Agency through comparison: Reference-point evaluations and rural environmental participation after mining-induced resettlement

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Abstract

Large-scale resettlement linked to mining-induced subsidence has reshaped rural living environments and community structures, raising the question of how to engage in rural environmental participation within new communities—a central concern for rural sustainability. Adapting the framework of agency to this context, we advance a reference-point perspective that situates residents' subjective evaluations of present conditions relative to past experiences, future expectations, and lateral benchmarks as frames through which agency is organized. Drawing on a household survey of 610 resettled rural residents in Huainan, one of China's largest mining-based pillar cities, this study provides initial evidence for this approach. Men ($p = .001$), married respondents ($p = .036$), middle-aged adults ($p < .001$), and those with higher education ($ps < .030$) reported greater environmental participation willingness, indicating marked demographic variation. Each reference point was positively associated with participation willingness in models estimated separately (past-oriented: standardized $\beta = 0.312$; future-oriented: $\beta = 0.190$; social comparison: $\beta = 0.236$; all $p < .001$); when entered jointly with controls, only the past-oriented reference—using previous environmental conditions to evaluate the current environment—retained a robust association ($\beta = 0.289$, $p < .001$). This pattern suggests that comparative evaluations of

41 the present versus one's previous environment are a salient basis for how resettled
42 residents participate in community environmental affairs, providing actionable cues
43 for participation mobilization in new resettlement communities.

44

45 *Keywords*: rural environmental participation; agency; environmental reference points;
46 resettlement communities; mining-induced subsidence.

Introduction

Mining-induced subsidence and associated population resettlement constitute a salient socio-environmental challenge across many resource-dependent regions worldwide. Large-scale mineral development in settings such as India, parts of Africa, and China has been linked with the displacement of thousands of residents (Owen & Kemp, 2015; Terminski, 2012). Following resettlement, questions of ecological management and the longer-term sustainability of new communities move to the forefront. Once farmers leave familiar land and social networks, an immediate issue is how resettled residents take part in environmental affairs in their new communities. Rural environmental participation is often treated as an indicator of community agency (World Bank, 2004). In practice, however, both willingness and capacity to participate can be limited (Zhan & You, 2024).

Mining-Induced Displacement and Rural Environmental Participation

Rural environmental participation has emerged as a substantive field of inquiry within environmental sociology and governance research. Prior work has documented the importance of farmer involvement in environmental governance across rural contexts, from household waste sorting to water conservation and soil remediation (Ouyang et al., 2022; Y. Zhang & Guo, 2023). Literature, however, tends to treat individuals as static carriers of attributes or values rather than as active interpreters of their changing social and environmental circumstances (Piao & Managi, 2024).

Particularly in displaced communities, where the very context of environmental experience has been radically altered, the relevance of pre-formed values and stable sociodemographic profiles to current participation decisions is theoretically unclear.

Mining-induced displacement is a direct consequence of global resource extraction pressures (Mirzania et al., 2023; Ofori et al., 2023). Research on energy commodity markets underscores how resource extraction economies generate profound socio-economic gains and losses across communities and regions (Flori, 2024; Jin & Xu, 2025a, 2025b). Recent studies on mining-induced displacement further show that resettlement disrupts livelihood assets, social capital, and place-based security, even as affected residents mobilize local networks and adaptive capacities to rebuild everyday livelihoods (Ahmer & Ostendorf, 2025; Gukurume & Tombindo, 2023). As nations navigate energy transitions away from fossil fuels, the communities most reliant on coal extraction face simultaneous ecological remediation burdens, livelihood transformations, and uneven capacities to adapt to coal phase-out (Agrawal et al., 2024; Mirzania et al., 2023). In this context, understanding how residents engage in post-extractive environmental governance is central to whether sustainability transitions achieve durable outcomes at the community level (Sutrisno et al., 2024; Tladi et al., 2024). The transformative potential of sustainable practices in fostering economic development and social welfare depends, in part, on the willingness of displaced communities to co-manage restored environments (Jin & Xu, 2025c; Svobodova et al., 2026).

When the role of residents is under-mobilized, the long-term maintenance of remediated environments may be weakened (Vashishtha & Tiwari, 2025). In response, national policy agendas increasingly emphasize co-construction, co-management, and co-benefit models (Xiang et al., 2024). For example, rural solid-waste sorting programs in several localities have experimented with recruiting villagers as volunteers for day-to-day oversight and maintenance (Zhou et al., 2022). Yet involuntary resettlement is often accompanied by a weaker sense of place attachment in the new environment (Zhu et al., 2021), which may dampen motivation to participate (Chang et al., 2025). It is therefore useful to identify, within migration contexts, which groups report a greater willingness to engage in rural environmental participation and what evaluative frames are associated with that inclination.

Although participation willingness is not equivalent to observed participation, it remains theoretically and practically important in resettlement contexts. The intention–behavior gap is well established: stated willingness does not automatically translate into action because actual participation may be constrained by time, resources, institutional channels, perceived efficacy, and social opportunity (Kollmuss & Agyeman, 2002; Sheeran, 2002). Nevertheless, willingness is not merely an attitudinal by-product. In the theory of planned behavior, behavioral intention is treated as the most immediate motivational antecedent of action, and pro-environmental behavior research likewise treats intention-related constructs as part of the psychosocial pathway through which knowledge, attitudes, norms, and efficacy

are translated into action (Ajzen, 1991; Bamberg & Möser, 2007). For resettled rural residents, willingness is therefore a meaningful indicator of motivational readiness to engage in environmental affairs, even if actual participation additionally depends on whether communities provide accessible and trusted opportunities for action. Accordingly, this study focuses on rural public environmental participation willingness as a proximal participation disposition rather than as direct evidence of observed environmental behavior.

Heterogeneity of Rural Environmental Participation

Participation in public affairs varies significantly between individuals (Mansuri & Rao, 2004). Prior studies have examined how age, gender, education, and subjective social status relate to participation in rural environmental matters. On average, more years of schooling coincide with greater environmental knowledge and skills and, in turn, stronger reported willingness (Dolisca et al., 2006; Hines et al., 1987), while higher perceived social status has been linked with attention to community reputation and engagement in public affairs (Eom et al., 2018; Yang et al., 2025). Yet the evidence is mixed and often context dependent. Adding to this heterogeneity, several studies report that demographic indicators lose consistency once subjective evaluations—such as satisfaction, perceived fairness, or efficacy—are considered (Piao & Managi, 2024). In a UK–US comparison, Skylark and Callan (2021) found that income and education correlate with pro-environmental intention in bivariate models, yet no

single demographic attribute remains a stable predictor when subjective appraisals enter the specification. Against this background, the additional objective of this study is to characterize group-level variation in rural public environmental participation among resettled residents, examining how age, gender, education, and subjective household economic status relate to participation willingness in post-resettlement communities.

Agency and Reference Points

A critical dimension in rural environmental participation is the role of subjective comparative evaluations. While several recent studies have documented that subjective well-being, satisfaction, and perceived social status are associated with environmental behavior (Ouyang et al., 2022; Piao & Managi, 2024; Ruan et al., 2022), these investigations typically treat subjective states as discrete predictors rather than as structured through comparative reference frames.

Research in psychology and behavioral decision-making establishes that individuals rarely appraise environmental or social states in absolute terms; they evaluate the present against reference frames anchored in prior experience, anticipated outcomes, or social peers (Boles & Messick, 1995; Hunter & Daw, 2021; Tversky & Kahneman, 1974). In resettlement settings, where routines, places, and networks shift, such frames can become especially salient for making sense of the present and for considering whether to engage.

