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THE IMPACT OF ECOLOGICAL MIGRATION ON ECOLOGICAL ENVIRONMENT AND LIVELIHOOD WELL-BEING SATISFACTION: AN EMPIRICAL ANALYSIS BASED ON HEZE CITY, SHANDONG PROVINCE

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Abstract: Ecological migration constitutes an essential component of China's ecological civilization construction, aiming to achieve dual goals of ecological restoration and livelihood improvement. Using three counties and seven ecological resettlement communities along the Yellow River in Heze City, Shandong Province as research samples, this study constructs a three-dimensional participation framework of "cognitive–affective–behavioral" engagement. Through reliability and validity tests, correlation analysis, analysis of variance, and multiple regression methods, the study systematically explores the influence mechanism of migrants' participation on satisfaction with the ecological environment and livelihood well-being. The findings indicate that: (1) Overall, post-relocation migrants report higher satisfaction with the ecological environment than with livelihood well-being, yet exhibit relatively low behavioral participation, revealing a structural pattern of "cognition–affection leading, behavior lagging." (2) Multidimensional participation significantly enhances both ecological and livelihood satisfaction, among which cognitive participation exerts the strongest direct effect on livelihood well-being satisfaction, while affective and behavioral participation indirectly influence it through improved ecological environment satisfaction. (3) Ecological environment satisfaction plays a partial mediating role in the "participation–well-being" relationship, unveiling the intrinsic coupling mechanism between ecological construction and livelihood improvement. The study concludes that the sustainable development of ecological migration depends not only on material resettlement but also on migrants' initiative and agency in institutional participation, social identity, and behavioral practice. Strengthening grassroots participatory governance, rebuilding community emotional cohesion, and improving ecological industrial incentive mechanisms are identified as key pathways to achieving synergistic enhancement of ecological protection and livelihood well-being in the Yellow River Basin.
Keywords: Middle and lower reaches of the Yellow River; Ecological migration; Ecological environment; Livelihood well-being; Satisfaction survey

1 INTRODUCTION

As an essential component of ecological civilization construction, ecological migration serves as a key policy instrument for coordinating the human–land relationship and achieving the dual goals of ecological restoration and livelihood improvement [1]. International research has shown that since the 1990s, ecological migration has gradually shifted from a passive response to environmental displacement toward an active approach to ecological governance [2]. Its core lies in achieving a dynamic balance between ecological security and social well-being through institutional design and community participation. Domestic studies similarly emphasize that ecological migration is not merely a technical measure of environmental protection, but a transformative process of social structure and lifestyle reconstruction, the effectiveness of which depends largely on migrants' level of participation in ecological governance and community rebuilding [3-4].

The Yellow River Basin represents one of the earliest, largest, and most complex regions for implementing China's ecological migration policy. In recent years, with the advancement of the Ecological Protection and High-Quality Development Strategy of the Yellow River Basin, ecological migration has evolved from the initial goals of "moving out and settling down" to the higher objectives of "becoming prosperous and integrating well". However, post-relocation ecological restoration and livelihood enhancement are not automatically achieved. Existing research has primarily evaluated post-migration outcomes in terms of income growth, housing improvement, and social security, yet has rarely examined how migrants' participatory behaviors influence their overall satisfaction with the ecological environment and livelihood well-being [5]. In this process, whether migrants cognitively understand the policy, emotionally identify with their communities, and behaviorally participate in governance directly affects the sustainability and effectiveness of post-relocation development.

Against this backdrop, this study focuses on typical resettlement villages in three counties along the Yellow River in Heze City, Shandong Province. It seeks to explore the "participation–satisfaction" causal chain by addressing three research questions:

(1) What is the overall level of ecological and livelihood satisfaction among post-relocation ecological migrants?

(2) How do cognitive, affective, and behavioral participation differ in influencing ecological environment satisfaction and livelihood well-being satisfaction?
(3) Does ecological environment satisfaction play a mediating role between participation level and livelihood well-being satisfaction?
By constructing an empirical model incorporating multidimensional participation variables and controlling for demographic characteristics, this study aims to reveal the intrinsic mechanisms through which migrants' participation enhances their post-relocation quality of life and ecological perceptions.

2 LITERATURE REVIEW

Since the 1990s, research on ecological migration has gradually shifted from "environmentally driven passive relocation" to "institutionally guided proactive governance." Black et al. argued that environmental change interacts with economic, social, and institutional factors to shape migration behavior [2], while McLeman conceptualized migration as an adaptive strategy for coping with ecological degradation, emphasizing the importance of institutional design and community participation [6]. This paradigm shift has transformed ecological migration into a crucial institutional arrangement for building ecological civilization, with objectives that extend beyond ecological restoration to include social stability and livelihood improvement [1]. In the Chinese context, ecological migration has been incorporated into the national framework for ecological civilization construction, serving as a key measure to balance human–land relationships and promote coordinated regional development [7].
With the evolution of environmental governance concepts, participatory governance has emerged as a critical perspective for explaining the effectiveness of ecological migration. Reed highlighted that stakeholder participation can significantly enhance the sustainability of ecological governance [8], while Pretty defined participation as a process of learning and co-governance, emphasizing the synergistic role of cognitive, affective, and behavioral dimensions in social governance [9]. Subsequent studies demonstrated that residents' cognitive understanding, emotional identification, and behavioral participation can markedly improve policy acceptance and satisfaction [10]. Moreover, post-relocation community satisfaction depends not only on improvements in income and housing but also on social integration and environmental identification [5, 11], providing theoretical support for examining the "participation–satisfaction" mechanism in ecological migration.
Although previous research has confirmed the positive effects of ecological migration on ecological restoration and livelihood improvement [12], two major gaps remain in post-relocation studies. First, existing literature primarily focuses on objective indicators, lacking systematic analysis of migrants' subjective perceptions and participatory behaviors. Second, few empirical studies have explored the intrinsic relationship between ecological environment satisfaction and livelihood well-being satisfaction. To address these gaps, this study takes ecological resettlement communities along the Yellow River in Heze City, Shandong Province, as its research sample. It constructs an analytical framework of "multidimensional participation–ecological environment satisfaction–livelihood well-being satisfaction," aiming to reveal, from a micro-level perspective, the mechanism through which ecological migration influences satisfaction with both ecological environment and livelihood well-being.

