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Absent but Engaged: Out-Migration and the Form of Contribution to Rural Environmental Governance

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Abstract

Whether rural out-migration withdraws households from local environmental governance or changes the form through which they contribute is not well understood. This study finds that what shifts is not only whether households participate but also the form their contribution takes. Drawing on a survey of rural China, this study models participation in village waste-sorting governance as a two-stage decision: in which a household first decides whether to take part and then, among those willing, whether to contribute labour, cash or both. The two stages are estimated jointly with a Heckman probit selection model, with home-village attachment tested as the condition shaping the form of contribution. Households with a higher share of out-migrating labour are less likely to be willing to participate and, among willing households, less likely to intend labour-only contribution. The move towards cash is conditional rather than general: supplementary subgroup estimates suggest that cash-only contribution rises with out-migration only where home-village attachment is strong, while the corresponding coefficient is not statistically distinguishable from zero where attachment is weaker. Out-migration is associated with both a lower willingness to participate and a reallocation of contribution among those still willing, and home-village attachment marks the boundary within which this holds in this sample. These findings suggest that rural environmental schemes should allow households to contribute through cash or labour, while maintaining opportunities for migrants to remain connected to their home villages.

1. Introduction

Local environmental governance in the countryside is commonly thought to rest on the presence of residents who are there to do the work and take their turn at it. Out-migration, from this perspective, reduces the resident labour available for collective provision and may weaken the capacity that sustains it. Yet migration also links village to city across distance, and a household that has left may continue to contribute to the place it has left even when it can no longer be present to do so. Whether absence dissolves a household's contribution, changes its form, or does both is an open question.

The empirical record is itself divided. One line treats out-migration as a drain, showing that the loss of resident labour and the fraying of village ties weaken collective action over common resources (Wang et al., 2016; Wang et al., 2022) and the community interaction on which local conservation depends (Qin and Flint, 2012). At the household level, a higher share of out-migrant labour has been tied to weaker willingness to join environmental governance and to a lower probability of on-site participation such as village greening and waste sorting (Wang et al., 2016), as departure loosens a household’s economic tie to the village and thins the resident labour it can supply. A second line finds that remittances and the outside connections migrants bring home widen access to rural public goods, from village drinking water (Pizzi, 2018) to forest recovery, where migrant earnings and the easing of pressure on farmland let woodland return (Oldekop et al., 2018). More recent evidence complicates a simple drain-versus-gain reading, since where social relations are reorganised rather than severed, out-migration need not reduce collective labour at all, as remaining and returning members and shifting gender roles sustain the work

(Leder et al., 2024). What these accounts share is a reading of participation as a single act, and of physical absence as withdrawal from it.

These apparently conflicting findings may be reconciled, at least in part, once participation is read not as a single act but as a portfolio of resources a household can contribute, labour and cash foremost among them. One possibility is that out-migration reshapes that portfolio, reducing the hours available for on-site work while easing the cash constraint through wages earned away (World Bank, 2023), and so raising the opportunity cost of contributing labour relative to cash. On this reading, absence alters the terms on which a household contributes rather than removing it from provision, allowing a move away from labour-only contribution towards forms that involve cash (Wu et al., 2022).

Reading participation as a single act obscures a distinction that matters for how the countryside is governed. Two villages with the same rate of participation can face very different governance conditions, because a household that turns up to sort waste supplies on-site labour, monitoring and organisational presence, whereas a household that pays towards collective collection supplies financing but none of the work. When participation is coded as a binary outcome, a household that moves from contributing labour to contributing cash records no change, and may even be counted as withdrawing where only turning out is recognised as taking part, although it continues to support the public good through a different resource. The form in which households contribute is therefore not a detail of measurement but part of what a governance system has to work with, and a shift in that form can alter the labour available, the financing on hand and the organisational burden a scheme must carry even as headcount participation holds steady.

