Research on the Evaluation and Improvement Path of Human Settlements Satisfaction in Ecological Relocation Sites under the Yellow River Strategy—— Taking Liangshan County as an Example

Jiayi Liu*, Linhan Zhang, Lei Liu, Zhuohan Dong, Jingjing Zhou

Shandong Institute of Technology, Yantai, Shandong, 264005, China

*Corresponding author: Jiayi Liu

Abstract: As outlined in the Yellow River Basin Ecological Protection and High-Quality Development Plan, the region faces critical challenges including flood risks, inadequate high-quality development, and insufficient livelihood improvements. Liangshan County has actively implemented ecological relocation projects for residents along the Yellow River in response to national initiatives. This study employs literature review, field investigations, questionnaire analysis, and SPSS data analysis to evaluate residents 'satisfaction with their living conditions post-relocation. The research identifies key factors affecting satisfaction levels and explores strategies to enhance residents' sense of fulfillment and well-being. These efforts aim to contribute to ecological conservation and sustainable development in the Yellow River basin while improving local residents' quality of life.

Keywords: Yellow River Basin; Ecological Relocation; Satisfaction of Living Environment; Improvement Path

The Yellow River Basin faces challenges including flood risks, lagging high-quality development, and livelihood deficiencies. Due to the extremely high sediment content in the river, governance remains highly challenging with severe water disasters. As a Yellow River basin county, Liangshan County has implemented ecological relocation projects, where resident satisfaction directly impacts project effectiveness. This study focuses on resettlement areas, analyzes factors influencing living satisfaction, proposes optimization strategies, and provides practical references for high-quality development in the Yellow River Basin.

1.Research subjects and methods

This study focuses on Xiaokouluo Town and Zhaogudui Township in Liangshan County, analyzing residents' overall satisfaction with relocation programs and specific aspects including resettlement, livelihood improvement, and social integration. A questionnaire was designed for evaluating satisfaction levels at the Huanghe Xinyuan Community and Cuiping Jiayuan Community in Liangshan County. Statistical analysis software (SPSS) and GIS tools were employed to examine factors influencing satisfaction, assess the effectiveness of living environment improvements, and identify key areas for enhancement. These findings aim to accelerate the stabilization and comprehensive optimization of the socio-economic,

cultural, and ecological development framework in relocation sites [1][2].

2.Research content

2.1 Relocation Project Overview

The Huanghe Xinyuan Community, located in Xiaolukou Town of Liangshan County, commenced construction in December 2017. A 300-square-meter Huanghe Memory Exhibition Hall was built on the third floor of the service center to preserve Yellow River culture. The Cuiping Jiayuan Community in Zhaogudui Township of Liangshan County serves as a key infrastructure and urban-rural integration project. Construction began in September 2018, featuring 112 relocated housing complexes that accommodated 7,373 residents, while significantly enhancing educational resources and promoting integrated urban-rural development. The ecological relocation initiative along the Yellow River consistently adheres to ecological and economic principles, integrating resource utilization protection, productive construction, and ecological conservation to harmonize economic benefits with environmental sustainability [3].

2.2 Sample structure

In this survey, 460 questionnaires were distributed and 363 returned. After validity screening, 312 valid responses were selected for statistical analysis and research. The participants comprised 163 males and 149 females, maintaining a gender ratio of approximately 1.1:1. Age distribution showed: 98 adolescents (31%) aged 0-18,65 middle-aged adults (21%), and 149 seniors (48%). As the survey was conducted offline, respondents were predominantly aged 55 and above.

2.3 Construction of resident satisfaction index system in the study area

This questionnaire establishes a satisfaction evaluation system for relocated residents 'living environment, with primary indicators covering natural ecological conditions, material infrastructure, socio-cultural environments, and economic development. The framework comprises three tiers: 4 primary indicators, 10 secondary indicators, and 24 tertiary indicators. Designed around 22 metrics, the survey employs a 5-point satisfaction scale (1-5 points) to quantify residents' subjective preferences. The detailed indicator system is presented in Table 2-1.

