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Postprint of the Study on the Coupling and Coordination between Household Modernization and Livelihood Stability in Qinghai Lake National Park

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Abstract

Promoting the synergistic development of rural household modernization and livelihood stability is key to achieving the rural revitalization strategy. Taking Qinghai Lake National Park as an example, and based on modernization theory and the concept of stability, this study utilizes the Participatory Rural Appraisal (PRA) method to obtain primary data. It evaluates the level of rural household modernization in 2022 across three dimensions—production, living, and ecological modernization—and measures rural household livelihood stability through the two dimensions of diversity and dependency. The study systematically analyzes the coupling coordination relationship and spatial distribution characteristics between these two systems and identifies core driving factors using a random forest model. Finally, targeted optimization strategies are proposed based on these empirical results.

The results indicate that: (1) In 2022, the overall development levels of rural household modernization and livelihood stability in Qinghai Lake National Park were relatively low; the two systems were in a moderate coordination stage, and their development processes were essentially synchronized. (2) Significant differences exist among different types of rural households regarding modernization levels, livelihood stability, and their coupling coordination degree, all exhibiting a gradient characteristic of: service-oriented > labor-oriented > agriculture and animal husbandry-oriented > government-subsidized. (3) The coupling coordination degree shows significant spatial differentiation, with high-value clusters appearing in scenic areas and surrounding regions characterized by convenient transportation and high development levels. (4) Rural households' excessive dependence on single income sources and natural resources is the key factor restricting the synergistic development of modernization and livelihood stability. By exploring the coupling relationship and driving mechanisms between rural

household modernization and livelihood stability, this study provides an effective reference for enhancing the sustainable livelihood capacity of regional rural households and implementing the rural revitalization strategy.

Full Text

Preamble

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GEOGRAPHY

Coupling Coordination Study of Rural Household Modernization and Livelihood Stability in Qinghai Lake National Park

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Abstract

Promoting the coordinated development of farmer modernization and livelihood stability is a key component in achieving the strategy of rural revitalization. Taking the Qinghai Lake National Park as a case study, this research explores the mechanisms through which modernization efforts influence the resilience and sustainability of local agricultural households. Grounded in modernization theory and the conceptual framework of livelihood stability, we utilized data obtained through Participatory Rural Appraisal (PRA) to evaluate the modernization levels of rural households in 2022 across three dimensions: production, living standards, and ecological modernization. Livelihood stability was measured through the dual dimensions of diversity and dependency.

The results indicate that: (1) In 2022, the modernization and livelihood stability of rural households in the Qinghai Lake National Park remained at a relatively low overall development level; the two systems are currently in a stage of moderate coordination, with their development processes largely synchronized. (2) Significant disparities exist among different types of rural households, exhibiting a clear gradient: service-oriented households > labor-oriented households > agriculture and animal husbandry-oriented households > government-subsidized households. (3) The degree of coupling coordination demonstrates significant spatial differentiation, with high-value clusters emerging in scenic areas and surrounding regions characterized by convenient transportation. (4) Excessive dependence on single income sources and natural resources serves as the critical constraint hindering synergistic development. This study provides an effective reference for enhancing sustainable livelihood capacity and implementing rural revitalization strategies in ecologically fragile areas.

Keywords: Farmer modernization; Livelihood stability; Coupling coordination; Spatial differentiation; Qinghai Lake National Park

1. Introduction

The modernization of farmers and the stability of their livelihoods are critical components for achieving sustainable development in ecologically sensitive areas. As China transitions toward high-quality rural revitalization, the relationship between the transformation of traditional agricultural practices and the resilience of household economies has become a focal point. This is particularly true in the context of national parks, where the dual objectives of ecological conservation and community development must be balanced.

Qinghai Lake National Park serves as a vital ecological barrier on the Qinghai-Tibet Plateau. However, the traditional livelihoods of local farmers and herdsmen are often characterized by high vulnerability and low modernization levels. Understanding the coupling and coordination between farmer modernization and livelihood stability is essential for promoting regional social-ecological harmony. Existing research has investigated the sustainable development of relocated populations [**?**], but often overlooks the co-evolutionary mechanisms between modernization factors and livelihood systems. This study aims to bridge this gap by analyzing the interactive relationships between these systems.

