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Spatial variation of perceived equity and its determinants in a gateway community of Giant Panda National Park, China

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Social equity is essential in the governance of protected areas (PAs), as ignoring such consideration can lead to resistance and jeopardize conservation objectives. However, more research is required to understand the spatial heterogeneity of perceived social equity and its underlying spatial factors. Using a survey of 361 respondents, we presented spatial distribution patterns of perceived equity by kernel density estimation (KDE) in Giant Panda National Park, China. The regression analysis showed that local residents who live closer to the PA boundary are more likely to develop negative responses and those who with easy access to tourism spots have more positive procedural and distributional perceptions. Notably, the proximity to the PA authority decreases locals' perceptions of fairness in all aspects, which is potentially due to the opaque participative channels provided by the PA authority. We argue that those spatial differentials in fairness perceptions are driven by the intrinsic discrepancy of biodiversity protection requirements and the unevenly distributed consequences of management policies. Key steps to advance social equity considerations include multi-industry guidance, extending participative channels, and co-producing better compensation plans. Herein, this study appeals to a greater focus on the spatial aspect of social equity issues in PAs.

KEYWORDS

protected areas, spatial justice, social equity, fairness perception, spatial accessibility

1. Introduction

Social equity has emerged as a vital aspect in governing PAs since the 2010s (McDermott et al., 2013; Bennett et al., 2020; Zafra-Calvo and Geldmann, 2020). Such fairness considerations were advanced in Aichi Target 11 in 2010, which sought to achieve more "effectively and equitably managed" PAs.[1] Ethically, it is essential to incorporate social equity as conservation successes should not be built upon the sacrifices of local vulnerable groups (Brockington, 2002;

1 Convention on Biological Diversity Strategic Plan for Biodiversity 2011–2020—COP 10 (2010). E. coli. Available at: https://www.cbd.int/undb/media/factsheets/ (Accessed December 20, 2022).

Schreckenberg et al., 2016; Dawson et al., 2018; Lecuyer et al., 2019). And instrumentally, positive fair judgments among local residents are frequently linked with higher local acceptance and compliance with conservation (Lind and Tom, 1988; Davenport et al., 2007; Suiseeya, 2014). By contrast, negative perceptions can potentially lead to social conflicts and resistance (Schlosberg, 2007; Hirsch et al., 2011; Blicharska et al., 2016), which may decrease conservation effectiveness as a consequence (Martin, 2017; Hamann et al., 2018; Leach et al., 2018; Strzelecka et al., 2022). To prevent such social deficiencies, concerted efforts have been formed among researchers and practitioners to strive for more equitably managed conservation areas.

The concern with questions of equity, fairness, and justice has long existed (Hay, 1995). In common parlance, those three concepts are similar and interchangeable. However, in a stricter sense, each term conveys a slightly different meaning (Njoh, 2013). According to Frederickson (1990), the concept of equity comprises an array of value preferences, organizational design, and management style. It is viewed as the connoting equality in the distribution of public service and the responsiveness to the needs of citizens. For Rawls (1971) equity entails the assignment of duties and rights, focusing on how gains and losses resulting from development initiatives are equitably distributed. Instead, the term of fairness connotes "rightness" both legally and ethically. The requirement for fair treatment in the environmental domain calls upon authorities to ensure that no societal group is disproportionately affected by natural or man-made environmental problems (Mobilizegreen, 2018). In addition, the concept of justice draws directly from jurisprudence, calling for the impartial resolution of conflicting claims and/or the assignment of punishment to transgressors (Njoh, 2013, 2022). Despite afore-mentioned differences, we do not distinguish between those three words in this study.

The notion of social equity comprises three indispensable and interrelated aspects (Schlosberg, 2007; McDermott et al., 2013; Martin et al., 2014; Pascual et al., 2014; Sikor et al., 2014; Schreckenberg et al., 2016; Zafra-Calvo et al., 2019). The component of distributional equity was the earliest to be noticed (Adams, 1965; Hatfield et al., 1978; Gordon, 2010; McLauchlan and Joao, 2011), and later came with the other two aspects, recognitional (Martin et al., 2016; Arsenault et al., 2019) and procedural equity (Marques et al., 2015; Mauerhofer and Larssen, 2016). Zafra-Calvo et al. (2017) enriched this classification framework by proposing a suite of 10 indicators to assess social equity in PAs, and those indicators were later supplemented and applied in other case studies (Bennett et al., 2020). Also, plenty of research has sought to understand how local fairness perceptions are shaped. Recent studies have extensively focused on the effects of unfair events (Ohl et al., 2008; Lecuyer et al., 2019; Wang et al., 2019), demographic attributes (Kellerhals et al., 1997; Clayton and Opotow, 2003), connection to nature (Clayton et al., 2016; Strzelecka et al., 2022), personal expectations (Parris et al., 2014) and involvement, as well as physical and social environment (Colvin et al., 2015; Marques et al., 2015; Agyeman et al., 2016).

