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Impact of Rural Household Livelihood Capital on Livelihood Strategies in Typical Desertified Areas: A Case Study of Hangjin Banner, Inner Mongolia Autonomous Region (Postprint)

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Abstract

Increasing the degree of livelihood diversification among farmer households is a primary approach to addressing critical issues such as rural poverty and fragile ecological environments. Using Participatory Rural Appraisal (PRA) and taking Hangjin Banner, located in the hinterland of the Kubuqi Desert, as a case study, this research establishes a multinomial Logistic regression model based on the analysis of farmer households' livelihood capital and livelihood strategies to investigate the key influencing factors in the transformation of household livelihood strategies from pure agriculture type to agriculture-dominant diversified type and diversified-agriculture type. The results indicate that: (1) Farmer households' livelihood capital is generally scarce, with natural capital being the most deficient, and there are certain differences in livelihood capital values. (2) Farmer households primarily adopt four types of livelihood strategies: pure agriculture type, agriculture-dominant diversified type, diversified-agriculture type, and non-agriculture type; households with different livelihood strategy types exhibit certain differences in livelihood activity arrangements and income composition. (3) Human capital is consistently the key livelihood capital influencing the transformation of farmer households' livelihood strategies; overall household labor capacity (H1), per capita cultivated land area (N1), per capita annual income (F1), and the number of relatives/friends who can provide assistance (S2) are key livelihood capital indicators affecting this transformation. Except for N1, the above livelihood capital and livelihood capital indicators all have a promoting effect on the transformation of farmer households' livelihood strategies from pure agriculture type to agriculture-dominant diversified type and diversified-agriculture type. Based on these findings, policy recommendations are proposed to improve the livelihood levels of farmer households in Hangjin

Banner and enhance the regional ecological environment.

Full Text

Preamble

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Impact of Farmers' Livelihood Capital on Livelihood Strategy in a Typical Desertification Area: A Case Study of Hangjin Banner, Inner Mongolia Autonomous Region

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Abstract

Improving the degree of farmer diversification represents the primary pathway for addressing critical issues such as rural poverty and fragile ecological environments. Using participatory rural appraisal (PRA) and multinomial logistic regression models, this study examines farmers' livelihood capital and livelihood strategies in Hangjin Banner, located in the hinterland of the Kubuqi Desert, to identify the key factors influencing the transition from pure agricultural strategies to agriculture-dominant and non-agriculture-dominant strategies. The results indicate that: (1) Farmers' livelihood capital is relatively scarce overall, with natural capital being the most limited, though variation exists among households; (2) Four primary livelihood strategies prevail: pure agriculture, agriculture-dominant, non-agriculture-dominant, and non-agriculture strategies, with households adopting different strategies exhibiting distinct livelihood activity arrangements and income structures; (3) Human capital consistently represents the critical factor affecting livelihood strategy transformation, with overall family labor capacity, per capita arable land area, per capita annual income, and the number of relatives and friends able to provide assistance serving as key indicators influencing strategy conversion. These capital components and indicators significantly promote the transition from pure agriculture to both agriculture-dominant and non-agriculture-dominant strategies. Finally, the paper proposes policy recommendations for improving livelihood levels and regional ecological conditions in Hangjin Banner.

Keywords: livelihood capital; livelihood strategy; influencing factors; Hangjin Banner