3 RESEARCH DESIGN

3.1 Research Hypotheses

In the field of ecological migration and environmental governance, scholars generally agree that individual participation constitutes a key mechanism influencing the effectiveness of ecological policies. Reed emphasized that community participation not only enhances the sustainability of ecological governance but also improves residents' recognition and satisfaction with environmental policies [8]. From the perspective of social learning, Pretty proposed that participation is a progressive process encompassing three dimensions—cognitive, affective, and behavioral—whereby residents' policy understanding (cognitive participation), emotional identification (affective participation), and practical engagement (behavioral participation) jointly form the internal structure of participatory governance [9]. This multidimensional participation framework has been widely applied in studies of environmental governance and community reconstruction.
Furthermore, existing research has confirmed a significant positive correlation between public participation in environmental governance and environmental satisfaction. Participation at the cognitive level enhances environmental attitudes through information acquisition, policy comprehension, and risk perception [13], thereby improving evaluations of ecological restoration and environmental quality. Participation at the affective level strengthens residents' emotional attachment and environmental identity to their resettlement areas, helping to alleviate potential psychological imbalances during the migration process [14]. Participation at the behavioral level, manifested through residents' actions in environmental protection, community governance, and resource utilization, promotes improvements in ecological conditions and the reconstruction of social order [15]. Hence, individual participation functions not only as a pathway variable in ecological governance but also as an important psychological mechanism influencing ecological satisfaction.
Within the context of ecological migration, migrants' satisfaction after relocation depends not only on improvements in objective conditions but also on their subjective experiences of participation. Domestic scholars have found that the effectiveness of migration policies largely hinges on the extent of migrants' involvement across cognitive, affective, and

behavioral dimensions: on the one hand, policy understanding at the cognitive level helps reduce institutional uncertainty; on the other hand, affective identification and active behavioral engagement facilitate synergistic effects in environmental governance [15-16]. Accordingly, this study proposes the following hypotheses:

H1: Migrants' level of participation has a positive effect on their satisfaction with the ecological environment.

H1a: Cognitive participation has a positive effect on ecological environment satisfaction.

H1b: Affective participation has a positive effect on ecological environment satisfaction.

H1c: Behavioral participation has a positive effect on ecological environment satisfaction.

Compared with ecological environment satisfaction, livelihood well-being satisfaction provides a more comprehensive reflection of post-relocation residents' overall quality of life across material, social, and psychological dimensions. Existing research generally suggests that individual participation is an important pathway to enhancing life satisfaction and subjective well-being [17]. Amartya Sen's Capability Approach posits that human well-being depends not only on objective conditions but also on the extent to which individuals can expand their capabilities and realize their values through social participation [17]. This theoretical perspective has inspired a growing body of empirical studies on the "participation–well-being" relationship.

In the Chinese context, recent empirical studies have increasingly explored the link between public participation and subjective well-being. Based on a meta-analysis of 76 studies, Dong et al. found that public participation significantly improves both environmental governance performance and residents' perceptions of livelihood, and that cognitive, affective, and behavioral participation each contribute positively—albeit to varying degrees—to individual life satisfaction [15]. Similarly, Han et al., in their study on farmers' participation in land transfer, found that higher levels of participation were associated with greater satisfaction in income, social relationships, and overall happiness [18]. These findings collectively indicate that post-relocation migrants' willingness and ability to engage actively in social affairs affect not only their economic adaptation but also their subjective perceptions of livelihood well-being and life quality.

Integrating prior theoretical and empirical evidence, it can be inferred that migrants' cognitive, affective, and behavioral participation during the post-relocation stage influence their livelihood well-being satisfaction through three distinct mechanisms. First, cognitive participation enhances individuals' confidence in institutional fairness and public service delivery at a rational level. Second, affective participation strengthens community identification and psychological belonging, thereby alleviating social distance and cultural alienation caused by relocation. Third, behavioral participation enables individuals to obtain tangible benefits and psychological fulfillment through involvement in community co-governance, public affairs, and resource sharing [19]. The synergistic effect of these three dimensions contributes to higher levels of livelihood well-being satisfaction among ecological migrants. Accordingly, this study proposes the following hypotheses:

H2: Migrants' level of participation has a positive effect on their livelihood well-being satisfaction.