Despite the increasing attention paid to assessing fairness perceptions of residents in PAs, the spatial distribution of social equity needs more attention. Several authors have noticed that the distance from PAs is somehow correlated with social equity (Molina Murillo et al., 2016; Croucher, 2020), but mostly limited within the distributional scope. For instance, Carvache-Franco et al. (2021) proposed that local residents living closer to the parks were acknowledged to have received more conservation benefits compared to locals residing farther away. Similarly, Jurowski and Gursoy (2004) noted that the proximity to tourism attractions was closely linked with how costs and benefits were distributed. In the broader assessment of social impact of PAs, Jones et al. (2020) highlighted the role of geographical location in affecting subjective well-being levels of locals. Even though previous research has disclosed that the impact of socioeconomic features, these factors may be strongly related to geographical spatial location, which is not fully revealed and interpreted yet.

The spatiality of social justice, though frequently overlooked in the conservation field, has proved to be exceedingly valuable in the broader social background ever since 1960s, when Davies (1970) linked justice to geography. While Rawls (1971) argued that the distribution of resources is central to the geographical aspect of justice, Soja (2010) further illustrated that the spatiality of human life should be understood as "a complex social product." In many other fields including urban greening, blue space, open space, and rural regions, the notion of spatial justice is frequently measured by the accessibility to public facilities and other resources (Raymond et al., 2016; Jian et al., 2020; Kenneth, 2020; Gradinaru et al., 2023). Farrington and Farrington (2005) define accessibility as "the ability of people to access and participate in opportunities and activities." While spatial accessibility is usually assessed by considering the number of cumulative opportunities, non-spatial accessibility usually emphasizes non-geographical barriers relevant to social justice concepts (e.g., social class, income, race, and age; Morris et al., 1979). To understand the broader background of spatial justice is essential to provide insights for our spatial analysis in the equitably management of PAs.

To address the afore-mentioned research gaps, the objectives of our study are: (1) to quantitatively present the spatial variation of perceived fairness surrounding PAs; and (2) to identify and further verify the spatial factors of fairness perceptions among local residents. This study bridges the spatial justice theory to the biodiversity conservation field and further provides scientific references to prioritize community-based countermeasures in PAs.

2. Materials and methods

2.1. Study area

The Tangjiahe Area of the Giant Panda National Park (TGPNP) is located in Qingchuan County, Sichuan Province in China. This conservation area was rated as an A-level nature reserve by the World Wildlife Fund for Nature (WWF), covering an area of 40,000 hectares and harboring a variety of rare and endangered species, such as giant pandas, snub-nosed monkeys, and takins. The total population of the surrounding communities is nearly 9,500, among which around 1,100 residents live within the PA boundary (Yang, 2022; Zhang et al., 2023). We select TGPNP as a case study for the following reasons:

Firstly, the mountainous landform of TGPNP shapes a scattered, isolated rural settlement pattern, referring that there is apparent heterogeneity in terms of environmental conditions. In addition, the scattered distribution of tourist attraction resources inside and outside the reserve may have effects on fairness perceptions of local residents (Mbise et al., 2021).

Secondly, the establishment of the TGPNP has imposed diverse impacts on surrounding communities. For example, there are

relatively severe human–wildlife conflicts within and around PAs, leading to loss of livestock and crops. Additionally, the TGPNP has a strong tourist attraction to the public, thus bringing about tourists and employment opportunities to surrounding communities (Carvache-Franco et al., 2021).

Thirdly, the Administration of Tangjiahe Area (ATA) has carried out community-based conservation practices with local communities since 1978, such as joint fire prevention and infrastructure building supports, organizing co-management committees, and China Bee Breeding Cooperative. These diverse co-management strategies may have diverse impact on local fairness perceptions (Chen et al., 2022; Zhang et al., 2023).

We selected four villages (Luoyigou, Yinping, Weiba, and Dongqiao) in the gateway town (Qingxi) of TGPNP as our research site. Luoyigou is only village located within the boundary of TGPNP, whereas the other three villages are situated outside (Figure 1). The basic information of those villages is displayed in Table 1. Among them, Luoyigou village is located within the boundary of PA, with the most intensive human–wildlife conflicts. Local residents there mainly rely on agriculture and farmhouse tourism for a living. In contrast, community-based tourism in Yinping village has gained large popularity in the past 2 decades, providing substantial revenue for family inns and restaurants. Being adjacent to TGPNP, local residents in Dongqiao village are mostly engaged in agriculture, breeding, and migrant work, while those of Weiba village are mainly employed by a local stone processing company (Chen et al., 2022; Yang, 2022).

2.2. Methods

2.2.1. Indicators of social equity

We measure the concept of social equity from three basic dimensions, recognitional equity (RE), procedural equity (PE), and distributional equity (DE). Regarding the specific indicators to measure each dimension of equity, the scale is preliminarily developed upon studies by Zafra-Calvo et al. (2017) and Bennett et al. (2020). We modified and added some attributes based on the features of TGPNP, such as Ecological compensation (DE2) and Wildlife conflicts compensation (DE3). In this way, five variables are finalized to represent each equity aspect, and a total of 15 indicators are used to depict the combined equity (CE) (Figure 2).

