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Neighbourhood satisfaction in rural resettlement residential communities: The case of Suqian, China

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Abstract

Against the background of large-scale urbanisation and rural land expropriation, rural resettlement residential housing has been built to accommodate local rural residents in the peripheral areas of China. To explore the context-specific policy implications for improving neighbourhood satisfaction (NS) of residents in rural resettlement residential communities (RRRCs), this paper examines the determinants of NS, and their spatial effects, in rural resettlement residential neighbourhoods using Suqian, in Jiangsu Province, as a case study. This study contributes to the current literature in two ways: it constitutes the first attempt to examine NS among RRRCs; second, our spatial model helps to gain further understanding of horizontal and vertical spatial dependence effects. Our results indicate that income, gender, age, family structure, number of years living in a community, transport and architectural age all have significant effects on NS in RRRCs.

Keywords

Rural resettlement residential communities; Urbanisation; Neighbourhood satisfaction; Bayesian hierarchical spatial autoregressive model; China

1 Introduction

With the acceleration of urbanisation, urban scale has expanded rapidly in China. A vast amount of agricultural or collective land has been expropriated, producing a special social group of landless farmers (Zhang and Cai, 2018). These changes have reshaped the physical and social environment at neighbourhood level (Lu, Zhang and Wu, 2018). To guarantee the livelihood of landless peasants, the Chinese government has built a large number of rural resettlement residential communities (RRRCs) in these expropriated lands and in the peripheral areas. These RRRCs constitute a special type of urban-rural integrated community, which share characteristics with both rural and urban communities (Zhao, 2015). RRRCs are the product of the government's subsidy policy, which constitutes part of the process of rural homestead renovation, and thus they differ significantly from common urban commercial housing, especially in relation to housing areas and the 'greening' of community landscapes (Wang, 2010). Figure 1 illustrates the living environment of the former rural areas and current RRRCs, respectively. As shown, the living environment of landless farmers has been transformed from that of a village to a city. However, as a stage of production in the transformation from rural to urban areas, RRRCs have not adapted very well to modern urban management. The quality of life for residents is low, and the unique economic and socio-spatial structure of these communities makes them a magnet for urban problems (Ye, 2015). For example, because there is not enough living space and some elderly people have difficulty climbing stairs, most older people live in narrow basements or annexes, because they have lost the agricultural land on which they depended. Thus, these residents have been forced to switch from being farmers to providing a source of cheap labour in factories. In addition, as a new type of community, because RRRCs exist in the peripheral areas of China (Zhao, 2015), they have to abide by the new and often unfamiliar management rules of urban communities, such as paying property management fees, and council tax, etc. Although they now live in an urban environment, these residents still retain their rural habits. Moreover, these communities are often far away from city centres, and some of them have even been rebuilt on the land where demolition has taken place. Thus, due to the aforementioned significant neighbourhood changes and urban problems associated with RRRCs, this study focuses on residents' neighbourhood satisfaction (NS).

NS is defined as how well neighbourhoods meet the desires and needs of local residents, and it is regarded as an important and effective predictor of neighbourhood quality (Greif, 2009; Hipp, 2009). High quality neighbourhoods can retain residents (Speare, 1974), and can improve the collective efficacy and social cohesion of communities (Silver and Miller, 2004). The living environment and quality of life in RRRCs may dramatically decrease the NS of residents because of higher living costs, the loss of cultivated land, limited living space, and poor public services and amenities, etc. (Hipp, 2009; Zhao, 2015). Given China's rapid urbanisation and social stability, little attempt has been made to explore NS in RRRCs. Only a few studies have considered how to increase residents’ levels of NS through heightening awareness of neighbourhood conditions in China’s RRRCs. In addition, hardly any research has examined the differences between RRRCs and urban communities. Thus, our study focuses specifically on this kind of community and aims to offer some significant suggestions for improving their governance and residents’ levels of satisfaction.

This study aims to examine the determinants of NS and their spatial effects, in RRRCs, by focusing on hierarchically structured data. Accordingly, based on 16,796 first-hand surveys, we explore which factors affect the NS of RRRCs by employing a Bayesian hierarchical spatial autoregressive model (BHSAM). In particular, this study examines the determinants of NS by controlling for horizontal and vertical spatial dependence effects. Our study is important because China's urbanisation process and demolition projects have resulted in a drastically altered living environment for rural residents, particularly in terms of public services and facilities (Ma, Chen and Dong, 2018), transport development, and geographical location relative to the urban centres (Ding, 2013). Therefore, this paper can offer significant insight into how NS is experienced by individuals through their subjective perceptions of the living environment. Furthermore, our study is also conducive to community management policy formulation and enhancing residents' communal identity within the RRRCs. Theoretically, our findings promote the wider dialogue on social inequalities, social stability and reduction of the urban-rural gap in the attainment of desirable neighbourhoods.

This study contributes to existing knowledge in the following ways. First, it focuses on perceived NS in RRRCs which is something that relatively few studies have previously explored. This study focuses on perceived NS which is a measure of how people see and evaluate their neighbourhood. These perceptions could provide significant clues about how to improve residents’ well-being in relatively deprived neighbourhoods (Matthieu, Gideon and Maarten, 2011), such as RRRCs. Although these rural resettlement projects have been a critical feature of China’s accelerated urbanisation during the last ten years, existing research on RRRCs mainly focuses on disputes about demolition, the types of houses built, and the laws and regulations associated with demolition compensation standards (Chai, 2014; Li, Zhao and Wang, 2015). Few studies have used large-scale survey data to examine perceived NS in RRRCs. Second, the study employs the BHSAM, which can help us to understand horizontal and vertical spatial dependence effects (Dong and Harris, 2015). This method can control spatial autocorrelation, spatial group dependence and spatial heterogeneity effects in the process of exploring the determinants of NS in RRRCs (Ma, Chen and Dong, 2018). Moreover, the hierarchical structure at individual, district and neighbourhood levels all impact on NS in RRRCs.

2 Literature review

2.1 Why does NS differ in RRRCs?

This section discusses differences in NS between RRRCs and other urban residential communities, based on the push and pull factors theory. Those factors that are conducive to improved living conditions in the inflow destination act as a ‘pull’ force, while the unfavorable living conditions in the outflow location are regarded as a ‘push’ force (Altbach, 1998; Zhai, Gao and Wang, 2019). In the case of this study, identifying the factors that drive rural resettlement to RRRCs can help to explain why NS in RRRCs differs from that in other urban residential communities.

