A configuration study on rural residents' willingness to participate in improving the rural living environment in less-developed areas—Evidence from six provinces of western China

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Maintaining the sustained improvement of human living environments in rural
areas while improving habitats poses a substantial challenge. While promoting
participation by rural residents is key to achieving the improvement of rural
living environments, existing studies have mostly focused on the "net effect"
single factors have on their participation. However, few studies have considered
the combined effects of multiple characteristics in complex contexts. In this
study, a revised model of planned behavior is constructed, based on
configuration theory; the histories of pathways that influence rural
households' willingness to participate in improving rural living environments
are also explored. The perspective of concurrent causality is adopted, and this
study examines whether a "mutual substitution effect" exists between the
antecedent conditions in different paths. A questionnaire survey was
conducted in six provinces (including autonomous regions) in less-
developed areas of China. Six configuration paths of rural residents' higher
willingness to participate in the improvement of rural living environments were
obtained using fuzzy-set qualitative comparative analysis. The results show that:
1) In the path of high willingness to participate, the behavioral attitudes
characterized by the "trustworthiness of village leaders" and "group identity"
play the central role. "Social capital" and the "trustworthiness of village leaders"
have a mutual substitution effect. 2) When using positive behavioral attitude
evaluation as a core condition, "educational level" and "environmental
awareness" have a mutual substitution effect. "Household income level", as
the marginal condition, has a mutual substitution effect with "environmentally
friendly habits". Therefore, to increase rural residents' willingness to participate
in improving rural living environments in less-developed areas, the level of the
"trustworthiness of village leaders" and "group identity" should be raised. In

addition, depending on the "mutual substitution effect" between different conditions, to achieve the same improvement in rural areas with a low level of "social capital", the focus should be on improving the "trustworthiness of village leaders". For rural areas with a slight difference in "household income level", the focus should be on promoting the formation of "environmentally friendly habits" among rural residents.

1 Introduction

Efforts are being made worldwide to improve rural living environments, as these form an important part of human habitation (Peterman et al., 2013; The third United Nations Environment Assembly, 2017; Hu and Wang, 2020). According to the United Nations Commission on Population and Development, about 44% of the global population was still living in rural areas in 2020 (Shen et al., 2022). In the process of rapid urbanization, rural areas' economic development places those areas at a relative disadvantage. Thus, efforts to achieve economic development in rural areas have become a priority strategy in most regions. However, the improvement of rural living environments is often neglected in this process (Hu and Wang, 2020). Rural areas typically have a high concentration and abundance of natural resources, and in these areas, the relationship between humans and nature is close. If the rural living environment is protected, then to a large extent, the natural ecological environment is also protected. Therefore, maintaining a sustainable rural living environment in rural areas that are relatively underdeveloped has become a global and central challenge in the process of improving the natural environment (He et al., 2022). This challenge is even more severe in less-developed areas (Brister, 2016; Cooney et al., 2017). In China, most of the less-developed areas are also located in key national ecological function protection zones, and a large spatial overlap has been found between ecologically fragile areas and areas with low economic development. Incidentally, relatively less-developed rural areas in China generally also have low economic development; this leads to a prominent shortage of governance resources for the improvement of living environments in rural regions (Kramer et al., 2009). Therefore, the problems associated with rural living environments in China's less-developed regions actually present a microcosm of the contradictory problems between economic development and environmental improvement; problems faced by many of the world's less-developed regions.

The rural living environment is a typical commons, and therefore, promoting rural residents' participation in its improvement is a core path to effectively governing problems associated with rural living environments (Wang et al., 2021). Many studies have explored the willingness of rural residents to participate in improving their living environments. In terms of research objects, most studies have focused on a specific aspect of rural living environments, such as domestic waste treatment (Han et al., 2018; Han et al., 2019; Li et al., 2019) or domestic sewage treatment (Gu et al., 2016; Cheng et al., 2020). In terms of research methods, most studies have focused on quantitative analyses under a single causal mechanism (Wang et al., 2021), mainly exploring the "net effect" of single factors on outcomes (Ragin, 2000). Depending on the findings of these studies, the factors affecting rural residents' willingness to participate in improving their rural living environments were divided into external factors at the objective level and internal factors at the subjective level. In terms of objective-level influencing factors, the main factors are institutional incentives and constraints (Maryia et al., 2015), social norms (Sun et al., 2020), and information supply (Starr and Nicolson, 2015). In terms of the influencing factors of rural residents' subjective level, the main factors are environmental cognition (Sun, 2019), demographic characteristics (Miafodzyeva and Brandt, 2013), and transportation conditions (Liu and Huang, 2014).

Although existing studies have explored this topic from different perspectives, three specific areas merit further research. 1) Thus far, the factors that are influencing rural residents' willingness to participate in improving their living environments in less-developed areas have not been considered from the perspective of differences in local development. 2) Influencing factors have mostly been considered from a single aspect, and a discussion regarding the combined effect of multiple factors is missing so far. 3) Existing relevant studies that focus on the subjective attitudes of rural residents are inadequate, and their results should be supplemented. To this end, in this study, four provinces and two autonomous regions located in less-developed regions of China were selected, namely Yunnan, Gansu, Shanxi, Guizhou, Guangxi, and Ningxia. The paths of configurations that influence rural residents' willingness to participate in improving their living environments were explored from the perspective of configuration analysis. Two research questions were addressed (in order) to provide a reference basis for developing strategies aimed at improving local rural living environments in less-developed areas and developing countries. 1) Which factors combine to influence rural residents' willingness to participate in improving their

living environments in less-developed areas? 2) What combination of factors affects the willingness of rural residents in less-developed areas to participate in improving their living environments?

2 Theoretical foundations

2.1 Collective action theory

Rural residents are the most direct beneficiaries of improvements in the rural living environment; they are also the most important builders, maintainers, and supervisors in this process (Wang et al., 2021). Without the participation of rural residents, improving rural living environments would be difficult (Yu, 2019). Rural living environments are typical common pool resources, because rural residents cannot be excluded from using the environment at a low cost. Also, rural residents are more likely to discharge pollutants, such as domestic sewage, garbage, and farming manure, directly into the rural public environment, without facing restrictions. Such behavior damages the rural living environments and eventually causes rural living environments to suffer the "tragedy of the commons". Faced with this problem, Ostrom (1990) argued that collective action, *via* the participation of all users, is the best solution to the problem of the tragedy of the commons. The key to the formation of collective action lies in the participation of all users, together with the provision of clear principles and paths for the governance of the commons in rural living environments.
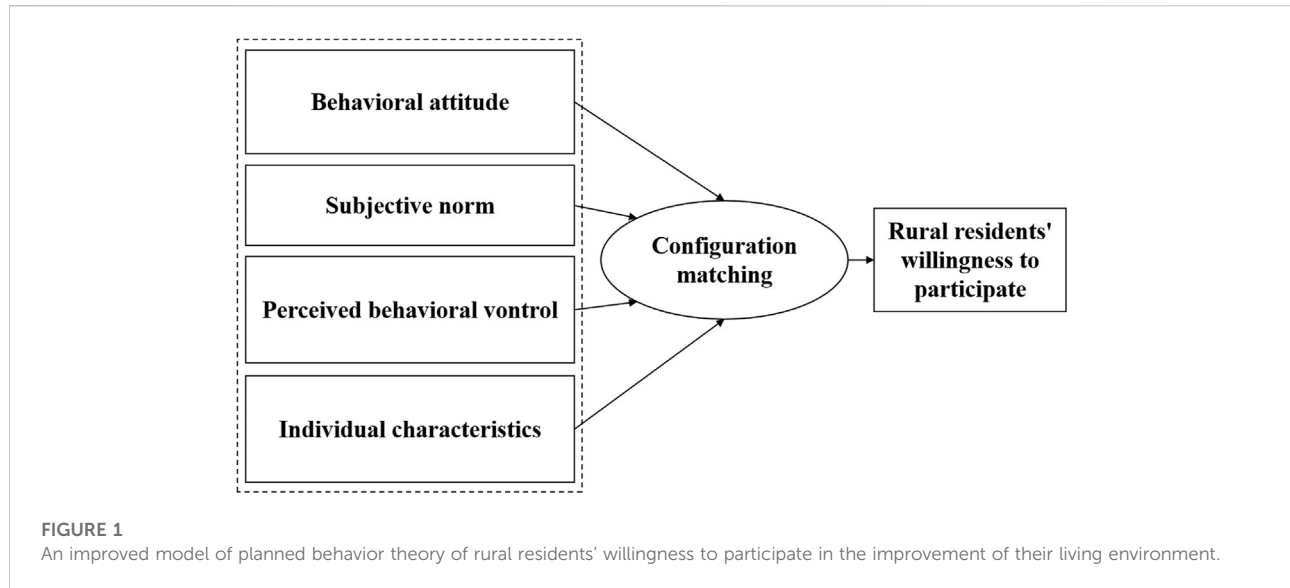
2.2 Theory of planned behavior (TPB)

The question of how farmers can participate in improving their rural living environments can be clarified by assessing the willingness of rural residents to do so. Ajzen's Theory of Planned Behavior (TPB) explores why individuals have specific intentions and how their meanings can be changed at the subjective level. The theory of planned behavior proposes that behavioral attitudes, subjective norms, and perceived behavioral control are the core elements determining individual choices and decisions (Ajzen, 1991, 2011). Attitudes are the positive or negative evaluations made by individuals when faced with a certain behavior. Subjective norms are the influences individuals face from other key individuals or groups around them, particularly regarding whether to adopt a certain behavior. Perceived behavioral control is the influence individuals perceive when displaying a certain behavior, which is referenced against past experiences and perceptions (Schwartz, 1992). Since its introduction, the TPB has been widely applied for studying individual behavioral intentions and problems with behavioral decisions. For example, Bagheri et al. (2021) applied the TPB to examine farmers' behaviors in using safe

pesticides in Ardabil Province, Iran. Arunrat et al. (2017) applied the TPB to discuss farmers' intentions and decisions to adapt to climate change. The study proposed that the farmers' wishes directly influence their decision-making behavior. Sereenonchai and Arunrat (2022) combined the TPB with value-belief-norm (VBN), and the health belief model (HBM) presents a practical framework for communication that extends the flexibility of the TBP in practical research. Xu et al. (2022) used the TPB to construct a two-stage decision-making framework for contracting-renewal, as well as to determine how the process influences the formation of willingness. Vijaya and Ranja (2022) refined and applied an expanded TPB in their application of the TPB to study the factors influencing commuters' intentions to use public transport after the COVID-19 outbreak (Vijaya and Ranja, 2022).