Whether such a shift occurs cannot be read from earnings alone. Migration loosens the daily interaction and thins the social capital that keep a household engaged in village affairs, so resources earned outside are more likely to translate into contribution at home when a tie to the origin village remains strong. We refer to this tie as home-village attachment, a village-specific form of place attachment, an affective and relational bond that can outlast physical presence. A household that has left may retain it, since attachment is sustained through continued connection rather than co-residence (Gustafson, 2001; Barcus and Brunn, 2010), even though migrants are on average less attached to a place than those who stay (Hernández et al., 2007). Because the bond does not require on-site presence, its influence is expected to fall on cash-based rather than labour-based contribution, so that continued home-village attachment conditions whether out-migration coincides with a change in the form of contribution rather than with a fall in participation.

Two features of the rural Chinese context make this pattern visible rather than merely conjectural. Out-migration separates the place where a household earns its income from the place where the environmental public good is provided, so that resources are generated in the city while provision remains bound to the village, and a household that wishes to contribute must bridge that distance with the resource it can send across it, which is money far more readily than time. The good can moreover be supported through both currencies, since sustaining it may depend on repeated on-site effort as well as

on the funds needed to run collective collection, so that the choice between labour and cash is an ordinary part of taking part rather than an artefact of how the question is posed.

Village household waste sorting offers a useful empirical setting in which to examine this. Sorting is a labour-intensive collective environmental practice a household can support either by doing the work itself or by paying towards collective collection, so the resource contributed is observed rather than assumed, and a nationwide effort to extend sorting to the countryside has made the decision to take part, and in what form, a live one for rural households, whose participation in rural environmental governance is increasingly studied (Zhang and Liao, 2025). We use village waste-sorting governance as an empirical setting for household contribution to rural environmental governance more broadly. Drawing on a survey of 453 households in Shaanxi province, we model participation as a two-stage decision, whether a household takes part and, conditional on taking part, whether it contributes labour, cash or both, using a probit model with sample selection whose selection structure corrects for the non-comparability of willing and unwilling households.

We find that willingness to participate is lower among households with more of their labour away and, among households willing to participate, so is the likelihood of intending labour-only contribution. Any shift towards intended cash contribution is conditional rather than general, appearing where home-village attachment is strong, among whom cash-only contribution rises with out-migration, and absent where that attachment is weak. The pattern is consistent with a change in the relative cost of contributing time and money rather than necessarily a change in how much households value participation, since it holds once perceived necessity, value and trust are accounted for.

The study speaks to three literatures. To work on migration and rural collective action, which often treats participation as a single outcome and so divides over whether absence helps or harms, it offers a decomposition into whether a household contributes and in what form, and shows that apparently divergent findings can be reconciled by distinguishing the presence of participation from its form, a distinction often obscured when time and money are treated as alternative measures of one willingness to contribute. To the valuation literature on labour versus cash as vehicles of contribution, long posed as a question of measurement, it gives a behavioural role, making the choice between them the margin on which demographic change acts. And to research on place attachment and pro-environmental behaviour, it supplies a boundary condition, identifying continued home-village attachment as the condition under which out-migration coincides with a shift towards cash-based contribution rather than a fall in participation. The remainder of the paper sets out the theoretical framework and hypotheses, describes the data and empirical strategy, presents the baseline and conditional results together with robustness checks, and closes with a discussion of mechanisms and implications.

2. Theory and hypotheses

A household's engagement with village waste-sorting governance is modelled as two linked decisions. The first, whether to take part, follows the logic of collective action, under which a household weighs a

private contribution cost against benefits from which it cannot be excluded and is tempted to free-ride (Olson, 1965; Ostrom, 1990), a capacity that depends on local leadership and the social capital available to sustain collective provision. The second, taken only once participation is chosen, is the form the contribution takes, labour, cash or both. Keeping the two apart matters because a force depressing the first margin need not act with the same sign on the second, and merging them conceals the reallocation this paper isolates.

It helps to think of a participating household as holding a small portfolio of resources it can direct towards the public good, principally the labour of its members and the cash its income affords, rather than a single propensity to take part. On this view the two margins draw on different things. Whether to participate reflects how a household weighs the good against the cost of contributing at all, while the form of contribution reflects which resource it can most readily spare. A household may continue to value a clean and orderly village highly and yet find itself less able to supply time there, so that a change in what it contributes need not signal any change in what it wants. Separating the two margins allows out-migration to bear on the composition of contribution without being read, by construction, as a retreat from the good itself.

