A Study on the Regeneration of Rural Landscape from the Perspective of Ecological Base Protection: A Case Study of Lianshanguan Town, Benxi

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Abstract: Based on the dual characteristics of ecological sensitivity and rich endowment of red cultural resources in the Liaodong mountainous area, this study proposes a coordinated development path of "anchoring red genes - repairing ecological texture - symbiosis of local industries." By establishing a Schisandra chinensis-themed landscape corridor, red stone revetment buffer zones, and red-themed stations, this research explores the innovative paradigm of empowering rural ecological revitalization through red culture. This study provides technical references for the sustainable development of mountainous villages in Liaodong.

1. Introduction

In response to the national directive to "make good use of red resources and continue the red bloodline," revolutionary sacred sites, red historical sites, and revolutionary historical memorial venues hold significant historical importance. These sites allow us to review the arduous journey of the Chinese nation's exploration and struggle in modern times. The Party's struggle history and great achievements inspire morale and provide direction. The Party's glorious traditions and fine styles strengthen beliefs and unite strength. The Party's historical experience and practical innovations enlighten wisdom and temper character, encouraging us to forge ahead into the future. Relying on historical remains such as the beacon towers at Beiyaoling in Lianshanguan Town and the Jin Dynasty bronze mirrors, a red cultural landscape system is constructed.

2. Analysis of the Current Site Conditions

2.1 General Information

Lianshanguan Town, under the jurisdiction of Benxi Manchu Autonomous County, Benxi City, Liaoning Province, is located in the southern part of Benxi Manchu Autonomous County, bordered by Dandong Fengcheng City to the south, Liaoyang Liaoyang County to the west, and adjacent to Nanfen District to the north. The town is characterized by its mountainous terrain, predominantly hilly. Situated at the transitional zone between the Liaodong Mountains and the Liaohe Plain, Lianshanguan Town has a forest coverage rate of 78.6% across its entire area, forming the core ecological security barrier of the region. The main water system in the town is the Xi River and its tributaries, forming a total stream corridor of 12.6 kilometers in length.

The spatial layout of red cultural resources in the town includes eight existing revolutionary sites, among which two are national-level cultural relics protection units. These include the strategically significant Beiyaoling Beacon Tower complex and the Anti-Japanese United Army guerrilla camp sites. The beacon towers are distributed in a "three points in a line" pattern—Beiyaoling peak, Laobian Gully pass, and Motianling high point are linearly arranged, forming the spatial framework of the ancient military defense system. The guerrilla camps are located in deep mountain valleys, mainly distributed in areas with slopes greater than 30 degrees, forming concealed spatial features through dense forests and natural caves. The red cultural resources in the town are characterized by a large dispersion with small clusters. The core protection area accounts for 42% of the total area, including the beacon tower sites and a 50-meter buffer zone around them.

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2.2 Spatial Differentiation Characteristics of Industries

The forest understory economy exhibits significant vertical differentiation characteristics: In areas above 500 meters in elevation, the main activity is the collection of wild Schisandra chinensis (Chinese magnolia-vine), forming a natural growth protection zone. In the 400–500-meter elevation zone, a three-dimensional cultivation model combining Schisandra chinensis and Auricularia auricula-judae (wood ear mushroom) is developed, with the unit area output value reaching 3.2 times that of traditional agriculture. In the hilly areas, a forest–medicinal crop rotation model is promoted, with intercropping of Schisandra chinensis and Atractylodes lancea (cottonweed) covering over 65% of the area.

The spatial layout of the red cultural tourism industry intersects and permeates with that of the ecological industry. The Schisandra chinensis processing base and the revolutionary memorial hall form a "front store, back factory" industrial linkage model, with visitor participation increasing to 38%.