2.2.2. Construction of the variable set for spatial accessibility

When setting up the variable set to measure spatial accessibility in communities around PAs, we finalized four indicators, including access to PA boundary, access to PA authority, access to main roads, and access to tourism spots, listed in Table 2.

- Accessibility to PA boundary: the designation of PA boundary can impose significant impact on local communities by exerting restrictions on land-use and livelihood sources. Since plenty of studies have explored how the proximity to PA boundary can affect locals' conservation attitudes and well-being (Naidoo et al., 2019; Carvache-Franco et al., 2021), it is worth paying attention

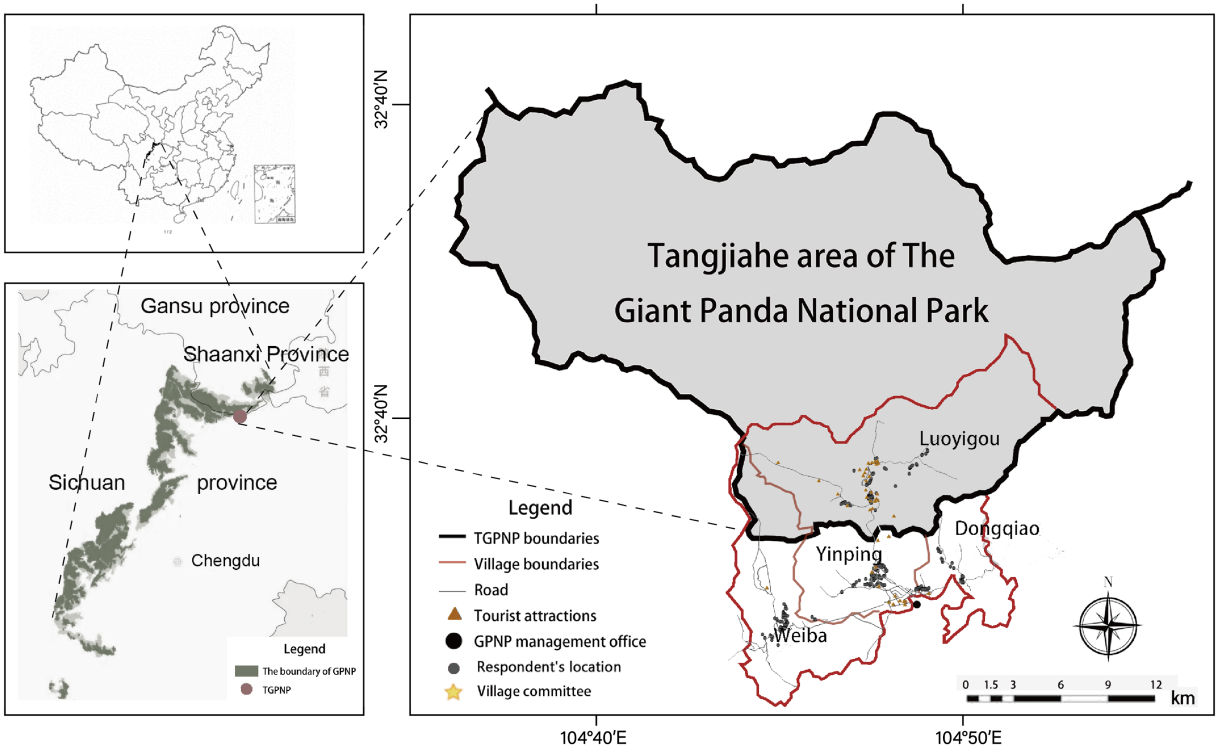

FIGURE 1
Map of the Tangjiahe area of the Giant Panda National Park. Our research area comprises Luoyigou, Yinping, Weiba, and Dongqiao villages, outlined by red lines.

to how the distance effect generated by the boundaries can affect fairness perceptions of local residents.

- Accessibility to PA authority: the communities around PAs are different from ordinary rural areas, since they are not only managed by the local government, but also affected by governance measures of ATA. This means that accessibility of PA authority can affect residents' likelihood of accessing policy information. Which consequently deserves further attention (Kenneth, 2020).
- Accessibility to main roads: as local residents spatially residing across the mountainous area mainly rely on the road traffic to travel to hospitals, schools, and other public facilities, the road accessibility may play an important part in shaping the fairness perceptions of residents (Wang et al., 2021).
- Accessibility to tourism spots: the access to tourist attractions is potentially linked with benefits received from tourist attractions. While some researchers believe that residents living near attractions may have more positive perceptions of tourism impacts (e.g., Mansfeld, 1992), others came to the opposite conclusion (e.g., Williams and Lawson, 2001). There are tourist points distributed inside and outside the TGPNP, and how those geographical locations can affect local residents' fair perceptions should be taken into consideration.

TABLE 1 Basic information on the four selected villages in TGPNP, sourced from the ATA.

