Can tourism development enhance livelihood capitals of rural households? Evidence from Huangshan National Park adjacent communities, China

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HIGHLIGHTS

- This paper reconstructs the rural house-holds' livelihood capital indicators.
- Institutional capital is an important dimension of livelihood capitals.
- The annual growth of the total livelihood capital has strong rigidity.
- Ecotourism development is an effective way to enhance the livelihood capitals.

GRAPHICAL ABSTRACT

Temporal changes in the livelihood capitals of rural households in 2006 and 2015. Relationship between the total livelihood capital of rural households and the distance from communities government resident to Huangshan Scenic Area in 2006 and 2015.

ARTICLE INFO

ABSTRACT
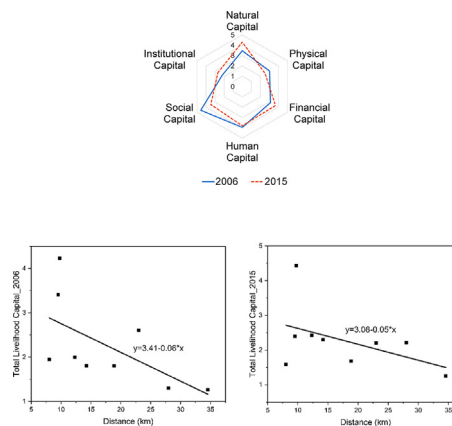
Measuring the change of the livelihood capitals of rural households in park-adjacent communities under the background of tourism development is an important predictor to identify the sustainable development status of national parks. This paper constructs measurement indicators of the livelihood capitals of rural household in communities surrounding national parks and takes Huangshan National Park, located in eastern China, as an example to calculate characteristics of spatiotemporal changes in the livelihood capitals of rural households, analyze the effect of tourism development on livelihood capitals in adjacent communities in 2006 and 2015. The findings indicate that the annual growth of the total livelihood capital has comparatively strong rigidity. However, there are some differences in temporal changes between different types of livelihood capitals. The distribution of zones of medium and high livelihood capital is mainly distributed in the communities adjacent to the national park research, education and recreation area (RERA). In addition, the total livelihood capital takes the RERA as the centre and decays over distance, which demonstrates that tourism development is an effective way to enhance the livelihood capitals. On the other hand, there is a spatial attenuation effect of tourism development on the enhancement of the livelihood capitals.

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1. Introduction

Eliminating poverty is a significant part of achieving Sustainable Development Goals for governments around the world. Focusing on the theme of eliminating poverty, government departments, international organizations and academia have put forward various solutions and analytical frameworks. Based on a systematic summary of related research results, the institution represented by the UK Department for International Development (DFID) developed the Sustainable Livelihood Framework (SLF) to better understand and solve poverty. The framework holds that various livelihood resources of those in poverties can be transferred into livelihood capitals, producing expected livelihood outcomes based on certain livelihood capitals working on specific livelihood strategies. Livelihood outcomes, in return, affect livelihood capitals (Chambers and Conway, 1992; Ashley and Carney, 1999; Scoones, 2009). Therefore, the livelihood capitals represent the livelihood capacities of household; and the available, configurable livelihood capitals are the starting points of livelihood analysis.

The livelihood capitals in SLF include natural capital, physical capital, financial capital, human capital and social capital. However, the five-above mentioned dimensions of livelihood capitals are proposed in the context of Western society, which means that they do not necessarily apply to all conditions, and cannot take temporal changes tendency and different institutional factors into consideration (Adato and Meinzendick, 1910; Singh and Gilman, 1999; Scoones, 2009). In this regard, it is important to explore the following aspects of the structure of livelihood capitals.

First, macrolevel development influences the amount of livelihood capitals of household on the microlevel. Compared with Western countries, most of the developing countries have centralized systems, which take public ownership, collective ownership and collectivism as core values of the states. The adoption of the top-down coordinated development pattern values the improvement of livelihood capitals at the microlevel of the person or the household and strengthens the importance of development on the macro level, further determining the total amount and change of livelihood capitals (Singh and Gilman, 1999; Plagányi et al., 2013; Lienert and Burger, 2015; Xu et al., 2016; Wang et al., 2017). To expand the research perspective of livelihood capitals, this paper combines the macrolevel perspective with the microlevel perspective to reconstruct measurement indicators of livelihood capitals.