H2a: Cognitive participation has a positive effect on livelihood well-being satisfaction.

H2b: Affective participation has a positive effect on livelihood well-being satisfaction.

H2c: Behavioral participation has a positive effect on livelihood well-being satisfaction.

From the perspective of the relationship between the ecological environment and livelihood well-being, ecological environment satisfaction serves as a crucial variable influencing residents' quality of life and overall well-being. Existing studies have demonstrated that favorable natural and living environments can significantly enhance life satisfaction by improving health, safety, and social participation [20–22]. Biedenweg et al. found that experiences with the natural environment foster social relationships and psychological belonging, thereby promoting life satisfaction [10]. Similarly, Brown and Raymond revealed that residents' emotional attachment to the environment and recognition of landscape values play a positive role in shaping subjective well-being [14].

In the Chinese context, Gao et al., through an investigation of resettled rural communities in Suqian, observed that improvements in ecological and neighborhood environments significantly increased residents' post-relocation life satisfaction [5]. Huang et al., using urban compulsory relocation as a case, confirmed that higher residential environmental quality leads to stronger satisfaction with life outcomes [11]. Wu et al. further demonstrated that the implementation of ecological migration policies substantially enhances migrants' environmental perception and life happiness [12], while Zhang et al. found that residents relocated to ecologically suitable areas reported higher levels of livelihood well-being [4]. Taken together, these findings suggest that ecological environment satisfaction enhances individuals' sense of security, health, and social identity, which in turn promotes positive evaluations of their living conditions. Accordingly, this study proposes the following hypotheses:

H3: Ecological environment satisfaction has a significant positive effect on livelihood well-being satisfaction.

3.2 Data Sources

The research team conducted a field survey across seven villages in three counties (districts) of Heze City, Shandong Province. Data were collected through questionnaires, interviews, and on-site observations to capture rural residents' perceptions and feedback regarding ecological environment protection, living conditions, living standards, and social security after relocation. A structured questionnaire was designed to measure multiple dimensions, including ecological migrant participation, ecological environment satisfaction, and livelihood well-being satisfaction. Using random sampling, residents from the seven villages across the three counties (districts) were invited to complete the survey. In total, 225 questionnaires were distributed, and 215 were returned. After excluding responses with excessively short or

long completion times and those containing incomplete information, 210 valid questionnaires were retained, yielding a valid response rate of 93.3%.

3.3 Questionnaire Reliability and Validity Testing

The reliability analysis results indicate that the overall reliability of the questionnaire is satisfactory. The Cronbach's α coefficients for the affective participation and cognitive participation dimensions are 0.765 and 0.794, respectively, both exceeding the 0.7 threshold, suggesting a high level of internal consistency. Although the behavioral participation dimension shows a relatively lower reliability coefficient ($\alpha = 0.624$), it still maintains acceptable explanatory power. For the two outcome variables, the Cronbach's α coefficients of ecological environment satisfaction and livelihood well-being satisfaction are 0.838 and 0.843, respectively, indicating strong reliability of the measurement instruments [23].

In terms of validity testing, the Kaiser-Meyer-Olkin (KMO) value of the questionnaire is 0.903, far exceeding the acceptable threshold of 0.7, demonstrating that the sample data are well-suited for factor analysis. The Bartlett's test of sphericity is also significant ($\chi^2 = 3537.983$, $df = 595$, $p < 0.001$), confirming the questionnaire's strong structural validity [24]. These reliability and validity results provide a solid empirical foundation for subsequent hypothesis testing.

In summary, the study's hypothesis framework is methodologically rigorous, encompassing the multidimensional pathways of migrant participation while modeling the logical relationship between ecological environment satisfaction and livelihood well-being satisfaction. The descriptive statistics clearly depict the demographic and social characteristics of the sample, highlighting the contextual relevance of the research. The reliability and validity analyses confirm the sound psychometric properties of the scales, ensuring the scientific rigor and credibility of the study's conclusions.

4 RESULTS

4.1 Descriptive Analysis

In terms of descriptive statistics, the sample of this study covers 210 respondents, with relatively diverse group characteristics. The age distribution shows that those aged 31–45 (29.05%) and 46–59 (30.48%) constitute the main groups, followed by those 60 years and above (24.76%), while the proportion of the youth group is relatively low. Regarding educational attainment, respondents with primary school and below (31.43%) and junior middle school (28.57%) account for nearly 60 percent, whereas the proportions of junior college (10.48%) and bachelor's degree and above (5.71%) are relatively low, reflecting an overall lower educational level in the sample. In terms of political affiliation, the majority are the general public (63.33%), Party members account for about 30.48%, and League members have the lowest proportion. In occupation types, agricultural production is the main form of employment (47.29%), followed by casual labor (19.70%) and self-employment (13.79%), indicating that the group as a whole is still dominated by traditional agriculture. Most respondents are employed within their own township (76.08%), reflecting relatively low regional mobility. In terms of sources of income, agricultural income and asset-based income are the main sources (44.24% and 38.79%), while the shares of government subsidies and transfer income are smaller. These results not only present the demographic structural characteristics of the sample but also provide a basis for subsequent tests of differences in satisfaction and participation across groups with different characteristics.