	Luoyigou village	Yinping village	Weiba village	Dongqiao village
Population (persons)	1,085	1823	1,389	1,160
Number of households (households)	470	642	318	445
Geographical location	Inside TGPNP	Outside TGPNP	Outside TGPNP	Outside TGPNP
Main industry	Farmhouse tourism, planting, etc.	Farmhouse tourism, planting, etc.	Stone production and processing, planting, etc.	Planting, etc.
Land area (km^2)	62	39.7	22	27.92

2.2.3. Data collection

428 questionnaires were distributed and collected on-site from June 29, 2022 to July 7, 2022 in TGPNP. Simultaneously, 17 semi-structured interviews were conducted with stakeholders, including ATA staffs, community leaders, rangers, farmers, and other groups.

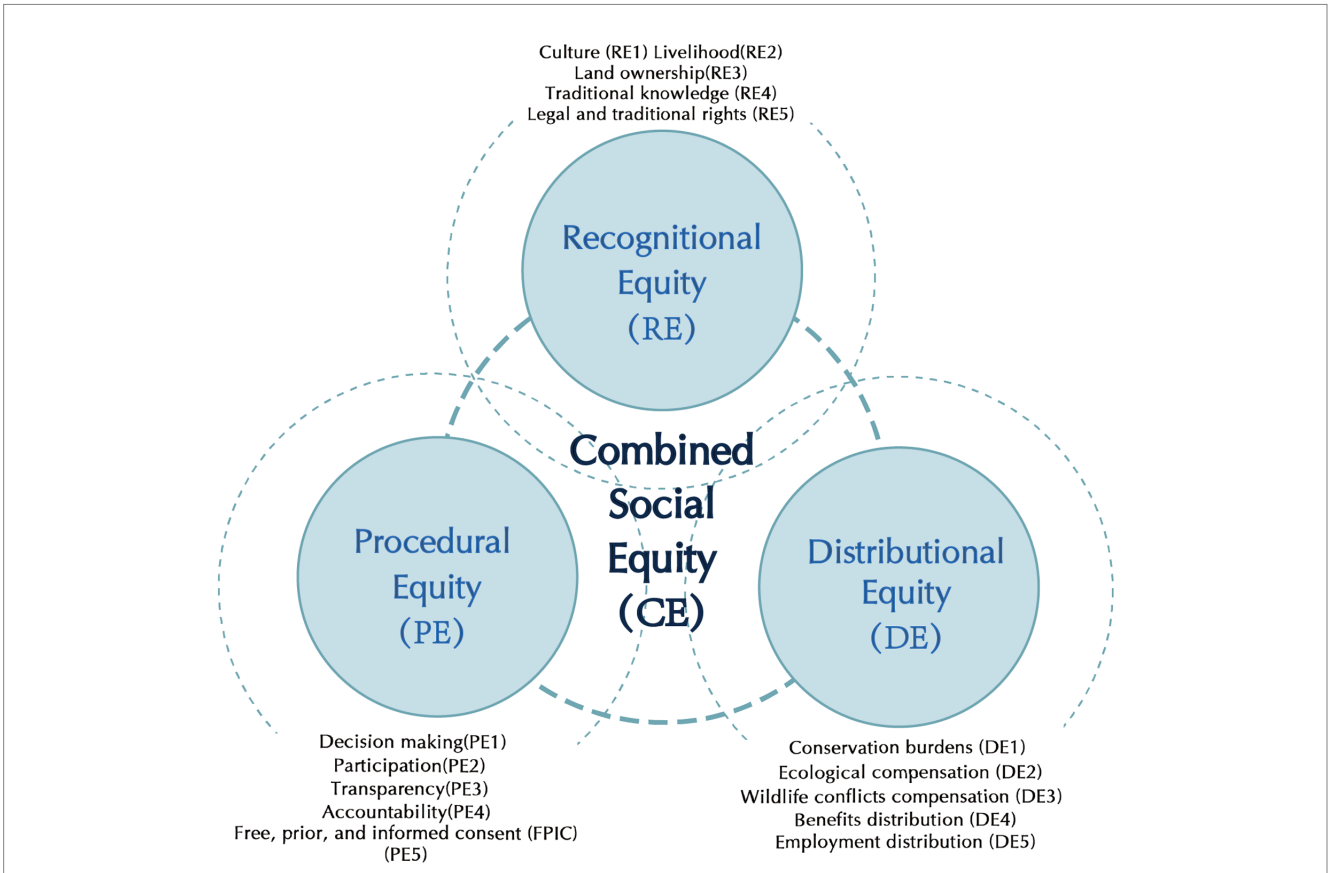

FIGURE 2
Theoretical framework of social equity in PAs. Indicators refer to the literature of Bennett (2016), Zafra-Calvo et al. (2017), Zafra-Calvo et al. (2019), Dawson et al. (2018), Bennett et al. (2020), and Chen et al. (2022), added to and modified according to the characteristics of TGPNP.

TABLE 2 Descriptions of four variables of spatial accessibility.