2.1 Out-migration and the willingness to participate

Out-migration acts on the first margin through opposing channels, so its net effect is a question for the data rather than a settled prior. On one side, it may depress willingness in three ways. It widens the economic heterogeneity within a village, which can raise the difficulty of sustaining collective action, though this relationship is itself nonlinear and contingent (Baland and Platteau, 1999; Poteete and Ostrom, 2008). It reduces the household labour available on site, since the new economics of labour migration predicts that the more mobile members leave first (Stark and Bloom, 1985), and it thins the social capital and community ties through which collective action in the rural commons is sustained (Wang et al., 2022). And it may weaken the perceived relevance of village environmental improvement as a larger share of a household's life is lived elsewhere. On the other side, out-migration may raise willingness by strengthening a household's capacity and outlook. Urban work may heighten environmental awareness, which through its bearing on intention could feed back into behaviour (Ajzen, 1991), while remittances raise the disposable income behind any willingness to pay (Taylor et al., 2003; World Bank, 2023). Which force dominates cannot be signed in advance, so H1a and H1b are stated as competing hypotheses reflecting the opposing channels through which out-migration may bear on willingness.

H1a. Out-migration lowers the willingness to participate, by widening within-village heterogeneity, reducing on-site labour, and weakening the perceived relevance of village environmental improvement.

H1b. Out-migration raises the willingness to participate, by strengthening households'

environmental awareness and capacity to pay.

2.2 Out-migration and the form of contribution

Conditional on taking part, the form of contribution follows from the relative opportunity cost of the two forms available to a household. That labour and cash are not interchangeable vehicles of contribution is well established in valuations of rural public goods, where a household's relative willingness to give time rather than money varies with the opportunity cost of labour and with trust in the institutions that would handle the funds (Echessah et al., 1997; Vondolia et al., 2014; Gibson et al., 2016; Kassahun et al., 2020; Meles et al., 2025). This study treats the choice between the two not as a measurement problem but as a behavioural margin through which out-migration operates, and expects distrust of local institutions to hold contribution towards labour even where cash capacity has risen (Kassahun et al., 2021). Labour requires presence and time on site, cash requires neither. By the logic of opportunity cost, out-migration raises the value of the household's time as hours shift to wage work away from the village, and at the same time eases its cash constraint through the earnings that work provides (Swallow and Woudyalew, 1994; Barrett et al., 2008; Rai and Scarborough, 2013; World Bank, 2023). Out-migration is therefore expected to raise the relative opportunity cost of labour compared with cash, and willing households to become less likely to intend to contribute labour alone; this should be reflected in greater reliance on forms that involve cash, although the specific destination of the shift is an empirical question.

The mechanism is one of relative cost rather than of taste. Migration need not make a household care less about the state of its village for it to contribute differently, since it raises the value of the members' time and eases the cash the household can spare, so that the same underlying regard for the good is expressed through a currency better suited to distance. Because labour is spent where the body is while cash can be moved to where it is needed, the widening gap between where a migrant household earns and where the good is provided falls more heavily on labour than on money. Out-migration is thus expected to lower reliance on labour alone without any implied fall in the value placed on the good, shifting the feasible form of contribution rather than the willingness behind it.

H2. Among households willing to participate, those with more of their labour away are less likely to intend to contribute labour alone.

2.3 Home-village attachment as a boundary condition

Whether the resources migration supplies are converted into contribution at home depends on more than their availability. By thinning daily interaction and social capital, migration weakens the local embeddedness that orients a household towards village affairs (Granovetter, 1985), so resources earned outside are more likely to translate into contribution at home where attachment to the origin village remains strong. Home-village attachment is a village-specific affective and relational bond that outlasts physical presence and varies across migrant households, and whose relation to pro-environmental action differs across behaviour types rather than being uniform (Scannell and Gifford, 2010; Daryanto and Song, 2021). Place attachment raises pro-environmental intentions, including the intention to sort and recycle, once it is built into the household's decision (Wan et al., 2021). Where attachment is strong, households may be more likely to convert the greater financial capacity that accompanies out-migration

into cash contribution, so that cash-only contribution rises more steeply with out-migration. Where attachment is weak, this compensating pattern is expected to be absent. Because the bond works through money that can be remitted rather than labour that must be performed on site, its conditioning role is expected to be concentrated on cash-based rather than labour-based contribution, which out-migration constrains directly in either case.