4.2 Correlation Analysis

In the correlation analysis, the relationships among the core variables show a high degree of consistency and significance. There is a significant positive correlation between ecological environment satisfaction and livelihood well-being satisfaction ($r = 0.637$, $p < 0.001$), indicating that individuals who are more satisfied with the ecological environment also tend to have higher satisfaction with their overall livelihood well-being.

All three dimensions of participation demonstrate significant positive correlations with both satisfaction indicators, though the correlation strengths vary. The correlation coefficient between cognitive participation and livelihood well-being satisfaction is the highest ($r = 0.706$, $p < 0.001$), suggesting that cognitive investment at the rational level has a profound impact on individuals' perceptions of overall life quality. Affective participation is also strongly correlated with livelihood well-being satisfaction ($r = 0.633$, $p < 0.001$), highlighting the crucial role of emotional identification and sense of belonging in shaping satisfaction with life. Behavioral participation shows relatively lower but still significant positive correlations (with livelihood well-being satisfaction: $r = 0.608$, $p < 0.001$; with ecological environment satisfaction: $r = 0.506$, $p < 0.001$), implying that while actual behavioral engagement is not as strong as cognitive or affective involvement, it remains an important influencing factor.

On the whole, the three dimensions of participation are also highly interrelated, particularly between cognitive participation and affective participation, which exhibit a correlation coefficient as high as 0.742 ($p < 0.001$), indicating that participation behaviors are often jointly driven by cognitive and emotional engagement.

Table 1 Correlations among Core Variables

Pearson Correlation	Mean SD	Ecological Environment Satisfaction	Livelihood Well-being Satisfaction	Cognitive Participation	Affective Participation	Behavioral Participation
Ecological Environment Satisfaction	3.9830.612	1				
Livelihood Well-being Satisfaction	3.6180.513	0.637***	1			
Cognitive Participation	4.1290.853	0.531***	0.706***	1		
Affective Participation	4.3590.683	0.512***	0.633***	0.742***	1	
Behavioral Participation	3.0190.696	0.506***	0.608***	0.668***	0.558***	1

Note: *** p<0.001, ** p<0.01, * p<0.05.

4.3 Analysis of Variance

4.3.1 Analysis of differences among age groups

In the difference analysis, this study conducted ANOVA tests to examine the variations in participation, ecological environment satisfaction, and livelihood well-being satisfaction among migrants with different demographic backgrounds. The results show that age has a significant effect on several core variables. Specifically, cognitive participation varies significantly across age groups ($F = 2.870$, $p = 0.024$), with younger groups demonstrating higher levels of cognitive participation, while those aged 60 and above exhibit the lowest level. Ecological environment satisfaction also differs significantly by age ($F = 2.522$, $p = 0.042$), with younger groups generally reporting higher satisfaction than older groups, indicating age-based differences in perceptions and satisfaction regarding the ecological environment. More notably, livelihood well-being satisfaction decreases with age, showing a highly significant difference ($F = 5.387$, $p < 0.001$), which may be related to the increased living costs and changing needs that come with aging.

Table 2 Differences in Core Variables among Age Groups

Variables	17 and below (n=6)	18–30 (n=27)	31–45 (n=61)	46–59 (n=64)	60 and above (n=52)	F	p
Cognitive Participation	4.389±0.953	4.370±0.775	4.284±0.827	4.094±0.872	3.833±0.828	2.87	0.024*
Affective Participation	4.667±0.558	4.556±0.539	4.388±0.684	4.365±0.676	4.179±0.742	1.819	0.126
Behavioral Participation	3.300±0.735	3.067±0.659	3.062±0.685	3.041±0.746	2.885±0.662	0.834	0.505
Ecological Environment Satisfaction	4.537±0.518	4.177±0.617	3.998±0.646	3.906±0.614	3.893±0.533	2.522	0.042*
Livelihood Well-being Satisfaction	4.156±0.559	3.835±0.542	3.651±0.544	3.610±0.485	3.414±0.397	5.387	0.000***

Note: *** p<0.001, ** p<0.01, * p<0.05.

4.3.2 Analysis of Differences among educational levels

In terms of education, the differences are particularly pronounced. Cognitive participation, affective participation, behavioral participation, ecological environment satisfaction, and livelihood well-being satisfaction all show significant differences among groups with different educational levels ($p < 0.001$). The overall trend indicates that the higher the level of education, the greater the degree of participation and satisfaction. For example, respondents with junior college or bachelor's degrees and above scored significantly higher in both cognitive and affective participation compared with those with primary school education or below. Similarly, ecological environment satisfaction and livelihood well-being satisfaction also increase with higher educational attainment. These findings suggest that education not only enhances migrants' understanding and ability to participate in public affairs but also strengthens their perception of improvements in living environments and welfare.

Table 3 Differences in Core Variables among Educational Levels

Variables	Primary or Below (n=66)	Junior Middle School (n=60)	Secondary/Technical/High School (n=50)	Junior College (n=22)	Bachelor's and Above (n=12)	F	p
Cognitive Participation	3.758±0.834	4.072±0.846	4.333±0.747	4.727±0.531	4.500±0.980	8.164	0.000***
Affective Participation	4.076±0.751	4.383±0.640	4.520±0.607	4.697±0.435	4.500±0.689	5.459	0.000***
Behavioral Participation	2.706±0.548	2.983±0.675	3.184±0.774	3.545±0.596	3.267±0.535	8.741	0.000***
Ecological Environment Satisfaction	3.785±0.524	3.920±0.657	4.073±0.599	4.374±0.510	4.287±0.613	5.607	0.000***

Livelihood Well-being Satisfaction	3.389±0.430	3.603±0.541	3.804±0.484	3.867±0.466	3.722±0.521	7.1040.000***

Note: *** p<0.001, ** p<0.01, * p<0.05.