RRRCs are a recent phenomenon, meaning they have short settlement histories, which makes it very difficult for residents to adapt rapidly to the lifestyle of urban communities. For example, face-to-face communication between neighbours in an urban commercial housing community is limited, as people tend to use online communication software (e.g. WeChat groups). However, most RRRC residents are used to visiting each other and having face-to-face conversations within a fairly large living space (e.g. a villa) and in public rather than being confined to flats. In addition, most people who live in RRRCs are on low incomes, leading to a reduction in community resources, particularly in terms of public assistance or social services (Massey and Capoferro, 2008), because most low-income people are unwilling and/or unable to pay the community property service charge. Some also feel no real sense of belonging to the community which may lead to social exclusion. Furthermore, low-income cohorts may need to draw on community assistance to a greater extent than their higher-income counterparts, which means that the local community has less to invest in other public services. Thus, it is difficult for RRRC residents to adapt quickly to a typical urban community lifestyle. In addition, because RRRCs only have a short period of settlement history, there is a lack of social support systems, such as those that can help residents secure housing, employment and other valuable community services (Noli, 2019). Social and institutional security plays an important role in improving the NS of RRRC residents and these can be obtained through local relationships and social connections based on reciprocity and trust (Putnam, 2000). Because RRRCs are newly established communities, residents have less access to the usual social and institutional security mechanisms, including formal community organisations and informal connections (Noli, 2019). Moreover, NS resulting from these mechanisms can help to minimise disorder within a new destination community (Harris and Feldmeyer, 2013), and contribute to socio-economic development through aspects such as employment, education, and housing (Dominguez and Watkins, 2003).

RRRCs are also characterised by a lower level of residential mobility. Based on the systemic model of NS, Kasarda and Janowitz (1974) argued that a stable residential neighbourhood will promote NS by increasing social interaction between residents. Although existing studies have indicated that new destination communities have higher levels of residential mobility (Kritz et al., 2011), residents of RRRCs have to remain within their existing housing environment because they have limited capital. In addition, studies have suggested that homeowners may have higher levels of satisfaction within new destination communities, because they have more significant economic commitment to their neighbourhood and thus are much less likely to give up when their neighbourhoods experience difficulties (Noli, 2019). Most RRRC residents are homeowners who have no other residential properties. Thus, they have low residential mobility and may have higher levels of NS with RRRCs.

Generally, higher levels of NS are based on the expectation that RRRCs have socio-economic advantages over residents' original rural living environment. Although the existing literature suggests that new destination communities generally have lower levels of poverty (Ludwig-Dehm and Iceland, 2017), RRRC residents actually experience a higher concentration of poverty compared with traditional urban communities. While new destination areas can provide favourable labour market conditions for low-skilled employment (Kandel and Parrado, 2005), they cannot support the kinds of expenses and financial plans that a family will incur over the long term. Thus, improved socio-economic conditions in RRRCs can be viewed as one of the pull factors that can help us to understand changes in NS in new destination communities (Noli, 2019).

The political environment is an important push factor that affects NS in RRRCs. The planning of RRRCs is a political instrument that is used to accelerate urbanisation. With the advancement of China's market economy, the construction of RRRCs not only serves the purpose of transforming a large proportion of the agricultural population into an industrial population, but also helps to invigorate the housing market (Painter and Yu, 2014). Thus, whether this political strategy can improve levels of NS is a question that needs to be examined. Although there is little that can be done to change central government policies, it is possible to work towards creating a better living environment by improving the governance of these kinds of communities. In addition, household registration is another factor that has an effect on NS in RRRCs. Existing studies have argued that birth status is another factor that shapes the relationships between NS in RRRCs and other types of destination communities (Johnson and Lichter, 2008), as residents with nativity status are more likely to have a relatively strong sense of belonging to the local communities, particularly in the Chinese context. Theoretically, urban immigrants may experience a lower level of NS, because it is more difficult for them to gain access to social and physical neighbourhood amenities (Cassel, 1999). Most RRRC residents have rural household registration, and have moved from the same village to the same RRRCs collectively. Thus, they are unlikely to establish new connections during the migration process, and in theory should have a good level of NS. However, it is unclear whether maintaining these connections with their native village and neighbours can compensate for the change in the living environment. Therefore, overall, NS in RRRCs is impacted by a variety of factors, and can be understood in the context of common urban communities.

2.2 Determinants of NS

Numerous studies have focused on NS. Although various theories have been proposed, because of the multidimensional nature of NS (Weidemann and Anderson, 1985; Amerigo and Aragones, 1997), these studies share a common concern: the impact of neighbourhood characteristics or personal attributes on residents' community satisfaction (Hur, Li and Terzano, 2015). Many empirical studies have explored the factors affecting NS and concluded that aggregation of neighbourhood attributes could predict the overall level of community satisfaction among residents (Bruin and Cook, 1997; Hur and Morrow-Jones, 2008). These factors affect NS in two main ways: at the macro-level and at the individual level. At a macro level, affective factors include the physical setting or characteristics of the environment (Kim and Kaplan, 2004), the socio-economic context or setting (Bruin and Cook, 1997; Greif, 2015), public services and facilities, such as the crime rate, noise levels, pollution and safety (Parkes, Kearns, and Atkinson, 2002), and the aesthetics of the neighbourhood (Hur and Morrow-Jones, 2008). At an individual level, Basolo and Strong (2002), and Ma, Chen and Dong (2018) identified the following factors as affecting NS: age, education, income, family composition, gender and marital status. Meanwhile, socio-demographic characteristics at the individual level are also essential (Westaway, 2007). Furthermore, existing studies have shown that homeownership and the combination of individual factors are particularly significant. Swaroop and Krysan (2011) asserted that homeownership is a prominent factor in promoting NS. Homeownership encourages residents to maintain their homes and participate in community organisations and activities, which contributes to neighbourhood stability and community identity (Rohe and Stewart, 1996). As mentioned previously, the combination of individual factors is also significant. For example, Lu (1999) indicated that older people with higher education and higher incomes are more likely to be satisfied with their communities.

