villages has occurred (Figure 2). Urban capital arbitrarily occupies and exploits all kinds of cheap dividends in the town and village landscape. The available value in the landscape has declined rapidly, and capitalists have no intention to protect nature or culture. Natural environment pollution first exposed social problems—such as capital withdrawal, population outflow, and declining folkways—and a rising crime rate began to emerge soon afterwards. The prominence of such social problems in a given place means that the complex ecosystem is on the verge of runaway, and its landscape system is about to collapse. Although the natural landscape will take the lead in restoration, it is just a temporary measure. Eventually, the town and village landscape system, including the social landscape, will separate rapidly, and then the compound ecological capital will disappear completely.

Urban capital has further deepened the separated landscape that had already been formed. In fact, landscape is separated in the rural development process. However, in this article, we propose that there is a dialectical relationship between landscape production and landscape sustainability, which requires that the construction of compound ecological capital and the optimization of landscape structure should be promoted simultaneously in towns and villages.
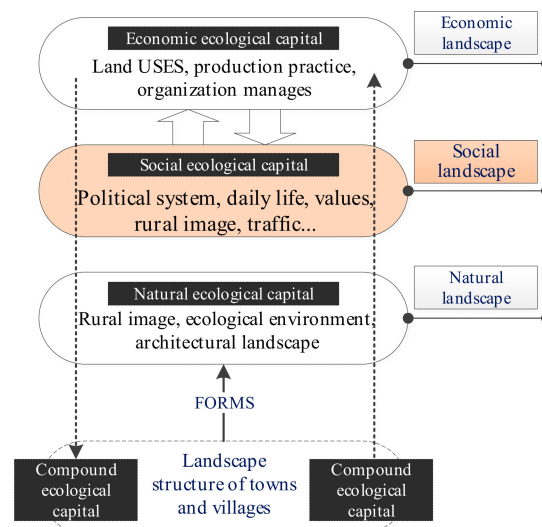
Figure 2. The deterioration process of landscape structure in towns and villages.

2.2. Landscape Structure of Towns and Villages Built on Compound Ecological Capital System

The goal of constructing compound ecological capital is to help villages to achieve development through self-prosperity. Self-prosperity here is an expression of an endogenous growth model. More often, it may be a kind of semi-endogenous growth [16], because the growth ability in rural areas in China is weak, with many towns and villages facing unprecedented shrinking problems. However, due to social and cultural reasons, villages cannot be merged or relocated, because they have good cultural resources and lots of arable land and could possibly achieve "people-oriented" development. We propose that physical social capital (PHSC) can be the foundation of compound ecological capital. PHSC, such as in education, health services, job creation, natural ecology conservation, or public transportation, contributes to health, well-being, and survival in rural landscapes [17]. Based on PHSC, from the perspective of self-prosperity, we propose a "production–social network–nature" pattern to form rural ecological capital [18].

Three types of capital (Figure 3) directly affect the expression of three landscape types: natural, social, and economic landscapes. More importantly, the interaction between capital and landscape is cyclical. In this circular system, the three kinds of landscape are equally important [19], and each kind of landscape has its own path in optimization, which ensures that the landscape reconstruction in towns and villages is a multi-dimensional and dynamic process. The natural landscape is the physical geographical environment, which means concrete space and the natural landscape. The natural landscape is the direct carrier of the social landscape, including rural scenery, ecological environment, and architectural image. The social landscape is one that has been constructed by humans, relying on social behaviors. It is a secondary landscape based on the natural landscape. Where there are human beings, there are social landscapes, mainly including ideologies, political systems, and daily life and values. The economic landscape emerged with human economic behaviors, including land use, production practice, and organization. At present, most social behaviors include economic behaviors, so the economic landscape and social landscape are interchangeable.

Figure 3. Landscape structure of towns and villages built on a compound ecological capital system.

2.3. Official Guidelines on Rural Landscape

Since 2018, Chinese government has released several documents which have provided strong policy guarantees for the construction of compound ecological capital in towns and villages. The Action Plan for Promoting the Quality Improvement and Upgrading the Rural Tourism (2018–2022) [20], points out that villages should be built and managed by villagers themselves. Adjusting rural social structure includes repairing of the ecological environment, innovation of the rural system, and participation of social resources. National Strategic Plan to Revitalize the Towns and Villages (2018–2022) [21], points out that from the perspective of planning and management, in order to achieve the overall revitalization of towns and villages, we should first reshape the relationship between urban and rural areas, and then optimize the interior spaces of rural areas. Opinions of the Central Government on Promoting Village Planning [22], suggests that all localities should study population changes, location conditions, and development trends, clarify the classification of county villages, and adopt different development strategies for different types of villages.

2.4. New Social Landscape Order Based On the Evaluation of Social Capital Ecology

The ecology of social capital is the continuous provision of landscape services (LS) in villages and towns. All analyzed social landscapes may be described as sustainable in terms of LS, because every landscape provides a specific bundle of LS and a reasonable level of landscape diversity, connectivity and regulated LS [23]. In an ecological landscape, the common international classification of ecosystem services (CICES) methodology is useful for determining indicators MA (Millennium Ecosystem Assessment) and TEEB (The Economics of Ecosystems and Biodiversity) [24]. Ecosystem service (ES) includes three categories: provisioning, regulating, and cultural services. Different from LS, CICES is used to explain the links between donors (landscape ecosystems) and recipients of services. According to CICES, the cultural landscape (one kind of social landscape) is a spatial product of human activity [25]. Therefore, in this paper, from the wide array of ecosystem services described in CICES methodology, we highlight the culture base and life of the social landscape.