Home-village attachment does two distinct things in this account, and it is worth keeping them apart. It sustains motivation, in that a household that still regards the village as its own community has reason to keep contributing to it, but its more particular role here is one of conversion, shaping whether the resources migration supplies are turned into contribution at home rather than spent elsewhere or not at all. Migration furnishes the capacity to give cash, and attachment conditions whether that capacity remains tied to the origin village. This is also why attachment should not be read as one more measure of environmental concern. The models already hold constant how necessary and how valuable a household judges participation to be and how far it trusts others and local institutions, so attachment enters not as a proxy for green attitudes but as a place-specific relational bond that keeps a mobile household connected to a particular community, which is precisely the condition under which resources earned away can flow back as support for the local good.

H3. Cash-only contribution rises with out-migration more strongly among households with stronger home-village attachment.

3. Data and variables

3.1 Data and sampling

The data come from a household survey conducted in Shaanxi province in July and August 2022. An inland province in northwestern China, Shaanxi is typical of the less-developed regions from which much of the country's rural labour migrates. Sampling followed a stratified random design over the county–township–administrative village–household hierarchy: two to three townships were drawn at random per county, two to three administrative villages per township, and ten to fifteen households per village, covering 33 administrative villages in total. Trained enumerators collected the data through face-to-face interviews, recording household and household-head characteristics, familiarity with environmental governance, and willingness to take part in village waste-sorting governance together with the form of contribution. Of 487 questionnaires returned, 453 remained valid after records with invalid, missing or anomalous values on key variables were removed, an effective rate of 93%.

3.2 Variables

The dependent variable is a household's decision to participate in village waste-sorting governance, measured at two stages, willingness and form of contribution. Willingness equals one where a household is willing to take part and zero otherwise. The form of contribution distinguishes three modes, labour alone, cash alone and both, where contributing cash means taking part by paying fees or other

funds and contributing labour means taking part through time and effort such as publicising and monitoring the scheme.

The core explanatory variable, the household labour-migration share, is the proportion of a household's labour force working away, a migrant worker being a member aged sixteen or over, able to work, employed outside the home township and away for a cumulative six months or more during the year. The conditioning variable, home-village attachment, is a composite measure of the household head's affective and relational attachment to the home village, adapted from prior work on place attachment (Scannell and Gifford, 2010; Daryanto and Song, 2021). It combines four five-point items, capturing whether village affairs are felt to concern the respondent, whether the respondent feels regarded and holds standing within the village, whether the respondent feels happy living in the village, and whether the respondent would feel distressed about leaving it, averaged with equal weights and split at the sample mean into low-attachment (0) and high-attachment (1) groups. The four items together capture affective and relational ties to the home village rather than place attachment in a narrow sense.

The models further control for environmental cognition (perceived necessity and perceived value of participation), social characteristics (interpersonal and institutional trust), personal characteristics (gender, age, schooling and political status), household characteristics (cultivated area and total income) and a regional dummy. The willingness equation additionally includes a village-level measure of emphasis on waste sorting, the household's assessment of whether the village takes waste sorting seriously, which identifies the participation-selection stage. Variable definitions and descriptive statistics appear in Table 1.

Table 1
Variable definitions and descriptive statistics

Variable	Definition / coding	Mean	S.D.
Willingness	Willing to participate = 1; otherwise = 0	0.625	0.485
Form of contribution	Labour alone = 1; cash alone or both = 0 (among willing households)	0.484	0.501
Labour migration	Migrant workers / total household labour force	0.412	0.395
High home-village attachment	Composite attachment score above the sample mean = 1; otherwise = 0	0.519	0.500
Perceived necessity	Five-point scale	4.002	0.913
Perceived value	Five-point scale	3.523	1.415
Interpersonal trust	Five-point scale	4.245	0.933
Institutional trust	Five-point scale	4.086	1.024
Gender	Male = 1; female = 0	0.521	0.500
Age	Years	51.25	16.30
Schooling	Years of education	7.389	4.443
Political status	Party member or cadre = 1; else = 0	0.104	0.305
Cultivated area	Mu	4.473	9.464
Total income	10k yuan/year	6.854	47.12
Regional dummy	Yan'an = 1; Weinan = 0	0.488	0.500
Village emphasis on waste sorting	Five-point rating of village emphasis on waste sorting	3.322	1.380

Note: the underlying attachment index is the equal-weighted mean of the four five-point items; the reported statistics are for the high-attachment indicator used in estimation; cultivated area is measured in mu (1 mu ≈ 0.0667 hectares). N = 453.