Introduction

The interrelationship between humans and ecosystems constitutes a core scientific proposition of sustainable development. As the most fundamental socioeconomic unit and decision-making entity in rural areas, farmers' livelihood strategies determine resource utilization patterns and efficiency, exerting profound impacts on ecological environments. These strategies fundamentally depend on the capital assets farmers possess. Research on how livelihood capital influences livelihood strategies holds significant importance for enhancing farmers' welfare and mitigating environmental degradation from agricultural production. This topic has become a research hotspot, with studies by Yan Jianzhong, Zhao Xueyan, and Wang Yanxing demonstrating that farmers' capital endowments affect their strategic choices, though different capital types carry varying significance. However, existing research predominantly focuses on correlation analysis, with limited quantitative findings and insufficient attention to key factors driving livelihood strategy transformation or policy-oriented strategy selection. Most studies categorize farmers into agriculture-dominant and non-agriculture-dominant types, employing logistic regression to examine relationships. In Hangjin Banner, farmers engage in both agricultural production and non-agricultural activities to increase income, with diversification being widespread. This study adopts a multinomial logistic model to classify farmers into pure agriculture, agriculture-dominant, non-agriculture-dominant, and non-agriculture types. Using survey data and statistical materials, it conducts quantitative analysis on promoting transitions from pure agriculture to agriculture-dominant and non-agriculture-dominant strategies, aiming to identify critical factors, enhance diversification levels, ensure income growth and improved living standards while reducing ecological pressure, strengthen farmers' adaptive capacity to environmental change, and provide theoretical foundations for scientific ecological governance policies.

1. Study Area Overview

Hangjin Banner is located in northwestern Ordos City, Inner Mongolia Autonomous Region, spanning approximately 161 km from east to west and 197 km from north to south, with a total land area of 18,811 km². It is a semi-agricultural, semi-pastoral banner predominantly inhabited by Mongolians but with a Han majority, classified as a district-level impoverished area, where agricultural and pastoral populations account for 81.12% of the total population. Situated in the transition zone between temperate arid steppe and desert steppe, the region features a typical temperate continental climate. The terrain is complex and diverse, with the Yellow River alluvial plain in the north, the Kubuqi Desert in the north-central region, hard beam areas in the central-south, and the Mu Us Sandy Land in the south. Annual precipitation ranges

from 144.6–336 mm, concentrated in July–September, while annual evaporation reaches 2,630 mm. The regional climate is arid, desertification is severe, and the ecological environment is extremely fragile. Since 2001, Hangjin Banner has implemented ecological protection policies and projects including grain-for-green, Three-North Shelterbelt, natural forest protection, Japanese yen loans for windbreaks, and grassland ecological compensation to improve its fragile environment, making it a key county for recent national ecological construction.

2. Data Sources

This study employed participatory rural appraisal (PRA) methods. In 2015, the research team conducted a preliminary survey of farmers' livelihood conditions in Duguitala Town, Hangjin Banner, subsequently revising and refining the questionnaire based on preliminary findings. Formal field surveys were conducted to obtain required data. Using stratified random sampling, the team selected 310 farmer households across Hangjin Banner, covering 100% of townships and 40.78% of administrative villages. The survey yielded 310 valid questionnaires (95.95% response rate). Survey content primarily included: (1) current agricultural and non-agricultural livelihood activities; (2) livelihood capital comprising natural, human, material, financial, and social capital.

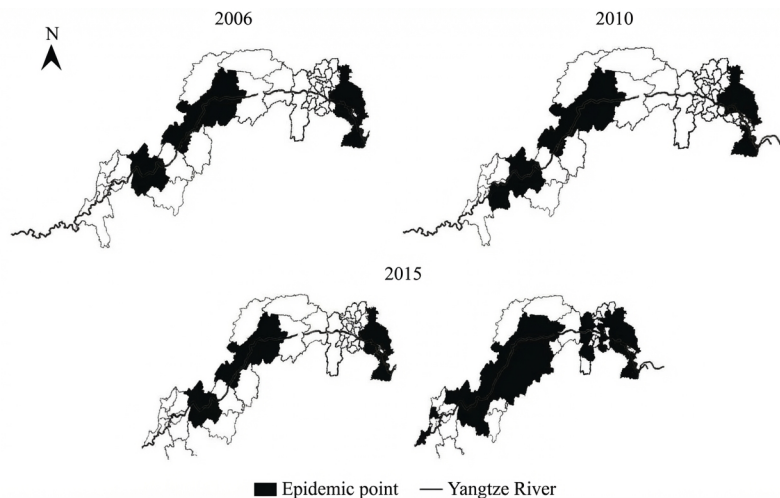


Figure 1: Figure 1

Study area and investigation sites

3. Livelihood Capital Measurement

Measurement Indicators. Based on the sustainable livelihood framework developed by the UK Department for International Development (DFID) and drawing upon domestic and international quantitative livelihood research, this