We propose a new social landscape order for towns and villages (Figure 4), which highlights that the social landscape is the core of development at the county level. The initial foundation of the social landscape is the economic landscape and natural landscape, but under the structure of compound ecological capital, the production process becomes increasingly multi-dimensional, and there is no clear distinction between the three of them, forming a fused relationship. It should be noted that, under the restrictions of the poorer economies in towns and villages, prosperity in the social landscape promoted by technological progress is a paradox [26], because technology will inevitably

lead to a protection crisis of the social landscape. Social ecological capital is evaluated by gravity index. We believe that the social landscape can fully display the ancient beauty of village lifestyle and traditional culture. Of course, this does not mean that towns and villages are excluded from modern civilization. It should be noted that there is a contradiction that emerges with the decline of the social landscape, there are diversified forms of development possibilities in rural areas, but most villagers do not have the ability to capitalize on such trends. They are excluded from mainstream society, but they have a strong psychological need to be integrated into mainstream society [27]. The adaptivity of social space is a pressing problem in China is based on the urbanization of rural living and natural space, the mechanism of rural landscape restructuring by conducting land consolidation is a bottom-up restructuring strategy accompanied by a few top-down elements [28].
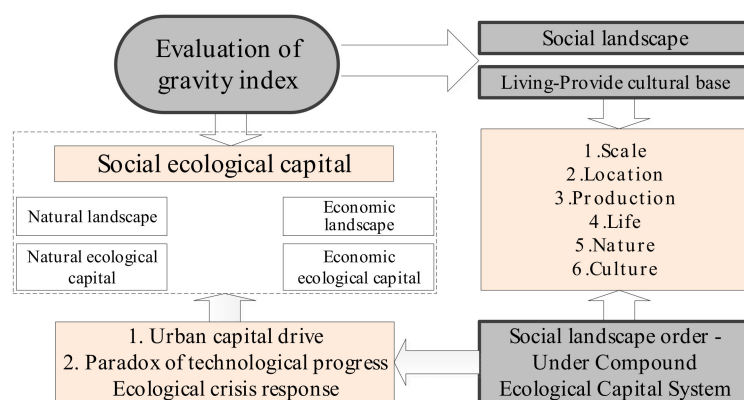
Figure 4. Social landscape order of towns and villages in a compound ecological capital system.

Therefore, in the new social landscape order, we must pay more attention to the improvement of residents' living quality and cultural environment, increasing the participation rate, protecting folk customs, and giving villagers fair access to basic rights [29]. We chose scale, location, production, life, nature, and culture to express the social landscape order, aiming to realize a new rural paradigm.

3. Data and Method

3.1. Data

We chose one county in the late-developing areas of Western China to be the empirical object studied in this paper. The optimization of the social landscape of towns and villages in this county is positive, because it is in line with the aforementioned arguments presented in this paper. However, due to the weak economic foundation of towns and villages and the late-developing characteristics of the surroundings, the present manifested features do not represent the final optimization result of its social landscape. Therefore, this paper serves mainly to attract more resonances, in order to promote the effective updating of the social landscape in this largest group of villages.

Hequ County, Shanxi Province is located at the junction of Shanxi, Shaanxi, and Inner Mongolia (Figure 5), which is a typical late-developing area (within the radiation range of the Hohhot–Baotou–Erdos–Yulin economic circle). There are 13 townships (towns) and 341 administrative villages in the county. Therefore, a compound ecological capital system of nature–economy–society at the county level means establishing a more open social system for rural areas. Because economy and society interact significantly with each other in this late-developing area (Figure 6), almost all the possible economic characteristics are expressed in village society. North concisely concluded that effective social organizations are the key to guaranteeing economic growth in the Western world [30]. Therefore, ecology evaluation of social capital has become the first step to optimizing the social landscape structure of towns and villages in Hequ County.

Figure 5. Location of Hequ County.

Figure 6. Economy and society interact with each other profoundly. Township fairs in which villagers from dozens of villages in the township buy necessities, are held every five days; they also provide a meeting space for many people.

3.2. Method

3.2.1. Social Landscape Vulnerability

Social landscape vulnerability can be accessed using three dimensions: susceptibility, resistance, and resilience [31]. We believe that the connotation of vulnerability has expanded from the early endogenous concept of vulnerability, which was only based on risk factors, to a comprehensive category that integrates the various aspects of nature, economy, society, humanity, environment, organization, and institutions [32]. It is now generally acknowledged that vulnerability consists of exposure, sensitivity, and adaptive ability [33–35]. We proposed that, though the connection between capital and vulnerability is complex, knowledge [36] is the principal driver of resilience conditions via facets of heritage (e.g., religious infrastructure and activities, traditional architectural vernacular, and multigenerational attachments to a place) and capital (e.g., income diversification, access to communication technologies, and societal welfare measures).

3.2.2. Eco-Evaluation of Social Capital: Analysis by Gravity and its Five Factors

We proposed that social capital refers to the comprehensive strength of towns and villages, thus, urban capital mainly affects the layout of the social landscape. Social capital is the most complex and comprehensive of the three kinds of capital. In the sustainability analysis of LS, connectivity and diversity of indicators are important [23]. The diversity and connectivity of the landscape are determined by landscape metrics (LM). Connectivity is determined by landscape connectivity, and diversity by spatial heterogeneity. Considering the diversity and connectivity in the landscape, and the links between the landscape ecosystem and humans [25], we used the concept of a gravity index to conduct an ecology evaluation and used the settlements as the objects of the evaluation. The concept of gravity signifies the absolute importance of central geography theory [37], and it indicates the importance and prosperity of a place. For factors in the gravity system, an integrated framework can be employed to conduct a nested social-ecological assessment of ecosystem service benefits, drawing upon landscape and vulnerability mapping [38]. Almost all CICES classes were represented, with cultural and some regulating ES being the most frequently considered [24]. At the same time, regulating and cultural services were more often assessed than provisioning services. For rural areas, regulating services refer to "people-oriented" indicators, such as educational, cultural, and physical use of land in CICES classes [24]. Thus, we proposed that the location, scale level, economic development, cultural resources, educational condition, housing, and natural environment of a given place are all factors affecting its gravity indicators. Based on the above factors, in reference to existing studies, and combined with the actual conditions of the towns and villages in Hequ County, we constructed a gravity index evaluation system consisting of five factors: scale, location, production, life, and nature.