Although many studies have tried to understand the characteristics and underlying mechanisms of NS, only a few have examined the NS levels in RRRCs. However, the sample size of the existing studies is too small, and the calculations are based on census tracts, which may not be the most accurate or appropriate means of capturing neighbourhood characteristics. Moreover, the small sample size may not provide sufficient support for exploring factors affecting NS (Hur, Li and Terzano, 2015). In addition, these studies have primarily addressed linear relationships between the determinants and NS. Thus, in order to examine the factors affecting NS in RRRCs, this paper emphasises the spatial and hierarchical effects by employing relatively large-scale survey data.

3 Methodology

3.1 Case study

Suqian is located in the northern wing of the Yangtze River Delta and lies in the north of Jiangsu Province. It is an important gateway city that connects the coastal areas to the Central and Western Regions. Suqian, founded in 1996, is the newest prefecture-level city in Jiangsu Province. For a long time, most areas in Suqian retained quite primitive rural living conditions, and the process of urbanisation has been prolonged. In the last 15 years, Suqian has committed to rural demolition and resettlement, and begun to build a large number of RRRCs. However, the difference between satisfaction levels with RRRCs and the original rural communities has not yet been investigated. Suqian's promotion of urban construction and commitment to rural demolition and resettlement has resulted in a large number of landless farmers. Because these landless farmers cannot afford the high cost of urban housing, they have to live in the resettlement communities built by the local government. Although residing in the resettlement housing may seem similar to living in an urban community, they still retain their former rural living habits and sense of identity. This conflict poses challenges for community governance and urban planners. Despite the large number of RRRCs in Suqian, community governance and residents' living environment remains very chaotic, which affects residents' quality of life and NS. Thus, Suqian constitutes a typical example with which to explore NS in RRRCs.

3.2 Method

To address the distributional impacts of RRRCs on NS, we employ a BHSAM, which was developed by Dong and Wu (2016). By capturing the hierarchical structure underlying NS, this method helps to explore the determinants of NS and their spatial effects by examining the distributional effects in Suqian's RRRCs. The method is more effective than the traditional spatial econometric evaluation of proximity because it can simultaneously calculate two kinds of unobservables (Dong and Harris, 2015). In the case of our study, the location level unobservable effects are examined by including spatially lagged locational variables, and the spatial autoregressive process is able to model the neighbourhood level unobservable effects (the following section provides more detailed discussion). The former shows a horizontal spatial dependence effect caused by geographical proximity between RRRCs, and the latter reveals a vertical dependence effect which suggests that neighbourhoods experience a top-down effect (Dong et al., 2015). The basic OLS model is as follows:

$$NS_{ij} = \alpha + \beta_1 L_{ij} + \beta_2 R_{ij} + \beta_3 N_{ij} + \theta_j + \varepsilon_{ij} \tag{1}$$

Where NS (dependent variable) is the NS of a resettlement residential area i in its neighbourhood j; L_{ij} is the set of variables relating to location and land factors, including the distance to the nearest infrastructure facility, such as public green space, community square, etc.; R_{ij} refers to residential variables, which comprises information about individual residents; N_{ij} represents the variables at the neighbourhood level; β is the vector of regression coefficients used to the estimations; and θ_j and ε_{ij} are unobserved neighbourhood effects and random terms respectively. In addition, ε_{ij} has an independent normal distribution with σ_e^2 variance and zero mean.

However, the aforementioned basic model cannot capture the horizontal spatial dependence effect of NS. To resolve this issue, fixed spatial effects are introduced into the model, that is, θ_j is treated as fixed. Because the dependence effect may also result from unobservable and spillover effects from one RRRC to surrounding RRRCs and vice versa, the fixed spatial effects model assumes that the dependence is due to unobservable effects at the neighbourhood level. To address this issue, Anselin et al. (2010) adopted the following typical spatial model:

$$NS_{ij} = \alpha + \rho w_i NS + \beta_1 L_{ij} + \beta_2 R_{ij} + \beta_3 N_{ij} + \varepsilon_{ij} \quad (2)$$

Where ρ and w_i refer to the vectors of regression coefficient and spatial weights respectively. The weights measure how closely other observations are linked to the i^{th} observation. According to Anselin (1988), the measure of spatial weights is based on an inverse distance or geographical contiguity. Multiplying w_i by the NS vector provides a weighted average NS figure for the neighbours of i, and w_i is normalised in order to make the sum of its elements 1. If the ρ of a spatial autoregressive parameter is significant, model (2) can assess whether NS in area i is linked to that of locations to which i is connected. Satisfaction within the same neighbourhood has identical unobservables (θ) and neighbourhood characteristics (N). Consequently, levels of NS in the same neighbourhood are more similar than those across different neighbourhoods. The vertical type of spatial dependence can be expressed by the following NS model:

$$NS_{ij} = \alpha + \beta_1 L_{ij} + \beta_2 R_{ij} + \beta_3 N_{ij} + \theta_j + \varepsilon_{ij};\ \theta_j \sim N(0, \sigma_u^2) \quad (3)$$

In Model (3), relying on an independent normal distribution N $(0, \sigma_u^2)$, the unobservable neighbourhood effects are viewed as random effects. An important contribution of the multilevel NS model is that, when we control for neighbourhood unobservables, it takes the estimation of observed neighbourhood characteristics into consideration (Dong and Wu, 2016). However, Model (3) does not consider the horizontal spatial dependence effect, resulting in the biased estimation of coefficients (Anselin, 1988). Therefore, this study employs a hierarchical spatial autoregressive model (HSAR) to test the vertical and horizontal spatial dependence, a method which has been adopted in land economics (Dong and Wu, 2016). Thus, the HSAR in this study is expressed as follows:

$$NS_{ij} = \alpha + \rho w_i NS + \beta_1 L_{ij} + \beta_2 R_{ij} + \beta_3 N_{ij} + \theta_j + \varepsilon_{ij};\ \theta_j = \lambda m_j \theta + u_j;\ u_j \sim N(0, \sigma_u^2) \quad (4)$$

Where m_j refers to a spatial weights vector at neighbourhood level, meaning how neighbourhood i is spatially related to other neighbourhoods. When horizontal spatial dependence is overlooked, the vertical dependence effect (σ_u^2) may be overestimated. Similarly, the strength of the horizontal spatial dependence (ρ) tends to be overstated by SAR as a result of controlling for the vertical dependence effect. The BHSAM used in the study can overcome the aforementioned problems. Regarding the spatial weights matrix, our study uses the same Gaussian kernel function employed by Dong and Wu (2016) to calculate this:

$$w_{ij} = \exp\{-0.5 \times (d_{ij}/h)\hat{2}\}, \text{ if } d_{ij} \leq h; 0 \textit{ otherwise} \quad (5)$$

Where h is a distance threshold; d_{ij} is the Euclidian distance between resettlement residential areas i and j; and h is set to 3km. Moreover, in order to test whether the estimation of the proximity effect of NS in resettlement residential areas is consistent, the threshold distances of 3.5km and 4km were chosen in the robustness study. The study employs district contiguity to measure the neighbourhood level spatial weight matrix (Dong and Wu, 2016). In accordance with spatial econometric modelling conventions, the spatial weights matrices are row-normalised.