2.3 Configuration theory

Configuration theory is based on "multiple concurrent causations", suggesting that paths leading to the same outcome may have multiple factors, i.e., different combinations and configurations of multiple factors result in equivalent paths (Meyer and Anne, 1993; Ragin, 2000, 2014; Fiss, 2007, Fiss, 2011). This theory provides systematic explanations for complex problems based on an integrated thinking and theory approach (Park et al., 2020). Configuration theory adopts a group perspective and a holistic analytical perspective. Initially based on Boolean logic employed to analyze the logical relationships that exist between antecedent conditions and outcome variables (Delery and Doty, 1996), rather than the "net effect" of a single variable, configuration theory focuses on holistic values that constitute the outcomes of social practices (Miller, 1986). The configuration theory research method differs from the traditional typo-logical test (Doty and Glick, 1994). However, configuration theory extended the application of the latter in terms of its theoretical explanation and has broader development and generalization prospects. For example, when comparing different pathways that lead to the same outcome, configuration theory makes it possible to explore whether the preconditions of various paths have a "mutual substitution effect". In other words, it is possible to explore whether one or more of the conditions that form a pathway can be substituted by other conditions, contributing to the same outcome. Thus, configuration theory provides viable theoretical guidance for the development of locally-adapted policies or practice strategies. In conclusion, the premise of configuration theory is to understand social phenomena as systems, to fully examine the combinatorial effects among conditional variables when exploring causal complexity, and to treat the combination of multiple conditional variables as concurrent causes constituting equivalent paths for the occurrence of outcomes (Adner, 2017; Du, 2021).

FIGURE 1
An improved model of planned behavior theory of rural residents' willingness to participate in the improvement of their living environment.

2.4 Analytical framework

Given that the destruction of rural living environments is a form of the tragedy of the commons with complex characteristics, the participation of rural residents is a key path to the governance and improvement of rural living environments. Therefore, an exploration of the factors that influence rural residents' willingness to participate in improving their living environments should be based on the complexity of the tragedy of the commons. On the one hand, based on the TPB, rural residents' willingness to participate may be simultaneously influenced by their behavioral attitudes, subjective norms, and perceived behavioral control. Moreover, individual characteristics of rural residents influence their willingness to participate in improving their living environments (Nan et al., 2011; Liu et al., 2019; Deng et al., 2021). On the other hand, to examine the concurrent effects of multiple variables on outcomes in complex situations, this paper combines the theory of configuration (which is applicable to studying multi-factor concurrent causation), with the TPB. Further, an extended TPB model is constructed (Figure 1) to examine the paths of histories that affect rural residents' willingness to participate in the improvement of their living environments.

2.4.1 Influence of behavioral attitudes on rural residents' willingness to participate

Behavioral attitudes are positive or negative evaluations individuals make when they are confronted with a particular behavior. When deciding whether to participate in actions to improve their living environments, rural residents will first evaluate whether such participation can produce expected

benefits. Improving rural living environments is a typical public goods supply behavior, as the result of environmental improvement will benefit all rural residents. Under this premise, if rural residents identify with the village collective and are willing to suffer individual costs to achieve collective common good, they will be ready to participate. In other words, if they have a high level of group identity, they will see their participation in the collective action as a collective benefit (Klandermans, 2002). Conversely, rural residents do not perceive collective benefits as benefits generated by participating in collective action. Therefore, rural residents' "group identity" becomes the basis for evaluating their participation in improving their living environments. This group identity is also a component of their attitudes toward participating. At the same time, the collective action of improving the human living environment is carried out under the supervision of village leaders and cadres. Whether villagers participate in the action is still based on their evaluation of the benefits to be expected subjectively when participating in related activities. If rural residents believe that village leaders have high trustworthiness, they will believe that participation in the action will lead to expected benefits. Conversely, if rural residents believe that the trustworthiness of their village leaders is insufficient, they will believe that participation in relevant actions will not lead to expected benefits (Jia et al., 2019). Therefore, the trustworthiness of village leaders is a further basis for rural residents' evaluation of the behavior of participating in improving their living environments. In other words, the trustworthiness of village leaders is also a component of rural residents' behavioral attitudes when making decisions regarding their willingness to participate in the improvement of rural living environments (Zhao et al., 2016).

2.4.2 Influence of subjective norms on rural residents' willingness to participate

Subjective norms refer to the influence key individuals or groups impose on individuals regarding whether to adopt a specific behavior. In the context of improving rural living environments, rural residents are influenced by the affirmative and negative influences of surrounding groups or others within their village. This influence can have either a demonstration or supervisory effect on their participation decisions. The demonstration effect can be understood to be the effect of relatives and friends on rural residents' willingness to participate in actions to improve rural living environments. This effect will spread through rural social networks and promote farmers to imitate each other; the effect will either enhance their desire to participate, or conversely, reduce their willingness to participate (Chen et al., 2007). The monitoring effect suggests that rural residents' participation in collective action decisions is restricted by their "acquaintance" group, i.e., farmers may be excluded from the same rural social network because they hold different opinions. Thus, subjective norms in rural residents' willingness to participate in improving their living environments are mainly influenced by the social network norms of the collective surrounding them.

2.4.3 Influence of perceived behavioral control on rural residents' willingness to participate

Perceived behavioral control refers to the perception of individuals regarding the influence a specific behavior will have, based on their previous experience and cognition. In the context of this study, rural residents sense the impact of their participation in actions to improve their living environments through their level of environmental awareness. Their previously displayed environmentally friendly habits also impose a certain influence, as these are a form of behavioral experience (Dunlap et al., 2000). Generally, rural residents with high ecological cognition and sound environmental practices are more willing to participate in improving their rural living environments. The main reason is that perceived behavioral control promotes their willingness to participate. Still, rural residents' participation in improvement actions is a subjective decision-making problem in a complex situation that is inevitably and simultaneously influenced by other factors. Therefore, this decision-making problem should be explored through a more systematic and comprehensive analysis.

2.4.4 Influence of individual characteristics on rural residents' willingness to participate

The individual heterogeneity of rural residents' characteristics also affects their willingness to participate in improving their rural living environments (Wang et al., 2021). Among these characteristics, education level is a typical individual characteristic that can enhance the rationality of individual rural residents' decision-making (Han et al., 2021).

Furthermore, based on quantitative analyses, it has been concluded that rural residents' education level significantly affects their willingness to participate in improving their living environments. However, a sufficient basis for determining the direction of their influence is still not available (Zhao et al., 2021). Household income level is an essential measure of rural residents' heterogeneity, especially their participation in providing rural public goods, making income level a crucial factor influencing rural residents' cost awareness (Van et al., 2021). The heterogeneity of residents' household income levels in rural areas, caused by the wide variation in agricultural resource endowments, results in different cost sensitivities. These affect rural residents' willingness to participate when making decisions about improving their living environments.

2.4.5 Framework for configuration analysis of rural residents' willingness to participate

Based on the above analysis, in this paper, behavioral attitudes are further allocated to the two dimensions of group identity and the trustworthiness of village leaders. Subjective norms are measured by social capital, and the two dimensions of environmentally friendly habits and environmental awareness are allocated to perceived behavioral control. The two dimensions of education level and household income level are allocated to rural residents' characteristics. Under full consideration of multiple factors influencing the results, an applied model of configuration analysis based on an improved TPB was constructed (Figure 2).