Scale can most directly reflect the completeness and importance of residential agglomeration areas in towns and villages. It is the basis for guiding the landscape optimization in the future. Positive indicators, such as population and the residential aggregation area in towns and villages, are used to express scale. It is difficult to obtain accurate indices of village-level industrial output, and other economic and output value indicators were not selected here.

Location is one of the main forces affecting settlements. With the continuous improvement of transportation networks and information infrastructure, location plays an increasingly important role. Location is indicated by three reverse indicators: the respective distances from settlements to the county towns' seat, rural towns' seat, and traffic lines. ArcGIS Desktop 10.5 (Esri, Redlands, CA, USA) was used to form 2 km wide buffer zones from the outlines of the county towns' seat, rural towns' seats, and traffic lines. Settlements were graded according to their distance from the buffer zones. Taking the rural towns as the objective element, settlements within 2 km of the rural towns' seats were assigned 3 points, those within 2–4 km were assigned 2 points, those within 4–6 km were assigned 1 point, and those more than 6 km away were assigned 0 points. Only settlements in the county were included in the calculation, and they were assigned a score up to 3 points according to their distance from the buffer zone. The obtaining process of the distance data was based on the functions of the ArcGIS software, such as "feature to point", "near", and "point distance"; the mass center of settlement's patch could be obtained, and then the distance between the mass center and the corresponding spatial elements was calculated.

Production represents the basic conditions for peasants to engage in economic activities in the suburbs of cities and towns. Production is expressed by four positive indicators: the labor force, the homestead area, the garden area, and the education level of the residents. Because most of the rural economy in the suburbs is based on grain cultivation, the indicator is listed in the natural capital indicator system as "cultivated land".

The *life/culture* factors reflect the level of cultural connotation and suitability. The life factors are expressed by three positive indicators—per capita net income, cultural influence, and per capita area of cultural facilities—as well as two reverse indicators of distance from settlements to a primary school and a middle school. The indicators of distance to primary and secondary schools were graded according to the distance from the buffer zone, in the same way as location factors. Grassland

area (vernacular environment) can beautify low-income neighborhoods by turning them into green landscapes of privilege and pleasure [39].

The *nature/natural ecology* factor here means all types of vegetation, soil, water, slope angle, and altitude in the settlement areas [6]. In addition to the natural environment needed for agricultural production, we predicted the possible impact of settlements on natural ecology and evaluated natural abilities of resistance and resilience to external stress. We proposed three indicators which reflect the natural ecology of the living standards: slope angle, green area (forest, grassland, water), and annual rainfall. Although these indicators are technically social capital, they have a significant impact on the ecological level of the social environment due to their close relationship with residents' lives.

3.2.3. Indicator Evaluation Process

According to the previous analysis, factor layer B has the greatest impact on the ecology of social capital. The 5 factor layers were divided into 17 indicators. The weights of the indicators were determined by an analytic hierarchy process (AHP), which could be divided into three steps. Step 1 involved analyzing the relationships between factors (indicators) in the system, constructing the evaluation system, comparing the importance of different factors (indicators) with each other at the same layer by considering their importance to the objective or a certain factor at the upper level, and constructing a judgment matrix with a one-to-one comparison. In step 2, the relative weights of the factors (indicators) to the objective or the certain factor were calculated by the judgment matrix, and then the consistency of the judgment matrix was checked. In step 3, the weight of each level in the system was calculated and then rated. The indicator evaluation system and the weight of each indicator is presented in Table 1.

Table 1. Indicator evaluation system and the weight of the gravity index for social capital in the towns and villages of Hequ County.

Objective Layer A		Factor Layer B		Indicator Layer C		
Serial No.	Content	Serial No.	Content	Serial No.	Content	Weight
A	**Gravity index of social capital**	B1	Scale factor	C1	Population	0.1117
				C2	Settlement area in towns and villages	0.0917
		B2	Location factor	C3	Distance to county town seat	0.0827
				C4	Distance to rural town seat	0.0512
				C5	Distance to traffic lines	0.0776
		B3	Production factor	C6	Labor force	0.0356
				C7	Homestead area	0.0724
				C8	Garden area	0.0481
				C9	Education level of residents	0.0695
		B4	Life factor	C10	Per capita net income	0.0948
				C11	Culture influence	0.0733
				C12	Per capita area of cultural facilities	0.0276
				C13	Distance from settlements to primary school	0.0169
				C14	Distance from settlements to middle school	0.0183
		B5	Natural ecology factor	C15	Slope angle	0.0546
				C16	Green area	0.0341
				C17	Annual rainfall	0.0399

3.2.4. Calculation of Gravity Index of Social Capital

Calculation formula for gravity index:

$$N = \sum_{i=1}^{n} S_i W_i, \tag{1}$$

where N is the gravity index value of the settlements, the higher the N, the more important the settlements, and the converse is also true. S_i is the value of the indicator i after standardization, W_i is the weight of the indicator i, and n is the number of indicators, which is 17 in this paper.

The gravity index of 341 villages in 13 townships and rural towns in Hequ was calculated using a multi-factor comprehensive evaluation method. Using the natural breakpoint method of the ArcGIS software, the ecology of social capital was divided into four grades, according to the value of the gravity index: grade I, grade II, grade III, and grade IV. In Figure 7, it can be observed that towns and villages with a high gravity index of social capital in Hequ County are located near the main traffic lines, such as the provincial road along the Yellow River. At the same time, the towns and villages where the governments are located had a higher gravity index value, and the scale of the towns and villages had a significant impact on the gravity index value. Throughout the county, settlements in the county seat had the highest gravity index value, which was as high as 0.7907. The ecology level of social capital in the county seat was the highest. Dongye Village in Zhaojiagou Township had the lowest gravity index value. Zhaojiagou Township is in the southeast of Hequ County, and its gravity index value was as low as 0.1173, because of its remote location and relatively primitive economy. The social capital ecologies of the 22 administrative villages (settlements) in the whole township were all assigned to grades III and IV.