study adapted the indicator system according to Hangjin Banner' s natural environment, resource endowments, and farmers' production conditions, while considering data availability. Human capital refers to knowledge, skills, and labor capacity for livelihood generation, measured by overall family labor capacity (marked by age and health status) (H1) and education level of adult laborers (H2). Natural capital denotes accessible natural resources and environmental services; given that farmers rely on crop cultivation and animal husbandry, indicators include per capita arable land area (N1) and grassland area (N2). Material capital comprises infrastructure and physical equipment for production and living, with livestock being an important component, measured by per capita housing value (M1), fixed asset value (M2), and livestock quantity (M3). Financial capital refers to cash for purchasing production and consumption goods and accessible loans, measured by household cash income (F1) and credit availability (F2). Social capital represents social resources utilized for implementing livelihood strategies; given the importance of relatives' and friends' assistance, measured by the likelihood of receiving aid when encountering difficulties (S1) and the number of relatives and friends providing assistance (S2).

Measurement indicators, assignment, and weights of farmers' livelihood capital in Hangjin Banner

Data Standardization. Since survey data have different dimensions, magnitudes, and variation ranges, this study employs forward range standardization:

$$x_{ij} = (x_{ij} - x_{\min}) / (x_{\max} - x_{\min})$$

Indicator Weight Determination. To effectively overcome information overlap among indicators and subjectivity in weight determination, this study uses the entropy method to determine weights. The proportion of indicator values for the j -th indicator of the i -th evaluation object:

$$p_{ij} = x_{ij} / \sum x_{ij}$$

The entropy value of the j -th indicator:

$$e_j = - (1/m) \sum p_{ij} \ln p_{ij}$$

The weight of the j -th indicator:

$$w_j = (1 - e_j) / \sum (1 - e_j)$$

Livelihood Capital Calculation. The livelihood capital index for farmers is the weighted average of sample households.

4. Livelihood Type Classification

Drawing upon previous research on farmer livelihood classification and considering local conditions, this study categorizes farmers based on the proportion of non-agricultural income to total household income: farmers with no non-agricultural income are pure agriculture households; those with non-agricultural

income accounting for less than 30% are agriculture-dominant; 30-65% are non-agriculture-dominant; and above 65% are non-agriculture households. Current data show pure agriculture households are most common (41.58%), followed by agriculture-dominant (30.00%), non-agriculture-dominant (22.63%), and non-agriculture (5.79%).

5. Model Establishment

This study employs multinomial logistic regression to examine key factors influencing livelihood strategy transformation. Due to limited non-agriculture household samples, the dependent variable includes only three types: pure agriculture, agriculture-dominant, and non-agriculture-dominant, using pure agriculture as the reference category. The model is constructed using SPSS 19.0. If a household adopts agriculture-dominant strategy, $y = 2$; if non-agriculture-dominant, $y = 3$; if pure agriculture, $y = 1$. x_i represents explanatory variables (livelihood capital or specific indicators). Coefficients explain changes in the dependent variable resulting from one-unit changes in independent variables. If estimated coefficients are positive, incidence rates increase with corresponding variables; if negative, incidence rates decrease.