Variable	Description	Measurement method
Accessibility to PA boundary	Distance from household to the nearest TGPNP boundary (m)	Used ArcGis10.2's proximity value to calculate
Accessibility to main roads	Time distance from household to the nearest county-level and township-level road (m)	Used time distance calculation
Accessibility to PA authority	Time distance from household to the ATA (min)	Used time distance calculation
Accessibility to tourism spots	Distance from household to the nearest tourism resources (m)	Calculated by using Euclidean distance

The questionnaire survey took the household as the basic unit and used random sampling to select respondents. The survey proportion is not less than 10% of the total population size of the village. At the same time, the spatial and geographical coordinates of the respondents' households were recorded as well. After excluding 67 invalid questionnaires with abnormal spatial geographic coordinates, the number of effective sample was 361, with an effective recovery rate of 84%.

The questionnaire consists of three parts. The first two sections include a broad set of questions related to the demographic characteristics of local residents (e.g., gender, age, education, location, and occupation), and their household characteristics (e.g., household income, family size, source of income, and place of residence). The final part of the questionnaire is about local people's perceptions of fairness in the TGPNP, measured by formulating statements for each indicator of social equity on a five-point Likert scale (see Supplementary Tables A, B).

The border of TGPNP was extracted from protected area maps provided by ATA. The location of ATA was approached from Baidu map data[2] on September 23, 2022. The data of tourism spots and main roads came from the tourism planning and road planning provided by the Qingxi town government. With the support of the ArcGIS 10.2 platform, the Landsat 8 OLI_TIRS satellite digital product database from the China Geospatial Data Cloud website (http://www.gscloud.cn/search, accessed on September 23, 2022) was used as the basic geographic data.

2.2.4. Data processing

First, we calculated an average score for each equity dimension (recognition, procedural, and distributive equity) by adding up five indicators in this category for each respondent. The combined social equity score for individuals by averaging the scores across all 15 indicators. Second, the kernel density estimation (KDE) was applied to characterize the spatial variation of fairness perceptions across the recognitional, procedural, distributive, and combined equity.

Third, ordinary least squares (OLS) regression was used to filter out variables affecting fairness perceptions. Given the possible impact of spatial correlation, a spatial econometric model was constructed to examine spatial factors on regional fairness perception. The models include a spatial lag model (SLM; Nurkse, 1996), considering the effects of spatial correlation between dependent variables of adjacent units, and a spatial error model (SEM; Yin and Zhang, 2008), which takes into account the spatial correlation effects of variables. These regression models were used to explain and reveal the inner correlations between fairness perception and its underlying spatial factors. Those above regression models were all operated on Geoda1.2 software.

3. Results

3.1. Sample description

The survey sample comprised 361 residents in Qingxi Town. The proportions of men and women were 45 and 55%, respectively. Many surveyed residents were in elder age groups, with 70% aged 50 and over. About 66% respondents completed only primary or secondary school, and 22% never attended school. A vast majority of respondents (89%) have lived here for more than 20 years. Residents from Yinping and Luoyigou villages were less dependent on agriculture, with 31 and 48% of respondents made a living by agriculture, while the percentages for Weiba (66%) and Dongqiao (57%) were obviously larger. Residents with an average annual household income of less than 30,000 yuan accounted for the highest proportion in Dongqiao (80%), followed by Luoyigou (67%), Weiba (61%), and Yinping (54%) subsequently (see Supplementary Table C).

3.2. Spatial variation patterns of perceived equity

As depicted in Figure 3A, the perceived recognitional equity was obviously lower inside the border of TGPNP compared to the outside. The recognitional equity score of Luoyigou was the lowest (Mean = 3.23) compared to the remaining three villages out of the PA boundary (Dongqiao = 3.97, Weiba = 3.81, and Yinping = 3.86). With respect to the procedural equity, there demonstrated a gradual increase from northeast to southwest (Figure 3B). Weiba village situated in the southwestern tip of our research region scored the highest (PE = 2.51) among all. In terms of distributional equity, the core clusters were concentrated in the northwestern part of the study area (Figure 3C). Among four selected villages, the highest distributional equity score was found in Luoyigou village (Mean = 3.03), whereas the lowest was displayed in Dongqiao village (Mean = 2.43).

In addition, Figure 3D clearly presented the spatial distribution of perceived combined equity, which shared a similar pattern with procedural equity and gradually increased from the northeast to southwest. Dwellers in Weiba village tended to have more positive feelings for combined fairness, the average score of which was 2.77. By contrast, residents in Dongqiao village were frequently more disappointed with their lot (Mean = 2.41; see Supplementary Table D).