Following the gravity index analysis, grades were assigned as follows: (1) The ecology of social capital in villages and towns with a gravity index N = 0.3984–0.7907 was considered to be grade I. In grade I, the level of urbanization of the towns and villages is very high, and the coherence between the villages is strong. The administrative functions are sound, the cultural resources are good, and villagers are wealthy, with the population increasing steadily. (2) The ecology of social capital of towns and villages with N = 0.3156–0.3984 was assigned to grade II. Most of the settlements assigned to grade II were administrative villages. In grade II, transportation is convenient, and the villagers live in a good state. Most farmers can earn a good income through farming or local work. However, some villages face the problem of over-exploitation of natural resources, as well as the shortage of medical and educational resources. (3) The ecology of social capital of the towns and villages with N = 0.2209–0.3156 was considered to be grade III. The villages assigned to grade III tended to be far from the county center or the main road of transportation. Although there are still some villagers living in such villages, most of them are the elderly. The economic pillar industry is mainly agriculture, and the attraction of foreign capital is very limited. (4) The ecology of social capital of towns and villages with N = 0.1173–0.2209 was assigned to grade IV. Grade IV settlements are extremely incoherent, and the natural ecological environment is extremely vulnerable. Settlements are far from the county center (more than 150 km), and the influence of local culture is almost zero. The population is declining, and therefore the labor force is limited.
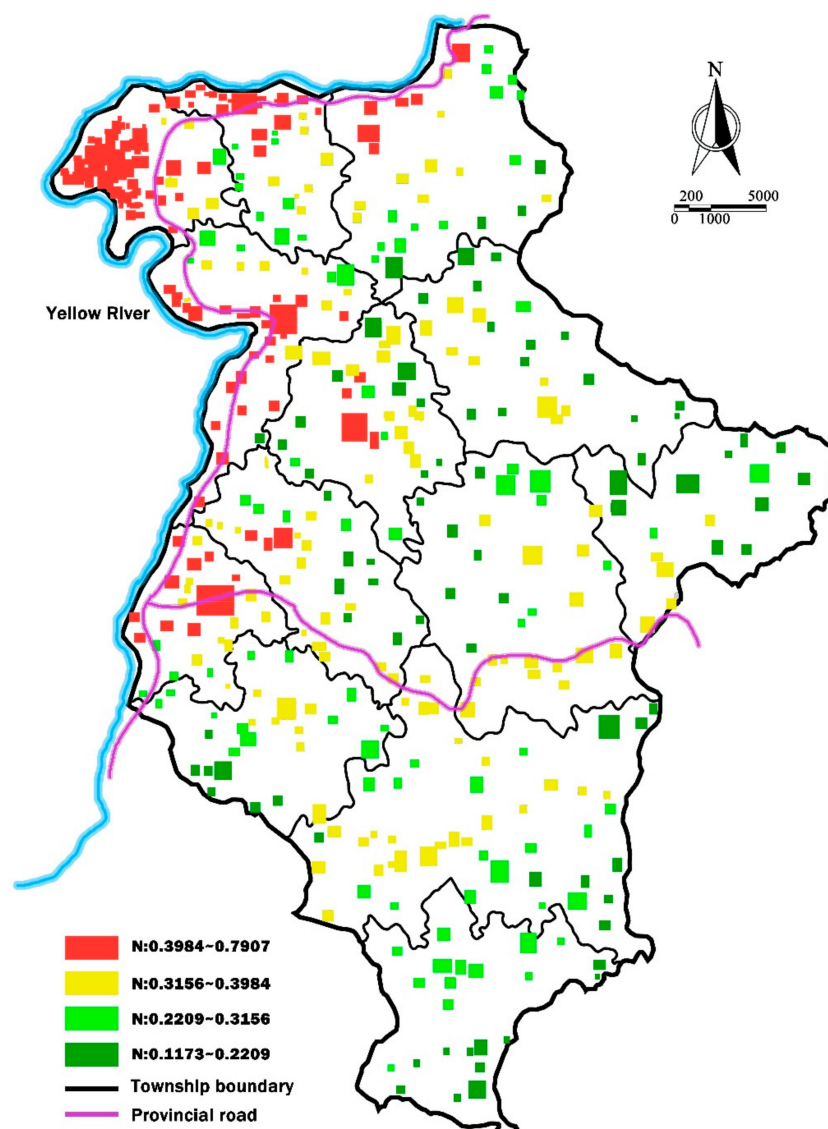
**Figure 7.** Gravity index value of settlements in Hequ County.

4. Result

4.1. Social Landscape Type in 13 Towns and Townships

The average gravity index values of the towns (townships) in Hequ County are presented in Table 2. By using the natural breakpoint method, settlements with a gravity index above 0.4895 were classified as urbanized settlements, and the ecology level of their social capital was considered the highest. Because of the long-term shortage of rural resources in the current dual system of urban and rural areas in China, it is considered important capital in rural areas to be close to the county center or the main traffic arteries. These settlements were distributed mainly around the county seat and along the Yellow River Industrial Belt. With the completion of inter-provincial highways, infrastructure and public service facilities in the northeastern and southern industrial areas of Hequ County are gradually being completed; therefore, businesses, service industries, and industrial enterprises with different scales are concentrated in these areas. These areas will eventually take the leading role in the county. Settlements with a gravity index value between 0.3328 and 0.4895 were classified as urbanized rural settlements with a moderate ecology of social capital. They were mainly located in administrative villages along the Yellow River. Settlements with a gravity index value between 0.1173 and 0.3328

were classified as non-urbanized rural settlements. They had the lowest ecology of social capital and were mainly located in mountainous areas with a large slope angle. According to the gravity index, the social landscape type is divided as follows: urbanized settlements in towns, urbanized rural settlements, and non-urbanized rural settlements (Figure 8).

Table 2. Average value of gravity index in towns (townships) in Hequ County.

