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From Artificial Restoration to Ecological Self-Restoration in Land Consolidation

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Abstract

Traditional land consolidation has long relied on "engineering thinking,"with terrain remodeling, rigid revetment, and monoculture vegetation restoration as primary measures. Although these approaches yield rapid results, they often disrupt ecological processes, leading to ecosystem degradation or secondary artificialization. Rewilding, as an emerging paradigm of ecological restoration, emphasizes reducing human intervention, restoring natural processes, and reintroducing keystone species, offering a transformative pathway for land consolidation to shift from "artificial restoration" to "ecological self-restoration." This paper systematically reviews the theoretical connotations of rewilding, examines its application strategies in land consolidation through domestic and international case studies, and proposes a practical framework that combines "passive rewilding" and "active rewilding" with zone-and type-specific implementation, aiming to provide new perspectives for territorial spatial ecological restoration.

Keywords

Self-Restoration; Artificial Restoration; Land Consolidation; Engineering Measures; Vegetation Measures.

1. Introduction

For a long time, land consolidation has been understood as a technical engineering process of "arranging, reclaiming, and developing" land resources, with core objectives of increasing farmland area and improving land utilization rates. Under this orientation, a large number of consolidation projects have adopted standardized procedures of "leveling-hardening-planting," with river channel straightening, riprap revetment of banks, and standardized field consolidation becoming routine operations. However, this excessively engineered consolidation model has caused severe ecological consequences: fragmentation of river habitats, wetland shrinkage, biodiversity decline, and loss of ecosystem self-regulatory capacity.

Taking Chang'an District of Xi'an as an example, this area is located in the ecological buffer zone at the northern foothills of the Qinling Mountains. Excessive consolidation once led to the drying-up of water sources in submontane wetlands and degradation of artificial forest ecological functions. This predicament is not an isolated case but a common chronic ailment of traditional consolidation models: when we "restore" land through engineering means, we often deprive the land of its capacity for self-restoration.

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It is against this backdrop that the concept of rewilding has entered the purview of land consolidation. Rewilding is not simply "leaving nature untouched" but rather a scientifically guided ecological restoration strategy-by restoring natural processes and keystone species, it enables ecosystems to regain their capacity for self-sustenance. British ecologist James Bullock points out that the core of rewilding lies in "restoring human-managed areas to a nature-dominated state," which fundamentally differs from the "human-dominated" logic of traditional consolidation[1-2].

2. Theoretical Core of Rewilding and Practical Implications

2.1. The "3Cs" Framework of Rewilding and its Evolution

The academic origins of the rewilding concept can be traced back to the large-scale wilderness conservation movement in North America. Its classic framework is the "3Cs" principle: Cores, Corridors, and Carnivores (keystone species). This framework reveals three key elements of ecological self-restoration: sufficient space for natural processes to unfold, connectivity for species and energy flow, and top predators to regulate food web structure.

However, in the specific context of land consolidation, the pure "3Cs" framework is often difficult to apply directly-because consolidation areas are typically located in regions with intensive human activity, where "uninhabited wilderness" conditions do not exist. European scholars have expanded upon this by proposing a "hybrid model" that embeds rewilding elements into agricultural landscapes: designating at least 20% of agricultural land as rewilding core areas, adopting wildlife-friendly farming practices on the remaining land, and connecting ecological patches through green corridors. This approach provides a more operational reference for rewilding in land consolidation[3].

2.2. The Dialectical Relationship between Passive and Active Rewilding

A key theoretical distinction is whether rewilding means "non-intervention" or "human intervention." The rewilding design for relocation sites in the Yellow River floodplain area provides a clear answer. The research team found that "the passive rewilding approach, which achieves site rewilding through early-stage artificial intervention, will restore site ecology and species diversity more quickly and effectively." In other words, rewilding does not reject intervention but requires "directional" intervention-the purpose of intervention is to initiate natural processes, not to replace them[4].

The case surrounding Portugal's Sabor River offers another perspective. The region experienced severe soil degradation due to large-scale wheat cultivation in the mid-20th century, followed by natural abandonment due to population outmigration. Research shows that without human intervention, forest recovery would take 60 to 80 years, and the direction of recovery would not be a "return to the original state" but rather an evolution toward a "new state that has never existed before." This demonstrates that pure natural recovery is time-consuming and directionally uncertain, while moderate early intervention (such as soil improvement and seed source introduction) can significantly accelerate the self-restoration process[5].