3.3 Data and variables

The data are derived from a large-scale NS survey on RRRCs in Suqian conducted by the authors in 2017. The design of the survey questions is based on a residential satisfaction survey conducted in Beijing in 2005, which prioritises information about the perceived neighbourhood environment. We used a similar approach and derived our questions from the work undertaken by Ma, Chen and Dong (2018). Our survey develops Ma, Chen and Dong's (2018) work and primarily focuses on satisfaction at an individual level, including residents' socio-demographic characteristics and evaluation of their living environment. The purpose of our survey is to examine perceived satisfaction with the general liveability of RRRCs in Suqian, and to provide detailed information about the human and physical environment, the convenience of the public transport system, and health and safety conditions. The target population are residents living in RRRCs in Suqian, which comprises 102 townships (towns) and 13 *Jiedaos* in total. The survey covers 230 RRRCs and was conducted over a period of five months. Following a stratified random sampling strategy, the sample size for each township or *Jiedao* is about 0.3% of its total population. There were 23,000 questionnaires issued in total, of which 20,897 were returned, and 18,986 of those were valid. In addition, any missing variable values were also dropped. Thus, the final sample size was 16,796, distributed across 108 townships or *Jiedaos*.

The dependent variable is NS. The survey assesses six dimensions of NS, namely: safety, pollution, access to transport, living amenities, sociocultural setting, and physical location. Each dimension has five different satisfaction levels, ranging from 1 (very dissatisfied) to 5 (very satisfied). We take specific characteristics of RRRCs into consideration. Due to the sudden change in living environment and lifestyle, the disorder experienced in RRRCs not only involves community governance, but also the residents themselves. Thus, RRRCs differ from other urban communities in terms of safety. Regarding pollution, RRRCs share the same space as the new planned industrial areas. Therefore, residents may be exposed to higher levels of pollution, leading to health problems. We decided to include the variable of public transport accessibility to central business districts (CBD), because residents who live in a more compact city are more likely to have higher levels of satisfaction than those who live in more sprawling areas (Kostas, 2018). Thus, transport is viewed as an important neighbourhood feature in high-density neighbourhoods (Arundel and Ronald, 2017). The provision of neighbourhood amenities can either reduce or enhance satisfaction levels and civil participation in an urban neighbourhood environment (Judd et al., 2010). Increasing public service facilities is regarded as one way of improving the liveability experience within a neighbourhood (McCrea, Shyy and Stimson, 2006). Thus, living amenities can reflect satisfaction levels within RRRCs, and can constitute one of the reasons why people want to move, work and live there (Desley, Laurie and Rosemary, 2012). Aspects of socio-cultural settings, such as educational levels, and how mealtimes are structured, including the source of food (e.g. whether it is home-made, or produced by restaurants or schools), and whether members of a family can eat together, are related to residents' well-being and satisfaction. Most RRRC residents are landless farmers, and they generally have a weak socio-cultural setting. China's central and local governments have committed to improving their quality of life by focusing on education, and community pensions, etc. Thus, the socio-cultural setting of residents can be used to test the success of current community governance. Finally, the variable of residential location can also be used to examine community satisfaction, because more affluent areas generally have sufficient provision of public services and a higher level of services generally (Eugene, 1985). Thus, this indicator can reflect whether residents of RRRCs have higher levels of satisfaction than those who previously lived in a rural environment.

Regarding the weighting of each dimension, respondents were asked to rate the importance of each dimension, on a scale of 1 (least important) to 6 (most important) (Ma et al., 2018). Following Zhang et al. (2006), the weights are divided into six types: 5% (least important), 10%, 14%, 19%, 24%, and 28% (most important). The weights are not only used to calculate the satisfaction score, but also to help understand individual heterogeneity (Ma et al., 2018). The overall NS scores are close to a continuous normal distribution, and the mean is 2.978, while SD=0.583. Therefore, in our study, NS is modelled as a continuous variable. In addition, there is a clustering spatial pattern in relation to NS. We carried out Moran's I test based on the spatial weights equation (3) to calculate spatial dependence. The final Moran's I is 0.184 ($p<0.01$), providing initial evidence for integrating spatial dependence effects into the standard MLM when modelling NS.

The independent variables comprise three types: location variables, individual variables and neighbourhood variables. The survey also provides specific information on respondents' socioeconomic and locational characteristics, including income, age, family structure, education, and housing conditions. Following Dong and Wu's (2016) work, the location variables are a set of five variables relating to physical distance and land: the distance to the nearest bus passenger terminal; the distance to the nearest park; the distance to the nearest recreational facility; the distance to the nearest central business district; and the prices of residential land parcels. The distance data were obtained from Baidu Map, and the residential land parcel prices from Suqian Land Resources Bureau. Regarding the individual variables, these comprise five factors: monthly income; gender; age; length of residence; and family structure. Greif (2015) claimed that these individual variables are important predictors of NS. In addition, data taken from Fifth Census enabled us to obtain the following neighbourhood variables: educational attainment, population density, and age of buildings, which help to explore the observable contextual impacts on NS. Neighbourhood variables can not only explain the sources of NS at neighbourhood level, but can also help to understand how neighbourhood and individual variables interact (Ma et al., 2018). We examine the aforementioned factors using location variables. The distance to parks and recreational facilities reflects the effects of physical facilities on NS. This study also considers pollution, living amenities and socio-cultural setting as aspects that can play a role in NS. Table 1 summarises the variables and descriptive statistics.