3 Data sources

The data for this study were obtained *via* a questionnaire survey, conducted from March to May 2021 in the six provinces (including autonomous regions) of Yunnan, Guangxi, Shanxi, Gansu, Ningxia, and Guizhou. Located in China's western region. The economic development level of China's western region lags behind that of the central and eastern regions, identifying this region as a typical underdeveloped region in China. The reasons why the above six provinces and autonomous regions were selected as survey subjects are summarized as follows: 1) All of the included provinces and autonomous regions belong to the less-developed regions of western China. 2) The population density of these provinces and autonomous regions is relatively higher than that of other western provinces in western China, which facilitates the acquisition of a sufficiently large sample. 3) Guangxi, Yunnan, and Guizhou belong to the southern region of China, while Ningxia, Shanxi, and Gansu belong to the northern region. Including both types of regions reduces the influence of the difference between the south and north of the sample in terms of geographical location. 4) The above six provinces and autonomous regions are richer in terms of rural natural
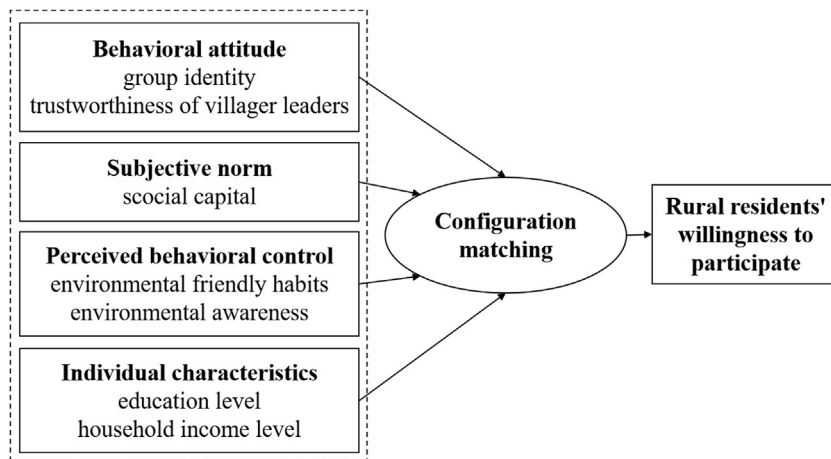
FIGURE 2
Applied model of rural residents' willingness to participate in the improvement of rural living environments subgroups based on an improved theory of planned behavior.
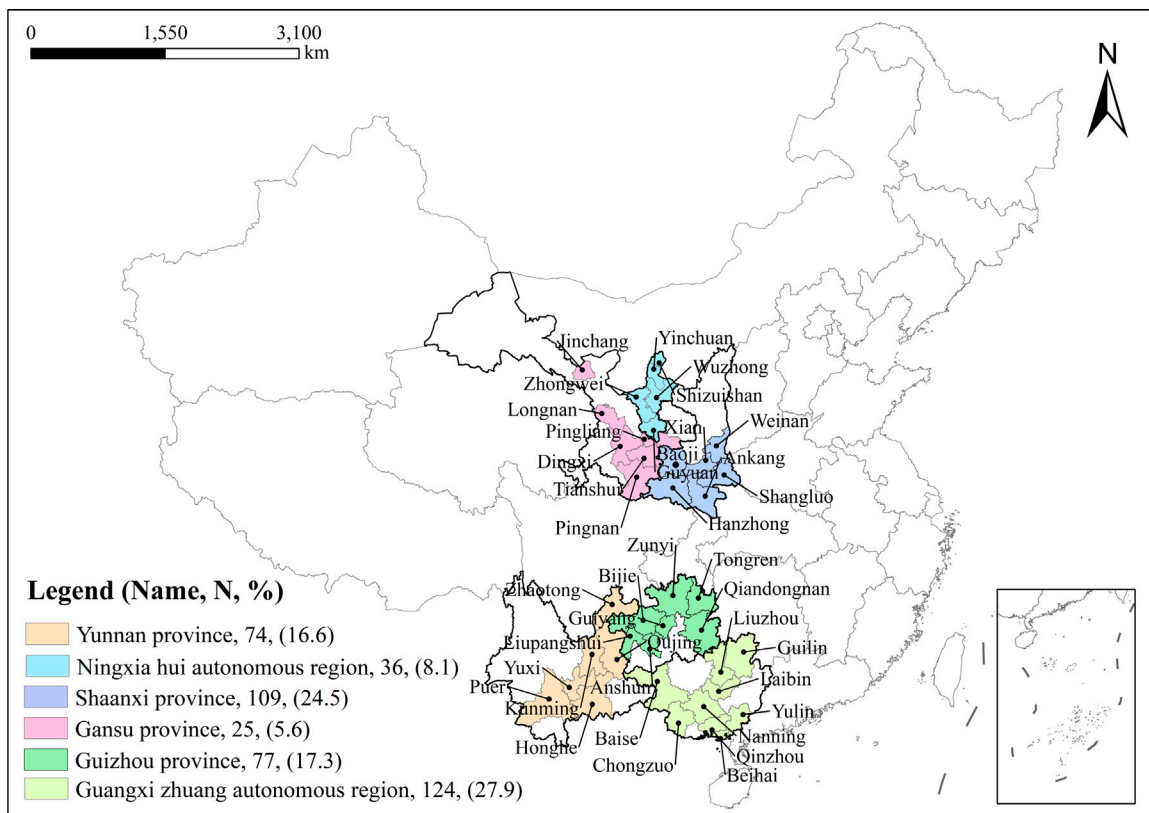

FIGURE 3
Geographical and quantitative distribution of samples.

environmental resources, compared with other western provinces, and their need for improved rural living environments is more urgent. Affected by the COVID-19 pandemic, this questionnaire survey was distributed *via* an online platform, and the sample was drawn by a combination of stratified and random sampling. According to differences in economic development and population size in the less-developed regions of China, the sample areas are located in the southern and northern regions of the geography of the less-developed regions of China (Figure 3). This location difference enables better control of the influence of the geographical variability between the north and south on the results.

Questionnaires in this study were distributed in the following ways: The research team first contacted the village cadres of the sample villages. With their consent, the village cadres were entrusted to issue the questionnaire to the villagers through the online platform. The village cadres were also asked to mobilize and encourage the villagers to fill in the questionnaire online. It should be noted that this way of asking respondents to fill out the questionnaire on line is prone to the problem of common method bias, which is a common problem with self-report questionnaires. The main reasons for this problem are consistency of motivation, implicit correlation bias, default tendency, mood state, and transient emotion. To overcome the common method bias problem, this study adopted the following two approaches in conducting the survey and in the data analysis process: first, at the beginning of the questionnaire, respondents were assured that the survey is anonymous and that their personal privacy information would be strictly protected. This meant respondents could fill in the survey with complete confidence and reduced speculation about the purpose of the study. Second, this study referred to Gao et al. (2016), Gao et al. (2015), and Jones et al. (2015) to find out how to improve the reliability of respondents' feedback in unsupervised subjective questionnaires. This paper set up several "trap questions" that were logically related to each other. The respondents' responses to the "trap questions" were used to determine whether the respondents had adverse reactions, intentionally provided useless information, and/or provided false information in the answering process. Those samples that failed the trap question were eventually eliminated, to minimize the impact of common methodology bias on the study, further improving the credibility of the data.

The questionnaire consisted of four parts, including basic information about the respondents, the implementation of habitat improvements in the village, the length of time respondents' families had lived in the region, and the data of each specific variable involved in this study. A total of 566 questionnaires were received; invalid questionnaires were identified according to the following items:

① More than 5% of questions were not answered.
② There are obvious logical errors in the answers.

③ The questionnaire results show clear regularity (e.g., continuous diagonal filling).
④ The time taken to complete the questionnaire was much shorter than the standard response time.

Finally, 445 questionnaires were identified as valid, and the overall efficiency of the questionnaire was 78.62%.

About the same number of male (50.3%) and female (49.7%) respondents participated in the survey. The distribution of respondents was relatively even across all ages, mainly concentrated in the 30–60 age group, which accounted for 63.1%. Respondents were primarily villagers who regularly reside in the village, with 48.9% living there for more than 10 months per year. A total of 68.5% of the sampled households own a residential site in town. Compared with data from China Statistical Yearbook 2021, the sample obtained for this study is consistent with the current rural reality in terms of the proportion of sexes, age groups, ownership of residential sites, and educational attainment. Therefore, the data are highly reliable and representative. In addition, the sampled rural residents are mainly long-term residents of rural areas and represent the prominent influence of improvement measures of rural living environments, ensuring the applicability of the data.

4 Data analysis methods

4.1 Fuzzy-set qualitative comparative analysis

Fuzzy-set qualitative comparative analysis (fsQCA) is a research method suitable for addressing multiple concurrent causations (Schneider and Wagemann, 2012). This method is based on a Boolean logic (ensemble) inference of outcomes, based on the conditional variable X and the outcome variable Y. Fuzzy-set qualitative comparative analysis treats causal explanations as configurations of factors, rather than as path effects of independent variables. The method is mainly based on the theory of configuration in practical operation and can be effectively applied to specific explored problems, based on the theory of configuration. Therefore, fsQCA is more suitable for exploring the various paths of rural residents' willingness to participate in improving their living environments. In the analysis process, condition and outcome variables are calibrated and transformed into sets. Then, a necessary condition analysis of a single condition variable is conducted to test whether a single condition variable constitutes an essential condition for the outcome variable. Finally, a sufficient condition analysis is conducted (Wagemann and Schneider, 2010), including a raw consistency threshold (*Consistency*), PRI (proportional reduction in inconsistency) thresholds, case frequency thresholds, and the combination of conditional

variables for the outcome occurrence, i.e., the grouping path, based on counterfactual thinking and Boolean minimization operations. According to Ilias and Arch (2021), a condition is considered necessary if that condition occurs at the time the outcome occurs, and is considered sufficient if a situation is observed in a case and the development occurs. Two leading indicators for assessing necessary and sufficient conditions are consistency and coverage. Consistency represents the degree of confidence associated with a combination of conditional variables producing a specific outcome. Consistency is calculated according to (Eq. 1):

$$\text{Consistency}\,(Y_i \leq X_i) = \sum [\min(X_i, Y_i)] \Big/ \sum Y_i \qquad (1)$$

where, X_i denotes the degree of affiliation of the condition variable, and Y_i denotes the degree of association with the outcome variable. Generally, a single condition or combination of conditions with a consistency exceeding 0.8 is considered sufficient for the outcome variable.

The degree of coverage is the degree of case coverage that consistently occurs with a particular combination of dependent variables, and is expressed as the strength of the explanation of the variety of conditional variables for the outcome variable. Larger values of the coverage metric indicate that individual conditions and combinations of conditions explain the outcome better (Ragin, 2014). The degree of coverage is calculated according to (Eq. 2):

$$\text{Coverage}\,(X_i \leq Y_i) = \sum [\min(X_i, Y_i)] \Big/ \sum Y_i \qquad (2)$$

where X_i and Y_i have the same meaning as above. The variable result of X_i has the value range of (0, 1); X_i includes seven conditional variables of education level, income level, environmental awareness, environmentally friendly habits, group identity, social capital, and trustworthiness of village leaders. Finally, Y_i is the ith household's willingness to participate in improving their rural living environments.

4.2 Description of variables

4.2.1 Outcome variables

The design of the outcome variables is based on official policy documents promulgated by the Chinese government and public news. For example, in the central government's policy document "Five-Year Action Plan for the Improvement and Upgrading of the Rural Living Environment (2021–2025)[1]", the core elements of improving rural living environments include the cleaning and management of public toilets, the management of rural domestic sewage, the management of household waste, and the

beautification of villages' appearance. In implementing this policy, local governments further include the maintenance of village roads[2], the repair of irrigation channels[3], the organization of cultural and sporting activities[4], and the restoration of public places of action[5], such as ancestral halls. For these reasons, this study ultimately chose the eight indicators shown in Table 1 to measure the rural residents' willingness to participate in improving their living environments.

