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Coordinated Development Strategies for Land Resources Management and Ecological Environment Protection in Townships

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Abstract: The ecological environment protection and land resources management in townships are conducive to promoting rural revitalization. The coordinated development of the two is of profound significance for promoting ecological civilization construction, improving the quality of life of residents, and ensuring national food security and ecological security. Through analysis, it is found that there is a close circular feedback mechanism between land resources management and ecological environment protection. Reasonable spatial patterns and institutional arrangements can stabilize ecosystem functions, while changes in environmental quality, in turn, affect land use efficiency. Based on this, this paper proposes operational coordinated development strategies, namely, constructing a coordinated pattern of production space and ecological space, implementing a system path of concurrent land transfer intensification and green agriculture, establishing an ecological monitoring network and land information platform in townships, and promoting the systematic implementation of village improvement projects and living environment improvement. These strategies not only address the practical contradictions in township land management but also provide feasible paths for rural revitalization and ecological civilization construction.

Keywords: Land Resources Management in Townships; Ecological Environment Protection; Spatial Pattern; Land Transfer

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1. Introduction

Rural revitalization can only be achieved by addressing the four major aspects of "policy, land, industry and operation" to realize the five revitalizations of "prosperous industries, pleasant living environment, civilized rural customs, effective governance and prosperous life". Land is the most important carrier for prosperous industries and prosperous life. In recent years, with the deepening of industrialization and urbanization, the development intensity of land resources in towns and townships has been increasing continuously, and the quantity and quality of cultivated land are facing dual pressures. The ecological environment is also under multiple challenges such as agricultural non-point source pollution, accumulation of domestic waste and emissions from small-scale industries. Against this background, the state has successively introduced national spatial planning, ecological civilization construction and rural revitalization strategies, putting forward new requirements for the development of towns and townships. This paper explores the strategies for the coordinated development of ecological environment protection and land resource management in towns and townships, aiming to provide theoretical support and practical guidance for building a green and sustainable ecological environment in towns

and townships.

2. The Current Situation of Land Resources Management in Townships and Villages

2.1. The Basic Pattern of Land Use Structure

In most township and village areas, cultivated land remains the main type of land use, but its proportion is gradually being changed by the expansion of construction land and ecological land. National land use survey data over the past few years show that the total area of cultivated land in township and village areas has remained relatively stable, but its distribution pattern has become more fragmented. Some villages and towns have expanded construction land to meet the demands of industrial development and population growth, resulting in the characteristic of "total quantity stable but local reduction" for cultivated land[1]. At the same time, in some areas, due to the implementation of ecological restoration projects, the quantity of forest land and grassland and other ecological spaces has increased. This interwoven pattern of "reduction and increase" reflects that land use in townships and villages is in a state of dynamic adjustment.

2.2. The Current Situation of Land Management System Implementation

In recent years, the national land space planning and use control system has gradually extended to the township level, and land approval, transfer, and improvement have been subject to stricter constraints. However, there are still gaps in the specific implementation process. On the one hand, some townships are constrained by human resources and professional capabilities in implementing the protection of basic farmland and the approval of construction land, resulting in insufficient implementation strength of the system. On the other hand, in the practice of land transfer, the coordination of interests between individual farmers and new business entities has not been completely smooth, leading to slow progress in large-scale land operation. Although local governments are actively promoting the pilot program of rural collective construction land entering the market, the adaptability of laws and regulations still needs to be further improved.

2.3. Prominent Problems in Land Resources Utilization

Overall, there are still many constraints on the utilization of land resources in towns and townships. During the expansion of construction land, some areas have neglected the protection of ecological space, leading to an increasingly prominent contradiction between the occupation and compensation of cultivated land and forest land. For instance, in the process of promoting the construction of the Jiali Ze Ecological Park in Songming County, Kunming City, Yunnan Province, basic farmland and forest land were illegally occupied without approval, which triggered the intervention of the National Natural Resources Inspection and became a typical case of ecological space conflict. At the agricultural production level, the problem of land fragmentation has not been fundamentally alleviated, and the infrastructure of farmland is weak, resulting in low land utilization efficiency. In the transitional areas between urban and rural areas, the disorderly expansion of industrial parks and residential areas has made the land use pattern more complex. Meanwhile, the informatization level of land management in towns and townships is limited, and there is a lack of systematic monitoring and assessment methods, which makes it difficult to support scientific decision-making.

3. Analysis of the Current Situation of Ecological Environment Protection in Townships

3.1. Overall Pattern of Ecological Environment Quality

In recent years, the ecological environment in townships has shown a trend of differentiation. Some areas have seen improvements in air quality and water conditions due to air pollution control and the green transformation of agriculture; however, other areas have experienced a continuous accumulation of environmental pressure due to a single industrial structure and weak environmental governance infrastructure. In terms of environmental elements, the pressure on water

environment is particularly prominent. The capacity for collecting and treating domestic sewage in townships is still insufficient, and the use of chemical fertilizers and pesticides in agricultural planting has led to obvious eutrophication of water bodies. Regarding soil, the problem of declining fertility in cultivated land due to long-term cultivation and improper fertilization still exists. Although air quality has generally improved, local air is still affected by winter heating and emissions from small-scale industries. These phenomena indicate that the quality of the ecological environment in townships alternates between improvement and deterioration and has not yet formed a stable and positive trend.