Emirbayer and Mische (1998) conceptualize agency as a temporally embedded process of social engagement, organized across three distinct but interrelated dimensions: an *iterational elemen*t drawing on past patterns and habits, a *projective element* involving imagination of future possibilities, and a *practical-evaluative element* enabling actors to make contextual judgments about how to act in the present. In their account, all three dimensions operate simultaneously in human agency, though any one of them may become more prominent in particular contexts. The iterational element draws on the selective reactivation of past patterns of thought and action as routinely incorporated in practical activity, serving to give stability and order to social life. The projective element involves the imaginative generation of possible future trajectories, allowing actors to distance themselves from habitual patterns and envision new possibilities. The practical-evaluative element refers to the capacity to make normative judgments among alternative trajectories in response to emerging situational demands.

Scholars have already applied this triadic framework to studies of rural environmental participation. Using the iterational–projective–practical-evaluative schema, researchers explain how resettled and long-term residents evolve into environmental stewards. This process involves reactivating past routines, imagining desired futures, and making present-tense judgments about land management (Cooke & Lane, 2015; Peçanha Enqvist et al., 2018). Furthermore, this approach helps analyze how local actors reorganize their practices to join collective activities as opportunities

shift (Rogelja et al., 2023). Building on this work, we situate personal agency within time and social space. We propose a *reference-point perspective* to explain rural environmental participation. In this view, comparisons to the past, future, and social peers serve as evaluative anchors. Residents use these anchors to interpret their new communities and decide how to act. Consequently, their present experience is filtered through remembered pasts, anticipated futures, and nearby examples.

A *past-oriented reference* aligns with the iterational dimension: attention and resource mobilization selectively draw on prior schemes and practice scripts (Albert, 1977; Wood, 2017). For resettled rural households, recollections of pre-move conditions—air quality, dust exposure, perceived safety from subsidence—coincide with satisfaction judgments and reported participation (Zhu et al., 2021). Perceived improvement relative to the past has been linked to greater support for existing management arrangements (Jia & Lin, 2025), whereas perceived decline corresponds to lower confidence and weaker participation (Van Ryzin, 2013; van Zomeren et al., 2008). As Evers and Kneyber (2015) note, habits and memories condition present tendencies to act, consistent with the idea that the iterational dimension can be foregrounded when people navigate unfamiliar settings through familiar scripts.

A *future-oriented reference* corresponds to the projective dimension, emphasizing imagination about possible trajectories and goal states (Hendriks, 2024). In resettlement narratives, authorities often highlight better amenities and ecological recovery, and residents themselves articulate hopes for improved conditions (Rogers

et al., 2020). When appraisals of the present fall short of personal expectations, some residents report stronger willingness to contribute to environmental improvement—an alignment with expectation-confirmation perspectives that treat (dis)confirmation as an evaluative driver of responses (Bhattacherjee, 2001), and with work linking discrepant goals to collective action intentions (Jiang et al., 2018; van Zomeren et al., 2008; J. Zhang et al., 2022).

A *social-comparison reference* reflects the practical-evaluative dimension: actors assemble present-tense information—including how neighboring communities fare—and exercise judgment under local contingencies (Emirbayer & Mische, 1998). Classic theory holds that people assess relative standing through lateral comparison (Festinger, 1954). In rural contexts, residents commonly benchmark their community's environmental conditions against adjacent villages (Sirgy & Cornwell, 2002). Perceived disadvantage can be translated into demands for redress or improvement (Gurr, 2015; Van Rooij, 2010), and under certain conditions, relative deprivation aligns with intentions for environmental or collective action (Skylark & Callan, 2021). Selection of the comparison set, its proximity, and perceived fairness of procedures function as boundary conditions for how strongly such evaluations register in participation judgments.

The Present Study

The foregoing review identifies three intersecting gaps that motivate the present

study. First, although reference-point frameworks are well established in behavioral decision research and agency theory independently, no study has synthesized them to explain environmental participation in resettlement contexts; existing accounts treat subjective states as discrete predictors rather than as organized through comparative reference frames. Second, while demographic heterogeneity in rural environmental participation is documented, evidence from involuntary mining-induced resettlement populations, whose severed place histories and compressed evaluative timelines may differ from those of voluntary migrants or long-term residents, remains sparse. Third, the relative salience of past, future, and social reference dimensions has not been tested simultaneously, leaving open the empirical question of which comparative orientation most robustly predicts participation.

Building on this framework, the study pursues two objectives. The first is to characterize group-level variation in rural public environmental participation intention among resettled residents, examining how age, gender, marital status, education, and subjective household economic status relate to participation intention in post-resettlement communities (Meng & Si, 2022; Yang et al., 2025). The second is to test whether past-oriented, future-oriented, and social-comparison reference-point evaluations each predict participation intention, and to determine which reference dimension retains an independent association when all three are modeled simultaneously. The study makes three contributions. Theoretically, it extends Emirbayer and Mische's (1998) chordal triad of agency by operationalizing its three

temporal dimensions as testable reference-point evaluations, bridging agency theory and behavioral decision research. Empirically, the study provides the multi-reference test in a mining-induced resettlement context to examine which reference dimension retains explanatory force when all three compete jointly. Practically, the findings offer actionable cues for participation mobilization: because different reference frames carry unequal weight, practitioners can design communications and community audits that align with the evaluative logic most salient to resettled residents.

Figure 1 illustrates the reference-point model of agency, mapping each dimension of the chordal triad to its corresponding reference frame. Guided by this framework, we operationalize a reference-point perspective grounded in Emirbayer and Mische's (1998) account of agency as co-constituted with environmental settings, where sensory experiences shape participation dispositions (Clark et al., 2025). Guided by this framework, we advance the following hypotheses, stated in associative terms:

H1: The subjective evaluation of current conditions relative to prior conditions (past-oriented reference) is associated with rural public environmental participation.

H2: The subjective evaluation of current conditions relative to personal expectations (future-oriented reference) is associated with rural public environmental participation.

H3: The subjective evaluation of current conditions relative to neighboring communities (social-comparison reference) is associated with rural public environmental participation.