4 Results

To test the model fit, this study calculated two commonly used indicators relating to Bayesian inference: deviance information criterion (DIC) and marginal log-likelihood. A smaller DIC and a larger log-likelihood indicates a better fit. According to Table 2, the single-level regression indicates the poorest model fit, because both the spatial dependence effect and the heterogeneity effect are absent (Ma et al., 2018). The improvement of the model fit in the random intercept multilevel model (MLM) indicates that the district-level unobservable of NS inequality is important. When we add spatial weights, the results of the DIC and log-likelihood suggest a significantly better model fit.

Table 3 shows the estimation results of two standard model specifications. Model 1 is the baseline model specification, which includes the fixed period effect and targeted individual variables. Low and high levels of monthly income play a significant part in NS. Low living costs in RRRCs produce high levels of satisfaction among people on low incomes, whereas high-income groups have lower levels of satisfaction because RRRCs cannot meet their quality of life needs, in terms of education, fitness, entertainment, etc. However, for those with a monthly income between 2,000 and 5,000 Chinese *Yuan*, income is not significantly related to NS. Regarding age-related variables, younger and older people have low levels of satisfaction, while middle-aged people appear to have higher satisfaction ratings. The location of RRRCs limits young people's access to external information and facilities, and increases their travel costs. In addition, moving to RRRCs may reduce older people's chances of receiving high-quality medical services, because levels of accessibility to healthcare are poor in lower-income urban neighbourhoods (Hawthorne and Kwan, 2013). Regarding gender, being female is significant, whereas being male is not. This may be because men often spend a lot of their time earning money elsewhere, and thus they do not attach much importance to NS. Regarding the family structure variables, families with children value NS more highly. In terms of length of residence, RL>=5 years plays a significant part in NS. The conclusion that a longer period of residence equates to greater satisfaction is supported by Ghozlane et al. (2008) and Fleury-Bahi (2000). However, as discussed in the method section, the problem of omitted variable bias may be present in the basic model specification (Model 1).

Table 3 shows the location variables and neighbourhood variables for Model 2. Moreover, to examine the proximity effects of location on neighbourhood attributes, we chose the interaction variable of distance to the nearest bus passenger terminal and neighbourhood characteristics. In Model 2, when we control for the location variables and neighbourhood variables, A<30 and 30<=A<50 are not significant. Compared to Model 1, the effects of MI<2000 and families with children decline rapidly, thereby demonstrating that geographical or locational factors play an important role in quality of life for families. PT*AD shows a significantly positive effect, suggesting that proximity to a bus passenger terminal tends to lead to higher levels of NS among RRRCs with older than average buildings. A possible explanation is that RRRCs where the buildings have been constructed more recently tend to be further away from a bus passenger terminal. There may be fewer bus passenger terminals in the areas where new settlements are located.

According to Model 2 in Table 3, most of the location variables are significantly associated with NS. PT, RF, and CBD are positively related to NS. One of the main things that residents of RRRCs value in terms of entertainment is the facility for 'square dancing'[1]. Square dancing helps to promote the cohesion of rural communities, increasing the sense of identity and community between residents to an extent (Yao et al., 2019). Although NP is negatively related to neighbourhood, it is not significant. A possible explanation is that residents in the rural resettlement communities generally do not regard parks or green spaces as very important, and their awareness of environmental protection is not high. In addition, LPP has a significant negative impact on NS. Generally, land prices for RRRCs are not very high because they are located in the fringes or suburbs of a city. The negative effect of LPP means the overall income and living standards of residents in RRRCs are not high.

[1] In the Chinese context, square dancing generally involves middle-aged or retired people, particularly women, dancing to music together in squares or other public spaces.

Regarding neighbourhood variables, PD and AD are significantly related to NS. NS in districts with a high population density and older buildings tends to be higher, suggesting that residents in RRRCs still maintain their former rural lifestyle, and have difficulty adapting to an urban lifestyle. The insignificant and negative impact of education (EA) indicates that, in RRRCs, the overall educational level of residents is relatively low or that residents do not attach much importance to education. Based on the spatial weights matrix displayed in Equation (5), we present the results of Moran's *I* in Table 3 to examine whether unmodelled spatial dependence exists in Model 2. The results indicate that there is significant spatial dependence in Models 1 and 2. Thus, it is necessary to refine our modelling strategy for the SAR and HSAR models.

The NS estimation results of the SAR and HSAR models are shown in Table 4. We employed the Bayesian Markov Chain Monte Carlo simulation method to compare the SAR and HSAR models. The prior distribution and the starting value of each parameter are the same for both models. Table 4 reports the credible intervals of each model parameter at the 95% level. In Model 3 (SAR), the significant spatial autoregression parameter (ρ) reveals that levels of NS in one area are linked to or impacted on by those of surrounding areas. Thus, NS has significant spatial autocorrelations. In Model 4 (HSAR), the ρ values are smaller than those in Model 3 (SAR). Dong et al. (2015) argued that the difference in spatial autoregression parameters is due to the fusion of horizontal spatial dependence and vertical spatial dependence on a regional spatial scale. The values of ρ and λ also support this conclusion. According to Model 4 (HSAR), there are significant horizontal dependence effects for both district and NS levels, and the values of ρ and λ are 0.102 [0.047, 0.152] and 0.621 [0.325, 0.899] respectively. In addition, the district level variance parameter σ_u^2 reveals that the vertical dependence is 0.041, which represents about 8.1% of variations in NS. The values of the Pseudo R^2 suggest that the fitness of the HSAR model is 9.7% better than that of the SAR model.

In Model 4 (HSAR), if the 95% credible intervals of these factors do not contain a 0, this means they have significant effects on NS in RRRCs. At an individual level, 2000<=MI <5000 is statistically significant in the HSAR estimation, whereas MI>=5000 is insignificant, indicating that residents with higher incomes have low NS levels in RRRCs. In terms of age, A>=50 is statistically insignificant, while 30<=A<50 is significant, suggesting that younger and older people dislike the living environment in RRRCs. Regarding gender, being female is significant. In terms of family status, only families with an elder member living with them are statistically significant. In RRRCs, the majority of elderly people are not supported by a robust pension system, and hence still need the support of their children in old age (Jia and Fan, 2019). In addition, RL>=5 years is significant, indicating that residents' levels of NS will rise with the length of time they spend living in RRRCs. Regarding local variables, when we control for vertical spatial dependence and horizontal spatial dependence in relation to NS, the PT*AD has a significant effect, indicating significant differentials in satisfaction with the proximity to a bus passenger terminal across districts. Except for NP, the other location variables are all significant, suggesting that having green spaces or a good natural environment does not increase NS. In terms of the neighbourhood variables, EA is still insignificant, while PD and AD have a significant impact on NS, showing that the residents tend to prefer a lively and crowded living environment, and that they have a strong attachment to a familiar living environment.