Second, there have been studies that are not focused enough on one the dimension of institutional capital of livelihood capitals. Institutional capital refers to the formal and informal institutions that act as a resource element to participate in the sharing of benefits. Institutional capital contains public development policy, social insurance policy, transfer payment policy, etc. Management agencies provide opportunities and guarantees for improving livelihood capitals (Imperial, 1999; Zhou, 2005; Shen et al., 2008; Scoones, 2009; Persha et al., 2011; Dang et al., 2020). Therefore, to acquire a scientific measurement of livelihood capitals, this paper takes institutional capital as another dimension of livelihood capitals.

Third, current studies focus more on the static evaluation of livelihood capitals, calculating livelihood capitals at some time point in a specific area (Stringer et al., 2010; Ifejika et al., 2014; Duan and Wen, 2017). However, resource management and tourism development are significant factors that influence rural community capital of national park (Stone and Nyaupane, 2014; Stone and Nyaupane, 2016). As an important part of stakeholder of national park, residents' support to environment protection is determined by their recognition of natural resource management control (Zhang et al., 2020). Previous studies also prove that the transformation of governance mode of national park from government control to multi-level government control effectively improves community capital (Stone and Nyaupane, 2016). Tourism development, the engine of sustainable development of national park, promotes reciprocal coexistence of national park and rural community, and exerts crucial influence on community rural household livelihood. However, scholars have not reached a consensus on the topic whether tourism development promotes livelihood capital of national park surrounding community (Stone and Nyaupane, 2017; Stone and Nyaupane, 2018). Questions such as whether livelihood capitals have been changed and what kind of changes or how the changes have been taken place are less addressed (Chen et al., 2013; Movono et al., 2018). To enrich the research content of livelihood capitals, this paper makes a spatiotemporal analysis of livelihood capitals.

The utilization of natural resources helps eliminate poverty, but excessive demands on nature leads to a reduction in biodiversity (Tvedt and Young, 2007). The establishment of protected areas is one of the most effective strategies and methods to protect biodiversity. According to the United Nations List of Protected Areas in 2014, there are 209,429 protected areas in the world, with an area of 32,868,673 km^2, accounting for 15.4% of the land area and 3.4% of the sea area (Deguignet et al., 2014). Among the protected areas that meet the IUCN's standard of classification, approximately 26.6% belong to the category of national park (Yang, 2016). A national park is a protected area that not only protects biodiversity but also provides the recreation and environmental education opportunities for visitors, promotes the sustainable livelihood for local communities (Dudley, 2008; Shen et al., 2020). National parks well address the relationship between protection and rational utilization of natural resources and consider the demands of using of the local community for fundamental livelihood resources into consideration (Dudley, 2008; Wittmayer and Büscher, 2010; Nepal and Spiteri, 2011). In this regard, most of the countries and regions have gradually constructed national parks and regard them as the major type of protected area under the background of the industrialized age (the latter part of the 19th century and the 20th century). Compared with other countries, China started to construct national parks at the end of year 2013 when its industrial civilization coexisted with ecological civilization. China's national park, a product of a special historical period, practices "the strictest protection" and has strong practical significance and necessity (Yang, 2019). The constructed area of China's national park is relatively large (the average pilot area is more than 250 km^2) (Zhuang et al., 2017), with many residents dwelling in inside and in the surroundings (especially the southeast part of the Heihe-Tengchong Line, with high population density). Local residents enjoy the traditional rights to enter the collective land in constructed areas and are highly dependent on the natural resources of the collective land to maintain and improve their livelihood standards (Zhang et al., 2005; Duan and Wen, 2017).

The construction of national park, however, definitely limits adjacent communities' utilization ways and rights to use and develop the natural resources of inside and nearby the national parks, which put those adjacent communities at the risk of reduced livelihood capitals (Stone and Nyaupane, 2016; Wang, 2017; Liu et al., 2018). Therefore, the sustainable livelihood development of adjacent communities is a great difficulty that troubles the construction of China's national parks.

A national park is a special area in which the man-land relationship is interactive; the residents of adjacent communities are main stakeholders and utilize natural resources to improve their livelihood (Twyman, 2001; Bergquist, 2007). Thus, in determining how to coordinate the influence of national parks, practising the strictest protection on livelihood development of the surrounding community residents becomes a theoretical and practical question that needs to be immediately answered. The key to solving the question is to measure the livelihood capitals rural households in national park communities. According to the data of measurement indicators of livelihood capitals of rural households in different years, this paper explores the changes of livelihood capitals in the surrounding communities and ecotourism development effect on livelihood capitals.