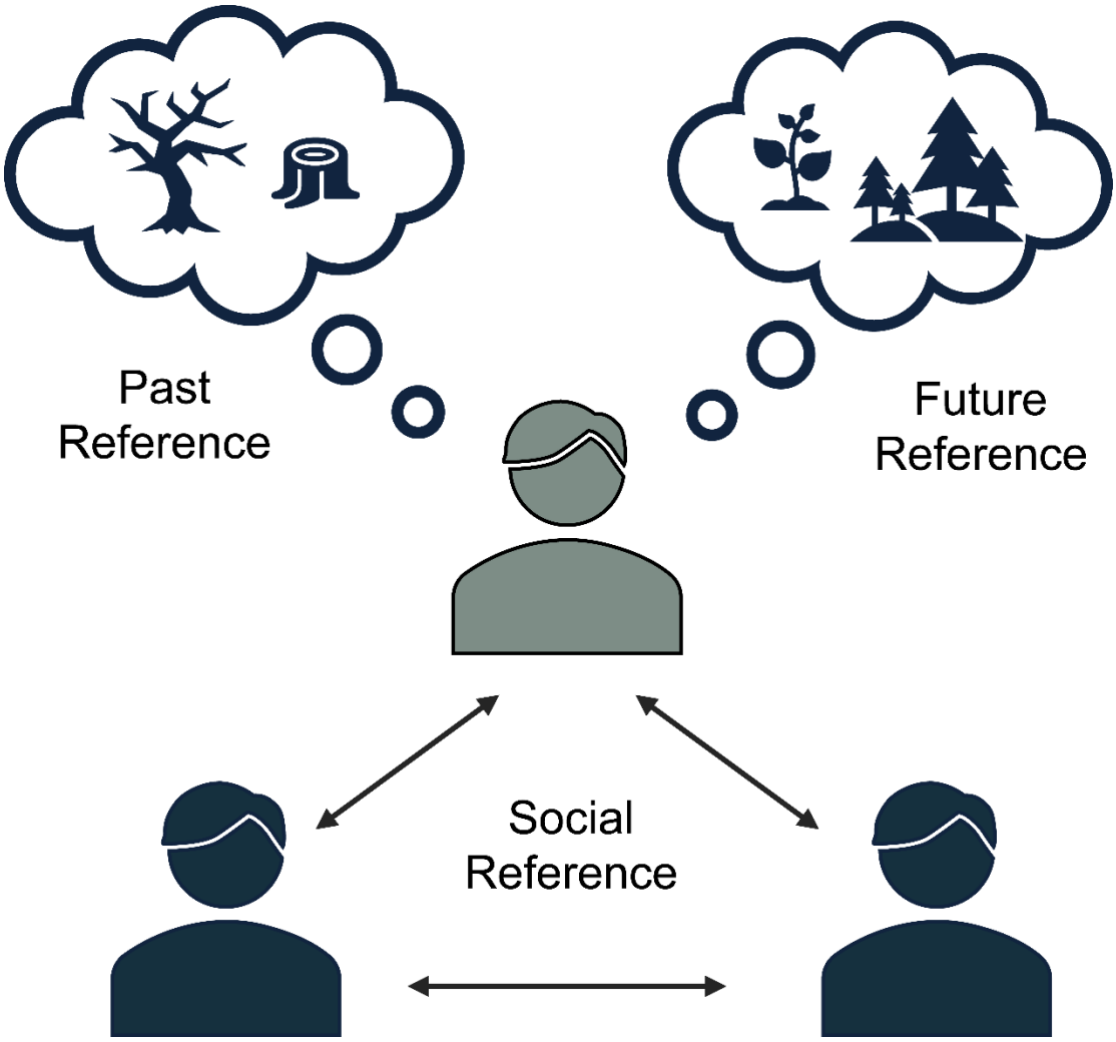


Figure 1.

Reference-Point Model of Agency in Rural Environmental Participation.

Method

Study Site and Participants

This study focuses on mining-induced resettlement residents living in coal-mining subsidence resettlement communities in Huainan, China. Huainan has a coal mining history of more than a century; while periods of extraction coincided with local economic growth, prolonged high-intensity mining was also associated with extensive land subsidence and ecological degradation (Quan et al., 2024). To address safety risks and support ecological improvement, authorities have implemented large-scale subsidence-area remediation and resettlement programs in recent years, relocating tens of thousands of rural residents to planned resettlement communities (NDRC, 2022; Wang et al., 2022; World Bank, 2014).

We conducted a household survey in June 2022 across multiple resettlement communities situated within the subsidence zone. Sampling combined stratification and random selection. First, based on the spatial extent of mining-induced subsidence (which does not map cleanly onto administrative boundaries), we delineated twelve mining-area strata; this unit of stratification better reflects subsidence impact than formal jurisdictions. Second, using the share of affected arable land within each stratum, we allocated village-level quotas to cover areas with different levels of impact. Third, within administrative villages located in each stratum, we randomly selected resettled households for interview. Trained enumerators conducted face-to-face interviews. A total of 660 questionnaires were distributed, and 610 valid responses

282 remained after excluding incomplete cases. The sample spans resettlement
283 communities across the affected zone, providing broad coverage of the variation in
284 local contexts. Before fieldwork, ethics approval for the household survey was
285 obtained from the relevant resettlement communities and the authors' institution.
286 Participation was voluntary, and respondents were informed that they could decline
287 to participate or withdraw at any time. Descriptive characteristics are summarized in
288 Table 1. Respondents were predominantly middle-aged; the gender split was roughly
289 even; most were married; and the modal education level was primary school or below
290 (44.3%), with middle school the next most common category (36.1%). Figure 2 displays
291 the geographic distribution of sampled communities. Compared with demographic
292 benchmarks from the National Population Census of Huainan (Table S1), the survey
293 sample was older than the general resident population and showed a somewhat lower
294 level of educational attainment than the citywide census profile. This pattern is
295 expected because the survey targeted adult household respondents in rural
296 resettlement communities, whereas the census covers the full resident population,
297 including children and urban residents. The Appendix provides the Chinese and English
298 translations of the questionnaire.
299

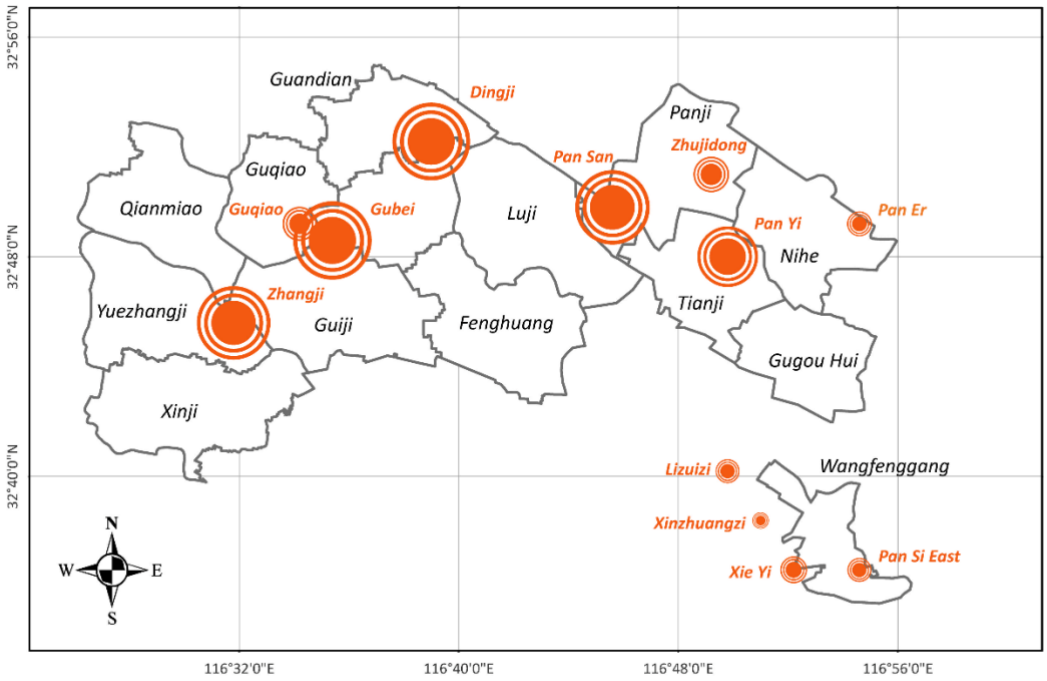
Table 1.

Demographic Distribution of the Survey Participants (N = 610)

Variable	Category	n	Percent
Age	18-30	38	6.20%
	30-40	111	18.20%
	40-50	110	18.00%
	50-60	160	26.20%
	60-70	97	15.90%
	70+	94	15.20%
Gender	Female	307	50.30%
	Male	303	49.70%
Marriage status	Single	44	7.20%
	Married	566	92.80%
Education	Primary or below	270	44.30%
	Middle school	220	36.10%
	High school	79	13.00%
	Junior college	32	5.20%
	Bachelor or above	9	1.50%

Figure 2.

Map of the study site.



Note: Circles denote the investigated mining areas, with circle size indicating the relative number of samples collected. Mining area and town names are annotated in orange and black text, respectively.

Measurement

Rural public environmental participation. The dependent variable was rural public environmental participation willingness, measured using a five-item intention scale developed for this study. Items asked: Would you be willing to regularly promote environmental protection knowledge and concepts to others? If you witness environmental damage, would you proactively report it to the relevant authorities? Would you willingly cooperate with ecological and environmental policies? Would you be willing to contribute ideas for improving your village's environmental conditions? Would you be willing to contribute funds toward improving your village's environmental conditions? Responses used a 5-point format (1 = "strongly unwilling/strongly disagree," 5 = "strongly willing/strongly agree"), with higher scores indicating stronger intention (Cronbach's α = .810). Rural public environmental participation willingness was computed as the mean score of five five-point items (M = 3.95, SD = 0.67).