Town (Townships)	No. of Villages	Total Value	Proportion of Each Factor
Wenbi Town	13	0.7216	
Xunzhen Town	28	0.5418	
Louziying Town	17	0.4997	Scale factor (20.34%)
Liujiata Town	32	0.4306	
Jiuxian Township	26	0.4191	Location factor (21.15%)
Lugu Township	27	0.4029	
Shaping Township	33	0.3284	Production factor (22.56%)
Shaquan Township	43	0.3012	
Qianchuan Township	23	0.2993	Life factor (23.09%)
Shanzhai Township	27	0.2864	
Tugou Township	24	0.2019	Ecological factor (12.86%)
Sheliang Township	26	0.1851	
Zhaojiagou Township	22	0.0127	
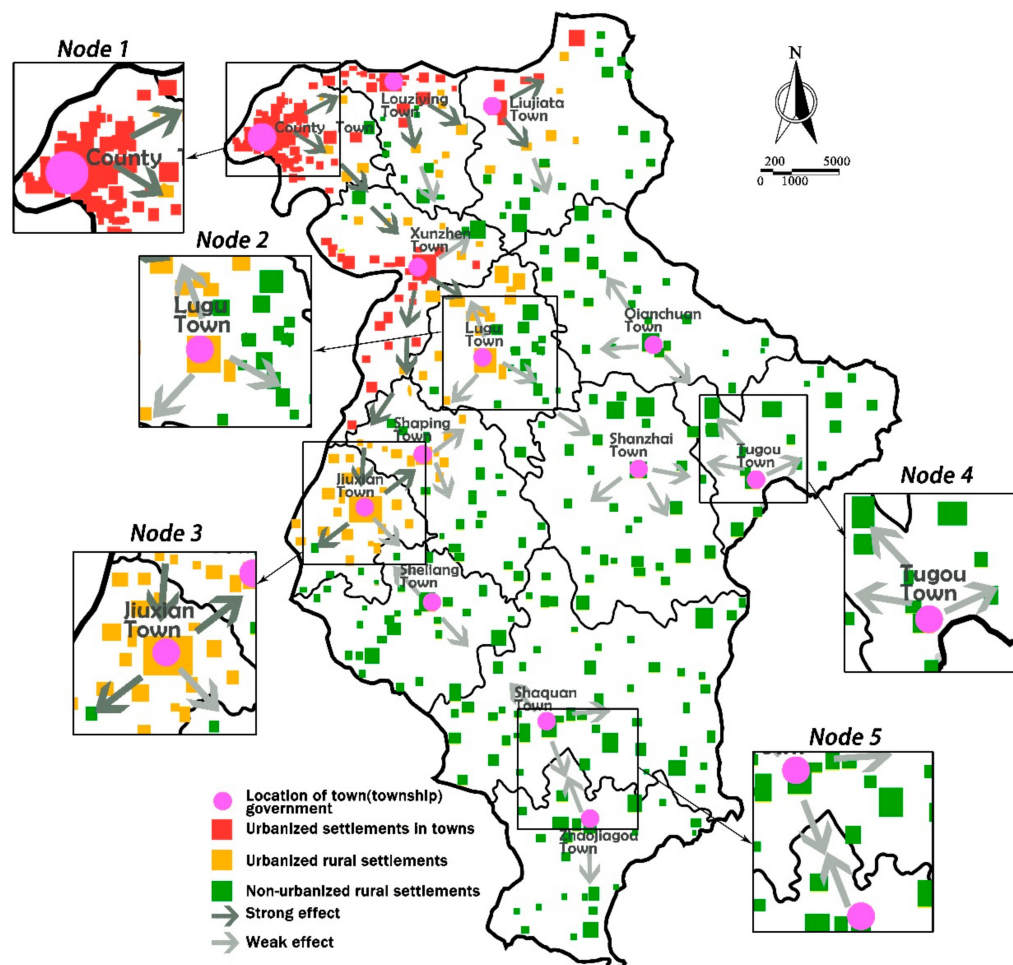
Figure 8. The social landscape type of the settlements.

From the typical nodes, we analyzed the driving result of the compound capital on the landscape type (Figure 8). The higher the ecology of the compound capital (especially the social capital), the more inclusive and dynamic the landscape is (nodes 1 and 2), and social landscape in these settlements has a strong effect on the surrounding settlements. If the capital ecology levels of several neighboring settlements are different, the social landscape in settlements with a higher ecology level will affect the lower ones (node 3). The most prevalent node type is the aggregation node (nodes 4 and 5)—due to the extreme shortage of ecological capital, social landscape in these settlements has a weak effect on the surroundings.

4.2. Coupling Model of Compound Ecological Capital Construction and Social Landscape Structure Optimization

In this paper, we presented the basic measurement techniques to determine the ecology level of social capital. Another important consideration is establishing the coupling model between the compound ecological capital system and the town–village social landscape [40].

The social landscape is the essential ecological capital (Figure 2). In the process of the construction of compound ecological capital, the social landscape—such as locality, characterization, economic behavior, and life—of a given place can be seen clearly [41]. Therefore, in social landscape optimization, the coupling between the landscape and capital must make full use of the social capital advantage (e.g., multidirectional bridging, resilience capacity, multi-faceted role, heterogeneity) [42–46]. Because the role of capital is reflected mainly in shaping the social landscape, through the landscape production of means of capital (economic leverage, power leverage, and cultural leverage), we may achieve the healthy reorganization of the social landscape in Hequ County (Figure 9). Economic leverage refers to the land price advantages in towns and villages to attract capital for expanding reproduction. Power leverage refers to the priority of towns and villages in China's current development status, because towns and villages currently receive more attention from central government. Cultural leverage refers to the use of priceless, traditional culture in towns and villages, drawing into advanced urban infrastructure and exporting traditional culture.
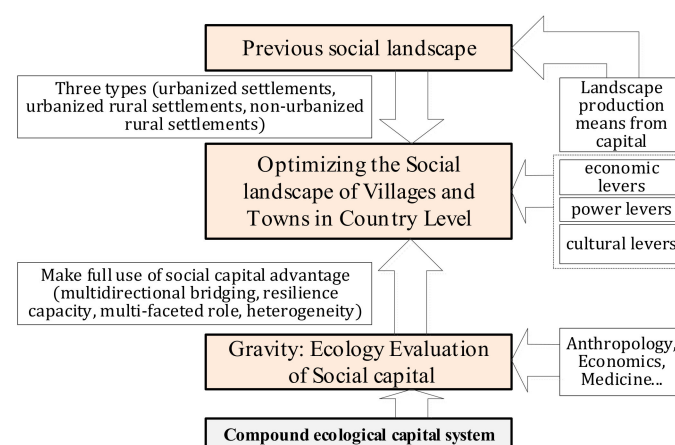

Figure 9. Healthy reorganization of the social landscape in Hequ County.