4.2.2 Conditional variables

The design of the "trustworthiness of village leaders" takes into account the fact that this study is based on a Chinese cultural context, and therefore adopts the Chinese government's indicators for cadre competency evaluation. These indicators include the five aspects of character, competence, initiative, output and integrity, a requirement that also comes from the official policy document, the "Regulations on the Assessment Work of Party and Government Leaders"[6].

The selection of "environmental awareness" was based on existing literature. Previous literature has found that farmers' environmental perceptions, such as their understanding of environmental hazards, as an internal factor, influence their pro-environmental behavior more than external constraints (Kotchen and Reiling, 2000). Farmers' perceptions of the environment in rural areas are mainly derived from their agricultural production and rural life processes. On the one hand, pesticides applied to control crop pests and diseases and the disposal of manure produced in livestock farming are essential aspects of farmers' participation in agricultural production. On the other hand, the use of water in daily life and the disposal of household waste are also actions that farmers have to take in their daily lives. Therefore, in designing the questionnaire, this study takes these four types of activities (that farmers must be exposed to in their production and living) and uses these activities to reflect the environmental awareness of farmers. This is achieved by examining their knowledge of the hazards of pesticide pollution, domestic sewage, domestic waste and livestock manure.

"Group identity", as a core psychological trait of group members, occupies an important place in collective action research (Tajfel and Turner, 1979; Tajfel, 1982). In addition, studies in the field of social psychology have demonstrated a high

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1 Please see: http://www.gov.cn/zhengce/2021-12/05/content_5655984.htm.

2 Please see: https://www.163.com/dy/article/HIEE4BG50534B9UK.html.

3 Please see: https://new.qq.com/rain/a/20221122A016NG00.

4 Please see: https://baijiahao.baidu.com/s?id=1639298706999982237&wfr=spider&for=pc.

5 Please see: https://baijiahao.baidu.com/s?id=1702132352859358345&wfr=spider&for=pc.

6 Please see: http://www.gov.cn/zhengce/2019-04/21/content_5384955.htm.

TABLE 1 Indicator system of outcome and condition variables for rural residents' willingness to participate in improving their living environments.

Variable name	Measurement indicators
Willingness to participate	Would you be willing to work if the village needed help with the following tasks? 1 = very willing; 2 = willing; 3 = unable to say; 4 = not very willing; 5 = not at all willing
	Cleaning of sewage ditches
	Repairing damaged roads
	Repairing water irrigation canals
	Picking up rubbish in the village
	Beautifying the appearance of the village
	Organizing cultural and sports activities
	Managing and cleaning public toilets
	Repairing ancestral halls and temples
Trustworthiness of village leader	Please rate the competence of the village clerk in your village according to the statements below: 1 = strongly disagree; 2 = disagree; 3 = fairly agree; 4 = agree; 5 = strongly agree
	He does a lot of good for the people
	He is a fair and honest man
	He is a man of high moral character
	He is a very hard-working man
	He is a man of great ability at work
Environmental awareness	Do you know anything about the following specific hazards? 1 = not at all; 2 = not very much; 3 = fairly; 4 = a little; 5 = very much
	The dangers of pesticide pollution
	The risks of wastewater run-off
	Hazards of domestic waste
	Hazards of livestock manure
Group identity	Do you agree with the following? 1 = totally disagree; 2 = not agree; 3 = unable to say; 4 = agree; 5 = strongly agree
	I would be happy if a journalist reported my good deed
	I would be pleased if village officials praised my good deed
	I would be pleased if a person is publicly praised for a good deed
	I would be pleased if a person is publicly criticized for an evil deed
	I feel honored when someone praises my village
	A well-developed village means a well-developed me
Social capital	Please rate your opinion based on the actual situation in your village: 1 = totally disagree; 2 = not agree; 3 = unable to say; 4 = agree; 5 = strongly agree
	I have a lot of good friends in my village
	Most of the people in the village are trustworthy
	Most of the villagers are willing to help each other
	The relationships between villagers are harmonious and united
	I feel at home back in the village

TABLE 1 (*Continued*) Indicator system of outcome and condition variables for rural residents' willingness to participate in improving their living environments.

Variable name	Measurement indicators
Environmentally friendly habits	Do you agree with the following comments about yourself? 1 = totally disagree; 2 = not agree; 3 = unable to say; 4 = agree; 5 = strongly agree
	I am a person who protects the environment
	I am a hygienic person
	I am a person who loves to do good things
Education level	Your education level is: 1 = primary school or below; 2 = junior high school; 3 = high school or secondary school; 4 = bachelor's or college; 5 = master's and above
Household income level	The household *per capita* disposable income rank: 1 = very low; 2 = moderately low; 3 = moderate; 4 = moderately high; 5 = very high

correlation between group identity and group members' willingness to participate or actual actions (Yin and Zhang, 2015). Rural China is a typical acquaintance society; therefore, individuals have a strong psychological need to gain a group identity. Based on this reality, this study selected indicators to measure group identity by referring to Shu's (2020) study.

"Social capital" has received extensive attention in the study of collective action and pro-environmental behaviour (Anderson et al., 2004; Leonard et al., 2010; Sanditov and Arora, 2016; Engbers and Rubin, 2018). Scholars also generally agree that mutual trust and communication among members can be an excellent way to facilitate cooperation between members, to achieve collective action (Dawes et al., 1977; Anderson et al., 2004). Therefore, in this study, the questionnaire was designed to measure social capital in three dimensions: social network (Song and He, 2021), social trust (Li and Ren, 2022) and social participation (Yang et al., 2022), also taking into account the Chinese cultural context and linguistic expressions.

"Environmentally friendly habits" are essentially a self-concept, which is often derived from personal norms, i.e., a self-expectation based on internalized values (Schwartz, 1977). It is believed that the mediating effect of subjective criteria on people's pro-environmental behavior is activated when they are aware of both the consequences of things and the need to take responsibility (Klöckner and Blöbaum, 2010; Lauper et al., 2016). Therefore, in this study, the questionnaire was designed to measure "personal hygiene" from a self-interested perspective, "passions for doing good" from an altruistic perspective, and "protecting the environment" from a neutral perspective. The three indicators were designed to measure environmental habits from an unbiased perspective.

"Education level" and "household income level" were chosen as indicators for individual characteristics. Zhu et al. (2021) and Zhao et al. (2021) pointed out that "education level" and "household income level" are essential factors influencing farmers' willingness to participate. Based on this, on the one hand, referring to Su et al.'s (2022) study, this paper uses the

following terms to measure the education level of respondents in five subgroups: "primary school or below", "junior high school", "high school or secondary school", "bachelor's or college" and "master's and above". On the other hand, this study has developed a basis for classifying income levels. Specifically, in order to protect the privacy of farmers' income in the questionnaire, we designed a calculation formula of *per capita* household disposable income that only farmers could see. The surveyed farmers input their household income in 2021 to finally calculate the *per capita* household disposable income of the surveyed farmers in 2021. Then, the surveyed farmers selected their own income categories according to the calculation results and compared with the hierarchical comparison table of household *per capita* disposable income from China Statistical Yearbook (2021) we provided in the questionnaire: less than 5,000 yuan = very low; 5,001–10,000 yuan = moderately low; 10,001–15,000 yuan = moderate; 15,001–20000 yuan = moderately high; more than 20,000 yuan = very high. And thus, the five levels of the household income of the respondents were obtained. Detailed measures of the condition and outcome variables are presented in Table 1.

4.3 Standardization of variables

Based on the influence of behavioral attitudes, subjective norms and perceived behavioral control on rural residents' willingness to participate were constructed, based on the previous theoretical foundation. Behavioral perspectives were measured by indicators of group identity and the trustworthiness of village leaders. Social capital and household income level were used to measure subjective norms. Environmentally friendly habits, environmental awareness, and education level were used to measure perceived behavioral control. The entropy weighting method was used to calculate the combined scores of outcome variables and the

condition variables of each dimension. The entropy method is an objective weighting method that determines weights based on the correlation between indicators and the changes in internal sample data. This method avoids the subjective bias caused by human factors (Shen et al., 2022). The calculation process is as follows:

First, the data are standardized. Indicators are standardized according to the selected indicators, assuming that i is the i th rural household and there are n residents in total; j is the j th evaluation indicator and there are m evaluation indicators in total. The standardization formula for the evaluation indicators is shown in Eq. 3:

$$X_{ij} = \frac{x_{ij} - min\{x_j\}}{max\{x_j\} - min\{x_j\}}, \, (i = 1, 2, \ldots, n; \, j = 1, 2, \ldots, m) \quad (3)$$

where x_{ij} is the original value of the j th evaluation indicator for the i th resident, X_{ij} is the value after standardization, $max\{x_j\}$ is the maximum value of indicator j, and $min\{x_j\}$ is the minimum value of indicator j.

Second, calculate the entropy value E_j of indicator j:

$$P_{ij} = \frac{X_{ij}}{\sum_{i=1}^{n} X_{ij}}, \, among \, them: \, X_{ij} \geq 0, \, and \sum_{i=1}^{n} X_{ij} > 0. \quad (4)$$

$$E_j = -k \sum_{i=1}^{m} P_{ij} \ln P_{ij}, \, among \, them: \, k = \frac{1}{\ln(n)} > 0, \, E_j > 0. \quad (5)$$

Third, calculate the coefficient of variation of indicator x_j, $G_j = 1 - E_j$. A higher G_j means that more emphasis should be placed on this indicator.

Fourth, calculate the weights of indicator x_j, $W_j = \frac{G_j}{\sum_{i=1}^{m} G_j}$, where W_j is the weighting factor after normalization.

Fifth, the overall evaluation score, $S_j = \sum_{j=1}^{n} W_j x_{ij}$ is calculated via weighted linear summation. The composite score S_j ranges from 0 to 1, with higher scores indicating higher levels of the impact of the indicator.