2 https://map.baidu.com/

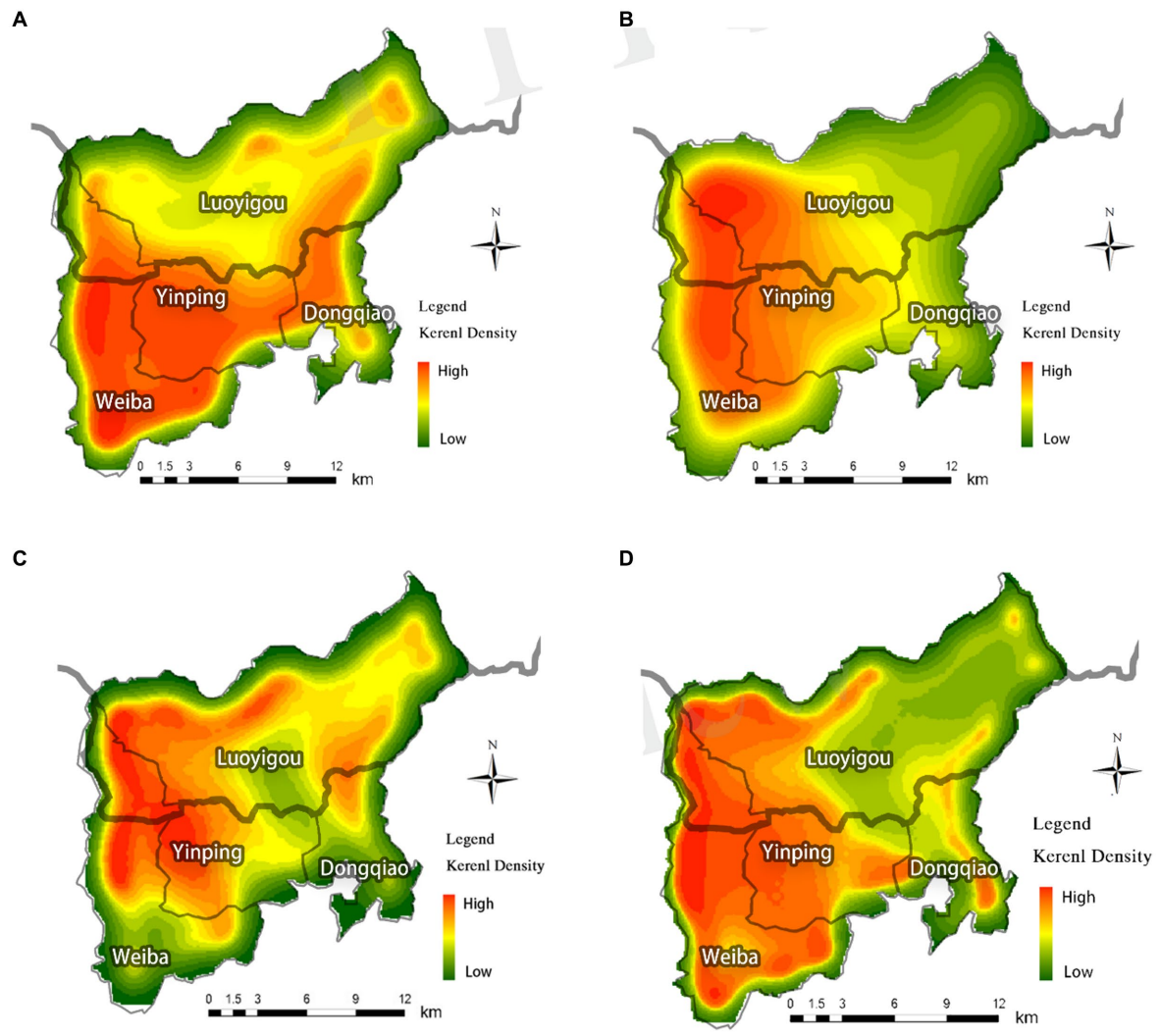

FIGURE 3
Spatial distribution patterns of perceived equity across recognitional **(A)**, procedural **(B)**, distributional **(C)**, and combined equity **(D)**.

3.3. Detecting the spatial determinants on perceived equity

According to OLS, both the statistical values of the Lagrange multiplier (lag) and the Lagrange multiplier (error) were significant at the level of $p < 0.01$, presented in Table 3. The statistical values of robust LM (lag) and robust LM (error) were also significant, verifying the necessity to construct the spatial econometric models. The SEM with a higher fitting coefficient than the SLM was selected for subsequent analysis (Anselin et al., 2004). The LogL of the SEM model was larger than that of the OLS model, while the AIC and the slope change (SC) values were much smaller than those of the OLS model, indicating that the fitting performance of the SEM model had significantly improved compared with the OLS model. Thus, we used results from spatial regressions for subsequent analyses.

As shown in Table 4, local respondents living closer to the PA boundary and PA authority tended to develop more negative judgments on combined social equity, while those who residing near tourism spots were more likely to perceive adversely. For recognitional equity, the proximity with PA boundary and PA authority was negatively linked local residents' fairness perceptions. As to perceptions toward procedural equity, surrounding communities with easy access to PA authority were more likely to perceive negatively, while those who with close connectivity to tourism spots behaved in an opposite way. In addition, positive judgments toward distributional equity were more likely to be found among local residents who lived far away from PA boundary and PA authority, and those who lived close to tourism spots (see Supplementary Table E).

4. Discussion

4.1. Spatial determinants of perceived fairness

Our research results indicate that the spatial distribution of perceived justice varies across three equity dimensions. While the perceived recognitional equity is largely divided by the PA boundary,

TABLE 3 Results of spatial dependence tests of the impact of spatial factors on perceived equity.