Environmental reference points. The main independent variables were three reference-point indicators. Guided by the proposed framework, we created three single-item indicators capturing subjective evaluations of present conditions against different reference baselines. The past-oriented reference was measured by the item "Compared to past environmental conditions, are you satisfied with the current environment?" (M = 3.97, SD = 0.86); the future-oriented reference was measured by "Compared to your own expectations for environmental conditions, are you satisfied

with the actual environment?“ (M = 3.63, SD = 0.90); and the social-comparison reference was measured by “Compared to environmental conditions in neighboring areas, are you satisfied with the local environment?“ (M = 3.75, SD = 0.83). Each item used a five-point scale from 1 = very dissatisfied to 5 = very satisfied; higher values indicate more favorable evaluations of the current environment relative to the relevant reference point.

To account for compositional differences, we recorded age, gender, marital status, education, and subjective household economic status (1 = far below the village average, 5 = far above the village average). We also logged each respondent’s pre-move township of residence to adjust for clustering by place of origin.

Statistical Analyses

To address group differences in participation, we applied methods aligned with variable types. For binary indicators such as gender and marital status, we used independent-samples t tests. For multi-category variables such as education, we used one-way ANOVA with false-discovery-rate (FDR) adjustment for post-hoc comparisons. For continuous predictors (age and subjective economic status), we estimated restricted cubic spline (RCS) regressions to probe possible nonlinearity (Marrie et al., 2009). To complement these analyses with an interpretable segmentation of profiles, we fitted a classification tree (CART) using participation as the outcome and demographic variables as predictors. Splits minimized within-node variance; we used

10-fold cross-validation to select the complexity parameter and applied pruning. Default stopping rules and key hyperparameters were: *cp* = 0.0005, *minsplit* = 30, *minbucket* = 15, *maxdepth* = 30.

To examine H1–H3, we estimated mixed-effects models (Brown, 2021; Laird & Ware, 1982). Rural public environmental participation is the dependent variable in all models. The three reference-point indicators—past-oriented, future-oriented, and social-comparison—serve as the primary independent variables of theoretical interest. The model is:

$$y_{ij} = X_{ij}\beta + Z_{ij}u_j + \varepsilon_{ij}, u_j \sim \mathcal{N}(0, \tau^2), \varepsilon_{ij} \sim \mathcal{N}(0, \sigma^2)$$

where $X_{ij}\beta$ captures universal relationships (fixed effects), $Z_{ij}u_j$ captures group-specific deviations (random effects), u_j has mean zero and variance τ^2, and ε_{ij} has mean zero and variance σ^2. We proceeded stepwise: Model 1 (baseline) included demographic controls only; Models 2–4 added, respectively, the future-, past-, and social-reference indicators to the baseline; Model 5 included all three reference indicators jointly with controls. We assessed multicollinearity (all VIF < 5). Analyses used R packages *lme4*, *ggstatsplot*, and *rpart* (Bates et al., 2015; Patil, 2021; Therneau & Atkinson, 2025).

To evaluate the robustness of the reference-point pattern, several sensitivity analyses were conducted. First, the main specifications were re-estimated as linear models without adding a random intercept for pre-move township, thereby assessing whether the pattern depended on the multilevel specification. Second, a leave-one-

town-out procedure was applied: the joint model was repeatedly re-estimated after excluding each township in turn, which allowed an assessment of whether the focal associations were driven by any single township. Third, the five participation-intention items were modeled separately to examine whether the composite-scale findings were concentrated in a particular behavioral domain. Finally, nonparametric bootstrap resampling was used to obtain percentile-based confidence intervals for the reference-point coefficients in the joint model.

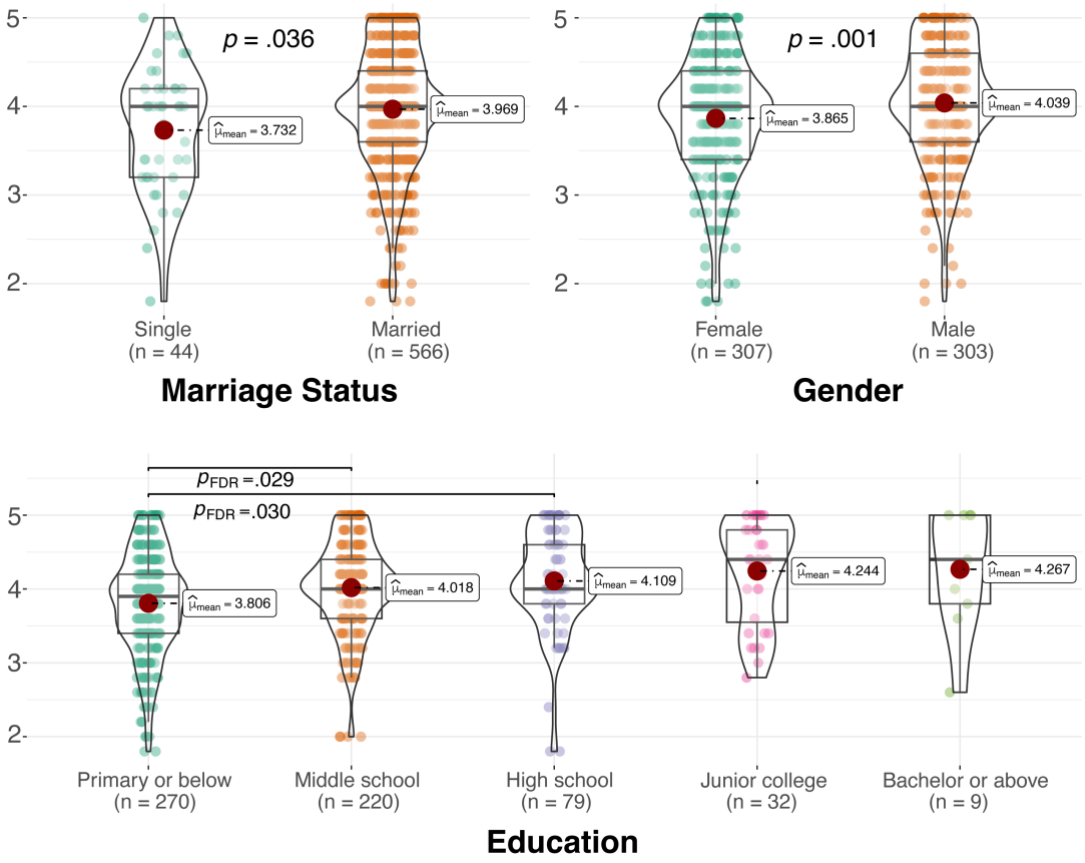
Results

Figure 3 contrasts participation across gender, marital status, and education, and Figure 4 plots RCS functions for age and subjective economic status. Among resettled residents, men reported higher participation than women ($p < .001$, Cohen's $d = 0.27$); married respondents scored higher than single respondents ($p = .037$, Cohen's $d = 0.34$); and those with middle school or lower education reported lower participation than peers with higher schooling (FDR-adjusted $p < .05$). Age exhibited an inverted-U association: participation increased up to roughly the early 50s and then declined. Subjective economic status showed a potential U-shaped pattern: respondents placing themselves in the lower-middle range reported the lowest participation, whereas mid- and higher-status groups reported higher levels. A supplementary CART analysis (Figure S1) indicated that being middle-aged, combined with higher education, most strongly characterized the higher-participation segments.