It is necessary to estimate some scalar summary effects to understand the partial marginal effect on NS in the SAR and HSAR models, namely direct impact, indirect impact and total impact (LeSage and Pace, 2009). The rationale for focusing on these statistics is that, as long as the autoregressive parameters are significantly different from zero, the partial derivative of NS to the covariate is not the regression coefficient of the variable (Dong and Wu, 2016). Tables 5 and 6 report the figures for these. The direct impact means the reflection of y_k as a result of the changes in x_{kr}, while the indirect impact, also known as spatial spillover effects, is the response sum of the outcomes for all the other locations as a result of the changes in x_{kr} (Dong and Wu, 2016). The total impact is the sum of the direct and indirect impacts. The direct and indirect impacts are different from spatial units, and the differences are mainly related to their neighbouring and relative locations at all geographical configurations (Dong and Wu, 2016).

According to Tables 5 and 6, the direct, indirect and total impact of 2000<=MI <5000 is significant in the SAR and HSAR models. These results prove again that residents with middle and low incomes have higher levels of NS in RRRCs. In addition, MI>=5000 is insignificant, and thus it cannot constitute an explanatory factor for levels of NS. In terms of age, only 30<=A<50 is significant. Regarding gender, females have significant levels of NS. The results for family status indicate that being a family with an elder produces significant levels of NS. In addition, the significant results associated with RL>=5 years suggest that living in a RRRC for many years can improve satisfaction with one’s neighbourhood. In the case of the location variables, the direct, indirect and total impacts of the PT in the SAR and HSAR models are significant. Because the indirect impact refers to spatial spillover effects, an increase in the proximity to a bus passenger terminal at a particular location can result in higher levels of NS for neighbouring locations as well. According to Table 5, a 1% PT increase in the direct, indirect and total impacts would result in a 0.53%, 0.47% and 1% increase in NS respectively, on average. Moreover, comparing the indirect impact of the SAR model to that of the HSAR models, the spatial spillover effect of PT in the SAR model is 0.47%, which is 0.013% less than that in the HSAR model. Due to the conflation of spatial dependence at the dependent variable (NS) and district scales, one of the parameters may be overestimated (Dong and Wu, 2016). Thus, the PT results demonstrate that there is no overestimated spatial autoregressive parameter in the SAR model in our case. Similar results were produced for CBD and PT*AD. Meanwhile, the results of the neighbourhood variables demonstrate that, in addition to EA, other variables are also significant, suggesting that residents living in RRRCs may have relatively low levels of education.

Table 7 reports the results of the sensitivity tests for the individual-level parameter estimates from the HSAR model, also known as a robustness check. Following Dong and Wu's (2016) method, we chose different threshold distances to construct the spatial weights matrix. Furthermore, we also took the 30 nearest neighbours as a spatial weights matrix with which to run the HSAR model. According to Table 7, having residents with lower incomes is significantly related to NS in all the HSAR models with different spatial weight matrixes, because 2000<=MI <5000 is a significant explanatory factor and its estimated coefficients (median) are greater than those of MI>=5000. In terms of age, levels of NS are significant among residents aged from 30 to 50. Females are more willing to live in RRRCs because of their significant and positive effects. Regarding family status, having an elder member living with a family is significant. Families with children are insignificant in the HSAR models with threshold distances of 3.5km and 4.0km, whereas they are significant in the model that includes the nearest 30 neighbours. This may be because having a greater number of playmates can lead to significant levels of satisfaction for children. Finally, residing in a community for several years is still associated with significant levels of NS. Table 7 also displays the parameters of the robustness check. ρ and λ are the spatial autoregressive parameters, and σ_e^2 and σ_u^2 are the variance parameters. The results of the spatial dependence effect with respect to these parameters demonstrate that our estimates for the HSAR model are robust.

5 Conclusions

The development of RRRCs is of great significance to China's urbanisation process, narrowing the gap between urban and rural areas and promoting social stability. NS is an effective predictor of neighbourhood quality and vitality (Greif, 2015), and our work contributes to the growing body of literature on the multifaceted determinants of NS for different community types. In order to improve the governance of these communities, it is important to investigate the levels of NS among RRRCs, and to understand their spatial variations. Using large-scale survey data for Suqian, the study explored the determinants and spatial effects for NS in RRRCs by employing a BHSAM. This paper is the first to try to explore levels of NS in China's RRRCs. Our study on NS will benefit future studies because residents tend to experience varying degrees of satisfaction with all aspects of the neighbourhood environment in different communities.

Our results suggest that middle- and low-income residents in RRRCs have significant levels of NS, while NS is very low among high-income residents. Middle-aged residents have significant levels of NS, perhaps because they do not have to deal with the same pressures as older or younger residents. However, due to problems associated with care in their old-age, and having fewer opportunities to interact with other residents than those in RRRCs, the NS levels of the elderly are not significant. Meanwhile, although A< 30 is used as a reference in our model, our results show that living in an RRRC limits young people's exploration of the outside world to a certain extent, and thus young people also have very low levels of NS. Women have significant levels of NS. In terms of family structure, because the cost of supporting their parents is relatively low, families who have an elder member living with them have higher levels of NS in RRRCs. We also found that residents' levels of NS will increase over time in RRRCs. At the locational level, proximity to transport stops, entertainment and business centres have significant effects on NS levels. However, the insignificant effects of land prices and proximity to parks and green spaces suggest low living standards and low levels of environmental awareness among residents in RRRCs, respectively. The results for the neighbourhood variables demonstrate that residents of RRRCs do not attach much importance to education. Moreover, they prefer a lively and crowded living environment, and they will increasingly come to rely on their current living environment over time. Our conclusions also verify Greif's (2015) findings. Dissatisfaction with public services and amenities does not mean dissatisfaction with social relationships. Despite the lack of local resources, satisfactory social ties in RRRCs can lead to high NS.