Table 2-1 Resident satisfaction index and average score of each index in the study area

Target layer A	supporting layer B	Average score	Classification level C	Average score	Indicator layer D	Average score
Reloca-tion resi-dents' satisfac-tion with living environ-ment	Natural ecological environment (B1)	4.01	Sanitary and environmental conditions (C1)	3.85	D1 Safety of drinking water	3.70
					D2 level of waste collection	4.00
			Agricultural ecological environment (C2)	4.05	D3 Production sewage treatment	4.00
					D4 Agricultural mechanization level	4.10
			State of the natural environment (C3)	4.17	D5 River and lake pollution treatment	4.01
					D6 Vegetation coverage	4.21
					D7 Natural disaster preparedness	4.30
	Material facilities environment (B2)	4.34	Public service facility conditions (C4)	4.44	D8 Education facilities level	4.45
					D9 Standard of medical facilities	4.46
					D10 Cultural facilities level	4.40
			Individual living conditions (C5)	4.37	D11 Location of the premises	4.40
					D12 Housing comfort	4.33
			Infrastructure supply (C6)	4.20	D13 Accessibility	4.19
					D14 Commercial facilities level	4.15
					D15 Network communication level	4.27

Target layer A	supporting layer B	Average score	Classification level C	Average score	Indicator layer D	Average score
Reloca-tion resi-dents' satisfac-tion with living environ-ment	Social and cultural environment (B3)	4.16	Cultural development environment (C7)	4.30	D16 Type of cultural activities	4.10
					D17 State of neighborhood relations	4.42
					D18 Social and moral standards	4.39
			Social security environment (C8)	4.02	D19 Level of democratic participation	3.81
					D20 Social security level	4.23
	economic develop-ment envi-ronment (B4)	3.89	Employment environment conditions (C9)	3.79	D21 Employment location conditions	3.76
					D22 Employment of farmers	3.81
			Income and consumption level (C10)	3.98	D23 Family income level	3.97
					D24 Price and consumption levels	3.98

2.4 Satisfaction analysis of residents in the study area

2.4.1 Analysis of the scores of four first-level indicators

As shown in Table 2-1, residents' average satisfaction scores for different environments are as follows: natural ecological environment (4.01 points), material facilities environment (4.32 points), social and cultural environment (4.16 points), and economic development environment (3.89 points). Notably, the material facilities environment received the highest satisfaction score, while the economic development environment had the lowest. Detailed results are presented in Table 2-1.

2.4.2 Statistical analysis of satisfaction with natural ecological environment

Regarding farmland land circulation, the "Party Branch + Cooperative" model is adopted where residents contribute their farmland as shares, with ownership remaining collectively owned, resulting in an additional income of approximately 1,300 yuan per mu (about 667 ㎡). For housing allocation, resettlement area prices are determined according to demolition compensation agreements, while any excess area is purchased at market rates. During the initial phase of relocation projects, residents' preferences for floor configurations were surveyed, offering options including multi-story buildings (4+1 and 5+1 layouts) and high-rise structures (11 stories). In terms of natural ecological environment, vegetation coverage scored highest among three indicators (4.21), while drinking water safety received the lowest score (3.70).15.5% of residents rated it as average. The community maintains 100% tap water supply, ensuring convenient access to water resources. Property management is self-managed, complemented by high vegetation coverage.

2.4.3 Statistical analysis of environmental satisfaction with material facilities

In terms of physical infrastructure, medical facilities scored the highest (4.46) among the three sub-indicators, while commercial facilities ranked lowest (4.15).92% of residents expressed satisfaction or high satisfaction with the environment. The new community has effectively addressed four major challenges in daily life by providing a 1,000-square-meter clinic space, organizing regular free clinics, and offering free medical consultations and health guidance.

2.4.4 Statistical analysis of social and humanistic environment satisfaction

In terms of social and cultural environment, the third-level indicators showed the highest score in neighborhood relations (4.42) while the lowest in democratic participation (3.81). The overwhelming majority of residents expressed satisfaction with the community's cultural environment, demonstrating strong public recognition of its development. Huanghe Xinyuan Community actively organizes cultural activities to enrich residents' spiritual lives. Neighborhood disputes are resolved through a tiered process: building managers → grid officers → community → government. The community features the "Old Ma" Mediation Studio where the Party Secretary personally handles conflicts. Cuiping Jiayuan Community adopts a multi-level approach—property management → community → village cadres → government—to systematically resolve disputes, effectively addressing conflicts.