4.3.3 Analysis of differences among political affiliations

Significant differences are also observed across political affiliations. Party members and League members score substantially higher than the general public in all three participation dimensions — cognitive participation ($F = 13.909$, $p < 0.001$), affective participation ($F = 7.915$, $p < 0.001$), and behavioral participation ($F = 15.784$, $p < 0.001$). Similarly, both ecological environment satisfaction and livelihood well-being satisfaction differ significantly among political groups ($p < 0.05$), with Party members reporting the highest overall satisfaction. These results may reflect the stronger sense of social responsibility, policy awareness, and access to institutional resources associated with political affiliation. Consequently, individuals with formal political identities tend to be more engaged in community affairs and express higher satisfaction levels with their ecological and livelihood conditions.

Table 4 Differences in Core Variables among Political Affiliations

Variables	Communist Youth League Members (n=13)	Communist Party Members (incl. probationary) (n=64)	Non-affiliated Public (n=133)	F	p
Cognitive Participation	4.641±0.552	4.484±0.713	3.907±0.864	13.909	0.000***
Affective Participation	4.718±0.542	4.568±0.602	4.223±0.697	7.915	0.000***
Behavioral Participation	3.323±0.635	3.356±0.671	2.827±0.643	15.784	0.000***
Ecological Environment Satisfaction	4.197±0.637	4.134±0.590	3.889±0.604	4.451	0.013*
Livelihood Well-being Satisfaction	3.754±0.476	3.802±0.472	3.516±0.511	7.645	0.001***

Note: *** p<0.001, ** p<0.01, * p<0.05.

4.3.4 Analysis of differences among occupational types

Significant statistical differences are observed across occupational groups in terms of cognitive participation, affective participation, and ecological environment satisfaction. Respondents with stable employment in enterprises reported the highest levels of both cognitive and affective participation, while temporary workers and self-employed individuals scored relatively lower (cognitive participation: $F = 5.419$, $p < 0.001$; affective participation: $F = 2.580$, $p = 0.039$; ecological environment satisfaction: $F = 3.420$, $p = 0.010$). Differences were also found in livelihood well-being satisfaction across job types ($F = 2.632$, $p = 0.036$), with formally employed respondents exhibiting the highest satisfaction, and temporary workers the lowest. This finding underscores the crucial role of stable employment in enhancing ecological migrants' sense of social integration and overall satisfaction with life after relocation.

Table 5 Differences in Core Variables among Occupational Types

Variables	Agricultural Production (n=96)	Self-employed (n=28)	Fixed Employment (>1 year) (n=26)	Temporary Work (n=40)	Others (n=13)	F	p
Cognitive Participation	4.295±0.758	3.964±0.813	4.487±0.675	3.700±1.001	3.923±0.954	5.419	0.000***
Affective Participation	4.424±0.715	4.226±0.679	4.628±0.435	4.142±0.704	4.282±0.705	2.58	0.039*
Behavioral Participation	3.129±0.684	2.907±0.719	3.123±0.640	2.780±0.659	3.000±0.702	2.209	0.069
Ecological Environment Satisfaction	4.101±0.603	3.810±0.548	4.073±0.500	3.744±0.636	3.863±0.647	3.42	0.010**
Livelihood Well-being Satisfaction	3.653±0.506	3.569±0.489	3.851±0.431	3.475±0.564	3.472±0.487	2.632	0.036*

Note: *** p<0.001, ** p<0.01, * p<0.05.

4.3.5 Analysis of differences among economic sources

The analysis of economic sources further highlights group-level variations. Significant differences were found in cognitive participation and affective participation across different income sources ($p < 0.05$). Respondents whose income mainly derives from agricultural activities or asset-based earnings scored higher in both dimensions, while those dependent on transfer payments (such as subsidies or family support) scored the lowest. A similar trend was observed in ecological environment satisfaction and livelihood well-being satisfaction ($p < 0.05$). Migrants relying on agricultural income or government subsidies exhibited higher satisfaction levels, whereas those depending primarily on subsidies and remittances showed significantly lower satisfaction. This pattern underscores the vital role of economic independence and stability of income sources in shaping post-relocation satisfaction.

Overall, the results of the difference analysis indicate that age, education, political affiliation, occupation, and economic sources collectively influence migrants' participation and satisfaction levels. Younger, better-educated, politically active,

and stably employed individuals with reliable economic sources demonstrate stronger cognitive, affective, and behavioral participation and report higher ecological and livelihood satisfaction. These findings reveal disparities in social participation and life experiences among different groups and suggest that policies should focus on improving education, promoting stable employment, and optimizing resource allocation to enhance migrants' overall satisfaction and social integration.