4.4 Consistency tests and calibration of variables

Cronbach's reliability coefficient was used to test the consistency of the questionnaire. The results show that the Cronbach's alpha coefficient values for each condition dimension ranged from 0.838 to 0.954, indicating that the questionnaire has high reliability and good internal consistency. Regarding the validity of the questionnaire, the KMO value was 0.874, and Bartlett's spherical test approximate chi-square value was 10305.328, with a p-value of 0.000, reaching the significance level. Except for the two dimensions of education level and income level, all remaining variables were extracted by applying principal component

analysis and the maximum variance rotation method. Six factors were obtained, all had eigenvalues larger than 1, and the cumulative variance contribution rate was 71.342%, excluding questions with factor loadings below 0.5. The measurement dimensions of conditional variables were obtained. The factors of the questions in each size were in the loading range of 0.551–0.898, indicating that the validity of the questionnaire is high.

According to the calculation logic of the fsQCA method, the set of conditional and outcome variables are first affiliated, and the values of calibrated variable will be affiliated between 0 and 1. Given the characteristics of the variables used in this paper (Ragin, 2000), the direct calibration method was used and 0.95 was set as a fully-affiliated calibration point, 0.05 as a fully unaffiliated calibration point, and 0.5 as a cross-calibration point. A value of 0.001 was added to results with a calibrated affiliation value of 0.5, in order to eliminate the problem that occurs when samples are not analyzed because they cannot be categorized (Ilias and Arch, 2021). The calibration results and descriptive statistical characteristics of conditional and outcome variables are presented in Table 2.

5 Results and analysis

5.1 Group path analysis of rural residents' willingness to participate

In the univariate analysis of necessary conditions, the values of the consistency indicators for each condition variable were less than 0.9. This result indicates that none of the single condition variables can constitute a high $versus$ non-high level of rural residents' willingness to participate in improving their living environments. Multiple condition combinations are therefore needed to analyze rural residents' willingness to participate in a grouped manner. In the analysis, the minimum acceptable observational consistency has been set to 0.8, and the PRI threshold has been set to 0.75, with reference to Ragin (2004). As the sample size used in this paper is medium to large, the minimum acceptable observation frequency was set to 2 (Fiss, 2011; Ilias et al., 2016). The results of the calculations are presented in Table 3. Six paths were obtained in which residents have a high willingness to participate in improving their rural living environments. In addition, the consistency of the individual and overall solutions of the six configuration paths was greater than 0.75, meeting the requirements of grouping analysis. The level of consistency of the overall solution indicates the extent to which histogram paths can explain the results. For example, the overall character of 0.910 for higher willingness to participate demonstrates that the general approach can explain 91% of the high level of the sampled residents' participation. The overall coverage level indicates the level of case coverage by pathways. For example, a general coverage level of 0.611 for a

TABLE 2 Calibration results and descriptive statistical characteristics of conditional and outcome variables.

Variable name	Calibration breakpoints			Descriptive statistics			
	Full-set non-membership	Intermediate-set membership	Full-set membership	Mean	Std. Dev	Min	Max
Willingness to participate	3.048	4.000	5.000	4.009	0.564	1.556	5.000
Trustworthiness of village leaders	2.782	4.000	5.000	3.786	0.791	1.000	5.000
Environmental awareness	2.000	4.000	5.000	3.685	1.000	1.000	5.000
Group identity	2.761	4.000	5.000	3.920	0.637	1.000	5.000
Social capital	3.000	4.000	5.000	3.960	0.522	1.000	5.000
Environmentally friendly habits	3.000	4.000	5.000	4.042	0.639	1.000	5.000
Education level	1.000	2.000	4.000	2.350	1.200	1.000	5.000
Household income level	1.000	2.000	4.000	2.390	0.897	1.000	4.000

TABLE 3 Paths of high-level willingness grouping of rural households to participate in improving their living environments.

Configuration	Solution					
	H1			H2		H3
	H1a	H1b	H1c	H2a	H2b	
Social capital			●	•	•	●
Environmentally friendly habitsact		•	•			●
Household income level	•			⊗	⊗	●
Education level	●	●	●	●	⊗	●
Environmental awareness	●	●	●	⊗	●	
Trustworthiness of village leaders	●	●		●	●	●
Group identity	●	●	●	●	●	●
Consistency	0.942	0.945	0.929	0.952	0.937	0.947
Raw coverage	0.330	0.375	0.401	0.251	0.325	0.325
Unique coverage	0.017	0.001	0.031	0.032	0.128	0.022
Overall solution consistency	0.910					
Overall solution coverage	0.611					

Black filled circles (●) indicate the presence of a condition, and circles with an "x" (⊗) indicate the absence of that condition. Large circles indicate core conditions; small circles indicate peripheral conditions. Blank spaces indicate "don't care".

higher willingness to participate demonstrates that the six histogram pathways explain 61.1% of the sample having a high willingness to participate.

Configuration H1a shows that, with behavioral attitudes represented by group identity and the trustworthiness of village leaders, core conditions represented by environmental awareness and education level, and marginal conditions represented by higher household income levels, rural residents generate higher levels of willingness to participate. This path can explain 33% of the sample having higher levels of willingness to participate. Also, H1b indicates that residents have a higher level of willingness to participate when the core conditions are behavioral attitudes represented by group identity and the trustworthiness of village leaders, environmental awareness, and education level, as well as subjective norms, represented by environmentally friendly habits. A total of 37.5% of the sample

having a higher level of willingness to participate can be explained by this pathway. In addition, H1c indicates that, in the case of differences in behavioral attitudes in terms of the trustworthiness of village leaders, rural residents perceive a higher social capital. When subjective norms are represented by environmental awareness and education, which complement environmentally friendly habits, playing the central conditional role, residents will have a higher level of willingness to participate. A total of 40.1% of samples having a higher level of willingness to participate can be explained by this path. Then, H2a indicates that in the case of a low level of household income and a relatively low level of environmental awareness, group identity and trustworthiness of village leaders represented by behavioral attitudes, and educational attainment represented by trustworthiness as core conditions, supplemented by relatively high social capital as marginal condition, farmers will generate higher levels of willingness to participate. A total of 25.1% of the sample with higher levels of willingness to participate can be explained by this path. Then, H2b indicates that, from the perspective of household income level and relatively low education level, with behavioral attitudes represented by group identity and trustworthiness of village leaders, environmental awareness as a core condition, supplemented by relatively high social capital as a marginal condition, residents will generate higher levels of willingness to participate. A total of 32.5% of the sample having with higher levels of willingness to participate can be explained by this path. Finally, H3 indicates that, with behavioral attitudes represented by group identity and trustworthiness of village leaders, subjective norms represented by social capital, and individual characteristics represented by education level and household income level, 32.5% of residents having higher levels of willingness to participate can be explained by this path.

5.2 Overall comparative analysis of group paths

Comparing all six paths through which residents are highly willing to participate in the improvement of their rural living environments shows that the core conditions of group identity and trustworthiness of village leaders appear in five paths, but not in H1c. Path H1c has a substitution effect, with social capital as the core condition, in the absence of the core condition of the trustworthiness of village leaders. The main reasons for this result are summarized as follows: First, rural residents' group identity (expressed as their perception of collective identity, their psychological sense of belonging to the village collaborative organization, and their identity with the shared value beliefs of the village collective organization) is a crucial variable influencing the residents' participation in improving rural living environments through emotional effects (Qing et al., 2022). The group identity of rural residents is a centralized

expression of their behavioral attitudes. Therefore, rural residents' group identity plays an essential role in influencing their willingness to participate in the collective action of improving their living environments. Second, Stern and Putnam (1994) pointed out that the level of political trust helps to increase the cooperation of the policy target group. The confidence rural residents have in their village leaders determines how they evaluate the actions suggested by those village leaders.

To a certain extent, the trust dimension embedded in social capital can act as a substitute for the lack of trustworthiness of village leaders, thus creating a substitution effect in the promotion of rural residents' willingness to participate in the governance of rural living environments. In conclusion, group identity and the trustworthiness of village leaders represent rural residents' behavioral attitudes, which are the result of rural residents' evaluation of collective action in their living environments. Rural residents' behavioral attitudes are fundamental subjective indicators determining their willingness to participate.

5.3 Grouping and intra-group comparison analysis of configuration paths

Based on the characteristics of the six configurations of residents with higher levels of willingness to participate, they can be grouped into three configurations: 1) The high level of perceived behavioral control path with positive behavioral attitude evaluation (H1); 2) the complementary path of subjective norm and perceived behavioral control with positive behavioral attitude evaluation (H2), and 3) the path of positive behavioral attitude evaluation and high level of personal criteria (H3).

(1) Perceived behavioral control path under positive behavioral attitude evaluation (H1)

Because of the presence of the trust dimension of social capital in H1c, this path could act as a substitute for the absence of the trustworthiness condition of village leaders and thus play the same role as the core condition of behavioral attitudes in H1a and H1b. Among these paths, household income level in path H1a has a substitution utility with environmentally friendly habits in paths H1b and H1c. In other words, in the absence of the marginal condition of environmentally friendly habits, the household income level plays the same role as a borderline condition. Therefore, the configuration of the three factors can be grouped into the same pathways that affect rural residents' willingness to participate at a higher level. In this category, rural residents' trust in village collective organization and village leaders leads to positive evaluations of actions that improve rural living environments. Higher levels of education and environmental awareness increase rural residents'

perceptions of positive outcomes of their participation in improvement actions. They also become more aware of the positive impacts of participating in improving rural living environments, complementing environmentally friendly habits or household income levels as marginal condition. The combined result is a high level of willingness to participate in improving rural living environments.