The present study answers the following questions: have livelihood capitals changed, and how have they changed? What kind of spatial features does the change of livelihood capitals have? Does tourism

development influence the livelihood capitals of rural households in the communities surrounding a national park? To answer the above questions, this article selects a mountainous national park in eastern China, with the characteristics of complex land ownership, high population density, more developed economy and sharply conflicting man-land relationship, as a case to attempt to enrich the research perspective and sustainable livelihoods knowledge system, provide a thorough understanding of ecotourism development effect on livelihood capitals, enhance the effectiveness of national park protection and the sustainability of community livelihood, and promote the coordinated development of the national park community.

2. Research methods

2.1. Sustainable livelihood capability framework

The lack of the livelihood capitals contributes to people's poverty, which makes the livelihood capitals a capability that can combat poverty. For this reason, improving and enhancing livelihood capitals are important ways to achieve sustainable livelihood development (Singh and Gilman, 1999; Li et al., 2012). Lienert and Burger integrate the capacity method and SLF and put forward the Sustainable Livelihood Capacity Framework (SLCF). This paper modified from the framework, and makes some modification by taking institutional capital into consideration (Fig. 1), and combines the macrolevel with the microlevel to construct measurement indicators of livelihood capitals (Fig. 2).

For most of the developing countries, especially for those rural households in mountainous areas, institutional capital mainly refers to public development policy, social insurance policy, and transfer payment policy (Imperial, 1999; Zhou, 2005; Shen et al., 2008; Persha et al., 2011); natural capital mainly refers to ecological environment and land resources, such as arable land, woodland and garden plots (Babigumira et al., 2014; Fang et al., 2014; Thulstrup, 2015); physical capital mainly refers to infrastructure, buildings, tool and equipment (Speranza et al., 2014; Donohue and Biggs, 2015; Cinner et al., 2018); financial capital mainly refers to government revenue and loans and personal or household income and deposits (Li et al., 2012; Huai, 2016; Hua et al., 2017); human capital mainly refers to the labour quantity and capacity formed by education, health and development investment

(Mahdi and Schmidt-Vogt, 2009; Ifejika et al., 2014; Wu et al., 2017); social capital mainly refers to social networks and social relations (Temple and Johnson, 1998; Li et al., 2017; Tanner et al., 2015); and institutional capital mainly refers to public development policy, social insurance policy, and transfer payment policy (Imperial, 1999; Zhou, 2005; Shen et al., 2008; Xu et al., 2016).

2.2. Measurement indicators of livelihood capitals of rural households

The specific indicators of rural households' livelihood capitals are not selected in the unilateral pursuit of comprehensiveness, but relies on the reality of the social and economic development of China's towns, the guidelines for China's national park function zoning (including strict protection zone, ecosystem conservation zone, native community zone, research, education and recreation zone) and the natural conditions of local communities are the basis for exploring the six types of livelihood capitals (including natural capital, physical capital, financial capital, human capital, social capital and institutional capital) and their forms of representation from the perspective of macrolevel and microlevel.

For the quantization of livelihood capitals, this paper systematically summarizes the related research literature. Connecting with the case's practical situation, this paper finally determines 17 measurement indicators of the livelihood capitals of rural households in the national park communities according to the principles of representativeness, independence, targeting and data availability (Table 1). Based on the previously collected data of measurement indicators of the livelihood capitals of rural households in park-adjacent communities in 2006 and 2015, this paper calculates and analyses the scores of and changes in livelihood capitals.