Regarding policy implications, to improve NS, the quality of life for residents in RRRCs should be emphasised (Huang and Du, 2015). In addition, this study can make a great difference to China's rural revitalization strategy. Our results indicate that social security issues, especially care of the elderly and education, should be the main focus of governance in RRRCs. Despite the poor geographical location of many RRRCs, having a well-developed transport system can contribute to NS. Environmental governance may not be regarded as an urgent priority for RRRCs at this stage, but it should not be neglected in the long run. Meanwhile, the quality of construction and house maintenance of RRRCs should be emphasised. In addition, our method, which incorporates spatial and hierarchical effects, can make a significant difference in the evaluation of NS. However, with the acceleration of urbanisation, it should be noted that an increasing amount of migrant workers are now living in RRRCs and working in nearby factories. Thus, the types of residents living in RRRCs are becoming more diverse. Therefore, future studies in this field could try to understand how different types of residents contribute to levels of NS or dissatisfaction in RRRCs. In addition, it should be kept in mind that RRRCs are still a relatively new form of community. Consequently, there may be differences between residents' current experiences and their perceived opportunities (see Cao and Hickman, 2019) in terms of NS. Therefore, future studies could investigate and compare the difference between residents' actual and perceived levels of NS in RRRCs.

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Figure 1 Living environments (On the left is the previous rural environment and on the right is an example of an RRRC)

Table 1 Variables and descriptive statistics

Variables	Definition	Mean / Percentage	SD
NS	NS scores	2.978	0.583
Location variables			
PT	Log of the distance to the nearest bus passenger terminal	5.312	0.823
NP	Log of the distance to the nearest park	6.293	0.625
RF	Log of the distance to the nearest recreational facility	2.165	0.725
CBD	Log of the distance to the nearest central business district	3.819	0.572
LPP	Log of residential land parcel prices per square metre (Yuan/sq m)	3.429	1.031
Individual variables			
MI (%)	Monthly income <2000 (Yuan)	21.5%	
	2000<=Monthly income <5000 (Yuan)	66.9%	
	Monthly income>=5000 (Yuan)	11.6%	
A (%)	Age <30	29.7%	
	30<=Age<50	38.5%	
	Age>=50	31.8%	
F (%)	Female	45.9%	
M (%)	Male	54.1%	
FS	Single	2.0%	
	Two-person family	14.7%	
	Family with children	79.4%	
	Family with elder	80.2%	
RL (%)	Residence length<5 years	13.8%	
	Residence length>=5 years	86.2%	
Neighbourhood variables			
EA	Average educational attainment in each neighbourhood: 4 = postgraduate, 3 = university or Dazhuan, 2 = high school or Zhongzhuan, 1 = junior or lower	1.026	0.603
PD	Population density - 1000 persons/ km^2	39.96	
AD	The average age of Rural Resettlement Residential Area buildings in years	5.324	0.189

Table 2 Results of model fit

	DIC	P_D	Log-likelihood
Single-level regression	13264.78	51.23	-6128.39
MLM (Equation 3)	13005.27	92.15	-5798.42
Spatial MLM (Equation 4)	12191.13	137.66	-5543.17

Table 3 Estimation of OLS

Variables	Model 1		Model 2	
	Coe.	Std. Error	Coe.	Std. Error
Intercept	17.65	0.513	19.23**	0.798
Individual variables				
MI <2000	Reference		Reference	
2000<=MI <5000	0.09*	0.07	0.052	0.074
MI>=5000	-0.201**	0.419	-0.056**	0.125
A<30	Reference		Reference	
30<=A<50	0.013*	0.132	0.041*	0.309
A>=50	-2.097**	0.511	-1.921***	0.107
M	Reference		Reference	
F	0.562***	0.514	0.639*	0.091
Single	Reference		Reference	
Two-person family	-0.109	0.074	-0.303*	0.068
Family with children	-0.101*	0.114	-0.274**	0.051
Family with elder	0.182	0.046	0.117	0.063
RL<5 years	Reference		Reference	
RL>=5 years	0.074***	0.099	0.076**	0.131
Location variables				
PT			0.152*	0.033
NP			-1.301	0.218
RF			0.516***	0.331
CBD			0.202**	0.371
LPP			-0.101*	0.233
PT*AD			1.089**	0.327
Neighbourhood variables				
EA			-0.104	0.213
PD			0.098**	0.121
AD			3.596*	0.915
Year dummies	Yes		Yes	
Sample size	16796		16796	
R^2	0.612		0.699	

Adjusted R^2	0.504	0.601
σ_e^2	0.743	0.617
Moran's *I*	0.205^{*}	0.091^{***}

Note: * p<0.10, ** p<0.05, *** p<0.01

Table 4 Estimation of SAR and HSAR

Variables	Model 3 (SAR)			Model 4 (HSAR)		
	Median	2.5%	97.5%	Median	2.5%	97.5%
Intercept	3.363	2.991	3.745	4.572	4.129	5.017
Individual variables						
MI <2000	Reference			Reference		
2000<=MI <5000	0.132	0.074	0.192	0.108	0.052	0.161
MI>=5000	-0.041	-0.103	0.025	-0.038	-0.103	0.025
A<30	Reference			Reference		
30<=A<50	0.301	0.172	0.431	0.533	0.138	0.927
A>=50	-0.035	-0.08	0.01	0.024	-0.181	0.229
M	Reference			Reference		
F	0.225	0.051	0.398	0.512	0.017	1.006
Single	Reference			Reference		
Two-person family	-0.041	-0.024	0.103	-0.083	-0.174	0.002
Family with children	-0.018	-0.066	0.031	-0.007	-0.039	0.027
Family with elder	0.375	0.114	0.631	1.092	0.513	1.667
RL<5 years	Reference			Reference		
RL>=5 years	0.019	0.011	0.029	0.018	0.007	0.028
Location variables						
PT	0.519	0.021	1.011	0.558	0.071	1.031
NP	-0.007	-0.014	0.029	-0.003	-0.021	0.016
RF	0.561	0.301	0.817	0.629	0.242	1.015
CBD	0.513	0.127	0.901	0.515	0.136	0.899
LPP	-0.002	-0.013	0.009	-0.004	-0.031	0.042
PT*AD	0.042	0.035	0.052	0.161	0.055	0.264
Neighbourhood variables						
EA	-0.006	-0.117	0.106	-0.025	-0.055	0.006
PD	0.451	0.297	0.603	0.512	0.398	0.625
AD	1.883	1.209	2.557	1.937	0.989	2.997
ρ	0.302	0.204	0.399	0.102	0.047	0.152
λ				0.621	0.325	0.899
σ_e^2	0.694	0.492	0.907	0.564	0.379	0.748
σ_u^2				0.041	0.017	0.059
Year dummies	Yes			Yes		
Sample size	16796			16796		
Pseudo-R^2	0.401			0.498		
Moran's *I*	0.021			0.013		