Table 6 Differences in Core Variables among Economic Sources

Variables	Agricultural Income (n=73)	Non-agricultural Employment (n=17)	Asset Income (n=64)	Transfer Income (n=5)	Government Subsidy (n=6)	F	p
Cognitive Participation	4.237±0.789	4.020±0.731	4.089±0.838	3.067±1.234	3.556±1.167	3.118	0.017*
Affective Participation	4.434±0.702	4.196±0.708	4.391±0.559	3.600±0.641	4.111±0.779	2.458	0.048*
Behavioral Participation	3.107±0.725	2.824±0.678	2.891±0.630	2.400±0.316	3.000±0.955	2.003	0.097
Ecological Environment Satisfaction	4.029±0.609	3.732±0.405	3.920±0.591	3.400±0.575	4.278±0.746	2.505	0.044*
Livelihood Well-being Satisfaction	3.625±0.492	3.529±0.366	3.586±0.426	2.920±0.708	3.544±0.695	2.684	0.033*

Note: *** p<0.001, ** p<0.01, * p<0.05.

4.4 Multiple Regression Model Analysis

4.4.1 Model 1: the impact model of participation on ecological environment satisfaction

Ecological environment satisfaction is taken as the dependent variable, population characteristics as control variables, and each dimension of participation as independent variables to test H1. In the regression analysis, this study takes ecological environment satisfaction as the dependent variable, population characteristics as control variables, and the three dimensions of participation—cognitive, emotional, and behavioral—as independent variables, constructing a model to test Hypothesis H1.

The results show that the overall model fit is good, with $R^2 = 0.394$, adjusted $R^2 = 0.350$, $F(11,150) = 8.879$, $p < 0.001$, indicating that the model has strong explanatory power. Specifically, emotional participation ($B = 0.230$, $t = 2.859$, $p = 0.005$) and behavioral participation ($B = 0.200$, $t = 2.676$, $p = 0.008$) both have significant positive effects on ecological environment satisfaction, while the effect of cognitive participation, though positive, does not reach the level of statistical significance ($B = 0.098$, $t = 1.339$, $p = 0.183$). This means that in the formation process of migrants' ecological environment satisfaction, emotional input and actual behavioral participation play more critical roles, while simple cognitive understanding and identification are not enough to directly improve satisfaction.

As for demographic control variables, most indicators do not have significant effects on ecological environment satisfaction, with only age and work location being close to the significant level ($p = 0.068$ and $p = 0.058$). This suggests that older groups and those working in other places may have potential differences in their perception of environmental satisfaction, but this effect is not yet stable. Other variables (such as education level, political affiliation, and economic source) do not show significant effects. This result further emphasizes that individual subjective participation plays a core role in shaping environmental satisfaction rather than merely relying on social background factors.

Table 7 Regression Analysis Results for Model 1

Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	p	VIF	Tolerance
Constant	1.478	0.299	–	4.946	0.000***	–	–
Cognitive Participation	0.208	0.047	0.368	4.383	0.000***	2.727	0.367
Emotional Participation	0.093	0.053	0.128	1.731	0.085	2.109	0.474
Behavioral Participation	0.125	0.049	0.178	2.52	0.013*	1.934	0.517
Ecological Environment Satisfaction	0.215	0.053	0.267	4.075	0.000***	1.651	0.606
Age	-0.079	0.027	-0.176	-2.938	0.004**	1.385	0.722
Education Level	-0.041	0.027	-0.1	-1.541	0.126	1.621	0.617
Political Affiliation	-0.001	0.027	-0.003	-0.043	0.966	1.436	0.697
Number of Registered Household Members	0.035	0.012	0.157	2.838	0.005**	1.181	0.846
Occupation Type	0.029	0.027	0.084	1.082	0.281	2.348	0.426
Work Location	-0.061	0.033	-0.104	-1.828	0.069	1.255	0.797
Economic Source	-0.014	0.032	-0.033	-0.441	0.66	2.116	0.473

Total Subsidy Amount	0.000	0.000	-0.125	-2.176	0.031*	1.269	0.788
$R^2 = 0.614$							
Adjusted $R^2 = 0.583$							
F(12,149) = 19.737, p = 0.000							
Durbin–Watson = 1.766							

Note: *** p<0.001, ** p<0.01, * p<0.05.

4.4.2 Model 2: the influence model of participation on livelihood well-being satisfaction

Livelihood well-being satisfaction is taken as the dependent variable, population characteristics as control variables, and each dimension of participation as independent variables to test H2. In the regression analysis of Model 2, livelihood well-being satisfaction is used as the dependent variable, population characteristics are taken as control variables, and the three dimensions of participation—cognitive, emotional, and behavioral—are introduced as independent variables to verify research hypothesis H2.

The results show that the model fits well ($R^2 = 0.571$, adjusted $R^2 = 0.539$, $F = 18.136$, $p < 0.001$), indicating that participation and some demographic factors can effectively explain the variation in livelihood well-being satisfaction. Among the independent variables, cognitive participation has the most significant effect ($B = 0.229$, $t = 4.620$, $p < 0.001$), showing that the deeper the migrants' participation in rational understanding and knowledge accumulation, the higher their satisfaction with livelihood well-being. Emotional participation and behavioral participation also have positive effects on livelihood well-being satisfaction ($B = 0.142$, $p = 0.010$; $B = 0.168$, $p = 0.001$), indicating that emotional identification and practical engagement are also important factors that promote the improvement of satisfaction.