3.3 Descriptive overview

Participation and intended form vary across out-migration groups. Overall, 62.47% of households report willingness to take part in some form, while the remaining 37.53% report no willingness to participate. Among intended forms, contributing labour alone is the most common at 30.24%, followed by both labour and cash at 16.34% and cash alone at 15.89%. The mean share of household labour that has migrated out is 0.412. Splitting the sample at an out-migration share of one half, the high-migration group is 21.77 percentage points less likely to intend labour alone than the low-migration group, and 6.08, 13.05 and 8.71 percentage points more likely to intend non-participation, cash alone and both, respectively.

4. Empirical strategy

We model a household's participation as two linked stages—whether to take part and, conditional on taking part, the form of contribution—which are not treated as independent. The form is observed only for households willing to participate, and estimating the form equation on willing households alone would suffer from sample-selection bias. The two stages are therefore estimated jointly as a probit with sample selection (Heckman probit), the selection equation for willingness and the outcome equation for the form of contribution, with correlated errors:

$$Participate^{*} = \alpha_1 \cdot Migration + \alpha_2 \cdot Emphasis + \alpha_3 \cdot X + \varepsilon_1,\ Participate = 1(Participate^{*} > 0) \quad (1)$$

$$Mode^{*} = \beta_1 \cdot Migration + \beta_2 \cdot X + \varepsilon_2,\ Mode = 1(Mode^{*} > 0),\ observed\ if\ Participate = 1 \quad (2)$$

where X denotes the controls, Emphasis is the village-level emphasis on waste sorting, and the errors (ε_1, ε_2) are bivariate normal with correlation ρ, estimated by maximum likelihood. A significant ρ indicates dependence between the two equations and supports accounting for sample selection. The village emphasis on waste sorting serves as the exclusion restriction, entered in the willingness equation and omitted from the form equation: conditional on the observed characteristics, it is assumed to shape whether a household takes part but not the form of contribution it then chooses. This exclusion restriction is an identifying assumption rather than an empirically testable condition within the present design.

The baseline and the heterogeneity analysis code the form of contribution differently. The baseline uses a single contrast, labour alone against any contribution that includes cash, while the heterogeneity analysis codes each of the three forms, labour alone, cash alone and both, as a separate binary outcome, so the cash-only margin the baseline cannot isolate can be read from the grouped models.

To test whether home-village attachment conditions the migration pattern, the three form outcomes are estimated separately for low- and high-attachment groups, split at the sample mean, and the equality of the labour-migration coefficients across the two groups is tested by seemingly unrelated estimation (suest) following separate probit estimations. Because these subgroup models are estimated without the sample-selection correction used in the baseline, the resulting between-group comparison is read as supplementary evidence of a heterogeneous pattern across attachment groups rather than as a structural interaction estimated on the same footing as the baseline.

5. Results

5.1 Baseline results

In the selection equation, labour migration enters negatively, with a coefficient of − 0.349 significant at the 5% level, so households with a higher share of labour away are less likely to be willing to participate, supporting H1a over H1b. Perceived necessity of participation, enters positively and carries the largest

coefficient among the attitudinal variables, significant at the 1% level, and interpersonal and institutional trust also enter positively, each significant at the 5% level, while perceived value is not significant. Schooling and household income also enter positively, significant at the 5% and 10% levels, and the village emphasis on waste sorting enters positively and significantly at the 5% level. Gender, age, political status and cultivated area show no significant relation. The full estimation results are reported in Table 2.