2.3. Data processing

Because differences exist in the order of magnitude, dimension and variation degree between different measurement indicators, this paper applies the maximum difference dormalization method to standardize the initial data of 17 measurement indicators in 2006 and 2015. The standardized formula of the positive indicator is $Z_{ij} = (X_{ij} - \text{Min}(X_{ij}))/\text{Max}(X_{ij}) - \text{Min}(X_{ij})$, among which Z_{ij} refers to the
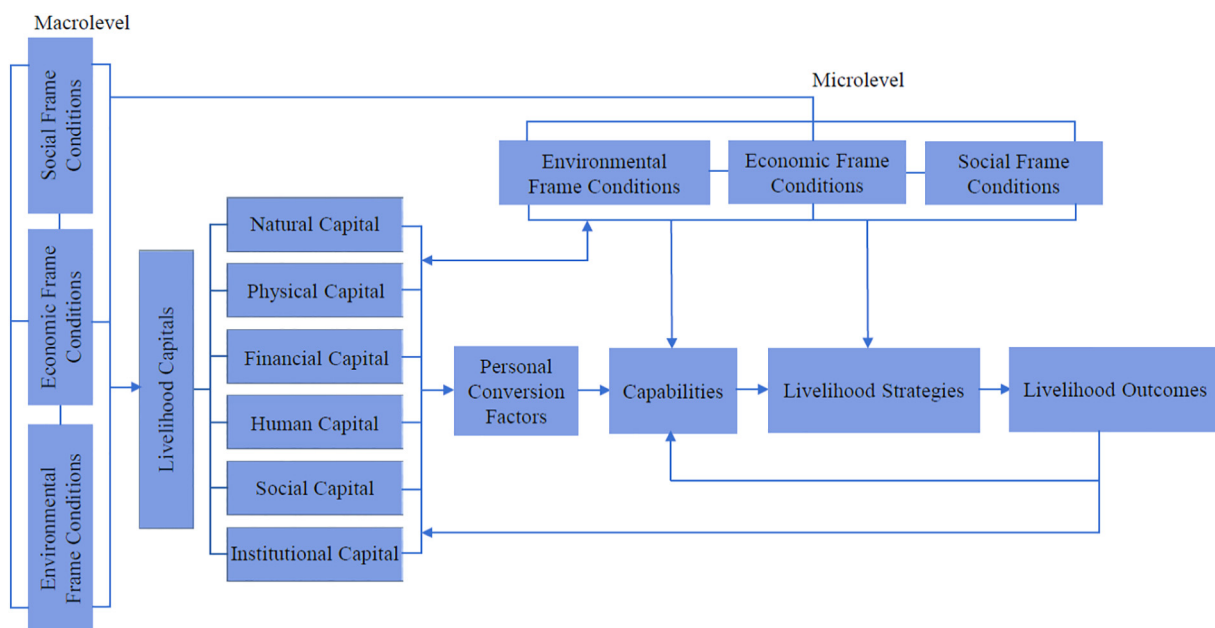

Fig. 1. Sustainable livelihood capability framework.
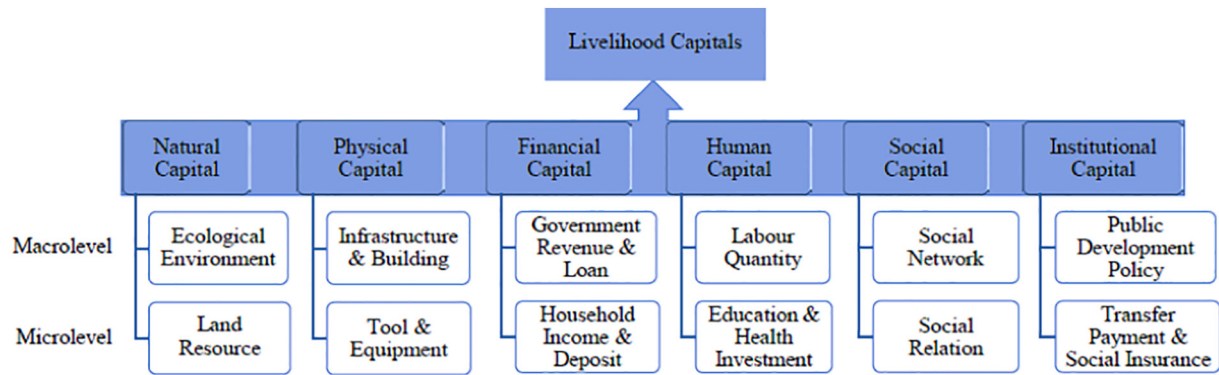(Modified from Lienert and Burger, 2015)

Fig. 2. Composition of livelihood capitals of rural households in developing country.

standardized value, and X_{ij} refers to certain measurement indicator values of livelihood capitals.