393 *Figure 3.*

394 Group Differences in Environmental Participation by Gender, Marital Status, and

395 Education.



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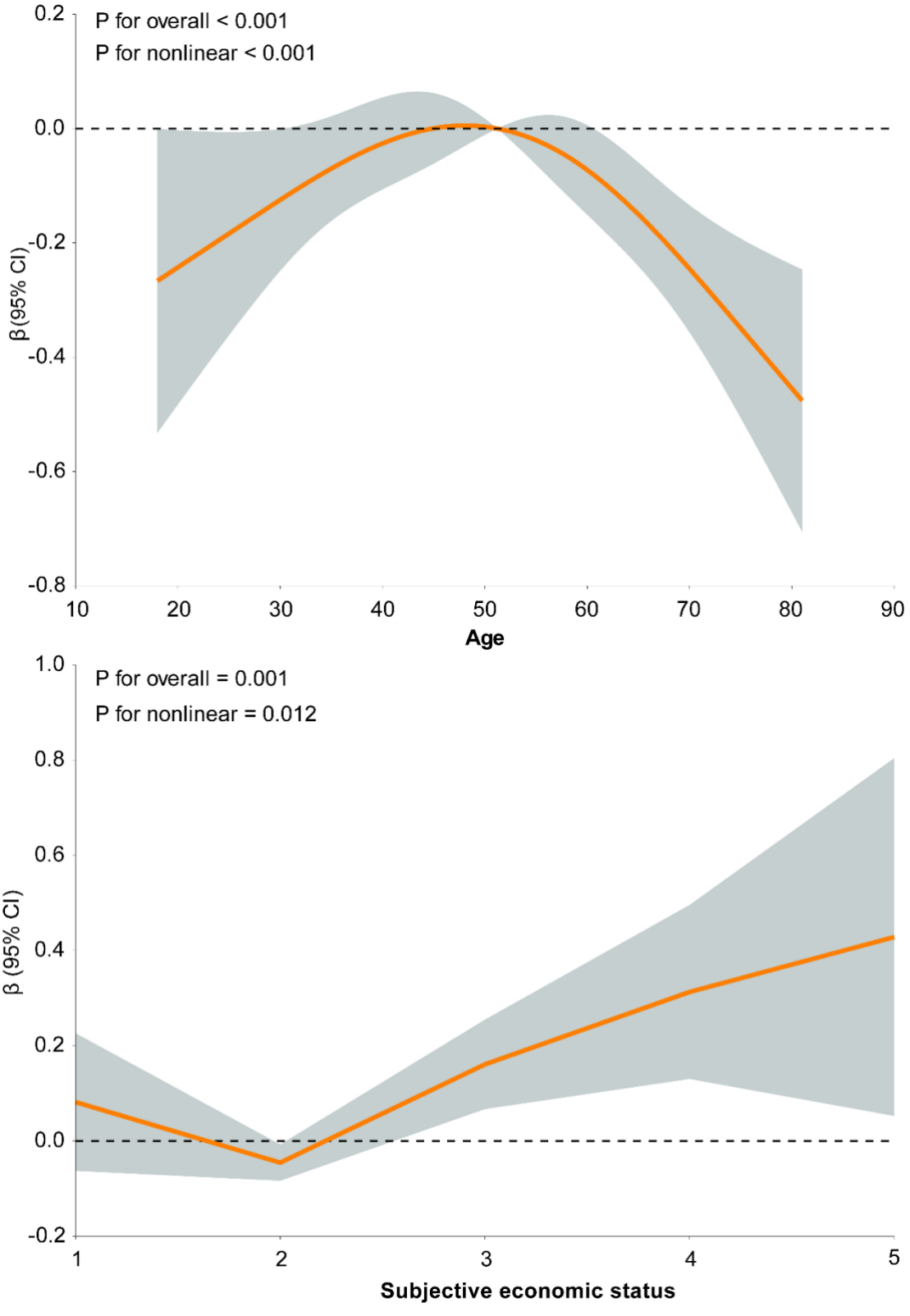
398 *Figure 4*.

399 Nonlinear Associations Between Age and Subjective Economic Status and

400 Environmental Participation.



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For H1–H3, Figure S2 displays bivariate Pearson correlations between the three reference-point indicators (past-oriented, future-oriented, and social-comparison) and environmental participation willingness. Pearson correlation was selected because all five variables are measured on symmetric 5-point Likert scales and show approximately symmetric distributions in the sample. All three pairwise correlations were positive and statistically significant (ps < .001). This pattern provides initial descriptive evidence that residents who evaluate the current environment more favorably relative to the past, their expectations, or neighboring areas tend to report stronger willingness to participate in environmental affairs. However, because these bivariate associations do not account for overlap among the three reference frames or for demographic differences, we further evaluated the three reference points as predictors of participation using mixed-effects models (Table 2).

When entered separately (Models 2–4), all three indicators were positively associated with participation: future-oriented reference ($\beta = 0.190$, $p < .001$), past-oriented reference ($\beta = 0.312$, $p < .001$), and social-comparison reference ($\beta = 0.236$, $p < .001$). These single-reference models indicate that each comparative frame is relevant when considered on its own. In the full specification (Model 5), including all three simultaneously, the past-oriented reference remained statistically robust ($\beta = 0.289$, $p < .001$), whereas the future-oriented ($\beta = –0.042$) and social-comparison ($\beta = 0.073$) indicators were attenuated and not statistically distinguishable from zero. This attenuation suggests that the associations of future-oriented and social-comparison

423 references with participation largely overlap with the broader comparative appraisal
424 captured by the reference-point indicators, whereas the past-oriented reference
425 contributes unique explanatory information. The results indicate that participation
426 willingness among resettled residents is most strongly anchored in concrete before–
427 after evaluations of environmental change rather than in more abstract future
428 expectations or lateral comparisons with neighboring areas.

429 Sensitivity analyses supported the same substantive pattern. First, when the
430 models were re-estimated as ordinary linear models without adding a random
431 intercept for pre-move township, the separate-reference models again showed
432 positive associations for the future-oriented, past-oriented, and social-comparison
433 references. In the joint specification, however, only the past-oriented reference
434 remained statistically robust ($\beta = 0.294$, $p < .001$), whereas the future-oriented
435 reference ($\beta = –0.035$) and social-comparison reference ($\beta = 0.076$) were not
436 statistically distinguishable from zero (Table S2). Second, leave-one-town-out analyses
437 indicated that this result was not attributable to any single township: the past-oriented
438 coefficient remained positive and statistically significant in every re-estimated model
439 (β range = 0.241–0.312, all $p < .001$; Figure S3), while the future-oriented and social-
440 comparison coefficients remained non-significant across exclusions. Third, analyses
441 using the five participation items as separate outcomes showed that the past-oriented
442 reference was positively associated with each item-level outcome, including reporting
443 environmental damage, promoting environmental protection, cooperating with

environmental policies, suggesting improvements, and contributing funds (β range = 0.173–0.304; Table S3). By contrast, the future-oriented reference was not statistically significant for any item, and the social-comparison reference was significant only for reporting environmental damage and promoting environmental protection. Finally, nonparametric bootstrap confidence intervals for the joint model yielded the same conclusion: the 95% confidence interval for the past-oriented reference excluded zero [0.186, 0.404], whereas the intervals for the future-oriented reference [–0.154, 0.079] and social-comparison reference [–0.050, 0.193] included zero. Together, these checks indicate that the central finding—the distinctive robustness of the past-oriented reference—was stable across model specification, township exclusion, outcome operationalization, and resampling-based uncertainty estimation.

Table 2.