	Combined equity		Recognitional equity		Procedural equity		Distributional equity	
Test	MI/DF	Statistical value	MI/DF	Statistical value	MI/DF	Statistical value	MI/DF	Statistical value
Moran's I (error)	0.7078	35.8101***	0.6565	33.2409***	0.6808	34.4571***	0.7204	36.4405***
Lagrange multiplier (lag)	1	1217.6475***	1	1046.0965***	1	1117.2857***	1	1255.6500***
Robust LM (lag)	1	13.6345 ***	1	16.5248***	1	6.5442***	1	6.7211***
Lagrange multiplier (error)	1	1206.0329***	1	1037.5547***	1	1115.7592***	1	1249.3058***
Robust LM (error)	1	22.0200 ***	1	8.0232***	1	5.0177***	1	9.3769***
Lagrange multiplier (SARMA)	2	1219.6675***	2	1054.0794***	2	1122.3034***	2	1256.0269***

*$p < 0.1$; ***$p < 0.01$.

TABLE 4 Preliminary results of the impact of spatial factors on perceived equity.

		Access to boundary	Access to authority	Access to roads	Access to tourism	LogL	AIC	SC
Combined equity	Coef.	3.61	1.47	0.01	−2.38	327.368	−644.735	−622.132
	Prob.	0.000***	0.000***	0.11	0.000***			
Recognitional equity	Coef.	6.24	0.32	−0.49	−0.18	289.262	−568.521	−545.917
	Prob.	0.000***	0.043*	0.984	0.398			
Procedural equity	Coef.	8.04	8.93	−0.03	−4.47	166.789	−323.578	−300.975
	Prob.	0.06	0.000***	0.07	0.000***			
Distributional equity	Coef.	2.49	9.48	−0.01	−9.20	75.133	−140.265	−117.662
	Prob.	0.000***	0.000***	0.314	0.000***			

*$p < 0.05$; ***$p < 0.01$.

the overall procedural justice obviously increases from the northeast to the southwest, and the optimism in local distributional perceptions tend to be clustered in the northwest direction. Despite numerous causes can be responsible for this heterogeneity, one innovative perspective of our study is to probe into its spatial predicators.

First of all, the accessibility to PA boundary was the most influential factor on recognitional perceptions among all spatial variables. This refers to the fact the remoteness from the PA boundary increases locals' positive judgments for recognitional justice. For one thing, the land use and livelihood within the TGPNP boundary are strictly restricted and controlled according to the Regulations on the Management of Nature Reserves. This leads to overwhelming low scores of legal and traditional rights (RE3) and land ownership (RE4) among respondents living inside the PA, adversely impacting recognitional equity. For another, this is also partially due to the widely existed human–wildlife conflicts, threatening the livelihood of local residents (RE2) in close proximity to the TGPNP. In our interviews, villagers of Luoyigou complained that "wild boars came to have crops every day," so they were heavily "affected by such wildlife accidents" for "losing the harvest throughout the year." Those findings corroborate the results of Digun-Aweto et al. (2020) who presented that the proximity to national parks was most of the time accompanied by pessimism toward conservation, for those nearby communities were much more affected by crop losses caused by wildlife.

One unexpected finding of our study was that the accessibility to PA authority has a negative effect on residents' perceptions across all dimensions of fairness. Proximity to the ATA can decrease local communities' perceived attitudes to the fairness of conservation. This finding, though surprisingly, reflects the fact that the governance of ATA is questioned by locals. One potential cause is that PA authorities can impose restrictions on local access to natural resources, and even the act of designating PAs is seen by some as a form of land grabbing. Furthermore, there is also possibly that due to a lack of information-sharing channels and insufficient participatory approaches provided by ATA diminishes their reputation. It is observed in TGPNP that some dwellers living far away mentioned that they did not know what the ATA is, while those who living close complained the lack of participatory opportunities. As one interviewee grumbled, "If the ATA asked me to give suggestions or get involved with conservation, I'd love to; but the thing is they never asked me." In that case, accessibility

to the ATA, though adds up to the probability to get access to information, can enhance the likelihood to feel "marginalized" or "excluded from the decision-making process" at the same time. This finding is consistent with study of He and Wei (2022) in Qianjiangyuan National Park, where local farmers spending more time on the Internet tended to develop more negative attitudes toward conservation, illustrating the exposure to information could bring down feelings for justice.

Our research findings also indicated that the tourism accessibility imposes a positive-going impact on procedural and distributional fairness among local residents. The proximity with tourist attractions is frequently associated with higher scores of procedural and distributional judgments. This finding verifies a prevailing situation that local residents living close to tourist attractions are usually provided with more participatory chances and diversified livelihood choices, such as employment in hotels and hostels (Nelson and Makko, 2005; Kideghesho et al., 2007; Lobora, 2016; Kaaya and Chapman, 2017; Mashauri, 2017). In the case study of TGPNP, local residents in tourism-based villages were more likely to develop more positive perceptions toward distributional justice (Yinping and Luoyigou, mean = 2.93) than non-tourism villages (Weiba and Dongqiao, mean = 2.48). Mashauri (2017) argued that such inequitable benefit-sharing mechanisms can impede locals from developing supportive attitudes toward conservation in adjacent communities of Serengeti National Park.