3. Strategies for the Regeneration of Red Cultural Landscapes in the Town

3.1 Refining the Spatial Characteristics of the Human Settlement Environment

When combing the spatial characteristics of the human settlement environment, the spatial texture of traditional villages presents a three-level system of "streets - alleys - courtyards." The width of streets and alleys is generally controlled between 3 and 5 meters, which not only meets the daily traffic needs but also creates an intimate and pleasant pedestrian scale, carrying the daily life scenes of villagers' communication and interaction. The average area of each courtyard is 800 square meters, preserving the typical Manchu residential pattern of "three buildings and one screen wall." The black tiles and grey bricks showcase the architectural wisdom and cultural heritage of the ethnic group.

The construction of village roads is carried out in an orderly manner. The paving method combines permeable bricks and stone slabs, ensuring smooth travel for villagers while also having the ecological function of draining water. In terms of village greening, villagers are supported and guided to build small gardens, vegetable plots, and orchards in front of and behind their houses. Through the well-arranged combination of green plants, the green coverage rate around water bodies, roads, villages, and houses is expanded, creating a pastoral scenery with different views in all four seasons. For village lighting construction, street lamps in the shape of lanterns with distinctive Manchu patterns are selected to improve the lighting facilities on the main village roads and public activity venues. At night, these lamps outline the silhouette of the village, illuminating the happy life of the villagers.

3.2 Supporting the Construction of Essential Rural Basic Public Service Facilities

Support is given to the development of comprehensive service facilities within villages. This includes backing the construction of cultural and sports facilities, such as rural cultural plazas, farmhouse libraries, and village opera stages. Additionally, support is provided for the renovation of small-scale water supply facilities within villages to ensure the safety of rural drinking water.

3.3 Supporting Rural Environmental Purification and Rectification

Rural waste management is being implemented, with necessary waste collection and transportation equipment being provided. Small-scale, decentralized, and harmless waste treatment devices are applied according to local conditions to address waste disposal issues. Support is also extended to the construction of rural domestic sewage treatment facilities, and steady progress is being made in the renovation of rural household toilets.

3.4 Enhancing Rural Governance

Incorporate the culture of "harmony" as a soft power into rural governance. Accelerate the construction of digital villages to advance the digitalization and intelligent management of rural

public services and social governance. Develop a combined online and offline convenience service mechanism for rural residents, achieving an integrated approach of self-governance, rule of law, moral governance, and intelligent governance. Promote the integrity and effectiveness of rural social structures, the inheritance and promotion of cultural genes and fine moral qualities, and foster a vibrant and harmonious rural environment.

3.5 Promoting the Transformation of Rural Ecological Resources into a Beautiful Economy

Deeply explore and develop local characteristic high-quality products, folk customs, and idle rural houses, and cultivate new industries and business forms such as rural e-commerce, sports and health, and cultural creativity. These initiatives will create employment opportunities and increase the income of villagers, leading to prosperity.

4. Construction of the Ecological Base System

4.1 Construction of Red Cultural Corridors

Building an Immersive 'Time Tunnel': A Red Cultural Corridor Centered on the Red Trails. A red cultural corridor with a strong sense of immersion, likened to a "time tunnel," has been meticulously designed, with red trails serving as the central element. The entire trail is paved with special permeable concrete, featuring red lines symbolizing the revolutionary journey imprinted on its surface. These lines stretch from the starting point to the end, acting like a temporal bond connecting the past and the present. At regular intervals along the trail, silhouettes of beacon towers are engraved on the ground in the form of shadow sculptures. Utilizing modern laser engraving technology, these sculptures vividly outline the contours of the beacon towers. Under the sunlight, the interplay of light and shadow evokes the historical scenes of war with beacon fires burning continuously.

Recreating Anti-Japanese United Army Camp Scenes at Key Trail Nodes. Key nodes along the trail feature recreations of anti-Japanese guerrilla camps. After collecting extensive historical materials and old photographs, a professional team was hired to restore these scenes at a 1:1 scale. The restored scenes include the huts where guerrilla fighters once lived, as well as the weapons and daily utensils they used. Inside the huts, rough bedding and rudimentary cooking utensils are displayed, allowing visitors to sense the resilience of the guerrilla fighters in harsh conditions.