The entropy method is a mathematical method used to determine the degree of dispersion of certain indicators by extracting the objective information of statistics to present the value effect of indicator information. The entropy method is widely applied in determining indicator weight because of its objectiveness (Singh, 1997; Wang et al., 2015; Xu et al., 2019). Therefore, this paper adopts the entropy method to evaluate the weight coefficient of the measurement indicators of livelihood capitals. The specific computational process is based on the standardized value Z_{ij}. First, this paper calculates the proportion (P_{ij}) of indicator value of research unit i in indicator j with formula $P_{ij} = Z_{ij} / \sum_{i=1}^{m} Z_{ij}$. Then, it calculates the entropy (e_j) of indicator j with formula $e_j = -k \sum_{i=1}^{m} P_{ij} \ln P_{ij}$, $k = 1/\ln m$. Later, it counts the coefficient of variation (g_j) of indicator j with formula $g_j = 1-e_j$. Last, it calculates the weight (w_j) of number j indicator with formula $w_j = g_j / \sum_{j=1}^{n} g_j$. (In the abovementioned formulas, $i = 1, 2, ..., m$; and $j = 1, 2, ..., n$.)

Based on the weight and standardized value of measurement indicators of livelihood capitals in 2006 and 2015, this paper calculates the six values of livelihood capitals and the value of the total livelihood capital with the formula Total Livelihood Capital $= \sum_{i=1}^{6} \sum_{j}^{n} W_{ij} Z_{ij}$; W_{ij} refers to the weight of measurement indicator j in livelihood capital i; Z_{ij} refers to the standardized value of measurement indicator j in livelihood capital i. The specific calculation process is data pre-processing, calculation of the standardized and weights of the livelihood capital indicators, calculation of the values of the six livelihood capitals and calculation of the value of the total livelihood capital.

3. Research context

3.1. Background of research site

As a pilot area of global sustainable tourism standard destination, the origin of China's modern tourism, Huangshan is a protected area that World Cultural and Natural Heritage, World Geopark and World Biosphere Reserve all rolled in one. Huangshan has made remarkable achievements in protected area protection and management, and made important contributions to tourism development in China and the world at large. In September 2014, Huangshan was recognized as one of the 26 natural units in the world, an outstanding representative of China's Scenic Area for effective nature conservation in the Sixth World Parks Congress of the IUCN.

Huangshan National Park (HNP) is one of the priority areas for China's national park construction between 2020 and 2025. Its construction area spans three districts and counties, including Huangshan district, Huizhou district and Yi county of Huangshan city, Anhui province. Its spatial range includes Huangshan Scenic Area (HSA), Jiulongfeng Nature Reserve, Wuxishan Nature Reserve, Tianhu Nature Reserve and the connecting parts of the four protected areas, among which the research, education and recreation area (RERA) of HNP is located within the Huangshan Scenic Area. The construction area adjoins nine towns including Tangkou, Tanjiaqiao, Sankou, Gengcheng, Jiaocun, Hongcun, Hongtan, Hongxing and Fuxi towns (Fig. 3). The basic information of the adjacent towns in 2015 is presented in Table 2. Consisting mostly of subtropical evergreen broad-leaved forest, HNP is a forest ecosystem with a total area of 330.3 km^2, among which woodland area accounts for 94.90% and collective land area accounts for 54.23%. Many residents dwell in the spatial area of HNP, and the approximate permanent population density is 85.07 people per square kilometer. The adjacent communities enjoy a relatively well-developed economy. In 2013, the rural per capita net income of all adjacent towns was higher than the average levels of China and Anhui province (Fig. 4). Therefore, the HNP has been aspects of both representativeness and exemplariness that are useful for exploring the coordinated development of mountain national park communities with characteristics of complex land ownership, high population density, well-developed economy and sharply conflicting man-land relationships.

3.2. Data collection

In August 2017, July and August 2018, the research group carried out field studies with the Huangshan Scenic Area Administrative Committee; Jiulongfeng, Tianhu and Wuxishan Nature Reserve Management Stations; and adjacent town governments of the HNP construction area to acquire the environmental, economic and social statistical data and local documentations. This study includes 17 measurement indicators of livelihood capital of rural household in national park-adjacent communities (Table 1). The collected data of measurement indicators of livelihood capital of rural household in Huangshan National Park-adjacent communities mainly come from local documentations and government questionnaire (Table 3). Among which 11 measurement indicators data are based on local documentations, including all the measurement indicators of natural capital, physical capital and financial capital; proportion of labor force to total population belonging to measurement indicator of human capital, proportion of urban registered population to total population belonging to measurement indicator of social capital, proportion of Tourism income to the rural economic income belonging to measurement indicator of institutional capital (Table 4).