6. Livelihood Capital Evaluation

Based on indicator values and weights, the five livelihood capital values for surveyed Hangjin Banner farmers were calculated, with the status illustrated in [FIGURE:2]. Unlike the ideal regular pentagon, livelihood capital is generally scarce and unevenly distributed due to natural environment, location conditions, and ecological protection policies. Natural capital is most limited (0.1034), primarily because of harsh ecological conditions, severe desertification, and policies such as grain-for-green and ecological migration that reduce available arable land; additionally, the arid climate limits grassland quality. Material capital is limited to basic living needs, with livestock (M3) having the highest weight but limited numbers due to grazing bans. Social capital is relatively closed (0.3562), with only 41.05% of households having more than 6 assisting relatives/friends and only 42.15% receiving definite or probable assistance when encountering difficulties. Human capital is limited (0.3881), with average household size of 3.34, 2.45 laborers per household, and 57.89% of adult laborers having primary school education or below. Financial capital is relatively high (0.4877), with per capita annual cash income of 23,160 yuan and 23.16% of households having definite or probable loan access, attributable to ecological compensation and subsidies from conservation policies and increased non-agricultural income.

[FIGURE:2] Status of livelihood asset values for farmers in Hangjin Banner

7. Livelihood Strategy Analysis

Hangjin Banner farmers primarily adopt four strategies: pure agriculture, agriculture-dominant, non-agriculture-dominant, and non-agriculture, with

differences in activity arrangements and income composition. Pure agriculture households focus on crop cultivation (88.61% of income) and animal husbandry (86.08% of income), with agricultural income comprising 91.23% of total income. Agriculture-dominant households engage mainly in crop cultivation (72.13% of income) and animal husbandry (77.19% of income), while also having members engaged in wage labor (17.54% of income), with non-agricultural income accounting for 27.87%. Non-agriculture-dominant households combine agricultural and non-agricultural activities, with non-agricultural income comprising 67.72% and agricultural income only 32.28%. Non-agriculture households lease out limited farmland or grassland, with household members primarily engaged in non-agricultural activities, generating 97.72% of income from non-agricultural sources.

Livelihood strategies of farmers in Hangjin Banner

8. Impact of Livelihood Capital on Livelihood Strategies

Multinomial logistic regression analysis of livelihood capital and strategy selection yields the following results :

Impact on Agriculture-Dominant Strategy Transition. Human and social capital are key factors significantly and positively affecting the transition from pure agriculture to agriculture-dominant strategies. Holding other variables constant, each one-unit increase in human and social capital increases the incidence of choosing agriculture-dominant strategies by 106.674 and 6.194 times, respectively. Material and financial capital show no significant effect.

Impact on Non-Agriculture-Dominant Strategy Transition. Natural and financial capital are key factors significantly and negatively affecting the transition from pure agriculture to non-agriculture-dominant strategies, while human capital has a significant positive effect. Each one-unit increase in human capital increases the incidence of choosing non-agriculture-dominant strategies by 300.280 times, while each one-unit increase in natural and financial capital decreases incidence by 0.001 and 0.194 times, respectively. Material and social capital show no significant effect.

Key Findings. Human capital consistently represents the critical factor influencing livelihood strategy transformation in Hangjin Banner, significantly promoting transitions to both agriculture-dominant and non-agriculture-dominant strategies, with greater impact on the latter (coefficients increasing from 4.670 to 5.705).

Multinomial logistic regression analysis of farmers' livelihood capital and livelihood strategy choice

9. Impact of Livelihood Capital Indicators

Impact on Agriculture-Dominant Strategy Transition. Household overall labor capacity (H1), per capita arable land area (N1), per capita annual income (F1), and number of assisting relatives/friends (S2) are key indicators significantly and positively affecting the transition from pure agriculture to agriculture-dominant strategies. Holding other variables constant, each one-unit increase in these indicators increases the incidence of choosing agriculture-dominant strategies by 18.022, 24.188, 4.696, and 4.358 times, respectively.

Impact on Non-Agriculture-Dominant Strategy Transition. H1, per capita grassland area (N2), F1, and S2 are key indicators significantly affecting this transition. H1, F1, and S2 have significant positive effects, with each one-unit increase increasing incidence by 64.042, 28.647, and 5.346 times, respectively. N2 has a significant negative effect, with each one-unit increase decreasing incidence by 0.000 times.