(2) Complementary pathways of subjective norms and perceived behavioral control under positive behavioral attitude evaluation (H2)

On the one hand, comparing the pathways of H2a and H2b in path H2 (with positive behavioral attitude evaluation as the core condition and other conditions unchanged), the two disorders of educational attainment and environmental cognition show a mutual substitution effect. In other words, the H2a combination of conditions had a lower level of environmental awareness as a marginal condition and a higher level of educational attainment as a borderline condition. In contrast, both paths induce willingness to participate in the H2b combination of the marginal state of low education and the marginal condition of heightened environmental awareness. On the other hand, lower household income is the common core condition in both H2a and H2b, which can be explained by the fact that residents with lower household income levels still show higher levels of willingness to participate, despite several other conditions. From a "cost-benefit" perspective in terms of the supply of public goods, this finding suggests that the main cause for these two results is that residents with higher household income levels are more willing to participate in collective action (Sulemana, 2016; Sarah, 2019). However, from a group-theory perspective, residents with lower household income levels are still influenced by the demonstration and monitoring effects caused by the combination of higher social capital stock and positive behavioral attitudes. This improves their evaluation of the expected benefits when participating in collective actions and eliminates the cost concerns in their decision to participate. Thus, a higher level of willingness to participate is generated.

(3) Positive behavioral attitudes and high level of subjective norms path (H3)

The path H3 is independent; i.e., residents show a high willingness to participate because of their positive behavioral attitudes, relatively high levels of education and household income, environmentally friendly habits, and high levels of social capital as core conditions. The suggested reasons for this result are summarized as follows: Rural residents' more positive evaluation of their participation behavior enables them to correctly judge the expected benefits of participating in improving their rural living environments. Higher levels of

education and household income reduce the impact of participation costs on residents. Higher stocks of social capital let residents consider the evaluation of others more, thus acting as a specific constraint and a promotor of environmentally friendly habits. Overall, this path increases rural residents' perceptions of and demand for improvements in their environments, and the combination of these factors increases their willingness to participate in relevant actions.

5.4 Robustness tests

In this paper, the robustness of configuration results is tested by adjusting both the frequency threshold and the PRI threshold (Schneider and Wagemann, 2012). With an adjusted frequency threshold of 3, the configuration paths changed slightly and were mainly concentrated around the edge conditions. The total consistency and coverage changed only slightly, compared with the previous results. The absolute texture improved from 0.910194 to 0.918084, which is well above the minimum acceptable level. After adjusting the PRI threshold to 0.80 (while keeping the frequency threshold at 2), the group paths changed slightly, again concentrating around the edge conditions. The overall consistency and coverage were 0.925537 and 0.554631, respectively, both exceeding acceptable levels. Overall, the robustness of the study results is good.

6 Discussion

6.1 Configuration of factors influencing rural residents' willingness to participate

Rural residents' participation exerts an essential impact on the effectiveness of improvements to rural living environments. This is especially the case in less-developed areas, where the funds available for investments are limited and any actions are more dependent on collective participation by rural residents. For this reason, there is a need to effectively explore the factors that influence rural residents' willingness to participate (Daniel et al., 2021). Because of the requirement for control variables, studies using quantitative analysis methods often cannot integrate the synergies between different factors and are therefore more likely to identify a linear effect of a single variable (Xue et al., 2021). In this case, the findings are also difficult to apply to rural areas with different natural and social conditions. However, the qualitative comparative analysis approach considers the combined effect of various potential factors, eliminates the inhibiting effect of control variables in the quantitative method, and provides a more realistic picture of the studied problem. The results presented in this paper show that the willingness of rural residents to participate in improving

their living environments is not a linearly-correlated issue (Liu and Gong, 2022). Rather, this willingness is a multi-factor concurrent causality in a complex scenario. In other words, different configurations of factors can have the same impact on the willingness to participate.

6.2 Substitution effects exist between different influencing factors

This study identifies a substitution effect between different factors that influence rural residents' willingness to participate in improving their living environments. Among these factors, the behavioral attitudes characterized by the trustworthiness of village leaders and group identity play a core role in different path groupings. A core substitution effect exists between the two factors of social capital and the trustworthiness of village leaders; i.e., trust in social capital has the same role as the trustworthiness of village leaders (Mongoljin et al., 2021). Under the core condition of positive behavioral attitude evaluation (leaving other conditions unchanged), there is a mutual substitution effect between education level and environmental awareness. A substitution effect also exists between education, environmental awareness, household income, and environmentally friendly habits. Because rural areas in less-developed regions have different resource endowments and social conditions (Wu et al., 2022), it will be challenging to enhance rural residents' willingness to participate in improving their living environments through the same path. This makes the formulation of strategies in practice and local policy formulation challenging (Wang, 2019). In this paper, a variety of pathways is identified, all of which influence rural residents' participation in improving their living environments. These paths demonstrate the substitution effects among various influencing factors in different paths, which can provide theoretical guidance for local adaptation in the process of increasing rural residents' willingness to participate in governance in rural areas with varying natural and social conditions. For example, in rural areas with similar conditions (e.g., paths H2a and H2b in Table 1), but where the level of residents' education is relatively low, efforts should be made to increase the level of residents' environmental awareness. This can be achieved by increasing the dissemination of knowledge about improvements in human living environment, thus achieving the effect of increasing the willingness of farmers to participate in relevant actions.

6.3 The different pathways influencing farmers' willingness to participate provide a basis for tailor-made institutional design

Improving rural living environments is a complex and systematic project, and farmers, as the main users of rural living environments as a public good, are also the core

participants in rural living environment governance. Therefore, in the process of rural living environment improvement, the interaction between the government's "top-down" policies and the rural residents' "bottom-up" autonomy is the key to successful governance (Zhu et al., 2022). A multifactorial exploration of farmers' willingness to participate in rural living environment improvements can provide insights into the various factors that influence farmers' willingness to participate in different contexts and the intrinsic linkages between other factors. This research can also provide a basis for governments to formulate policies that are tailored to local conditions. For example, in the less-economically developed regions of western China, the relatively complex geographical features have led to the formation of unique customs and practices in the rural areas of those different geographical regions. On the one hand, this leads to differences in the factors that influence farmers' willingness to participate in improving rural living environments. On the other hand, local authorities must consider regional cultural differences when implementing policies related to rural living environment improvement; this must be done at higher levels of government. At the same time, policy implementers also need to adopt policy implementation strategies that are more in line with local practices, according to the different cultural differences. This would help to ensure the effective implementation of national policies.

7 Conclusion and policy implications

The results of this study show that a combination of factors influences the willingness of rural residents to participate in improving their living environments. Rural areas in less-developed areas, with relatively low economic and social development levels, face certain shortcomings when carrying out relevant improvements. In this paper, the factors that influence rural residents' willingness to participate are examined in less-developed areas; six provinces in western China are taken as the sample. Existing research has mostly adopted quantitative analysis methods to explore single variables affecting rural residents' willingness to participate in improving their living environments, while controlling for certain potential variables. This paper adopts the configuration theory, which posits that synergistic interaction exists between the various possible variables that affect rural residents' willingness to participate. Further, the combination of different variables can generate a configuration path that affects rural residents' willingness to participate, which compensates for the suppression of potential variables by the single-variable approach. In addition, different path groupings can provide a realistic basis for implementing improvement strategies in less-developed areas, according to local conditions.

The policy implications of this study are threefold. First, the credibility and group identity of rural village officials should be enhanced, to improve the behavioral attitudes of rural households in less-developed areas toward participating in collective action and to increase their willingness to participate. On the one hand, the decision-making power of rural residents in the election of village cadres should be emphasized, in order to increase the trust of rural residents in their village cadres from the start. On the other hand, the links between village cadres and villagers, and between different villagers, should be strengthened, especially regarding issues of a public nature in rural areas. This will strengthen the villagers' sense of participation, and help to improve the group identity of rural residents. Second, various publicity and education activities regarding the rural living environment should be carried out to increase environmental awareness among farmers. For example, the benefits of environmental protection and the dangers of environmental damage in the village should be publicized at meetings or in the village's WeChat group. Third, various types of rural public environmental protection systems should be developed, to restrain villagers from damaging the environment and to promote the formation of environmentally friendly habits among residents. For example, individual environmental protection initiatives should be incorporated into village rules and regulations, and individual environmental protection recognition activities should be regularly carried out for all residents of the village.

This paper also has limitations. Because of the impact of COVID-19, the data do not cover all provinces located in the less-developed regions of China, thus preventing a comparative analysis with data from the relatively developed areas of the Middle East. Future studies can further incorporate geographical heterogeneity to obtain more comprehensive data, which could be used to explore the pathways of rural residents' willingness to participate in improving their living environments. Comparisons could be made between different regions by combining geographical heterogeneity. At the same time, due to the limited sample size obtained by this study, it is difficult to fully take into account more indicators of individual characteristics, such as gender, age and household size. Future studies need to find ways to obtain more samples, in order to verify more combination paths that affect the outcome variables. This would provide a more comprehensive basis for the continued promotion of initiatives to improve rural living environments in less-developed areas and other developing countries.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication. YS: Conceptualization, and manuscript; YQ and QS: Manuscript editing and manuscript review; QS, YS, and ZL: Manuscript review; YS, YQ, and YX: Methodology and manuscript editing.