However, our study found no impact of traffic accessibility on perceived social equity in the context of TGPNA. We authors suppose this is potentially due to the "Village to Village" project, a road building and improvement project arranged for all villages surrounding the TGPNA, ensuring relatively equitable access to transport infrastructure among local dwellers. He and Wei (2022) noticed that farmers with higher levels of satisfaction toward the basic infrastructure tended to have more positive conservation attitudes in Qianjiangyuan National Park. Such correlations deserve further exploration and verified in the context of TGPNP.

4.2. Policy relevance

Our study, though attentively focusing on the spatial distribution of perceived fairness, never intends to deny the driving force of biodiversity attributes and policy drivers behind. From the perspective of spatial justice, human spatiality is socially constructed. This means that what is regarded as fair and just will vary from place to place, and may be affected and modified by the characteristics of a specific place decision (Plant, 1998). Therefore, the potential for seeking spatial justice by modifying human spatiality according to the characteristics of a particular place should exist in all situations. Soja (2010) argued that spatial justice and injustice can be seen as both outcome and process, as geographies or distributional patterns that are in themselves just/unjust as the processes that produce these outcomes. If PA authorities fail to implement fair and legal allocation policies and protection compensation mechanisms, it will not only weaken the communities' trust in political institutions, but also undermine the level of spatial justice. In short, as mentioned above: local characteristics, interacted with structural factors such as governance policy systems, can exert significant impact on the rights and participation of residents, thus consequently forming the spatiality of injustice.

Given that "oppression and inequity are rife at all geographic scales" (Crampton and Elden, 2007), and the importance of seeking more equitably managed PAs we put forward some proposals for consideration by the PA authority. First, it is common to spot human–wildlife conflicts surrounding the TGPNA, yet the current compensation program for wildlife conflicts is merely undertaken in Luoyigou village, causing widespread feelings for injustice among the remaining villages. Therefore, we suggest extending this program to other adjacent villages, providing economic compensation for losses of local livelihoods damaged by the unexpected intruding of wildlife. Second, the restrictions imposed on land use within the TGPNP boundary have led to recognitional injustice, based on which we argue for initiating franchise mechanisms provided for inside dwellers to strive for more equitably distributed income. Third, the proximity with ATA can obviously reduce fairness perceptions, which is apparently due to opaque policies and low participation in the policy formulation process. Therefore, we call upon to optimize the community-based participation procedures and involve locals in the planning, management, and policy formulation process. Fourth, as the inclination of tourism policies lead to disappointed feelings among residents who live far away, we advocate for more spatially scattered tourism spots to balance income among communities. In particular, it is worthwhile to increase the added value of agricultural and forestry products (e.g., honey, persimmon, and fungus) in surrounding forest-dependent communities (Zhang et al., 2023).

5. Conclusion

This paper depicted the spatial patterns of fairness perceptions in a gateway community of TGPNP, and examined the impact of accessible factors on local fairness perceptions. Our main findings are summarized as follows: (1) The spatial patterns of perceived fairness vary across three equity dimensions. The scores for recognitional equity are much lower in the interior side of TGPNP compared to the exterior; perceptions for procedural equity gradually increase from the northeast to southwest; and core clusters of distributional equity are concentrated in the northwestern part of the study region. (2) Local residents living far away from PA boundary (outside the park) are more likely to develop positive feelings toward recognitional, distributional, and combined justice. (3) The proximity with PA authority is positively associated with feelings of injustice across all surveyed fair dimensions. (4) Local residents with easy access to tourism attractions tend to develop more optimistic fairness perceptions in procedural and distributional aspects. Furthermore, we argue that those spatial differentials in fairness perceptions are actually driven by the intrinsic discrepancy of biodiversity protection requirements and unevenly distributed management policies. This points to the need for promoting multi-industry guidance, extending participative channels and improving co-producing compensation plans in TGPNP.

Despite all those findings, some research limitations remain. For one thing, our study region is limited within a gateway community of a national park, excluding other non-gateway communities. A comprehensive study incorporating all adjacent communities in the future might come up with more comprehensive research findings.

For another, the spatial distribution pattern of perceived equity may vary across PAs with different types of natural resources. As TGPNP is situated in a mountainous region with abundant forest resources, future researches incorporating marine resources, wetland, and grassland are urgently needed to make comparisons. More research shedding light on the spatial aspect of equitably managed PAs are constantly required.

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

QL: introduction, field survey, statistical analysis, literature review, and original draft preparation. JH: statistical analysis, methodology, and original draft preparation. YZ: introduction, field survey, conceptualization, data curation, literature review, original draft preparation, project administration, and funding acquisition. GG: review and editing. DB: conceptualization, and review and editing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fevo.2023.1129556/full#supplementary-material

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