3.2. Prominent Environmental Pressures and Risks

Ecological environment protection refers to the conscious protection of natural resources and their rational utilization, prevention of pollution and damage to the natural environment, and comprehensive management of polluted and damaged environments to create a suitable living and working environment for humans. In environmental protection practices, the pressures faced by townships are concentrated in three aspects. Agricultural non-point source pollution remains a core challenge, especially in major grain-producing areas, where excessive fertilization and improper handling of livestock and poultry waste have led to frequent pollution of rivers and groundwater. Industrial pollution risks mainly concentrate in township industrial parks and some “scattered, disorderly, and polluting” enterprises. These enterprises are small in scale, lack adequate treatment facilities, and pose significant challenges for environmental supervision. Domestic pollution issues also deserve attention. The system for garbage classification and harmless treatment has not yet been fully established, and some rural domestic waste is still disposed of through simple landfill. The degradation of ecological space further amplifies the risks. In some townships, wetlands have been occupied, and forest and grass vegetation has deteriorated, leading to a decline in water conservation and biodiversity.

3.3. Policy Implementation and Governance Practice Outcomes

In recent years, the concept of ecological civilization construction has gradually been extended to the governance level of townships, and various regions have accumulated certain experience in policy implementation and governance methods. The demarcation of ecological red lines and the establishment of basic farmland protection zones have set boundaries for land development activities. Some townships have launched green agriculture pilot projects, promoting soil testing and formula fertilization as well as organic fertilizer substitution, which has reduced the damage caused by chemical inputs to the ecosystem. At the same time, the management of household waste has been gradually improved, and some areas have established an integrated rural and urban sanitation mechanism to promote classified collection and centralized treatment. The river chief system has played a positive role in water environmental protection, and the water quality of some rivers in townships has been restored. Taking Wangwenzhuang Town in Xiqing District, Tianjin as an example, the town has focused on the management and protection of rivers and lakes at the grassroots level and promoted rural revitalization through the development of water economy. According to the data released by the Tianjin Municipal Ecology and Environment Bureau, in 2021, the annual average concentration of PM2.5 in this area dropped from 62 micrograms per cubic meter in 2017 to 38.3 micrograms per cubic meter; all eight major rivers in the area have eliminated substandard water quality, and the proportion of surface water bodies of grade V or worse has decreased from 100% in 2017 to 16.7%.

4. Coordinated Relationship Between Township Land Resources Management and Ecological Environment Protection

4.1. Analysis of Interaction Mechanisms

The utilization methods of land resources in townships determine the carrying capacity of ecosystems, while the stability of the ecological environment conversely influences the sustainability of land use. The relationship between the two is not a one-way cause-and-effect chain but a cyclical feedback loop. If the spatial structure of land use is based on a balanced allocation of cultivated land and ecological land, it can maintain water conservation, soil retention, and biodiversity,

thereby providing long-term support for agriculture and the township economy. Conversely, if construction land expands disorderly, ecosystem degradation will weaken land productivity and regulatory functions, ultimately threatening the safety and stability of township socio-economic systems. In this interaction, the rigor and enforcement of land management policies play a crucial role. Regulatory measures can restrict development intensity and maintain reasonable spatial boundaries, while environmental protection policies impose constraints on land use, preventing excessive encroachment on ecological spaces.

4.2. Necessity of Coordinated Development

In township development practices, the conflict between land use and ecological protection has become a critical factor constraining long-term growth. Food security depends on the quality of cultivated land, and ecological security relies on environmental carrying capacity. If these two aspects are disconnected, dual risks arise: declining land use efficiency and loss of ecological functions. Therefore, promoting the coordinated development of land management and ecological protection is both a response to resource scarcity and an inevitable requirement for achieving the rural revitalization strategy.

The significance of coordination is reflected in three dimensions:

Economic Development: Rational land use provides spatial guarantees for green industries and modern agriculture.

Environmental Governance: Optimizing land use methods reduces pollution emissions and ecological losses.

Social Benefits: A positive interaction between land and ecology improves residents' living environments and enhances public well-being[3].

Under the pressures of climate change and urban-rural integration, township areas must fulfill multiple functions. Pursuing either development or conservation in isolation fails to meet comprehensive demands. Only through balanced coordination can townships safeguard basic farmland and ecological red lines while promoting industrial upgrading and improvements to human settlements.