3. Practical Pathways for Rewilding in Land Consolidation

3.1. Zoning and Classification

Rewilding in land consolidation cannot adopt a one-size-fits-all approach but should be designed by zone based on site conditions and ecological objectives. The "three-zone symbiosis" model of the Yellow River floodplain provides a typical zoning framework:

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Wild Floodplain Zone (complete rewilding): Adopting a "minimum intervention" strategy along the river, allowing natural river meandering, forming floodplain wetlands and ecological islands, and achieving natural water purification through wetland plants. The core function of this zone is ecological conservation, with agricultural production and construction activities prohibited.

Agricultural Floodplain Zone (agriculture-wilderness rotation): Adopting an "agriculture-wilderness rotation" strategy, where agricultural land and rewilded land are used alternately. During fallow periods, the land naturally restores vegetation; during cultivation periods, ecological farming models are employed. This rotation can maintain a certain level of agricultural production while allowing time windows for natural recovery.

High Floodplain Zone (safety protection): In areas near residential settlements, on the premise of ensuring flood safety, ecological slope protection techniques (such as slope-stabilizing straw grids and chutes) are adopted to balance safety and ecological functions.

The brilliance of this zoning lies in the fact that it does not pursue "complete rewilding" but rather forms a gradient of "completely natural-semi-natural/semi-artificial-artificial-dominant" across space, respecting ecological laws while accommodating the practical realities of land use[6].

3.2. Introduction of Keystone Species

The core feature that distinguishes rewilding from general ecological restoration is its emphasis on "keystone species." These species are known as "ecosystem engineers"—their presence can alter environmental conditions and create new habitat spaces for other species. Rewilding practices in Europe demonstrate that introducing beavers to restore wetland hydrology, introducing bison to regulate grassland succession, and introducing predators to control herbivore populations can all produce chain reactions where "a single move affects the whole system."

In land consolidation, the introduction of keystone species should follow a "substrate first, species second" sequence: first improve the physical environment through terrain adjustment and water system restoration, then introduce key plant species (such as nitrogen-fixing plants to improve soil), and finally introduce animal species. The experience from the Knepp rewilding project in the UK shows that the introduction of grazing animals not only controls excessive vegetation growth but also promotes seed dispersal through trampling and fecal matter, creating a dynamic equilibrium of "disturbance-succession."

3.3. Construction of Ecological Corridors and Landscape Connectivity

The spatial foundation of rewilding is "connecting patches into networks." If rewilded areas are isolated from one another, species cannot migrate and genes cannot flow, severely hindering the process of ecological self-restoration. Research on the rewilding network of the Qinghai-Tibet Plateau shows that constructing a spatial network combining core areas and corridors can increase wildlife habitat coverage to 25.69% of the total regional area, while species occurrence records can reach 56.4% to 69.88%[7].

In land consolidation projects, this means that we should not focus solely on the internal consolidation effects of the "project area" but should consider the project within a broader landscape context. The experience from the integrated mountain-river-forest-farmland-lake-grassland-sand project in Chang'an District demonstrates that connecting water systems through "open channels + underground pipes," reconstructing river meandering forms through "deep pools and shallow riffles," and transforming monocultural forest stands through "strip and block mixed planting" can effectively break ecological dead ends and form functionally complementary ecological networks.

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4. From "Engineering-dominated" to "Process-guided"

The greatest obstacle to promoting rewilding in land consolidation is not technical but conceptual and institutional. Traditional consolidation projects have clear engineering indicators (such as consolidation area and newly added farmland rate), clear acceptance milestones, and standardized fund usage regulations, while the effects of rewilding often take decades to manifest and are difficult to measure with standardized indicators.

European experience shows that incorporating rewilding into policy frameworks is key. The EU's 2030 Biodiversity Strategy commits to restoring at least 20% of degraded ecosystems, with corresponding subsidy mechanisms; non-governmental organizations such as Rewilding Europe adopt "results-oriented" performance evaluations, using biodiversity restoration outcomes rather than engineering completion volumes as acceptance criteria. These institutional innovations are worth emulating.

In domestic practice, Chang'an District has incorporated the mountain-river project into the "Eight New Breakthroughs" task list for Qinling ecological protection, coordinating 15 departments for collaborative implementation. By developing ecotourism, understory economy, and other business models, it has transformed ecological restoration outcomes into economic benefits, initially exploring a sustainable model of "ecological restoration-industrial integration-value transformation." This approach of combining rewilding with rural revitalization provides a practical model for the transformation of land consolidation.

5. Conclusion

Rewilding is not a negation of land consolidation but rather an expansion and deepening of its connotations. It requires us to shift our focus from "land quantity" to "ecological quality," and from "short-term engineering effects" to "long-term self-restoration capacity." In practices at the Yellow River floodplain, the northern foothills of the Qinling Mountains, and Portugal's Sabor River, we have already seen that when humans step back with restraint, the power of nature takes a step forward. This power is far more subtle and enduring than any engineering project.

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