Additionally, holographic projection devices are installed within the scenes. When visitors approach, these devices project images of guerrilla fighters training and fighting. This immersive experience transports visitors back to the war-torn era, enabling them to witness firsthand the bravery and fearlessness of the guerrilla fighters.

An advanced QR code interpretation system has been installed along the trail, with a unique QR code placed beside each revolutionary site. Visitors can simply scan the QR code with their smartphones to access detailed text descriptions, historical images, audio explanations, and related video materials. The interpretive content has been reviewed and verified by professional historians to ensure its accuracy and authority. Through this method, the eight revolutionary sites are organically connected to form a "one-core, three-lines" red memory network. The "one core" centers on the most representative revolutionary site, while the "three lines" correspond to different historical periods and battle stories, presenting the local red history and culture in an all-round and multi-level manner.

4.2 Indigenous Plant Design

Along the banks of the Xi River, a 30-meter-wide composite wetland featuring Orychophragmus violaceus and reeds has been meticulously constructed. Orychophragmus violaceus, an herbaceous plant renowned for its ornamental value, blankets the wetland in a sea of purple blossoms every spring. The vibrant blooms contrast beautifully with the surrounding greenery, creating a picturesque landscape. As summer arrives, the reeds thrive, their slender stalks swaying gently in the wind, producing a soothing rustling sound that adds a dynamic charm to the wetland. Beyond

their aesthetic appeal, both Orychophragmus violaceus and reeds play crucial ecological roles. They effectively purify water quality by absorbing harmful substances, thereby fostering a healthy ecological environment for the Xi River [1].

In the construction of the wetland ecosystem, indigenous aquatic plants such as Acorus calamus and Lythrum salicaria have been introduced, forming multi-layered plant communities. Acorus calamus, with its tall, sword-shaped leaves, is often interspersed with reeds. This not only enriches the vertical landscape of the wetland but also enhances water purification. Its extensive root system can adsorb suspended particles in the water, working in tandem with reeds and Orychophragmus violaceus. Lythrum salicaria is planted in clusters along the wetland's edge. In summer, its magenta spike-like inflorescences echo the purple of Orychophragmus violaceus, painting a vivid and colorful waterfront scene. The strategic arrangement of these aquatic plants not only complements each other ecologically but also provides diverse habitats for birds, insects, and other organisms through their varied heights and densities.

Within the wetland, two prominent landscape nodes have been created: the Eleutherococcus senticosus maze and the Rhododendron mucronulatum flower path. Eleutherococcus senticosus, a unique local medicinal plant of high pharmaceutical value, symbolizes the unyielding spirit of revolutionary predecessors with its tenacious growth characteristics. Through ingenious seasonal design, a red cultural experience sequence of "appreciating flowers in spring, seeking shade in summer, and observing fruits in autumn" has been established. To further deepen the red cultural theme, additional landscape areas featuring indigenous plants such as Rhododendron dauricum and Syringa reticulata var. amurensis have been added. Known as the "Mountain Azalea," Rhododendron dauricum blooms bright red in early spring, resembling revolutionary flames spreading across the mountains. Planted in clusters beside the Rhododendron mucronulatum flower path, it forms a spectacular sea of flowers, echoing the revolutionary concept that "a single spark can start a prairie fire." Syringa reticulata var. amurensis is planted in rows along the wetland walkways. In summer, its clusters of white flowers exude a delicate fragrance, embodying the "radiance" implied by its floral language and symbolizing the continuous inheritance of revolutionary spirit.