Table 2
Baseline Heckman probit estimates

Variable	**Willingness (coef., S.E.)**	**Form: labour-only (coef., S.E.)**
Labour migration	−0.349** (0.170)	−0.361** (0.181)
Perceived necessity	0.460*** (0.077)	−0.179* (0.100)
Perceived value	0.013 (0.047)	0.000 (0.049)
Interpersonal trust	0.148** (0.071)	−0.195** (0.076)
Institutional trust	0.140** (0.065)	−0.159** (0.071)
Gender	−0.154 (0.132)	−0.088 (0.138)
Age	−0.004 (0.005)	−0.001 (0.005)
Schooling	0.047** (0.019)	−0.026 (0.019)
Political status	0.372 (0.249)	−0.102 (0.224)
Cultivated area	0.007 (0.008)	−0.010 (0.008)
Total income	0.019* (0.011)	0.002 (0.004)
Regional dummy	0.215 (0.155)	0.455*** (0.166)
Village emphasis on waste sorting	0.106** (0.043)	—
Constant	−3.244*** (0.645)	2.957*** (0.680)
Log-likelihood	−421.393	−421.393
LR test (ρ = 0)	3.84*	3.84*
Wald χ^2	54.35***	54.35***

*Note:Standard errors in parentheses; *, **, *** denote significance at the 10%, 5% and 1% levels. N = 453. The LR test provides evidence against the null of zero error correlation at the 10% level and supports accounting for sample selection. A multicollinearity check on the baseline gives a maximum variance inflation factor of 1.58, indicating no collinearity concern.*

In the outcome equation for the form of contribution, labour migration enters negatively, with a coefficient of − 0.361 significant at the 5% level, so among willing households those with more labour away are less likely to intend labour-only contribution relative to any contribution that includes cash, consistent with H2. This reflects a lower reliance on labour alone rather than direct evidence on any single cash form. Perceived necessity, interpersonal trust and institutional trust likewise lower the likelihood of labour-only participation, significant at the 10%, 5% and 5% levels respectively, and the regional dummy is significant at the 1% level, while the remaining controls are not.

5.2 Sensitivity to omitted-variable bias

Although the models condition on the household head's environmental, social and personal characteristics, unobserved or omitted factors could still bias the coefficient on labour migration. We therefore assess how strongly selection on unobservables would need to compare with selection on observables to account for the estimated migration coefficient, following the coefficient-stability logic set out by Altonji, Elder and Taber (2005) and implemented as a bounding ratio by Bellows and Miguel (2009). The statistic is

$$\sigma = | \beta\tilde{} / (\beta\dot{} - \beta\tilde{}) | \quad (3)$$

where $\beta\tilde{}$ and $\beta\dot{}$ are the labour-migration coefficients under the limited and full control sets. The smaller the movement $\beta\dot{} - \beta\tilde{}$ as controls are added, the more stable the coefficient and the larger σ, and a value above one means that selection on unobservables would have to exceed selection on the full set of observables to explain the estimate away.

The resulting statistic exceeds one on both margins, at 16.62 and 11.28, as Table 3 shows, so under the assumptions of the bounding approach substantial selection on unobservables would be required to account for the baseline pattern.

Table 3
Sensitivity to omitted-variable bias

Model	Willingness	Form: labour-only	Bounding statistic
Limited controls	−0.370** (0.163)	−0.393** (0.166)	
Full controls	−0.349** (0.170)	−0.361** (0.181)	
Statistic (willingness / form)			16.62 / 11.28

*Note:The coefficient is stable as controls are added, and the bounding statistic exceeds one in each case, so selection on unobservables would have to exceed selection on observables to overturn the result. S.E. in parentheses; **, *** at 5% and 1%.*

5.3 Robustness checks

The baseline survives two further checks. First, the household head's age is winsorised at the 5th and 95th percentiles to limit the influence of extreme observations. Second, political status is replaced by

whether any resident household member is a Party member. Both leave the sign and significance of the estimates unchanged, as Table 4 shows.