4.3. Optimization Approach to Classification of Social Landscapes

Based on the ecology level of social capital and the previous social landscape type, by developing a compound ecological capital system—the proposed social landscape optimization approach (OA)—the 341 administrative villages in Hequ County were divided into four categories, as shown in Table 3. We calculated the gravity of social capital of every village in the preceding text, and the applications of the optimization approach to social landscape refers to Table 4, locations of representative villages are presented in Figure 10.
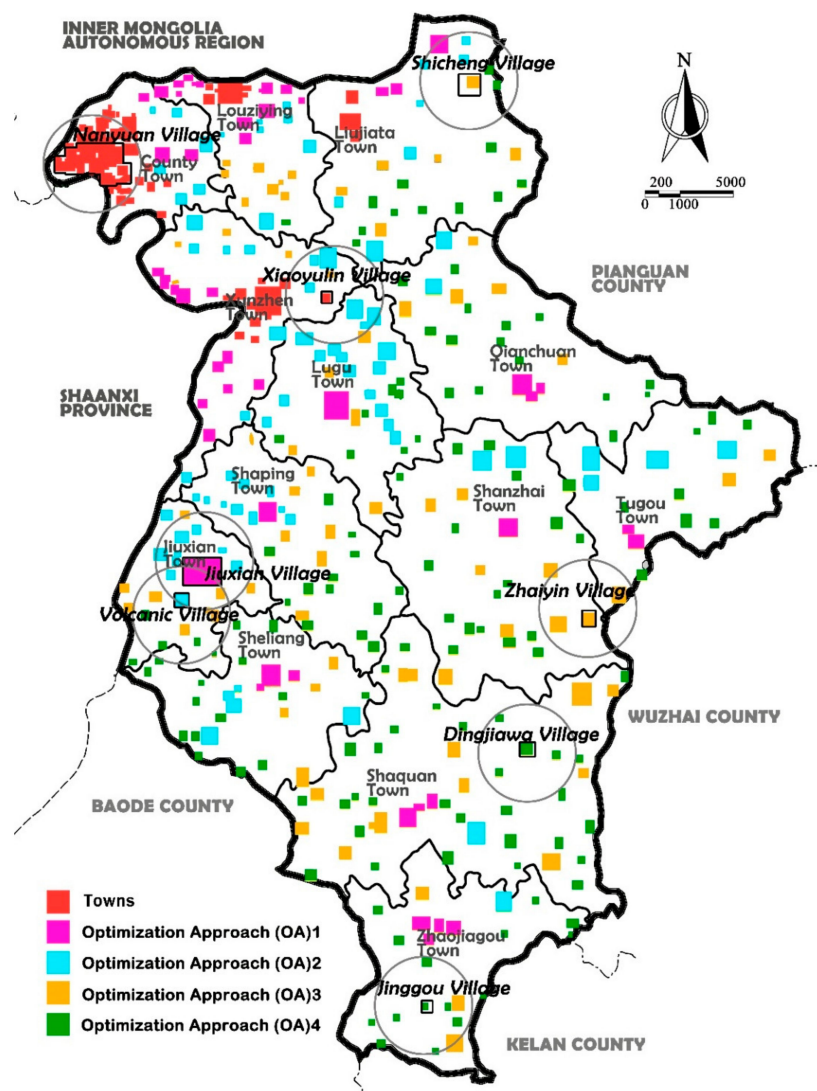
Table 3. Corresponding relationships between level, type, and approach.

Assessment of Social Capital Ecology	Previous Social Landscape Type	Optimization Approach (OA) of Social Landscape
Ecology of Social Capital: Level I	Urbanized settlements	Optimization Approach 1 (OA1)
Ecology of Social Capital: Level II or III	Urbanized rural settlements	Optimization Approach 2 (OA2)
Ecology of Social Capital: Level III	Non-urbanized rural settlements	Optimization Approach 3 (OA3)
Ecology of Social Capital: Level IV	Non-urbanized rural settlements	Optimization Approach 4 (OA4)

Table 4. Application of optimization approach to social landscape for 341 villages in Hequ County.

Application of Optimization Approach (AOA)	Number of Villages	Total Area km^2	Maximum Patch Area km^2	Minimum Patch Area km^2	Average Patch Area km^2
OA1	38	282.17	59.89	3.92	7.42
OA2	68	291.93	18.93	3.84	4.29
OA3	111	365.64	23.21	3.01	3.29
OA4	134	387.26	15.26	2.12	2.89

Figure 10. Application of optimization approaches in villages.

4.4. Application Interpretation of the Optimization Approaches to Social Landscape in Hequ County

4.4.1. OA1: Construct the Meso–Micro Natural–Economic–Social Ecosystem

A total of 38 villages belong to OA1. The ecological level of social capital is level I. The previous landscape is urbanized settlements. The patch area of the largest village (Nanyuan Village in Wenbi Town) is 59.89 km², and that of the smallest village (Xiaoyulin Village in Xunzhen Town) is 3.92 km². The average patch area in this type of settlement is 7.42 km². These area values are the largest of the four landscape types.

Simultaneously improving the ecology of three kinds of capital means we should complete the urbanization, aiming to achieve organic symbiosis among society, economy, and nature. Hequ County belongs to the late-developing area, so by constructing the meso–micro natural–economic–social ecosystem, we can establish a more open social system at the county level, so that the county can have direct interaction with urban capital in a mature paradigm. Rural areas will be transformed from a "simple economic development point" into a "multi-value space".