And the other 6 measurement indicators are based on rural household income and expenditure questionnaire conducted by local

Table 1
Indicators, weights and formulas of the livelihood capital of rural households in the national park adjacent communities.

Livelihood capital	Indicator	Unit	Direction	Weight		Formula
				2006	2015	
Natural capital (N)	*Average cultivated area* (N_1)	hm²/ household	+	0.23	0.24	$N_{2006} = N_1*0.23 + N_2*0.42 + N_3*0.23 + N_4*0.12$
	Average garden area (N_2)	hm²/ household	+	0.42	0.29	$N_{2015} = N_1*0.24 + N_2*0.29 + N_3*0.33 + N_4*0.14$
	Average forest area (N_3)	hm²/ household	+	0.23	0.33	
	Forest cover rate (N_4)	%	+	0.12	0.14	
Physical capital (P)	Rural electricity consumption (P_1)	10 thousand kWh	+	0.39	0.61	$P_{2006} = P_1*0.39 + P_2*0.61$
	Fixed assets investment completion (P_2)	10 thousand CNY	+	0.61	0.39	$P_{2015} = P_1*0.61 + P_2*0.39$
Financial capital (F)	Rural per capita net income (F_1)	10 thousand CNY/ per person	+	0.25	0.44	$F_{2006} = F_1*0.25 + F_2*0.75$
						$F_{2015} = F_1*0.44 + F_2*0.56$
	Fiscal revenue of the town (F_2)	10 thousand CNY	+	0.75	0.56	
Human capital (H)	Cultural, educational and entertainment products and services expenditure (H_1)	10 thousand CNY/ household	+	0.17	0.43	$H_{2006} = H_1*0.17 + H_2*0.32 + H_3*0.51$
	Health care expenditure (H_2)	10 thousand CNY/ household	+	0.32	0.27	$H_{2015} = H_1*0.43 + H_2*0.27 + H_3*0.30$
	The proportion of Labor force to total population (H_3)	%	+	0.51	0.30	
Social capital (S)	Gift-giving relatives and friends expenditure (S_1)	10 thousand CNY/ household	+	0.35	0.30	$S_{2006} = S_1*0.35 + S_2*0.40 + S_3*0.25$
	Transportation and communication expenditure (S_2)	10 thousand CNY/ household	+	0.40	0.39	$S_{2015} = S_1*0.30 + S_2*0.39 + S_3*0.31$
	The proportion of urban registered population to total population (S_3)	%	+	0.25	0.31	
Institutional capital (I)	Insurance expenditure (I_1)	10 thousand CNY/ household	+	0.23	0.24	$I_{2006} = I_1*0.23 + I_2*019 + I_3*0.58$
	Ecological compensation income (I_2)	10 thousand CNY/household	+	0.19	0.26	$I_{2015} = I_1*0.24 + I_2*0.26 + I_3*0.50$
	The proportion of Tourism income to the rural economic income (I_3)	%	+	0.58	0.50	

statistical bureau, including expenditure on cultural, educational and entertainment products and services expenditure, and health care belonging to measurement indicators of human capital, expenditure on gift-giving relatives and friends and transportation and communication belonging to measurement indicators of social capital, insurance expenses and ecological compensation income belonging to measurement indicator of institutional capital. The rural households survey which are designed and conducted by Statistical Bureau of Huangshan City, arranged by Anhui Province, China. The survey contents including cash deposit and withdrawal, household consumption, and other livelihood conditions. Rural household sample adopts the method of systematic sampling to investigate all the counties (including Huangshan district, Huizhou district and Yi county in this study) and all the towns (including nine towns in this study) in Huangshan city. Investigation spots account for 52% of total numbers of town villages. Sampling survey of more than 100 rural households from each town over the years. In this regard, the research case in this paper is included in investigation field of government questionnaire data.

Though these survey data was second-hand questionnaire data, they offer a much better reflection of rural household production and living standard and meet partial data requirement of this research. Firstly, the application of rural household sample questionnaire data collected and collated by government reflects town's rural household living standard and income and expenditure condition comparatively accurately, which further helps to effectively identify town's rural household livelihood capitals. Secondly, government sample questionnaire data offer convenience for tracing town's rural household living standard and income and expenditure condition over the years, and contributes to identify the change tendency of town's rural household livelihood capitals.