Table 4
Robustness checks (labour-migration coefficient)

Check	Willingness	Form: labour-only
Winsorised age (5th–95th pct)	−0.353* (0.171)	−0.362** (0.179)
Replaced political-status control	−0.369** (0.171)	−0.339* (0.180)

*Note:Full controls included; S.E. in parentheses; *, ** at 10% and 5%. Estimates match the baseline in sign and significance.*

5.4 The conditioning role of home-village attachment

The baseline shows a lower reliance on labour alone but cannot say which cash-based form takes its place, since it groups cash-only and mixed contribution together. To open up that combined category, and to ask whether the pattern depends on a household's tie to its village, the three form outcomes are estimated separately for low- and high-attachment groups, with the equality of the labour-migration coefficients across groups tested by suest following separate probit estimations, with the estimates shown in Table 5. A significant between-group difference is read as a heterogeneous rather than structurally interacted pattern.

Table 5
test of the conditioning role of home-village attachment (labour-migration coefficient)

Outcome	Low attachment	High attachment	Between-group difference (Prob > χ^2)
Labour alone	−0.496* (0.253)	−0.850*** (0.254)	0.272
Cash alone	−0.162 (0.278)	0.613** (0.291)	0.040
Both labour and cash	−0.139 (0.304)	0.487* (0.261)	0.108
Observations	218	235	

*Note:Cells report the labour-migration coefficient (S.E. in parentheses) from a separate binary model for each contribution form (that form = 1, the other two = 0), estimated within each attachment group with full controls; the final column reports the between-group coefficient-equality test from seemingly unrelated estimation (suest) following separate probit estimations. *, **, *** denote 10%, 5% and 1% significance.*

Home-village attachment conditions the labour-migration pattern on the cash-only margin alone. For cash-only contribution, the labour-migration coefficient is − 0.162 and insignificant among weakly

attached households but 0.613 and significant at the 5% level among strongly attached households, and the between-group difference is itself significant (suest, p = 0.040). Among strongly attached households, then, cash-only contribution rises with the share of labour working away; among weakly attached households the corresponding coefficient is not statistically distinguishable from zero. This pattern is consistent with H3.

The other two margins show no statistically significant between-group difference. For labour-only contribution the labour-migration coefficient is negative and significant among both weakly and strongly attached households, at − 0.496 and − 0.850, yet the two coefficients are statistically indistinguishable, the between-group test returning a p-value of 0.272. For contributing both labour and cash it is positive and significant only among the strongly attached, at 0.487, and here too the between-group difference is not significant, the test returning 0.108. Home-village attachment thus conditions the migration pattern on the cash-only margin alone.

6. Discussion

What out-migration shifts is not only whether households remain willing to participate, but also the resource through which willing households intend to contribute. Willingness to participate is lower where more of the household's labour is away; the net association in this sample is negative, which is consistent with the countervailing channels through which migration might raise engagement—greater environmental awareness and higher income—being outweighed, though the design cannot isolate them. What changes more clearly with migration is the composition of contribution among those still willing. One plausible reading is that migration raises the opportunity cost of on-site labour while easing household financial constraints, which may help explain the lower reliance on labour-only contribution. That the pattern persists once perceived necessity, value and trust are held constant is consistent with a change in the relative cost of the contribution modes rather than in how much households value participation, though the present design cannot separate the two cleanly.

Whether this shift extends to cash turns on attachment to the home village. Where attachment holds, cash-only contribution rises with out-migration. Where attachment is weaker, labour contribution still falls but no compensating rise in cash contribution is statistically distinguishable from zero. Attachment bears on the cash margin but not the labour margin, a pattern consistent with the labour that migration withdraws being lost to the village whatever a household still feels for it, since money can be remitted while an absent member cannot supply on-site labour. Consistent with this, the between-group difference is significant for cash-only contribution alone, and attachment is not expected to restore labour-only or combined participation once the workers have left.

These patterns help reconcile a divided literature. Studies reporting negative effects on collective action typically foreground labour-based participation (Qin and Flint, 2012; Wang et al., 2016; Wang et al., 2022) and would register the lower labour contribution found here, whereas those stressing the resources migration sends home (Oldekop et al., 2018; Pizzi, 2018) would register the higher cash contribution

among attached households, consistent with evidence that migration reshapes rather than dissolves collective contribution where village relations persist (Leder et al., 2024). Read through the form of contribution, the labour-versus-cash split is the behavioural margin that valuation studies treat only as an elicitation choice (Kassahun et al., 2020), and the role of institutional trust here echoes evidence that distrust pulls contribution away from cash (Kassahun et al., 2021). That attachment conditions the cash margin extends the place-attachment literature (Wan et al., 2021) from whether households act to how they contribute under mobility. Alongside this boundary condition, perceived necessity of participation and institutional trust are complementary levers that lower the perceived and institutional cost of taking part.