Table 5 Impact estimation of SAR

Variables	Direct impact	Indirect impact	Total impact
2000<=MI <5000	0.062 [0.018, 0.107]	0.081 [0.029, 0.132]	0.143 [0.047, 0.239]
MI>=5000	-0.062 [-0.137, 0.009]	-0.058 [-0.112, -0.003]	-0.12 [-0.249, 0.006]
30<=A<50	0.348 [0.207, 0.499]	0.075 [0.015, 0.134]	0.423 [0.222, 0.633]
A>=50	-0.023 [-0.09, 0.040]	-0.014 [-0.035, 0.007]	-0.037 [-0.125, 0.047]
F	0.239 [0.071, 0.423]	0.169 [0.036, 0.301]	0.408 [0.05, 0.733]
Two-person family	-0.063[-0.084, -0.037]	-0.008 [-0.012, -0.006]	-0.071 [-0.096, -0.043]
Family with children	-0.017 [-0.063, 0.030]	-0.012 [-0.027, 0.016]	-0.029 [-0.09, 0.046]
Family with elder	0.363 [0.124, 0.596]	0.296 [0.079, 0.513]	0.659 [0.203, 1.109]
RL>=5 years	0.017 [0.009, 0.023]	0.007 [0.004, 0.012]	0.024 [0.013, 0.035]
PT*AD	0.024 [0.014, 0.033]	0.019 [0.012, 0.027]	0.043 [0.026, 0.060]
PT	0.531 [0.052, 1.026]	0.468 [0.041, 0.894]	0.999 [0.093, 1.920]
CBD	0.513 [0.151, 0.874]	0.431 [0.156, 0.704]	0.944 [0.307, 1.578]
PD	0.491 [0.402, 0.579]	0.099 [0.007, 0.192]	0.591 [0.409, 0.771]
AD	2.142 [1.432, 2.583]	1.239 [0.595, 1.883]	3.381 [2.027, 4.466]

Note: The numbers in square brackets are the 95% confidence intervals for the direct, indirect, and total impacts of each independent variable; Except for the individual variables, the table only reports statistically significant variables.

Table 6 Impact estimation of HSAR

Variables	Direct impact	Indirect impact	Total impact
2000<=MI <5000	0.074 [0.015, 0.132]	0.047 [0.004, 0.091]	0.121 [0.019, 0.223]
MI>=5000	-0.043 [-0.109, 0.021]	-0.045 [-0.107, 0.019]	-0.088 [-0.216, 0.040]
30<=A<50	0.597 [0.192, 1.004]	0.275 [0.051, 0.503]	0.872 [0.243, 1.507]
A>=50	-0.002 [-0.185, 0.145]	-0.021 [-0.139, 0.095]	-0.023 [-0.324, 0.240]
F	0.563 [0.073, 1.052]	0.527 [0.072, 0.983]	1.091 [0.145, 2.035]
Two-person family	-0.037 [-0.077, 0.005]	-0.017 [-0.052, 0.019]	-0.054 [-0.129, 0.024]
Family with children	-0.006 [-0.051, 0.039]	-0.033 [-0.129, 0.055]	-0.039 [-0.180, 0.094]
Family with elder	1.261 [0.687, 1.831]	0.686 [0.239, 1.143]	1.947 [0.926, 2.974]
RL>=5 years	0.017 [0.011, 0.024]	0.012 [0.004, 0.020]	0.029 [0.015, 0.044]
PT*AD	0.146 [0.021, 0.269]	0.109 [0.015, 0.203]	0.255 [0.036, 0.472]
PT	0.589 [0.092, 1.074]	0.481 [0.017, 0.933]	1.071 [0.109, 2.007]
CBD	0.571 [0.152, 0.989]	0.463 [0.121, 0.803]	1.034 [0.273, 1.792]
PD	0.521 [0.416, 0.632]	0.325 [0.232, 0.417]	0.846 [0.648, 1.049]
AD	2.606 [1.206, 4.005]	1.167 [0.995, 1.336]	3.773 [2.201, 5.341]

Note: The numbers in square brackets are the 95% confidence intervals for the direct, indirect, and total impacts of each independent variable; Except for the individual variables, the table only reports statistically significant variables.

Table 7 Robustness checks for HSAR with different spatial weights matrices

	HSAR (3.5 km)			HSAR (4.0 km)			HSAR (nearest 30 neighbours)		
	Median	2.5%	97.5%	Median	2.5%	97.5%	Median	2.5%	97.5%
2000<=MI <5000	0.279	0.247	0.313	0.288	0.233	0.342	0.078	0.016	0.141
MI>=5000	-0.061	-0.232	0.115	-0.162	-0.962	0.639	-0.266	-0.885	0.354
30<=A<50	0.315	0.137	0.499	0.323	0.143	0.497	0.267	0.132	0.397
A>=50	-0.014	-0.092	0.069	-0.025	-0.152	0.102	-0.037	-0.164	0.088
F	0.881	0.659	1.089	0.108	0.021	0.193	0.372	0.107	0.635
Two-person family	-0.013	-0.054	0.029	-0.043	-0.058	-0.024	-0.139	-0.354	0.056
Family with children	-0.029	-0.066	0.008	-0.017	-0.042	0.008	0.091	0.067	0.114
Family with elder	0.311	0.226	0.397	0.339	0.279	0.398	0.336	0.235	0.429
RL>=5 years	0.031	0.022	0.042	0.039	0.028	0.055	0.092	0.024	0.166
ρ	0.291	0.191	0.388	0.231	0.062	0.399	0.274	0.093	0.461
λ	0.586	0.374	0.777	0.579	0.258	0.901	0.619	0.244	0.993
σ_e^2	0.562	0.435	0.718	0.615	0.506	0.723	0.623	0.536	0.709
σ_u^2	0.077	0.042	0.104	0.132	0.076	0.185	0.084	0.031	0.133