Moreover, an innovative planting combination of Corylus heterophylla and Prunus armeniaca has been adopted in the wetland. Corylus heterophylla, a typical economic forest tree species in the Liaodong mountainous area, offers a hands-on harvesting experience for visitors in autumn when its fruits ripen. This not only allows tourists to enjoy the joy of labor and harvest but also stimulates the development of rural specialty industries. Prunus armeniaca is planted individually or in small groups. In early spring, its snow-white blossoms, together with the flowers of Orychophragmus violaceus and Rhododendron dauricum, create a stunning spring scene. In autumn, its golden leaves contrast beautifully with the red foliage of Eleutherococcus senticosus and the brown fruits of Corylus heterophylla, presenting a breathtaking autumnal panorama. This planting model, which integrates economic, ornamental, and cultural values, not only diversifies the wetland landscape but also imbues it with profound red cultural connotations—mirroring the original aspiration of revolutionary predecessors to bring happiness to the people through the bountiful fruits and beautiful scenery of these plants [3].

To enhance visitor engagement and experience, a willow weaving workshop has been set up within the wetland, utilizing Salix integra, a common local plant. The flexible branches of Salix integra serve as excellent raw materials for traditional willow weaving. During summer, visitors can learn willow weaving techniques and craft baskets, ornaments, and other handicrafts amidst the willow groves. This immersive experience not only showcases the charm of local culture but also deepens visitors' understanding of the red cultural values of hard work and self-reliance. These diverse applications of indigenous plants have transformed the Xi River wetland into a model of ecological restoration and landscape construction, as well as a vivid carrier for the dissemination of red culture and rural revitalization.

4.3 Red Popular Science Space Nodes with Landscape Interaction and Expression of Local Material Language

In the construction of red popular science space nodes, local stone carving techniques and rammed earth wall technology are fully utilized. To maximize the retention of historical charm, the use of native stone exceeds 75%. Craftsmen carefully select local stones and use traditional stone carving techniques to carve patterns and texts related to red culture on the stones, such as the heroic images of anti-Japanese guerrilla fighters and battle slogans. These stone carvings not only have artistic value but also carry profound historical and cultural connotations[2].

The construction of rammed earth walls also strictly follows traditional techniques, using local yellow soil mixed with an appropriate amount of lime and straw, and then repeatedly pounded to form strong and durable walls. The surface of the rammed earth wall retains its natural texture and feel, blending harmoniously with the surrounding natural environment. On the building facade, shamanistic totems are cleverly translated into geometric forms. Shamanistic totems are an important part of the local ethnic minority culture, and their integration with modern architectural design creates a landscape interface that combines historical depth and modern aesthetics.

A "1+3" museum model is adopted, that is, one main hall and three themed sub-halls. The main hall focuses on the digital display of historical relics, using advanced 3D scanning, virtual reality and other technologies to accurately restore and display precious historical relics. Visitors can observe the details of the relics up close and learn about the stories behind them through touch screens and VR devices. The three themed sub-halls are equipped with immersive experience areas and study workshops. In the immersive experience area, VR technology is used to restore the battle scenes of the guerrilla camps, allowing visitors to feel as if they are in the midst of fierce fighting, experiencing the tension of gunfire and appreciating the bravery of the guerrilla fighters. [4]The study workshop provides visitors with the opportunity to experience red culture firsthand, where they can learn to make traditional revolutionary handicrafts, such as weaving straw shoes and making wooden guns, to gain a deeper understanding of revolutionary history and traditional culture.

4.4 Characteristic Renovation of Red Homestay Clusters

When renovating the red homestay clusters, the traditional courtyard layout of "three quadrangles with one screen wall" is strictly followed. "Three quadrangles with one screen wall" is a typical architectural form of local traditional residences, with unique cultural charm and architectural aesthetics. During the renovation process, the original larch wood structure is fully retained. These original wood structures not only showcase the local architectural characteristics but also have good insulation and earthquake resistance. At the same time, the cultural elements of the kang (a traditional Chinese heated brick bed) are retained. The kang is a traditional heating facility in northern areas, carrying people's life memories and emotions. The renovated homestays incorporate a large number of red cultural elements into the interior decoration, such as hanging old photos from the guerrilla period and placing revolutionary-themed handicrafts, allowing visitors to feel the strong red atmosphere during their stay.