2.4.5 Statistical analysis of satisfaction with economic development environment

In terms of economic development environment, the three-level indicators show employment location conditions scored 3.76, household employment levels 3.81, family income levels 3.97, and price consumption levels 3.98. Among residents, 30% expressed general satisfaction, 1.84% dissatisfaction, and 0.16% strong dissatisfaction. The economic environment significantly impacts residents' livelihoods, requiring attention from community governments. To address employment issues, the community has actively established social-enterprise partnerships, created job opportunities, formed a "Two New" alliance group, and developed public welfare positions.

2.5 Entropy analysis

2.5.1 Steps

Step 1: Data standardization

forward pointer：

$$X_{ij}^{'} = \frac{X_{ij} - \min(X_{ij})}{\max(X_{ij}) - \min(X_{ij})}$$

Negative indicators:

$$X_{ij}{'} = \frac{\max(X_{ij}) - X_{ij}}{\max(X_{ij}) - \min(X_{ij})}$$

Step 2: Calculate the proportion of each indicator

$$p_{ij} = \frac{X_{ij}^{'}}{\sum_{i=1}^{n} X_{ij}^{'}}$$

Step 3: Calculate information entropy

$$e_j = - k \sum_{i=1}^{n} p_{ij} \ln(p_{ij})$$

Step 4: Calculate the utility value of information

$$d_j = 1 - e_j$$

Step 5: Calculate weights

$$w_j = \frac{d_j}{\sum_{j=1}^{m} d_j}$$

Step 6: Calculate the composite score

$$S_i = \sum_{j=1}^{m} w_j \times X_{ij}{'}$$

2.5.2 Results analysis

The entropy value method analyzed the information entropy (e), information utility value (d), and weight coefficients (w) of primary and secondary indicators to determine their relative importance in overall satisfaction. The results showed that employment location conditions had the highest weight (8.22%), followed by farmers 'employment levels (8.06%), indicating that employment opportunities and work location convenience have the greatest impact on residents' satisfaction. Price consumption level (7.09%) carried a relatively high weight, highlighting living costs as a key factor. Water safety (6.87%) and household income level (5.72%) also ranked high, demonstrating that infrastructure and income significantly contribute to satisfaction. Specific findings are detailed in Table 2-2.

Table 2-2 Summary of weight calculation results by entropy method

Item	weight coefficient w	Item	weight coefficient w
D1 Safe drinking water for life	6.87%	D13 Traffic accessibility	3.91%
D2 level of waste collection	4.57%	D14 Commercial facilities level	3.98%
D3 Production sewage treatment	3.43%	D15 Network communication level	2.78%
D4 Agricultural mechanization level	2.70%	D16 Type of cultural activities	4.36%
D5 River and lake pollution treatment	4.03%	D17 Neighborhood relations	3.24%
D6 Vegetation coverage	2.10%	D18 Social and moral standards	4.24%
D7 Natural disaster preparedness	2.93%	D19 Level of democratic participation	5.50%
D8 Education facilities level	2.68%	D20 Social security level	2.62%
D9 Medical facilities level	2.65%	D21 Employment location conditions	8.22%
D10 Sports and recreation facilities	2.53%	D22 Farmer employment level	8.06%
D11 Location of the house	2.68%	D23 Family income level	5.72%
D12 House comfort	3.11%	D24 Price consumption level	7.09%

2.5.3 Satisfaction weighted score

In order to use the entropy method to comprehensively evaluate satisfaction, we set 5 levels as follows:

Table 2-3 Satisfaction rating scale

Composite index score	1 below	1-2	2-3	3-4	4-5
satisfaction evaluation	range	Need improvement	same as	good	outstanding

According to the weighted score of entropy method, the comprehensive average score of satisfaction of 312 samples is 4.045, which belongs to the "excellent" rating (4-5 points). On the whole, the resettlement site has achieved good effects in ecological protection and community development, which improves residents' sense of happiness and gain, provides a practical basis for similar projects, and points out the key areas for continuous improvement.

4.Current problems in the Yellow River ecological relocation research area

Feng Li's (2023) research reveals that China's Yellow River Basin ecological governance faces challenges in achieving coordinated outcomes across multiple dimensions, including unified leadership among stakeholders, interdepartmental coordination, and regulatory tool selection preferences [4]. Sun Fuhua, Pan Deng, and Shang Zelong (2023) further demonstrate that satisfaction levels in residential relocation, livelihood resettlement, and rights protection directly influence overall satisfaction with the resettlement process [5].