Among the control variables, age shows a significant negative effect on livelihood well-being satisfaction ($B = -0.095$, $p < 0.001$), meaning that as age increases, the level of satisfaction tends to decline; number of household members has a positive effect ($B = 0.033$, $p = 0.011$), showing that larger family size may enhance overall well-being through resource sharing or social support; work location and total subsidy amount have certain negative effects ($p < 0.05$), reflecting that working outside the home and relying on subsidies may lead to a lower perception of life quality. Overall, these results confirm Hypothesis H2—that migrants' participation level has a significant positive influence on their livelihood well-being satisfaction.

Table 8 Regression Analysis Results for Model 2

Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	p	VIF	Tolerance
Constant	1.949	0.29	–	6.729	0.000***	–	–
Cognitive Participation	0.229	0.05	0.406	4.62	0.000***	2.695	0.371
Emotional Participation	0.142	0.055	0.197	2.597	0.010*	2	0.5
Behavioral Participation	0.168	0.051	0.24	3.302	0.001**	1.846	0.542
Age	-0.095	0.028	-0.212	-3.41	0.001***	1.354	0.738
Education Level	-0.03	0.028	-0.074	-1.087	0.279	1.605	0.623
Political Affiliation	0.006	0.028	0.013	0.207	0.836	1.43	0.699
Number of Registered Household Members	0.033	0.013	0.149	2.56	0.011*	1.18	0.848
Occupation Type	0.019	0.028	0.053	0.652	0.515	2.326	0.43
Work Location	-0.082	0.035	-0.14	-2.367	0.019*	1.225	0.816
Economic Source	-0.004	0.034	-0.01	-0.124	0.902	2.104	0.475
Total Subsidy Amount	0.000	0.000	-0.127	-2.105	0.037*	1.269	0.788
$R^2 = 0.571$							
Adjusted $R^2 = 0.539$							
F(11,150) = 18.136, p = 0.000							
Durbin–Watson = 1.749							

Note: *** p<0.001, ** p<0.01, * p<0.05.

4.4.3 Model 3: prediction model of livelihood well-being satisfaction incorporating ecological environment satisfaction

Livelihood well-being satisfaction is the dependent variable, and ecological environment satisfaction is added to Model 2 to test H3. In the regression analysis of Model 3, ecological environment satisfaction is introduced as an additional independent variable based on Model 2 to further verify Hypothesis H3. The model's goodness of fit is significantly improved ($R^2 = 0.614$, adjusted $R^2 = 0.583$, $F = 19.737$, $p < 0.001$), indicating that the inclusion of ecological environment satisfaction further enhances the explanatory power for livelihood well-being satisfaction. Specifically, ecological environment satisfaction has a significant positive effect on livelihood well-being satisfaction ($B = 0.215$, $t = 4.075$, $p < 0.001$), suggesting that when migrants' perception of their living environment improves, their overall satisfaction with livelihood well-being also increases accordingly.

Compared with Model 2, cognitive participation remains the strongest positive factor ($B = 0.208$, $p < 0.001$), and behavioral participation continues to be significant ($B = 0.125$, $p = 0.013$). However, emotional participation no longer reaches significance after introducing environmental satisfaction ($B = 0.093$, $p = 0.085$), indicating that the role of emotional engagement may partly influence livelihood well-being satisfaction indirectly through environmental perception.

Among the control variables, the results remain largely consistent: age continues to have a negative effect ($B = -0.079$, $p = 0.004$), number of household members exerts a positive effect ($B = 0.035$, $p = 0.005$), and total subsidy amount has a negative impact ($p = 0.031$), further emphasizing the potential influence of demographic structure and resource allocation on well-being perception.

Table 9 Regression Analysis Results for Model 3

Variable	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	p	VIF	Tolerance
Constant	1.478	0.299	–	4.946	0.000***	–	–
Cognitive Participation	0.208	0.047	0.368	4.383	0.000***	2.727	0.367
Emotional Participation	0.093	0.053	0.128	1.731	0.085	2.109	0.474
Behavioral Participation	0.125	0.049	0.178	2.52	0.013*	1.934	0.517
Ecological Environment Satisfaction	0.215	0.053	0.267	4.075	0.000***	1.651	0.606
Age	-0.079	0.027	-0.176	-2.938	0.004**	1.385	0.722
Education Level	-0.041	0.027	-0.1	-1.541	0.126	1.621	0.617
Political Affiliation	-0.001	0.027	-0.003	-0.043	0.966	1.436	0.697
Number of Registered Household Members	0.035	0.012	0.157	2.838	0.005**	1.181	0.846
Occupation Type	0.029	0.027	0.084	1.082	0.281	2.348	0.426
Work Location	-0.061	0.033	-0.104	-1.828	0.069	1.255	0.797
Economic Source	-0.014	0.032	-0.033	-0.441	0.66	2.116	0.473
Total Subsidy Amount	0.000	0.000	-0.125	-2.176	0.031*	1.269	0.788
$R^2 = 0.614$							
Adjusted $R^2 = 0.583$							
$F(12,149) = 19.737$, $p = 0.000$							
Durbin–Watson = 1.766							

Note: *** p<0.001, ** p<0.01, * p<0.05.