Predictors of Public Environmental Participation.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
(Intercept)	–0.551**	–0.578***	–0.549***	–0.557***	–0.545***
	(0.172)	(0.163)	(0.154)	(0.160)	(0.154)
Age	–0.057	–0.076	–0.080	–0.075	–0.080
	(0.045)	(0.044)	(0.042)	(0.043)	(0.043)
Income	0.031	0.020	0.017	0.034	0.021
	(0.041)	(0.041)	(0.039)	(0.040)	(0.039)
Gender (Ref Female)	0.276***	0.265***	0.253***	0.286***	0.260***
	(0.081)	(0.079)	(0.077)	(0.079)	(0.077)
Marriage (Ref Single)	0.479**	0.511***	0.472**	0.467**	0.462**
	(0.154)	(0.152)	(0.146)	(0.150)	(0.147)
Education	0.168***	0.146***	0.135**	0.146***	0.135**
	(0.044)	(0.044)	(0.042)	(0.043)	(0.043)
Future Reference		0.190***			–0.042
		(0.040)			(0.059)
Past Reference			0.312***		0.289***
			(0.038)		(0.053)
Social Reference				0.236***	0.073
				(0.039)	(0.062)
Marginal R^2	0.073	0.106	0.164	0.124	0.166
Conditional R^2	0.113	0.128	0.177	0.142	0.178
AIC	1715.447	1700.153	1659.814	1687.591	1670.335
BIC	1750.754	1739.874	1699.535	1727.312	1718.883
Num. obs.	610	610	610	610	610
Num. groups: Town	14	14	14	14	14

Note. Standardized regression coefficients are displayed, with standard errors in parentheses.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

This study examined how environmental reference points are associated with rural environmental participation willingness among resettled residents in communities affected by mining-induced subsidence. Using survey data from Huainan, China, we observed notable between-group differences in reported willingness after relocation and consistent links between participation and three reference frames—past-oriented, future-oriented, and social-comparison evaluations of the current environment. When the three references were entered jointly, only the past-oriented reference retained a robust independent association, with sensitivity analyses further supporting this pattern, suggesting that residents' comparative judgments of present conditions vis-à-vis their own prior environments are especially salient in this context.

In terms of group patterns, men, married respondents, and those with more schooling reported higher participation. This pattern aligns with research indicating that gendered roles and decision authority in rural affairs can coincide with greater engagement among men (Agarwal, 2001; Burns et al., 2009; Westermann et al., 2005), that marital ties may anchor attention to community living conditions (Y.-I. Kim & Dew, 2016; J. Wilson, 2000), and that education is often linked with environmental knowledge, skills, and perceived efficacy (Bamberg & Möser, 2007; Wei et al., 2025). Age exhibited an inverted-U association, with participation peaking around the early-to-mid fifties and tapering thereafter; this pattern is consistent with accounts that link midlife experience and community responsibility to engagement, alongside later-life

declines in physical capacity or public involvement (Han et al., 2022; Morawski et al., 2022). Subjective economic standing showed a potential U-shaped trend: respondents in the lower-middle range reported the lowest willingness, whereas both lower and higher ends reported relatively higher levels. One interpretation, consistent with prior work, is that those facing economic strain may depend more on public services and thus remain sensitive to environmental quality (Mohai et al., 2009), while better-off households may mobilize social capital and reputational concerns in support of community affairs (Verba et al., 1995); at the same time, perceptions of relative deprivation can coincide with disengagement among those who see themselves just below the middle (Hargaden & Duquette, 2024; Korndörfer et al., 2015). We treat these non-linear patterns as descriptive regularities in need of further corroboration.

To interpret the role of reference points, we drew on Emirbayer and Mische's (1998) temporally embedded account of agency. All three references—comparisons to the past, to personal expectations for the future, and to neighboring places—were positively associated with willingness when modeled separately. This pattern is consistent with a view in which iterational, projective, and practical-evaluative orientations each provide motivational structure for action. In the joint model, however, only the past-oriented reference remained statistically robust. In resettlement settings characterized by discontinuities in place, livelihood, and routine, comparative judgments against one's own past appear to be especially influential for how residents appraise the present and consider participation (Lewicka, 2005, 2008).

Future expectations and lateral comparisons may still matter, yet their associations could be partially channeled through, or intertwined with, the salience of experience—consistent with the idea that the three *tones* of agency sound together but not always with equal prominence in particular contexts (Emirbayer & Mische, 1998). This reading also nuances findings from general-population studies in which future time perspective has been emphasized (Milfont et al., 2012), by highlighting a relocation context where the iterational orientation is comparatively foregrounded. Our results, therefore, align with a reference-point perspective in which residents' appraisals of the present, relative to lived histories, coincide with higher or lower participation.

The dominance of the past-oriented reference in joint specifications is theoretically coherent across several intersecting frameworks in cognitive and motivational psychology. Prospect theory establishes that individuals evaluate outcomes not in absolute terms but relative to a reference point, with losses weighted more heavily than equivalent gains (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). In a resettlement context, the prior living environment constitutes the most cognitively accessible and motivationally potent reference: it is autobiographically anchored, repeatedly rehearsed in community discourse, and carries the affective weight of an involuntary loss. Research on autobiographical memory confirms that disruptive collective experiences, particularly those with negative emotional valence, are encoded with heightened fidelity and remain persistently accessible over time, because emotional intensity amplifies memory consolidation (Conway & Pleydell-

Pearce, 2000; Rouhani et al., 2023). When residents perceive the present environment as an improvement over a degraded past, this comparative gain may activate what regulatory focus theory (Higgins, 1997) characterizes as a prevention-focused motivational orientation: rather than aspiring toward a still-better future, residents are motivated to protect a valued status quo against regression, a state that may translate into participation-related intentions directed at maintaining and safeguarding environmental improvements. Empirical studies confirm that loss-framed environmental comparisons reliably elicit stronger conservation decisions than gain-framed projections (Belle et al., 2025), and that individual-level loss aversion is robust across different choice contexts and demographic groups (Gächter et al., 2022).

The dominance of the past-oriented reference warrants deeper mechanistic interpretation. Solastalgia—the distress caused by environmental change in one's home environment—has been documented among displaced mining communities in Germany, Australia, and Ghana, where forced relocation disrupts the emotional bond between residents and their original landscape (Krüger et al., 2022; Mackey et al., 2023). In the Huainan context, residents who experienced subsidence-induced displacement may carry not only concrete memories of pre-move environmental conditions but also a deeper psycho-emotional orientation rooted in loss and longing. This suggests that the past-oriented reference may operate through multiple pathways: a purely cognitive benchmark (the current environment is better/worse than before), an emotional valence component (nostalgia or solastalgia), and a motivational impulse

(desire to restore or protect what was lost). The emotional geography and place-attachment literature on coal and energy-transition communities suggests that attachment, loss, anxiety, and uncertainty often coexist in places historically organized around coal, and that these emotional framings can shape whether communities support transition policies, resist environmental interventions, or withdraw from governance processes (Devine-Wright, 2009; Egan et al., 2024; Rohse et al., 2020). Future work could profitably map these emotional trajectories in Huainan to illuminate the affective architecture underlying the statistical associations observed here.

A question that warrants explicit attention concerns the uniqueness of these findings to the Huainan context versus their potential generalizability. Several findings appear to be relatively context specific. The dominance of the past-oriented reference over future and social comparisons in joint models aligns with features particular to coal-mining subsidence displacement: the pre-move environment was objectively degraded and well-documented, making before-after comparisons especially salient and easily anchored; the displacement was involuntary and state-managed, meaning residents did not self-select into resettlement and thus retain vivid memories of prior conditions; and the new communities are standardized, limiting variation in current environmental conditions that might otherwise amplify social comparison effects. Cross-regional evidence suggests that other resettlement settings organize agency through different interpretive frames: in Ghana and Sierra Leone, compensation, livelihood restoration, and the distribution of social and natural capital are especially

prominent; in Zimbabwe and Odisha, agency is often expressed through livelihood resilience, rebuilding of social networks, identity claims, or resistance; in Latin American mining frontiers, territorial movements and contestation over extractive governance shape mobilization; and in climate- or dam-related relocation, livelihood security, long-term adaptation, and the remaking of home and belonging tend to structure residents' evaluations (Arhin et al., 2022; Bebbington et al., 2008; Feng & Zhu, 2022; Gukurume & Tombindo, 2023; Ofori et al., 2023; Piggott-McKellar et al., 2020; Samal, 2025; S. A. Wilson, 2019). The inverted-U age pattern and U-shaped economic status pattern, however, are consistent with findings from diverse national contexts and may reflect more universal life-course and socioeconomic dynamics in civic participation (Hargaden & Duquette, 2024; Morawski et al., 2022). The practical primacy of the past reference, and its actionable implications for mobilization design, should thus be treated as a context-sensitive finding in need of careful replication before it is extended to other resource-dependent resettlement settings.