5. Strategies for the coordinated development of township land resource management and ecological environment protection

5.1. Establishing a coordinated pattern for optimizing production space and restoring ecological space

In township governance, production space and ecological space should be integrated within the same planning framework. Practical operations involve clarifying the functional boundaries of different areas, defining farmland, construction land, and ecological land as distinct spatial units, and solidifying them in the overall township planning. For example, in towns dominated by agriculture, core cultivated areas should be designated as permanent basic farmland, with strict usage restrictions imposed to prohibit any form of non-agricultural construction encroachment. In ecologically sensitive areas, ecological protection zones should be delineated, and a dynamic monitoring mechanism established. At the same time, it is necessary to combine land consolidation projects with the centralized and contiguous organization of severely fragmented farmland to improve the overall quality of farmland. Furthermore, abandoned mining areas, idle mudflats, and degraded grasslands should be included in the scope of ecological restoration, using methods such as vegetation restoration and water system dredging to enhance ecological functions. In spatial utilization, it is recommended to introduce an ecological compensation mechanism, requiring construction projects to provide equivalent alternative restoration sites while occupying ecological space, or to support off-site restoration through financial compensation[4]. This measure can stabilize the quantity of cultivated land and ecological space, and achieve dynamic balance in spatial utilization. In this process, township governments are advised to establish land use accounts based on village groups, forming traceable management records to provide a basis for subsequent supervision and evaluation.

5.2. Implementing a system path that integrates land circulation intensification with green agriculture

The problem of fragmented land resources in townships is severe, affecting land use efficiency and ecological environment quality. To address this issue, it is necessary to establish an institutionalized path for land circulation and agricultural transformation. Specific measures include: promoting full coverage of land confirmation registration, eliminating institutional barriers to land circulation, and providing stable property rights protection for farmers and business entities; establishing land circulation service centers at the township level to centrally release land supply and demand information, provide contract templates and legal consultation, and reduce transaction risks; in the circulation process, guiding land to be concentrated to capable family farms, cooperatives, and agricultural enterprises to form large-scale and intensive operations. At the same time, ecological requirements should be embedded into the circulation system, stipulating that lessees must adopt green farming methods in production, such as soil testing and fertilization, agricultural film recycling, and resource utilization of livestock and poultry manure, and if necessary, third-party organizations can be introduced for production supervision. For emerging industries such as rural tourism and the integration of ecological planting and breeding, environmental protection clauses should also be stipulated in the circulation contracts to ensure that the ecological function is taken into account during land use. To enhance execution, townships can also establish a green credit system, incorporating eco-friendly business entities into the positive incentive scope, so that they can enjoy financial subsidies, loan concessions, and other support.

5.3. Establish a township ecological monitoring network and land management information platform

Promoting the synergy between land management and ecological protection relies on real-time and accurate data support. Townships should establish an ecological monitoring network covering the entire area and integrate it with the land management platform. Specific operations can be divided into several steps: At the monitoring level, remote sensing images, drone aerial surveys, and ground sensors are used to regularly obtain key data such as land use changes, vegetation coverage, and water quality indicators, and these data are uniformly stored in a township-level database. At the information integration level, a township-oriented land and ecological information management platform can be developed to link land approval, circulation, remediation, and other information with ecological monitoring results, achieving “one-map” management. In terms of early warning functions, the platform should be equipped with an automatic analysis module that can immediately push early warning information to township management departments when cultivated land reduction, ecological red line violations, or pollutant exceedances are detected. To further ensure the operability of data, a multi-level sharing mechanism should be established to facilitate data flow among township, county, and municipal departments, thereby avoiding issues of duplicate construction and information silos. Furthermore, a monitoring team composed of agricultural technicians, environmental protection personnel, and village cadres can be established at the township level to collect ground data and make preliminary judgments on abnormal situations[5]. Finally, it is recommended to open up some information, allowing villagers to use mobile applications to inquire about changes in the use of their land and the surrounding environmental conditions, and then report issues to the management department. In this way, a monitoring and management system that integrates technology, institutions, and the public can be truly implemented.

6. Conclusion

Land use patterns and ecological environment quality exhibit a high degree of coupling at the township level, making collaborative development an inevitable trend. To this end, this paper proposes strategies: promoting the integration of production and ecology in spatial layout, achieving parallel development of land circulation and green agriculture in institutional pathways, constructing monitoring networks and information platforms in terms of technical support, and implementing remediation and environmental improvement at the village level.

Future research and practice should be further expanded in the following directions: On the one hand, we should

accelerate the establishment of cross-departmental and cross-regional coordination mechanisms to ensure that land and ecological management policies form a synergistic force at the grassroots level. On the other hand, we should strengthen technology empowerment and promote the widespread application of informatization and intelligent means in township management. In addition, it is necessary to cultivate a pattern of diverse subject participation and guide village collectives, farmers, and social organizations to jointly assume responsibilities in land use and ecological protection. As the governance concept and practical path continue to deepen, rural revitalization can achieve further development.

Disclosure statement

The author declares no conflict of interest.

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