According to the investigation and analysis of Huanghe Xinyuan community and Cuiping Home Community, this paper analyzes the following problems:

4.1 Infrastructure and living environment:

The Huanghe Xinyuan Community, situated in a low-lying area prone to water accumulation, occasionally experiences severe water shortages in high-rise buildings due to pressure issues. Both communities face substandard tap water quality and delayed sewage treatment. Additionally, medical facilities remain inadequate, with only a community clinic available while lacking large hospitals and specialized medical institutions. This situation makes it difficult to meet residents' daily healthcare

needs, particularly for emergency care and specialized treatments.

4.2 Community Relations and Development:

The current situation regarding residents 'participation in community governance manifests three key issues: First, excessive intervention by local governments has weakened community self-governance capabilities; second, there exists a lack of effective communication between communities and residents; third, residents demonstrate limited capacity to participate in community governance [6]. The random housing allocation system in Cuiping Jiayuan Community leads to minimal neighbor interaction, frequent conflicts, and inefficient mediation processes. While public satisfaction with community democratic participation remains high, challenges persist including information asymmetry and low engagement levels. Research by scholars Dong Feilong and Wu Hongchen (2024) on post-relocation residents' satisfaction with livelihood benefits in Dongming Yellow River floodplain areas revealed slightly higher dissatisfaction rates regarding employment [7]. Both Huanghe Xinyuan Community and Cuiping Jiayuan Community face severe aging populations and demonstrate weak sustainable development potential.

4.3 Public services and resources:

Educational resources are scarce and uneven in quality, the number of schools is limited, teaching facilities are old, teachers are weak, extracurricular tutoring and interest classes are scarce; employment and entrepreneurship support is weak, overall employment opportunities are scarce, the attraction to highly educated and skilled talents is insufficient, and the support for entrepreneurs is small.

5.Strategies and recommendations

5.1 Optimize infrastructure and living environment

We will comprehensively upgrade the water supply system through a rainwater-sewage separation project. Drawing on Shanghai's successful experience and considering the low-lying terrain of residential areas, we will construct new main stormwater pipelines and renovate drainage facilities to enhance flood prevention and drainage capabilities. To address water shortages in high-rise buildings, we will install additional pressure booster systems and optimize the distribution network layout to ensure stable water supply for residents in elevated buildings.

The water plant has upgraded its water supply pipelines using new materials and purification equipment to enhance water quality standards. A long-term water quality monitoring system has been established with smart management technology for real-time tracking. Community medical facilities have been strengthened through updated equipment and improved service quality. An efficient referral network has been created in collaboration with nearby major hospitals to ensure timely emergency care and specialized treatment. The pharmaceutical supply chain has been optimized through partnerships with drug manufacturers to guarantee sufficient medication availability.

5.2 Promoting harmonious development of the community and residents' participation

Communities should strategically plan public spaces by developing cultural and recreational plazas with comprehensive sports and cultural facilities. Regularly organize community enhancement initiatives such as cultural festivals and family-friendly activities to foster neighborhood interaction. To address neighborhood relations, host diverse social events like Neighborhood Festivals and interest groups to enhance communication opportunities. Establish regular discussion forums and exchange meetings to create two-way communication channels. Pay special attention to the needs of vulnerable groups including seniors and children through personalized services. Set up online and offline suggestion boxes to encourage residents' active participation in community decision-making and management processes.

Accelerate industrial development by upgrading furniture parks through intelligent transformation, introducing advanced production lines to enhance product quality and value-added capabilities. The government will invest in large-scale cultivation of specialty agricultural products, encouraging public participation with technical guidance and market access support. Strengthen brand building by promoting local specialties through digital platforms, attracting young talent back to rural communities for employment and entrepreneurship. This initiative aims to alleviate community aging issues while fostering sustainable development.

5.3 Improve the level of public services and resource security

Increase investment in education by expanding schools and kindergartens, upgrading teaching facilities, and attracting high-quality teachers. Establish deep collaborations with leading institutions to conduct regular teacher-student exchange programs that enhance educational quality. Diversify extracurricular activities through art, sports, science, and technology enrichment classes to promote students' all-round development. Develop an educational resource sharing platform to enable online access to premium learning materials.

Establish a dedicated entrepreneurship support fund to provide financial assistance for startups. Conduct entrepreneurship training programs with expert guidance to enhance entrepreneurs' capabilities. Develop preferential policies such as tax reductions and venue rental discounts to attract highly educated professionals and skilled talents to the community. Build an employment and entrepreneurship service platform that publishes job listings and offers career counseling services.

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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