Theoretical and Practical Implications

Theoretically, the study extends dialogue between rural environmental participation and agency theory by introducing a reference-point lens. Much work on environmental action in rural contexts has emphasized instrumental reasoning or value–norm pathways (e.g., the theory of planned behavior; value–belief–norm models) (Ajzen, 1991; Stern et al., 1999), while comparatively fewer accounts have

587 centered on the temporal and comparative frames through which residents evaluate
588 their situations. By adapting the notion of reference points from behavioral decision
589 research to the setting of resettlement communities (Tversky & Kahneman, 1974), the
590 analysis foregrounds how people draw on remembered pasts, anticipated futures, and
591 horizontal comparisons to organize participation. The findings also speak to the
592 literature on environmental migration and resettlement, which often spotlights
593 vulnerability, policy performance, and livelihood recovery (Gong et al., 2021; Heming
594 & Rees, 2000; Tashi & Foggin, 2012; Xun & Bao, 2008). Our results suggest that
595 resettled residents are not merely passive recipients of institutional designs; rather,
596 they actively interpret new settings through comparative frames that help re-locate
597 the self in relation to place and public affairs. Even within institution-led processes,
598 agency can be articulated through the reframing of experience and evaluation, which
599 may support or dampen participation.

600 This study advances the literature on rural environmental participation in three
601 respects that, to our knowledge, have not been jointly established elsewhere. First,
602 while prior research has examined satisfaction, expectations, and social comparison as
603 separate correlates of environmental behavior (Ouyang et al., 2022; Piao & Managi,
604 2024; Ruan et al., 2022), the present study provides the first empirical test of their
605 joint explanatory weight. We found only the past-oriented reference retain a robust
606 association, indicating that the three frames are not interchangeable, and that
607 retrospective comparison carries disproportionate motivational weight. Second,

existing mining-displacement scholarship has primarily addressed livelihood restoration, compensation, and social capital (Ahmer & Ostendorf, 2025; Arhin et al., 2022; Gukurume & Tombindo, 2023); our findings introduce a complementary cognitive-motivational pathway, showing that retrospective gain perception anchors residents' willingness to engage in post-extractive environmental governance. Third, whereas prior rural participation studies have emphasized sociodemographic and economic determinants (Meng & Si, 2022; Yang et al., 2025), our results show that comparative reference-point evaluations retain significant explanatory force net of these controls, elevating subjective interpretive frames as a central rather than peripheral component of post-resettlement participation models.

Beyond the immediate setting of rural community management, these findings also speak to broader debates on resource governance and post-extractive sustainability transitions. Residents' willingness to participate in environmental affairs can be understood as part of the social infrastructure through which post-mining regions pursue durable remediation, fairer resource allocation, and more inclusive transition pathways. The present study complements this literature by shifting attention from macro-level resource and market dynamics to the community-level agency through which sustainability transitions are experienced, interpreted, and potentially supported by affected residents. Local participation constitutes a bridge between ecological restoration targets and everyday legitimacy: when residents recognize improvements relative to the degraded environments from which they were

relocated, they may be more willing to help maintain, monitor, and co-produce the restored environment.

Practically, the patterns offer direction for program design in resettlement communities. Differentiated engagement strategies seem warranted: men, married respondents, middle-aged adults, and those with higher education reported higher participation and may be positioned as early organizers or peer facilitators, while parallel efforts can lower barriers for other groups. The prominence of the past-oriented reference suggests that governments and communities can adopt a past-oriented mobilization strategy. First, local governments and community managers could organize participatory environmental audits that explicitly compare before-and-after ecological conditions, using photographic or monitoring data from the subsidence period alongside current assessments. Second, community narrative workshops could invite residents to co-produce accounts of how their environmental conditions have evolved since displacement, converting private memories into collective records that recognize both losses and gains. Third, communication campaigns that frame participation as protecting what we have rebuilt may better align with the comparative logic that appears to drive resident agency.

Limitations

Several limitations qualify these interpretations. The cross-sectional design is the most consequential. Theory motivates the expectation that comparative reference

650 frames precede and shape participation dispositions. Emirbayer and Mische's (1998)
651 framework treats agency as temporally constituted, with iterational orientations,
652 rooted in prior schemes and habits, logically preceding practical-evaluative responses
653 to current situations. Moreover, psychological research on memory and comparative
654 appraisal suggests that retrospective evaluations of prior conditions are cognitively
655 more stable than real-time participation decisions (Conner & Norman, 2022; Kuwabara
656 & Pillemer, 2010). Similarly, unmeasured community-level factors, such as local
657 leadership quality and access to participation channels, may jointly influence both
658 reference-point evaluations and participation willingness, creating omitted variable
659 bias. The second limitation is the operationalization of the dependent variable. The
660 study measures participation willingness rather than observed behavior. The intention-
661 behavior gap is well documented in environmental psychology (M.-S. Kim & Hunter,
662 1993; Kollmuss & Agyeman, 2002). Accordingly, the findings should be interpreted as
663 evidence about participation willingness rather than observed environmental
664 participation. Future work combining willingness measures with behavioral records
665 would clarify the predictive scope of the reference-point framework. Finally, the
666 findings are specific to coal-mining subsidence resettlement in Huainan, a context
667 shaped by China's distinctive institutional arrangements. While the theoretical
668 framework is generalizable, context-specific replication is needed before applying
669 these conclusions to resource-dependent communities in Africa, India, or South
670 America.

Conclusion

This study introduces a reference-point perspective to rural environmental participation in resettlement communities. Past-oriented appraisals of present conditions displayed the most consistent association with participation when modeled alongside future- and social-comparison references. Placing residents' subjective frames at the center of analysis underscores the role of agency in shaping engagement and suggests that interventions may benefit from aligning with how people evaluate the present through the lens of lived histories, anticipated futures, and nearby examples.

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Appendix

Table S1

Comparison between the survey sample and population census benchmarks for Huainan

Indicator	Survey sample	Census benchmark
Gender	Male 49.7%, Female 50.3%	Huainan: Male 51.01%, Female 48.99%
Age	18–59: about 68.6%; 60+: about 31.1%	Huainan: 15–59 = 59.34%; 60+ = 20.98%; among people aged 15+, 60+ is about 26.1%
Education	Primary or below 44.3%; middle school 36.1%; high school 13.0%; junior college or above 6.7%	Huainan per 100,000: college+ 11,491; high school 12,454; middle school 36,616; primary school 27,540; the remaining population includes below-primary/no-schooling groups

Table S2.

Sensitivity Analysis Without Pre-Move Township Random Intercepts.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
(Intercept)	–0.556***	–0.601***	–0.560***	–0.577***	–0.559***
	(0.157)	(0.153)	(0.148)	(0.152)	(0.148)
Age	–0.034	–0.065	–0.074	–0.068	–0.076
	(0.044)	(0.044)	(0.042)	(0.043)	(0.042)
Income	0.033	0.018	0.016	0.034	0.020
	(0.042)	(0.041)	(0.039)	(0.040)	(0.040)
Gender (Ref Female)	0.226**	0.235**	0.233**	0.261***	0.241**
	(0.081)	(0.079)	(0.076)	(0.078)	(0.077)
Marriage (Ref Single)	0.479**	0.522***	0.479**	0.482**	0.473**
	(0.155)	(0.151)	(0.146)	(0.150)	(0.147)
Education	0.182***	0.153***	0.140***	0.152***	0.140**
	(0.045)	(0.044)	(0.042)	(0.043)	(0.043)
Future Reference		0.210***			–0.035
		(0.039)			(0.059)
Past Reference			0.324***		0.294***
			(0.037)		(0.053)
Social Reference				0.251***	0.076
				(0.038)	(0.062)
R^2	0.069	0.112	0.172	0.131	0.174
Adj R^2	0.062	0.103	0.164	0.122	0.163
Num. obs.	610	610	610	610	610

Note. Standardized regression coefficients are displayed, with standard errors in parentheses.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table S3.