Key Indicators. H1, N1, F1, and S2 are critical indicators affecting livelihood strategy transformation, all significantly promoting transitions from pure agriculture to both agriculture-dominant and non-agriculture-dominant strategies, with greater impact on the latter. N1 shows significant negative effects on both transitions, with greater impact on non-agriculture-dominant strategy adoption.

Multinomial logistic regression analysis of farmers' livelihood capital index and livelihood strategy choice

10. Conclusions and Discussion

Enhancing farmer diversification not only addresses single-livelihood vulnerability and improves risk resistance but also mitigates environmental degradation and ecological pressure. Based on survey data and analysis of livelihood capital and strategies, this study employed multinomial logistic regression to analyze key factors influencing transitions from pure agriculture to agriculture-dominant and non-agriculture-dominant strategies. The findings reveal that Hangjin Banner farmers' livelihood capital is generally scarce and unevenly distributed. Constrained by natural and anthropogenic factors, natural capital is most limited, material capital barely meets basic needs, social capital is relatively closed, human capital stock is limited with low education levels, and financial capital—though relatively high—reflects excessive dependence on ecological compensation requiring improved economic autonomy. Farmers primarily adopt four strategies (pure agriculture, agriculture-dominant, non-agriculture-dominant, and non-agriculture), with distinct differences in activity arrangements and income composition.

Human capital consistently emerges as the key factor influencing livelihood strategy transformation, significantly promoting transitions from pure agriculture to both agriculture-dominant and non-agriculture-dominant strategies—a finding consistent with Zhao Xueyan, Meng Jijun, and Wei Huilan's research.

This study further reveals that human capital's impact on transitioning to non-agriculture-dominant strategies exceeds its impact on agriculture-dominant strategies. With limited average laborers per household (2.45) and low education levels (57.89% with primary school or below), human capital constraints restrict farmers' non-agricultural options and investment, necessitating human capital improvement to facilitate livelihood transformation.

Household overall labor capacity (H1), per capita arable land area (N1), per capita annual income (F1), and number of assisting relatives/friends (S2) are critical indicators. H1, F1, and S2 significantly promote transitions to both strategy types, with stronger effects on non-agriculture-dominant transitions. N1 significantly inhibits both transitions, with stronger negative effects on non-agriculture-dominant adoption, indicating that larger per capita farmland encourages agriculture-focused strategies due to economies of scale and cost reduction benefits. These findings provide more targeted and actionable insights than previous studies by examining specific capital indicators.

11. Recommendations and Outlook

Based on these conclusions, we propose the following recommendations:

Enhance Human Capital. Prioritize education, skills training, and healthcare improvement. Strengthen educational infrastructure, particularly at the township and village levels, to address schooling inconveniences from administrative consolidation, reduce education-related costs, and improve enrollment and educational attainment. Establish and improve rural health service networks, especially village-level facilities, to address healthcare accessibility and affordability. Develop targeted non-agricultural employment skills training based on social development needs to enable farmers to secure non-agricultural employment opportunities.

Improve Infrastructure and Social Capital. Strengthen rural roads, communications, and information service networks. Develop specialized cooperative economic organizations based on kinship and geographical ties to enhance farmers' organizational capacity, promote agricultural scale management, increase cash income, and strengthen collective risk resistance.

Promote Land Transfer. Actively study and implement the Rural Land Contracting Law and Management Measures for Rural Land Contracting Right Transfer to facilitate land scale management, increase farmer income, release labor for secondary and tertiary industries, and improve diversification while reducing ecological pressure.

Policy Integration. Farmers' livelihood strategies are influenced by capital endowments, which in turn affect land use and local ecological conditions through livelihood activities. Future ecological governance should not only focus on vegetation restoration but also strengthen guidance on livelihood capital allocation and behavior from a social management perspective to enhance adaptive capac-

ity to environmental change. Future research should quantitatively analyze the ecological impacts of livelihood transformation to evaluate ecological effects, representing an important scientific issue in human-environment systems research.

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