Taken together, the results of the multiple-model analysis indicate that Models 2 and 3 jointly reveal the close relationship between migrants' participation and livelihood well-being satisfaction. Cognitive participation consistently plays a central role, showing that enhancing rational understanding and knowledge level can directly improve individuals' satisfaction with life quality. Emotional and behavioral participation are both significant positive factors in Model 2, but when ecological environment satisfaction is included, the direct effect of emotional participation weakens—implying a mediating role of environmental perception. In Model 3, ecological environment satisfaction is confirmed as a significant predictor, further verifying Hypothesis H3: ecological environment satisfaction is not only an essential component of migrants' life experience but also enhances their overall satisfaction with livelihood well-being by strengthening environmental identification and a sense of security.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on a sample of ecological migrants in Heze City, Shandong Province, this study constructed a multidimensional participation model consisting of cognitive, emotional, and behavioral dimensions to explore its effect on ecological environment satisfaction and livelihood well-being satisfaction. The results show that migrants' multidimensional participation significantly enhances both types of satisfaction. Among them, cognitive participation exerts the strongest direct effect on livelihood well-being satisfaction, while emotional and behavioral participation influence it indirectly by improving ecological environment satisfaction. Ecological environment satisfaction plays a partial mediating role in the relationship between participation and well-being, revealing the internal coupling mechanism between ecological construction and livelihood improvement. The study indicates that the sustainable development of ecological migration depends not only on material resettlement but also on the migrants' active participation in cognitive understanding, emotional identification, and behavioral practice. Enhancing migrants' subjectivity and sense of participation is a key pathway to achieving the coordinated advancement of ecological civilization and social well-being, providing empirical support for the transformation of ecological migration policy from "resettlement-oriented" to "participation and co-construction-oriented."

5.2 Recommendations

In the new era, China's ecological migration policy system has been continuously improved. The ecological relocation projects in the middle and lower reaches of the Yellow River have achieved remarkable progress in ecological restoration and livelihood improvement, yet post-relocation challenges remain prominent. These include weak participation awareness, insufficient community integration, low environmental identification, and lagging public service provision. Overall, the institutional design of current policies emphasizes "relocating and stabilizing" but pays insufficient attention to fostering the psychological and social conditions as well as the agency and capability needed for "prosperous integration". As a result, some migrants have developed a passive dependency on state policies and show limited motivation to participate in community building. Based on the empirical results of this study, reforms should focus on institutional design, community reconstruction, and developmental empowerment, so as to promote the transformation of ecological migration from policy-driven relocation to socially embedded integration.

(1) Build a participation-oriented grassroots co-governance system. In the Yellow River floodplain areas such as Heze, the ecological migration policy should shift from administrative resettlement to institutionalized co-governance. Governments should establish a three-tier participation platform composed of "village-level consultation – township coordination – county-level feedback," ensuring migrants' voice and decision-making power in key domains such as land transfer, compensation funds, and public projects. Through institutional arrangements such as policy disclosure, budget transparency, and democratic evaluation, the government can enhance migrants' policy cognition and trust, reducing both policy alienation and welfare dependency. Meanwhile, a post-assessment system for ecological relocation communities should be established, incorporating migrant satisfaction indicators into ecological project performance evaluations to realize institutional feedback and dynamic improvement.

(2) Rebuild community solidarity and cultural identity mechanisms. Ecological migrants along the Yellow River in Heze often face psychological and social reconstruction challenges due to village disintegration and relationship disruption. Local governments and grassroots Party organizations should focus on cultural revitalization and public participation, encouraging village councils, women's federations, and youth volunteer teams to engage in community governance. By promoting custom-reforming activities, local festivals, and moral conventions (such as red-white councils and cultural revitalization initiatives), communities can rebuild social trust and emotional bonds. Cultural identity projects—centered on themes like "The Yellow River Stories" and "Homeland Culture"—should be developed to restore a sense of belonging and historical continuity, enabling ecological migrants to feel "at home" both materially and emotionally.

(3) Improve the ecological industry chain and behavioral incentive mechanisms. At present, industries in the Yellow River floodplain ecological migration areas remain dominated by primary agriculture, lacking diversified support. It is essential to leverage ecological resource advantages to establish a "eco-agriculture – cultural tourism – community services" three-dimensional development pattern. The development of industries such as dairy farming, high-quality grain production, and wetland ecotourism should be encouraged to achieve "ecological assetization"—transforming ecological advantages into economic value. Meanwhile, behavioral incentive mechanisms should be established: residents who actively participate in ecological restoration, waste sorting, and water-saving irrigation can earn points and shared green dividends, translating personal participation into sustainable economic and social returns. Local governments may set up ecological public service positions and migrant entrepreneurship funds to encourage participation in community management and industrial operations, thus enhancing the practical benefits of behavioral participation.

(4) Enhance post-relocation participation capacity and civic awareness. Given that many Heze migrants have relatively low educational levels and limited access to information, it is vital to build an enabling foundation for participation.

Party schools, agricultural training centers, and community schools should regularly organize programs on ecological knowledge, vocational skills, and policy literacy. Universities and research institutions should participate in community-based ecological civilization education programs, offering specialized social work and psychological counseling services to strengthen migrants' institutional understanding, sense of self-efficacy, and public consciousness. This will help transform ecological migrants from policy recipients into active participants and co-creators in sustainable development governance.

COMPETING INTERESTS

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