Reference-Point Predictors of Single-Item Environmental Participation Outcomes.

	Report violations	**Advocate environmental protection**	**Cooperate with policy**	**Suggest improvements**	**Contribute financially**
(Intercept)	–0.444**	–0.491**	–0.262	–0.359*	–0.507**
	(0.155)	(0.153)	(0.164)	(0.166)	(0.158)
Age	–0.043	–0.074	–0.041	–0.032	–0.100*
	(0.044)	(0.043)	(0.044)	(0.045)	(0.044)
Income	–0.028	–0.022	0.030	–0.023	0.096*
	(0.041)	(0.040)	(0.041)	(0.041)	(0.041)
Gender (Ref Female)	0.337***	0.296***	0.134	0.060	0.185*
	(0.080)	(0.078)	(0.080)	(0.081)	(0.080)
Marriage (Ref Single)	0.299*	0.373*	0.215	0.355*	0.471**
	(0.152)	(0.150)	(0.153)	(0.155)	(0.152)
Education	0.105*	0.096*	0.048	0.142**	0.116**
	(0.044)	(0.043)	(0.044)	(0.045)	(0.044)
Past Reference	0.173**	0.236***	0.296***	0.223***	0.186***
	(0.055)	(0.054)	(0.055)	(0.056)	(0.055)
Future Reference	–0.045	–0.047	0.019	–0.012	–0.062
	(0.061)	(0.060)	(0.061)	(0.062)	(0.061)
Social Reference	0.131*	0.138*	–0.050	–0.004	0.075
	(0.064)	(0.063)	(0.064)	(0.065)	(0.064)
Marginal R^2	0.109	0.142	0.093	0.077	0.114
Conditional R^2	0.111	0.145	0.115	0.099	0.124
AIC	1716.578	1692.841	1719.551	1730.551	1711.034
BIC	1765.126	1741.389	1768.099	1779.099	1759.582
Num. obs.	610	610	610	610	610
Num. groups: Town	14	14	14	14	14

Note. Standardized regression coefficients are displayed, with standard errors in parentheses.

* $p < .05$. ** $p < .01$. *** $p < .001$.

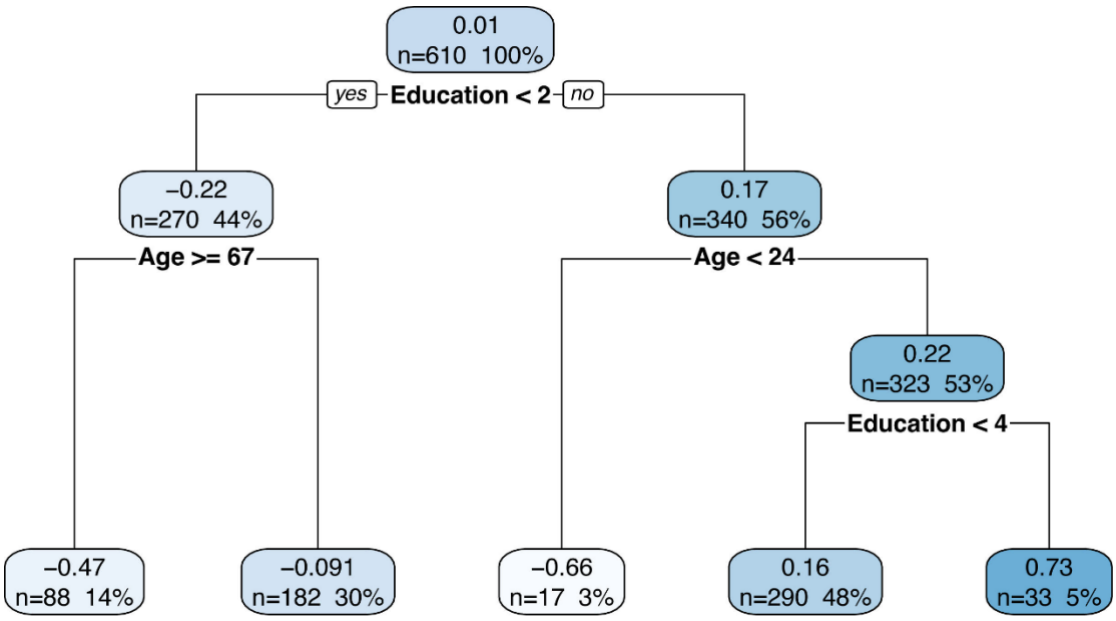

Figure S1.

CART Classification Tree Predicting Participation from Demographic Characteristics.

Note: For education, 1 = Primary or below, 2 = Middle school, 3 = High school, 4 = Junior college, 5 = Bachelor or above.

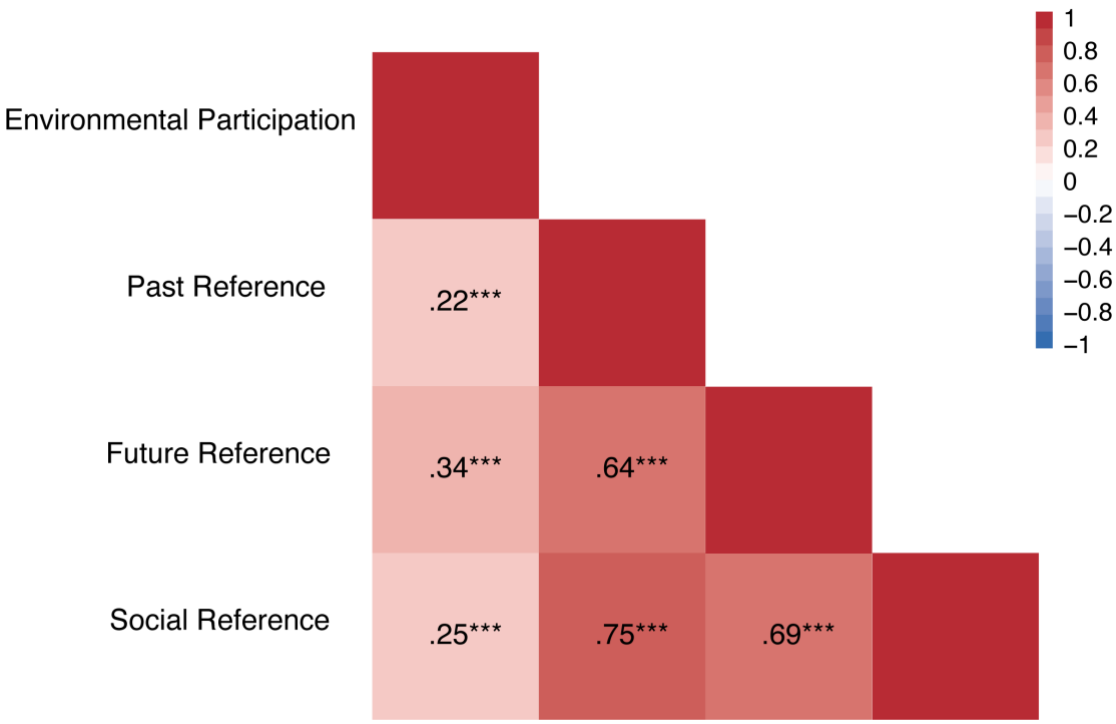

Figure S2.

Bivariate Associations Between Reference-Point Indicators and Environmental Participation Willingness.

Note: Pearson correlation coefficients were used for the main correlation matrix because the variables were coded on symmetric five-point response scales. To avoid applying Pearson correlations indiscriminately to ordinal response items, we additionally estimated Spearman rank-order correlations as a sensitivity check. The Spearman results were substantively consistent with the Pearson results in direction and statistical significance.

Figure S3.

Leave-One-Town-Out Estimates for Reference-Point Predictors.