The same distinction points to how governance might adapt. A model that assumes provision flows from residents present to supply labour fits a settled population poorly once a large share of members earn their living elsewhere, and the results suggest a shift in emphasis from participation defined by residence towards contribution defined by a continuing connection to the village, in which a household absent for most of the year still counts as taking part by supporting the good in the currency it can send. This is an implication drawn from the pattern of results rather than a further finding, and it holds only so far as the cross-sectional patterns reported here do.

Several limitations remain. The data are a single-year cross-section, so the estimates should be read as conditional associations rather than causal effects. The outcomes are stated willingness and intended form of contribution, and whether intention translates into action may differ between labour and cash. The data also record the form but not the level of contribution, so they show whether a household leans towards labour or cash rather than how much of either it supplies. The Heckman probit relies on an exclusion restriction, namely that village emphasis on waste sorting affects the willingness to participate but, conditional on other factors, does not directly determine the form of contribution. This variable is measured at the village level and is theoretically prior to the household's form decision, which provides some basis for the assumption. The rise in cash-only contribution conditioned by attachment should be read as a theoretically consistent boundary condition, to be further tested by future panel and multi-region studies using data on actual contributions.

7. Conclusion and implications

Rural environmental governance is usually thought to rest on residents being there to provide it, so out-migration reads as a plain loss. The relationship, this study finds, is not only about presence; it also concerns the form contribution takes. Out-migration bears on participation at two distinct margins. Out-migration coincides with a lower likelihood of labour-only contribution, but not with a general rise in cash-only contribution; cash-only contribution increases with out-migration only among strongly attached households. What changes with migration is not only whether households take part but also the form their contribution takes.

The contribution is to treat participation in rural environmental governance as a two-margin decision, whether a household contributes and in what form, and to show that out-migration operates differently on the two, coinciding with lower willingness on the first and a changed composition on the second. Read this way, a literature divided over whether migration helps or harms local provision can be understood as reflecting different margins of the same participation process, with home-village attachment marking the boundary between them, the condition under which out-migration coincides with a shift towards cash-based contribution, alongside a lower willingness to participate.

Two implications follow for rural environmental schemes under out-migration. Schemes that rely on residents turning up to do the work will increasingly miss households whose members have left, and a standing, formal channel for contributing in cash could help prevent physical absence from becoming equivalent to non-participation, particularly among households that remain attached to their home villages. Because that channel is taken up mainly where a tie to the village survives, maintaining migrants' continued membership in, and channels for remote engagement with, their home villages may also matter for rural environmental governance, alongside its social and emotional value.

A cash channel will do the work asked of it only if it is transparent about what is collected and visibly tied to the sorting service it funds, since households that doubt how funds are handled have reason to keep their contribution in labour they can see rather than money they cannot follow.

The findings recast a demographic pressure as a matter of governance design. Where the countryside is emptying, the task is less to lament the labour that has gone than to build institutions that enable those who have left to keep contributing in the currency now open to them, and the argument, resting on the form of contribution rather than on waste sorting as such, may extend to other local environmental goods that depopulating regions must go on providing through household effort or payment. How durable such cash-based engagement proves, and whether it reaches forms of remote contribution beyond payment, are questions a single cross-section cannot settle and that panel or multi-region evidence could take up.

Declarations

Author Contribution

Credit authorship contribution statement. Chaozhen Zhang and Yueyue Li: Conceptualization, Methodology, Formal analysis, Writing – original draft. Xinmiao Wang: Investigation, Data curation, Writing – review & editing. Yalin Yuan: Conceptualization, Data curation, Methodology, Supervision, Writing – review & editing, Funding acquisition. All authors read and approved the final manuscript.

Data Availability

The data presented in this study are available on request from the corresponding author.

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