2. Theoretical Framework and Methodology

2.1 Conceptual Framework

Farmer modernization is a multi-dimensional process involving the transformation of production methods, living standards, and ecological concepts. Livelihood stability refers to the capacity of households to maintain their standard of living and recover from external shocks. The interaction between these two systems is complex: modernization can enhance stability by diversifying income, while a stable livelihood provides the material foundation for adopting modern practices.

2.2 Evaluation Indicator System

We construct a comprehensive evaluation index system comprising 18 indicators across three dimensions: production, living, and ecological modernization . Production modernization includes industrial organization, labor quality, and mechanization. Living modernization covers housing, sanitation, and infrastructure. Ecological modernization focuses on environmental awareness and sustainable practices like rotational grazing. Livelihood stability is assessed using indicators related to income diversity, asset accumulation, and resource dependency.

2.3 Research Methods

2.3.1 Entropy Weight Method The weights of each indicator are determined using the entropy weight method to ensure objectivity. The standardized value x_{ij} is calculated to eliminate the influence of different units and scales.

2.3.2 Coupling Coordination Degree Model The coupling coordination degree model is utilized to measure the level of synergistic development between subsystems [**?**, **?**]. The coupling degree C is calculated as:

$$C = m \times \left[\frac{\prod_{i=1}^{m} U_i}{(\sum_{i=1}^{m} U_i)^m} \right]^{\frac{1}{m}}$$

The coordination degree D is derived as:

$$T = \sum_{i=1}^{m} \alpha_i U_i$$
$$D = \sqrt{C \times T}$$

where U_i represents the evaluation value of the i-th subsystem, and T is the comprehensive evaluation index.

2.3.3 Random Forest Model A Random Forest model was employed to identify core driving factors. This ensemble learning method allows for the processing of high-dimensional features and captures complex non-linear relationships to evaluate the relative importance of variables influencing coordination.

3. Results and Analysis

3.1 Analysis of Farmer Modernization

The modernization index for rural households in Qinghai Lake National Park is 0.288 , indicating an overall lagging trend. The living modernization index (0.170) is significantly higher than the production (0.053) and ecological (0.065) indices, revealing a structural imbalance. Modernization levels follow a gradient: service-oriented (0.344) > labor-oriented (0.309) > agro-pastoral dominant (0.274) > government-supported (0.223).

3.2 Analysis of Livelihood Stability

The livelihood stability index is 0.311, representing a lower-middle level. Service-oriented households exhibit the highest stability (0.454) due to diversified income from tourism. Government-supported households exhibit the weakest performance, with high dependency on transfer payments (0.142) and low autonomous development capacity. Agro-pastoral households show the highest natural resource dependency (0.188), highlighting their reliance on grassland resources.

3.3 Coupling Coordination and Spatial Distribution

The coupling degree between modernization and stability is high (0.936), but the coordination degree D is only 0.521, placing the region in the "moderate coordination" stage. Spatial analysis via Kriging interpolation [Figure 2: see original paper] reveals that high-value clusters are concentrated in scenic areas and regions with better transportation infrastructure, while "cold spots" persist in remote pastoral zones.

[Figure 1: see original paper]

4. Discussion and Optimization Strategies

The study finds that low land-use efficiency and heavy income dependency are primary constraints. While modernization efforts like mechanization and digital integration offer pathways for growth, the "digital divide" and fragmented land holdings remain barriers. For agro-pastoral households, the transition from subsistence to market-oriented production is hindered by high resource dependency.

To optimize development, we propose: (1) Enhancing industrial organization through cooperatives to improve labor productivity; (2) Promoting livelihood diversification, particularly in the service and tourism sectors; (3) Strengthening ecological compensation and social safety nets for government-supported households to reduce vulnerability.

5. Conclusion

This study systematically analyzed the coupling relationship between rural household modernization and livelihood stability in Qinghai Lake National Park. The findings highlight that while the two systems are synchronized, they remain at a moderate level of coordination. Spatial disparities and household-type differences necessitate targeted policy interventions. By balancing ecological protection with modern production techniques, the region can achieve sustainable rural revitalization and long-term livelihood resilience.

Note: Figure translations are in progress. See original paper for figures.

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