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References

Adner, R. (2017). Ecosystem as structure:an actionable construct for strategy. *J. Manag.* 43, 39–58. doi:10.1177/0149206316678451

Ajzen, I. (1991). The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* 50 (2), 179–211. doi:10.1016/0749-5978(91)90020-T

Ajzen, I. (2011). The theory of planned behaviour:reactions and reflections. *Psychol. Health* 26 (9), 1113–1127. doi:10.1080/08870446.2011.613995

Anderson, L. R., Mellor, J. M., and Milyo, J. (2004). Social capital and contributions in a public-goods experiment. *Am. Econ. Rev.* 94 (2), 373–376. doi:10.1257/0002828041302082

Arunrat, N., Wang, C., Pumijumnong, N., Sereenonchai, S., and Cai, W. J. (2017). Farmers' intention and decision to adapt to climate change: A case study in the yom and nan basins, phichit province of Thailand. *J. Clean. Prod.* 143, 672–685. doi:10.1016/j.jclepro.2016.12.058

Bagheri, A., Emami, N., and Damalas, C. A. (2021). Farmers' behavior towards safe pesticide handling: An analysis with the theory of planned behavior. *Sci. Total Environ.* 751, 141709. doi:10.1016/j.scitotenv.2020.141709

Brister, E. (2016). Disciplinary capture and epistemological obstacles to interdisciplinary research: Lessons from central african conservation disputes. *Stud. Hist. Philosophy Sci. Part C Stud. Hist. Philosophy Biol. Biomed. Sci.* 56, 82–91. doi:10.1016/j.shpsc.2015.11.001

Chen, X. P., Wasti, S. A., and Triandis, H. C. (2007). When does group norm or group identity predict cooperation in a public goods dilemma? The moderating effects of idiocentrism and allocentrism. *Int. J. Intercult. Relat.* 31 (2), 259–276. doi:10.1016/j.ijintrel.2006.02.004

Cheng, P., Jin, Q., Jiang, H., Hua, M., and Ye, Z. (2020). Efficiency assessment of rural domestic sewage treatment facilities by a slacked-based dea model. *J. Clean. Prod.* 267 (10), 122111. doi:10.1016/j.jclepro.2020.122111

Cooney, R., Roe, D., Dublin, H., Phelps, J., Wilkie, D., Keane, A., et al. (2017). From poachers to protectors: Engaging local communities in solutions to illegal wildlife trade. *Conserv. Lett.* 10, 367–374. doi:10.1111/conl.12294

Daniel, K. W., and Lucy, W. N. (2021). Analysis of participation in collective action initiatives for addressing unilateral agri-environmental externalities. *Environ. Sci. Policy* 117, 1–7. doi:10.1016/j.envsci.2020.12.013

Dawes, R. M., Mctavish, J., and Shaklee, H. (1977). Behavior, communication, and assumptions about other people's behavior in a commons dilemma situation. *J. Personality Soc. Psychol.* 35 (1), 1–11. doi:10.1037/0022-3514.35.1.1

Delery, J. E., and Doty, D. H. (1996). Modes of theorizing in strategic human resource management: Tests of universalistic, contingency and configurational performance predictions. *Acad. Manag. J.* 39, 802–835. doi:10.5465/256713

Deng, Z. H., Dai, L. Q., Deng, L. P., and Peng, P. F. (2021). Analysis of farmers' perceptions and behavioral response to rural living environment renovation in a major rice-producing area: A case of dongting lake wetland, China. *Cienc. Rural.* 51 (5), 1–12. doi:10.1590/0103-8478cr20200847

Doty, D. H., and Glick, W. H. (1994). Typologies as a unique form of theory building: Toward improved understandingand modeling. *Acad. Manag. Rev.* 19, 230–251. doi:10.5465/amr.1994.9410210748

Du, Y. Z., Li, J. X., Liu, Q. C., Zhao, S. T., and Chen, K. W. (2021). Configurational theory and QCA method from a complex dynamic perspective: Research progress and future directions. *J. Manag. World* 3. doi:10.19744/j.cnki.11-1235/f.2021.0042

Dunlap, R. E., Liere, K. D. V., Mertig, A. G., and Jones, R. E. (2000). New trends in measuring environmental attitudes: Measuring endorsement of the new ecological paradigm: A revised nep scale. *J. Soc. Issuses.* 56 (3), 425–442. doi:10.1111/0022-4537.00176

Engbers, T. A., and Rubin, B. M. (2018). Theory to practice: Policy recommendations for fostering economic development through social capital. *Public admin. Rev.* 78 (4), 567–578. doi:10.1111/puar.12925

Fiss, P. C. (2007). A set-theoretic approach to organizational configurations. *Acad. Manag. Rev.* 32, 1180–1198. doi.org/. doi:10.5465/amr.2007.26586092

Fiss, P. C. (2011). Building better causal theories:A fuzzy set approach to typologies in organization research. *Acad. Manag. J.* 54, 393–420. doi.org/. doi:10.5465/amj.2011.60263120

Gao, Z., House, L. A., and Xie, J. (2015). Online survey data quality and its implication for willingness-to-pay: A cross-country comparison. *Can. J. Agric. Economics/Revue Can. d'agroeconomie.* 64 (2), 199–221. doi:10.1111/cjag.12069

Gao, Z., House, L., and Bi, X. (2016). Impact of satisficing behavior in online surveys on consumer preference and welfare estimates. *Food Policy* 64, 26–36. doi:10.1016/j.foodpol.2016.09.001

Gu, B. J., Fan, L. C., Ying, Z. C., Xu, Q. S., Luo, W. D., Ge, Y., et al. (2016). Socioeconomic constraints on the technological choices in rural sewage treatment. *Environ. Sci. Pollut. Res.* 23 (20), 20360–20367. doi:10.1007/s11356-016-7267-z

Han, W., Wei, Y. G., Cai, J. M., Yu, Y. J., and Chen, F. R. (2021). Rural nonfarm sector and rural residents' income research in China. An empirical study on the township and village enterprises after ownership reform (2000-2013). *J. Rural Stud.* 82, 161–175. doi:10.1016/j.jrurstud.2021.01.001

Han, Z. Y., Liu, Y., Zhong, M., Shi, G., Z., Li, Q. B., Zeng, D., et al. (2018). Influencing factors of domestic waste characteristics in rural areas of developing countries. *Waste Manag.* 72 (2), 45–54. doi:10.1016/j.wasman.2017.11.039

Han, Z. Y., Zeng, D., Li, Q. B., Cheng, C., Shi, G. Z., and Mou, Z. S. (2019). Public willingness to pay and participate in domestic waste management in rural areas of China. *Resour. Conservation Recycl.* 140, 166–174. doi:10.1016/j.resconrec.2018.09.018

He, S. J., and Zhang, Y. S. (2022). Reconceptualising the rural through planetary thinking: A field experiment of sustainable approaches to rural revitalisation in China. *J. Rural Stud.* 96, 42–52. doi:10.1016/j.jrurstud.2022.10.008

Hu, Q., and Wang, C. (2020). Quality evaluation and division of regional types of rural human settlements in China. *Habitat Int.* 105, 102278. doi:10.1016/j.habitatint.2020.102278

Ilias, O. P., and Arch, G. W. (2021). Fuzzy-set qualitative comparative analysis (fsQCA): Guidelines for research practice in information systems and marketing. *Int. J. Inf. Manag.* 58 (6), 102310–102323. doi:10.1016/j.ijinfomgt.2021.102310

Ilias, Q. P., Panos, E. K., Michail, N. G., and Vassilios, C. (2016). Explaining online shopping behavior with fsQCA:The role of cognitive and affective perceptions. *J. Bus. Res.* 69, 794–803. doi:10.1016/j.jbusres.2015.07.010

Jia, Y. J., Zhao, M. J., Xia, X. L., and Yao, L. Y. (2019). Mode of classified treatment of rural domestic wastes and suggestions. *Resour. Sci.* 41 (2), 338–351. doi:10.18402/resci.2019.02.12

Jones, M. S., House, L. A., and Gao, Z. (2015). Respondent screening and revealed preference axioms:Testing quarantining methods for enhanced data quality in web panel surveys. *Public Opin. Q.* 79 (3), 687–709. doi:10.1093/poq/nfv015

Klandermans, B. (2002). How group identification helps to overcome the dilemma of collective action. *Am. Behav. Sci.* 45 (5), 887–900. doi:10.1177/0002764202045005009

Klöckner, C. A., and Blöbaum, A. (2010). A comprehensive action determination model: Toward a broader understanding of ecological behaviour using the example of travel mode choice. *J. Environ. Psychol.* 30 (4), 574–586. doi:10.1016/j.jenvp.2010.03.001

Kotchen, M. J., and Reiling, S. D. (2000). Environmental attitudes, motivations, and contingent valuation of nonuse values: A case study involving endangered species. *Ecol. Econ.* 32 (1), 93–107. doi:10.1016/s0921-8009(99)00069-5

Kramer, D. B., Urquhart, G., and Schmitt, K. (2009). Globalization and the connection of remote communities: A review of household effects and their biodiversity implications. *Ecol. Econ.* 68, 2897–2909. doi:10.1016/j.ecolecon.2009.06.026

Lauper, E., Moser, S., Fischer, M., and Matthies, E. (2016). Explaining car drivers' intention to prevent road-traffic noise: An application of the norm activation model. *Environ. Behav.* 48 (6), 826–853. doi:10.1177/0013916515570476

Leonard, T., Croson, R. T. A., and Oliveira, A. C. M. D. (2010). Social capital and public goods. *J. Socio-Economics* 39 (4), 474–481. doi:10.1016/j.socec.2010.02.009

Li, J. C., and Ren, Z. Y. (2022). Does internet use exacerbate social stratification. *Economist* 07, 98–108. doi:10.16158/j.cnki.51-1312/f.2022.07.006

Li, X. R., Bi, F., Han, Z. D., Qin, Y., Wang, H. S., and Wu, W. X. (2019). Garbage source classification performance, impact factor, and management strategy in rural areas of China: A case study in hangzhou. *Waste Manag.* 89, 313–321. doi:10.1016/j.wasman.2019.04.020

Liu, D., and Gong, Q. (2022). Promoting farmers' participation in rural settlement environment improvement programmes: Evidence from China. *Int. J. Environ. Res. Public Health* 19 (14), 8585. doi:10.3390/ijerph19148585

Liu, Y., and Huang, J. K. (2014). Rural domestic waste disposal:an empirical analysis in five provinces of China. *China Agric. Econ. Rev.* 6 (4), 558–573. doi:10.1108/CAER-05-2013-0076

Liu, Z., Zhang, T. T., Yu, J. N., and Zhou, L. (2019). Determinants of rural households' afforestation program participation: Evidence from China's Ningxia and Sichuan provinces. *Glob. Ecol. Conservation* 4, 1–14. doi:10.1016/j.gecco.2019.e00533

Maryi, M., Pytrik, R., Kiki, K., Martinvan, I., and Bas, A. (2015). Institutional constraints for adaptive capacity to climate change in Flevoland's agriculture. *Environ. Sci. Policy* 48, 147–162. doi:10.1016/j.envsci.2015.01.001