Hequ County is the home of folk songs in North China, with a long history. The relevant settlements belonging to OA1 are mostly close to towns, with good transportation, a higher education level of residents, and relatively sound infrastructure. These villages may share social networks and public service facilities with nearby settlements [47]. Through the construction of the meso–micro natural–economic–social ecosystem, traditional culture, modern agriculture, and life services can be fully integrated in the process of economic development. The new social landscape has utilized the enormous creativity of traditional culture, achieving the double value of cultural resources and human assets. Most importantly, villagers did not lose their real wealth in the process of increasing financial wealth. In villages applied to OA1, the medium-scale natural–economic–social system is explained by "trending" indicators (Table 5), and finally forms the multi-social landscape. For example, in the cultural inheritance of Wuhua Castle Village, Xunzhen Town, we protect traditional culture through daily displays of cultural heritage in everyday life [48]. Presently, there are dozens of peasant households living in the traditional courtyards built during the Qing Dynasty in Wuhua Castle Village. Thus, historical relics, including daily activities, are the best representatives of social sustainability (Figure 11).

Table 5. Framework of the meso–micro natural–economic–social ecosystem driven by urban capital.

| Objective Layer A	Factor Layer B	Indicator Layer C	Specific Attributes
A: Multi-social landscape	B1: Economy—production relationship	C1: Benefit distribution between urban and rural Areas	Urban capital to the rural areas/Urban elite to the rural ares
		C2: Post-Productionist rural areas	
	B2: Nature—environment creating	C3: Construction activities	Local materials/Symbols/Scales of open spaces/Residential buildings
		C4: Environment renovation	Low impact enterprises/Shrinkage/ Agricultural economy
	B3: Society-Cultural matrix	C5: Continuity of traditional texture	Cultural inheritance/Pastoral products/Folklore Culture
		C6: Social network	Village communities/NGOs (Non-governmental organization)

Figure 11. Rural residents living in buildings built during the Kangxi Dynasty, Qing.

4.4.2. OA2: Strengthen the Construction of Social Networks

A total of 68 villages belong to OA2. The ecological level of social capital is level II or III. The previous landscape is urbanized rural settlements. The patch area of the largest village (Jiuxian Village in Jiuxian Township) is 18.93 km^2, and that of the smallest village (Volcanic Village in Jiuxian Township) is 3.84 km^2. The average patch area of this settlement type is 4.29 km^2.

County villages, as the most grass-roots self-organizing groups, have strong autonomy. Therefore, the essential difference between rural and urban is that social networks naturally present in rural areas. The traditional social network is based on the transfer of rights, in which villagers are the terminal executors. The social network proposed in this paper is villagers' oriented, and grass-roots governments, village committees, and NGOs (Non-Governmental Organizations) are the media through which villagers establish contact with each other. Taking the protection of Xiaying Village as an example, the social network of villagers' participation (Figure 12) can be divided into three levels: the leading level, the organizational level, and the action level. Of these, the leading level in the protection of ancient villages from top to bottom is government, and the leading level in the protection of villagers' daily is the villagers. These two types of protection share the same organizational level and action level, with the organizational level including village committees and NGOs, and the action level including villagers, experts, research institutions, and volunteers. In the social network, the leading and organizational levels cooperate with each other, village committees and NGOs assist the government in docking with villagers, launching public opinion polls and other work; NGOs provide technical support for the government and villagers, and assist village committees in mobilizing villagers; the government mainly provides assistance for village committees and NGOs in terms of policy and resources. Village committees and NGOs can also provide timely feedback to the government through submitting bills and other means. The action level should clarify their respective responsibilities. Villagers should assist experts and research institutes to master relevant information about ancient village and participate in the whole process of protection. By offering various learning courses, experts and research institutes teach villagers the knowledge of ancient village protection and cultivate villagers' participation consciousness.
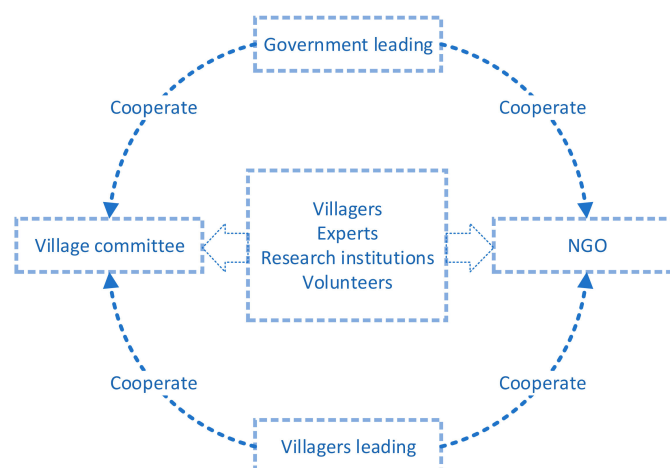

Figure 12. Social network of villagers' participation.

4.4.3. OA3: Smart Shrinkage

A total of 111 villages belong to OA3. The ecological level of social capital is level III. The previous landscape is non-urbanized rural settlements. The patch area of the largest village (Shicheng Village in Liujiata Town) is 23.21 km^2, and that of the smallest village (Zhaiyin Village in Shanzhai Township) is 3.01 km^2. The average patch area of this landscape type is 3.29 km^2.

Villages belonging to OA3 have suffered serious population loss in recent years, the landscape in these towns and villages tends to be hollow [49]. Abandoned elementary school houses are often seen in these villages such as Yangjiating Village, Sheliang Township. To villages restricted and controlled in the land expansion, the baseline is to ensure that the living quality of villagers does not decline. For example, through the integration of living spaces, villages will form a more aggregated public space equipped with adequate public facilities, so the vitality of public spaces will not decline. For the development path, the accumulation of economic capital is at the core. Villages should have paid exchange with urban capital, they may continue to develop or withdraw. On the other hand, villages need to establish the ecological farmland protection mechanism and improve villagers' awareness of natural ecology protection (Figure 13)—this is the only way that villagers can participate in protecting rural spaces.
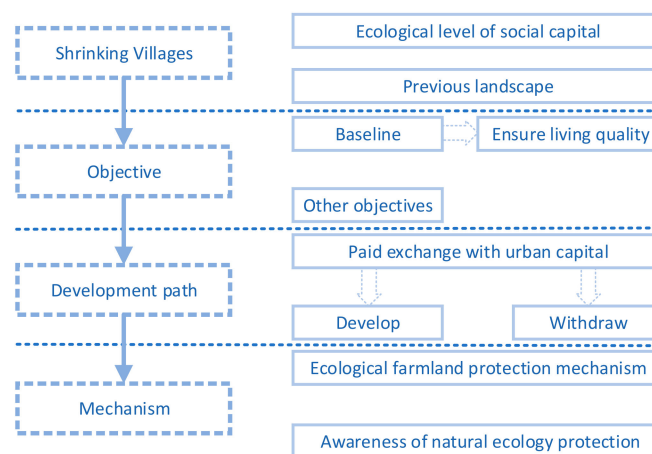
Figure 13. Framework for shrinking development of human settlements.