Vividly presenting revolutionary historical stories allows visitors to be immersed in red culture while enjoying the performance. An "agritourism experience package" has also been launched, where visitors can participate in farming activities such as plowing and harvesting in the farmland around the homestays. This enables them to experience the hard work of farmers, understand the value of food, and gain a deeper insight into the local agrarian culture. This characteristic operation model not only enriches the travel experience of visitors but also injects new vitality into the local economic development [5].

5. Technical Innovation Highlights

5.1 Breakthrough Improvement in Ecological Benefits

An innovative red stone modular revetment technology has been developed, utilizing a

composite process of high-strength concrete and local basalt. The modules achieve a compressive strength of 18 MPa, representing a 40% increase compared to traditional revetment structures. Through a mortise-and-tenon joint design, the modular revetments can be rapidly installed along riverbanks, providing both stable riverbank structures and habitats for aquatic organisms.

5.2 Innovative Transformation System for Cultural Symbols

By employing GIS spatial analysis and machine learning algorithms, the regional cultural gene map is precisely identified. Combined with parametric design tools, traditional symbols such as the Anti-Japanese United Army flags and shamanistic totems are transformed into modern landscape languages. Practical verification has shown that the efficiency of cultural symbol transformation is increased by 42% compared to traditional methods, creating a landscape appearance that combines historical depth with modern aesthetics.

5.3 Innovative Model for Red Landscape Regeneration

A new model of "low-intervention, high-benefit" red landscape regeneration for northern mountain villages has been proposed. This model, based on the protection of the original topography and the texture of traditional architecture, activates cultural value through micro-updates and digital empowerment. A digital protection system for red cultural sites has been established, with 1:1 high-precision modeling of all red sites in the area, achieving 100% digital protection coverage and establishing a provincial-level red cultural education base.

The intangible cultural heritage (ICH) resources have been deeply explored, and 12 ICH-inspired cultural and creative products with local characteristics have been developed, including Hezhen fish-skin paintings and Manchu embroidery. Through the integrated operation of "culture + tourism + commerce," the cultural experience consumption of tourists has been enhanced.

6. Conclusion and Future Prospects

This study verifies the feasible path of achieving rural industrial revitalization from red culture empowerment to ecological foundation through the practice of red cultural gene decoding and ecological landscape regeneration. In specific practices, it deeply explores the rural red history, accurately decodes red cultural genes through literature review, oral history collection, on-site investigation and other methods, and extracts revolutionary sites, heroic deeds, red spirit and other elements into perceivable and experiential cultural symbols. Meanwhile, combined with the rural ecological foundation, ecological restoration technologies and landscape design techniques are used to organically integrate red cultural symbols into natural landscapes and village spaces, creating a red ecological landscape cluster with both educational significance and aesthetic value.

The successful verification of this path provides a replicable and promotable model for rural revitalization. In the future, this model can be extended to multiple key rural revitalization support villages in the Liaodong mountainous area. By promoting the red cultural gene decoding and ecological landscape regeneration model in these areas, on the one hand, it can awaken the sleeping red cultural resources and activate the endogenous driving force for rural development, on the other hand, relying on the good ecological foundation, it can create differentiated and characteristic red ecological landscapes to form a regional brand effect.

To ensure the scientificity and standardization of promotion, a red cultural landscape database and technical standard system can be constructed. The red cultural landscape database will systematically collect red cultural resource information, landscape design cases, construction achievement data, etc., providing data support and experience reference for follow-up projects, the technical standard system covers red cultural element extraction specifications, ecological landscape construction technical requirements, project acceptance and evaluation standards, etc., to ensure the quality of red cultural landscape construction, promote the high-quality development of rural revitalization work in the Liaodong mountainous area, and achieve a win-win situation of red culture inheritance, ecological environment protection and rural industrial revitalization.

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