Meyer, A. D., Anne, C. R., and Hinings, C. R. (1993). Configurational approaches to organizational analysis. *Acad. Manag. J.* 36, 1175–1195. doi:10.2307/256809

Miafodzyeva, S., and Brandt, N. (2013). Recycling behaviour among householders: Synthesizing determinants via a meta-analysis. *Waste Biomass Valor.* 4 (2), 221–235. doi:10.1007/s12649-012-9144-4

Miller, D. (1986). Configurations of strategy and structure: Towards a synthesis. *Strat. Mgmt. J.* 17, 233–249. doi:10.1002/smj.4250070305

Mongoljin, B., He, T. S., and Li, Y. P. (2021). Accents, group identity, and trust behaviors: Evidence from Singapore. *China Econ. Rev.* 70. doi:10.1016/j.chieco.2021.101702101702

Nan, W., Zhao, B. H., and Yang, H. F. (2011). A research on impacting factor of rural environment and environment protection awareness of famers. *Energy Procedia* 5, 2623–2628. doi:10.1016/j.egypro.2011.03.341

Ostrom, E. (1990). *Governing the commons:the evolution of institution for collective action*. Cambridge, UK: Cambridge University Press. doi:10.1017/CBO9780511807763

Park, Y., Fsiss, P. C., and Sawy, Q. A. (2020). Theorizing the multiplicity of digital phenomena: The ecology of configurations, causal recipes, and guidelines for applying QCA. *MIS Q.* 44, 1493–1520. doi:10.25300/MISQ/2020/13879

Peterman, W. E., Crawford, J. A., and Kuhns, A. R. (2013). Using species distribution and occupancy modeling to guide survey efforts and assess species status. *J. Nat. Conservation* 21, 114–121. doi:10.1016/j.jnc.2012.11.005

Qing, C., Guo, S., Deng, X., and Xu, D. (2022). Farmers' awareness of environmental protection and rural residential environment improvement: A case study of sichuan province, China. *Environ. Dev. Sustain.* 24, 11301–11319. doi:10.1007/s10668-021-01909-9

Ragin, C. C. (2000). *Fuzzy-set social science*. Chicago, IL, USA: University of Chicago Press.

Ragin, C. C. (2014). *The comparative method:moving beyond qualitative and quantitative strategies*. Chicago: University of Chicago Press.

Sanditov, B., and Arora, S. (2016). Social network and private provision of public goods. *J. Evol. Econ.* 26 (1), 195–218. doi:10.1007/s00191-015-0436-2

Sarah, M. (2019). The effect of collective action on smallholder income and asset holdings in Kenya. *World Dev. Perspect.* 14, 100099. doi:10.1016/j.wdp.2019.02.010

Schneider, C. Q., and Wagemann, C. (2012). *Set-theoretic methods for the social sciences—a guide to qualitative comparative analysis*. Cambridge, UK: University Press.

Schwartz, S. H. (1977). Normative influences on altruism. *Adv. Exp. Soc. Psychol.* 10, 221–279. doi:10.1016/S0065-2601(08)60358-5

Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. *Adv. Exp. Soc. Psychol.* 25 (2), 1–65. doi:10.1016/S0065-2601(08)60281-6

Sereenonchai, S., and Arunrat, N. (2022). Farmers' perceptions, insight behavior and communication strategies for rice straw and stubble management in Thailand. *Agronomy* 12 (1), 200. doi:10.3390/agronomy12010200

Shen, L., Zhang, Y., Yao, M., and Lan, S. (2022). Combination weighting integrated with topsis for landscape performance evaluation: A case study of microlandscape from rural areas in southeast China. *Sustainability* 14, 9794. doi:10.3390/su14159794

Shu, Q., F. (2020). *Leadership, public service motivation and rural collective action in China*. Beijing, China: Tsinghua University Press.

Song, L., and He, Y. (2021). The impact of internet use on family entrepreneurship decision in urban and rural China. *Stud. Sci. Sci.* 39 (3), 489–506. doi:10.16192/j.cnki.1003-2053.2021.03.009

Starr, J., and Nicolson, C. (2015). Patterns in trash: Factors driving municipal recycling in Massachusetts. *Resour. Conservation Recycl.* 99, 7–18. doi:10.1016/j.resconrec.2015.03.009

Stern, F., and Putnam, R. (1994). Making democracy work: Civic traditions in modern Italy. *Orbis* 72 (3), 333–341. doi:10.1016/S0030-4387(96)90074-5

Su, Y. Q., Yu, H. L., Wang, M. L., Li, X. Q., and Li, Y. Y. (2022). Why did China's cost-reduction-oriented policies in food safety governance fail? The collective action dilemma perspective. *Can. J. Agri. Econ.* 1, 203–217. doi:10.1111/cjag.12313

Sulemana, I. (2016). Are happier people more willing to make income sacrifices to protect the environment? *Soc. Indic. Res.* 127, 447–467. doi:10.1007/s11205-015-0960-3

Sun, Q. L., Fang, K. X., and Liu, T. P. 1. (2020). Impact of social norms and public supervision on the willingness and behavior of farming households to participate in rural living environment improvement: Empirical analysis based on generalized continuous ratio model. *Resour. Sci.* 42 (12), 2354–2369. doi:10.18402/resci.2020.12.08

Sun, Q. L. (2019). Study on the influencing factors of the willingness of Tibetan farmer's households to participate in the improvement of rural living environment. *J. Ecol. Rural Environ.* 35 (8), 976–985. doi:10.19741/j.issn.1673-4831.2018.0757

Tajfel, H. (1982). *Social identity and intergroup relations*. Cambridge, UK: Cambridge University Press.

Tajfel, H., and Turner, J. C. (1979). "An integrative theory of intergroup conflict," in *Social psychology of intergroup relations*. Editors W. G. Austin and S. Worchel (Monterey, CA, USA: Brooks/Cole), 33–48.

The third United Nations Environment Assembly (2017). A report of "Towards a pollution-free planet". avaliable at https://www.unenvironment.org/resources/report/towards-pollution-free-planet-background-report.

Van, T. P., Saowalak, R., Thong, Q., and Pjuong, H. (2021). Can payments for forest environmental services help improve income and attitudes toward forest conservation? Household-level evaluation in the central highlands of vietnam. *For. Policy Econ.* 132 (11), 1–13. doi:10.1016/j.forpol.2021.102578

Vijaya, B., and Ranja, B. (2022). Understanding public transport use intention post Covid-19 outbreak using modified theory of planned behavior: Case study from developing country perspective. *Case Stud. Transp. policy* 10 (4), 2044–2052. doi:10.1016/j.cstp.2022.09.002

Wagemann, C., and Schneider, C. Q. (2010). Standards of good practice in qualitative comparative analysis (qca) and fuzzy-sets. *Comp. Sociol.* 9 (3), 397–418. doi:10.1163/156913210X12493538729793

Wang, W. X., Gong, H. L., Yao, L. Y., and Yu, . L. H. (2021). Preference heterogeneity and payment willingness within rural households' participation in rural human settlement improvement. *J. Clean. Prod.* 312 (20), 127529. doi:10.1016/j.jclepro.2021.127529

Wang, Z. (2019). Policy suggestions on government-led rural habitat environmental governance. *IOP Conf. Ser. Earth Environ. Sci.* 295 (2), 12059. doi:10.1088/1755-1315/295/2/012059

Wu, W. H., Li, Y. C., and Liu, Y. S. (2022). What constrains impoverished rural regions: A case study of henan province in central China. *Habitat Int.* 119, 102477. doi:10.1016/j.habitatint.2021.102477

Xu, Y. X., Lyu, J., Xue, Y., and Liu, H. B. (2022). Intentions of farmers to renew productive agricultural service contracts using the theory of planned behavior: An empirical study in northeastern China. *Agriculture* 12 (9), 1471. doi:10.3390/agriculture12091471

Xue, Y. H., Guo, J. B., Li, C., Xu, X. B., Sun, Z. Y., Xu, Z. Y., et al. (2021). Influencing factors of farmers' cognition on agricultural mulch film pollution in rural China. *Sci. Total Environ.* 787, 147702. doi:10.1016/j.scitotenv.2021.147702

Yang, M. M., Li, G. C., and Li, X. T. (2022). The effect of social capital on rural household income: Micro-evidence and action mechanism. *World Agric.* 6, 101–114. doi:10.13856/j.cn11-1097/s.2022.06.009

Yin, R., and Zhang, F. F. (2015). The mechanism of group identity in collective action. *Adv. Psychol. Sci.* 23 (9), 1637–1646. doi:10.3724/SP.J.1042.2015.01637

Yu, F. W. (2019). Improving human habitat environment in the context of the rural vitalization strategy. *Stud. Soc. Chin. Character* 2, 80–85.

Zhao, W., Zhou, H., Yang, G. Q., and Li, J. Y. (2016). Farmers' transformation between willingness and behavior of post land consolidation supervision and maintenance: A case study of dengzhou, henan province. *China Land Sci.* 30 (3), 55–62. (in Chinese).

Zhao, X. M., Jiang, W., and Cheng, W. M. (2021). Study on the willingness of rural residents to participate in the environmental governance of human settlements based on the theory of planned behavior: Taking xinjiang as an example. *J. Ecol. Rural Environ.* 37 (4), 439–447. doi:10.19741/j.issn.1673-4831.2020.0560

Zhu, K. N., Gao, Q., and Jin, L. S. (2021). The influence of rural household income and trust in village leaders on households' willingness to treat the domestic solid wastes: Based on survey data of 465 households in yunnan province. *Resour. Environ. Yangtze Basin* 30 (10), 2512–2520. doi:10.11870/cjlyzyyhj202110019

Zhu, W. Z., and Luan, J. D. (2022). Influencing factors and multiple realization paths of farmers' satisfaction with the improvement of rural living environment: Based on FSQCA method. *J. Chin. Agric. Mech.* 43 (11), 231–238. doi:10.14026/j.cnki.0253-9705.2018.19.010