4.4.4. OA4: Develop Agricultural Economy

A total of 134 villages belong to OA4. The ecology of social capital is level IV. The previous landscape is non-urbanized rural settlements. The patch area of the largest village (Dingjiawa Village in Shaquan Township) is 15.26 km^2, and that of the smallest village (Jinggou Village in Zhaojiagou Township) is 2.12 km^2. The average patch area of this landscape type is 2.89 km^2. These area values are the smallest of the four landscape types.

Almost all these villages are located in steep mountains, and the hollowness rate is very high. Due to the vulnerable natural environment and the lowest index of gravity, most of these villages were relocated or merged, and the villagers would then get a large amount of arable land. Developing agricultural economy not only protects the natural environment, but is also the cheapest way to increase villagers' income. Because of the large slope angle, per capita energy consumption (as well as per capita land occupation) is too high, villagers have paid more attention to land intensive use, so they have grown arid crops in the hillside. According to the climatic and geographical characteristics, Hequ County has planted a lot of cash crops suitable for growing in arid areas (semi-mountainous region and highest mountainous region) (Figure 14). Advanced agricultural technology can be applied, too.
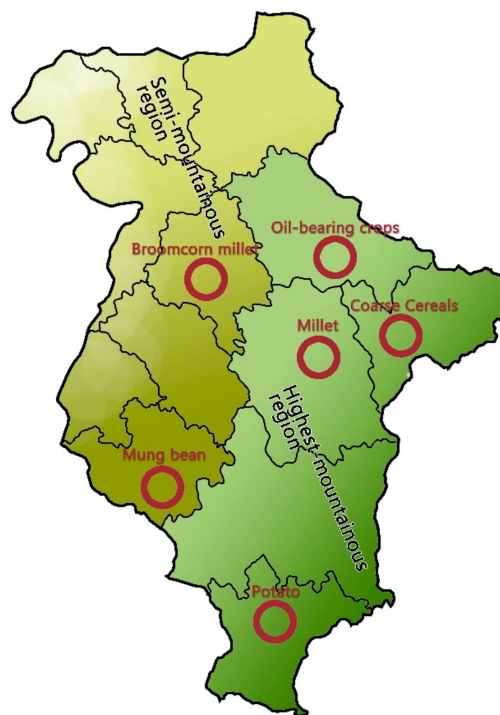
Figure 14. Cash crops planted in Hequ County.

5. Conclusions

5.1. Automatic Allocation of the Result

With the progress of urbanization, new rural problems in the world are constantly emerging and evolving. We are facing the challenge of rebuilding landscapes for rural redevelopment in the future. Rural is a complex synthesis and must be considered from various viewpoints [50]. The social landscape is a combination of space elements with different sizes, shapes, and attributes. The construction of compound ecological capital is a dynamic process, which means that material, energy and information are flowing and transferring all the time between elements. Moreover, the evaluation of social capital cannot be assumed or simulated completely in advance, and any landscape characterization is just an instantaneous state in transferring [51].

Because of the complexity and abstraction exhibited in the transferring process of different villages, it is difficult to quantitatively and directly define their social capital ecology level only by gravity index, so we have included economic and ecological indicators in the evaluation system of social capital in this paper. Four approaches for landscape optimization represent the ideal route for compound ecological capital constructing. However, eco-economic assessment and eco-natural assessment also need to be analyzed rigorously in an approach similar to that in this paper. The ecological evaluation indicator system of these two landscapes also needs to be further critically analyzed. We proposed that the social landscape has the maximum equilibrium which may be assessed through the following dimensions of sustainable development: ethical, ecological, social, economic, technical, political, and legal. Thus, social landscape optimization means maintaining the balance of these dimensions [52]. In the future, it will be necessary to continue to explore the interaction mechanisms of different landscape types. In fact, ecological processes are not limited by the existence of administrative boundaries, and therefore, we will also need to consider the surrounding environments.

5.2. Sensitive Things/Sub-Cultural Phenomenon

Popular sub-culture in a region can affect social structure invisibly. The bottom-up culture affecting rural landscapes is changing, and many farmers have been included in the changing process. Among

the great changes in rural areas of China in recent years, a remarkable cultural phenomenon has emerged—the fast-growing trend of farmers using the "Douyin" app. By using this app, farmers attract audiences through exaggerated performances, and the audiences reward them. Some farmers have formed their own unique style, have attracted a large number of fans, and have earned a good income. This sub-cultural phenomenon has affected the social events in many rural communities [53]. Many farmers gather to play Douyin, commercializing the folk culture of their hometown, calling for characteristic agricultural products, appealing for the urban elite to visit, etc. Superficially, driven by urban capital, as the internet enters the countryside, farmers even thought they had achieved rights equity in one step.

However, many farmers are beginning to abandon agricultural production and become addicted to the sub-culture, such as Douyin. In addition, these eye-catching performances on the internet often have vulgar plots. This seemingly fair participation on internet is essentially the performance of an extremely unfair distribution of capitals. Nevertheless, because huge rural groups have participated and their thinking habits are relatively unified, this kind of sub-cultural phenomenon will lead to great changes in the rural social landscape. Therefore, we must analyze the participating groups, components, and media of sub-cultures in the future.

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