In addition, in order to further understand the relationship between tourism development and changes in livelihoods of rural household, research group also made interview with stakeholders such as administrator, entrepreneur and rural household about the changes of ecological resources protection, natural disaster, tourism development, labor input structure, rural household source of income and town social-economy structure since 1980s. These interview materials compensate for the limitation of second-hand data and help to have an idea of the general picture of the case.

China's agricultural taxes were abolished in 2006, and the administrative division of certain towns was modified in Huangshan city in 2005 and 2006 (Sixi town and Jiujiang town were merged into Hongcun town, Guocun town and Xianxiang town were merged into Jiaocun town, and the administrative areas of both Hongcun town and Jiaocun town were increased). Meanwhile, HSA started to establish national 5A level tourist attraction in 2006, and was identified as the highest level of tourist attraction in China later. Establishing national 5A level tourist attraction promotes local government to increase investments to improve infrastructure, attracts both domestic and overseas tourists and expands tourism market share, which further help tourism development to move to a new stage. With the promotion of HSA social and economic benefits, livelihood of surrounding community rural household also make continuous progress. Besides, revision of master plan of HSA was completed in 2006 and implemented gradually. This plan includes recent protection and development planning and community regulation and economic guidance planning, whose implementation further influences surrounding community livelihood resource utilization and rural household livelihood development. In view of the continuity and availability of data, this paper takes 2006 and 2015 as a time section to study the characteristics of livelihood spatial disparity and change.

4. Findings

4.1. Temporal change of livelihood capitals

The temporal change of livelihood capitals has the following three characteristics. First, total livelihood capital enjoys the characteristic of annual growth. The total livelihood capital of rural households in towns adjacent to the HNP are 20.371909 and 20.496176 in 2006 and 2015, respectively, with a total growth of 0.61% and an annual rate of increase of 0.07%. Second, different types of livelihood capitals change over time and present different development trends. The annual growth rates of natural capital, institutional capital and financial capital are on
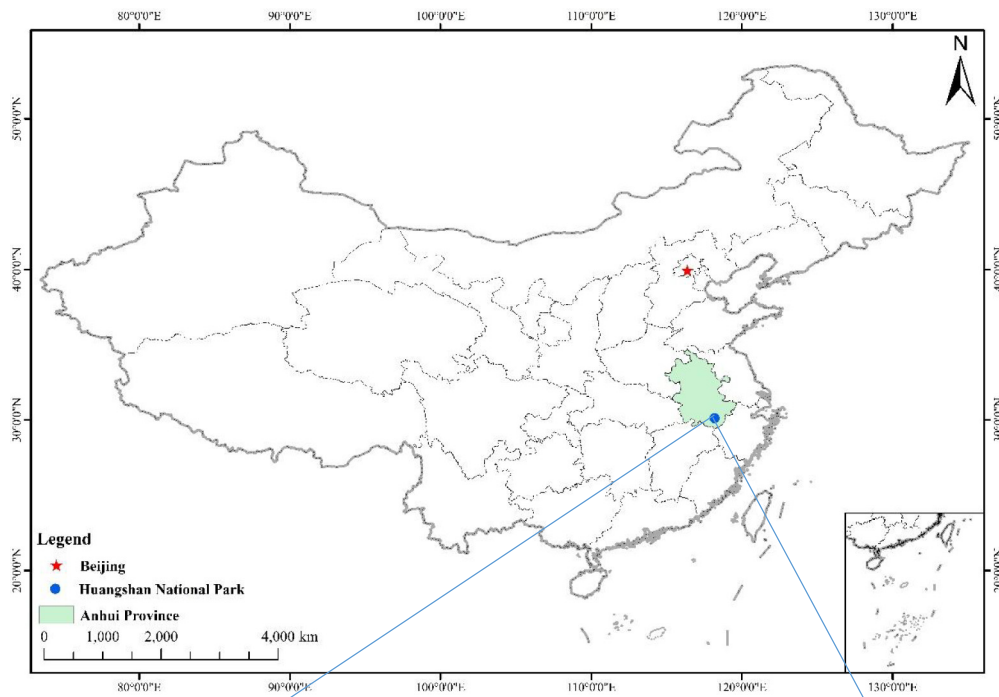
a) Huangshan National Park's location in China
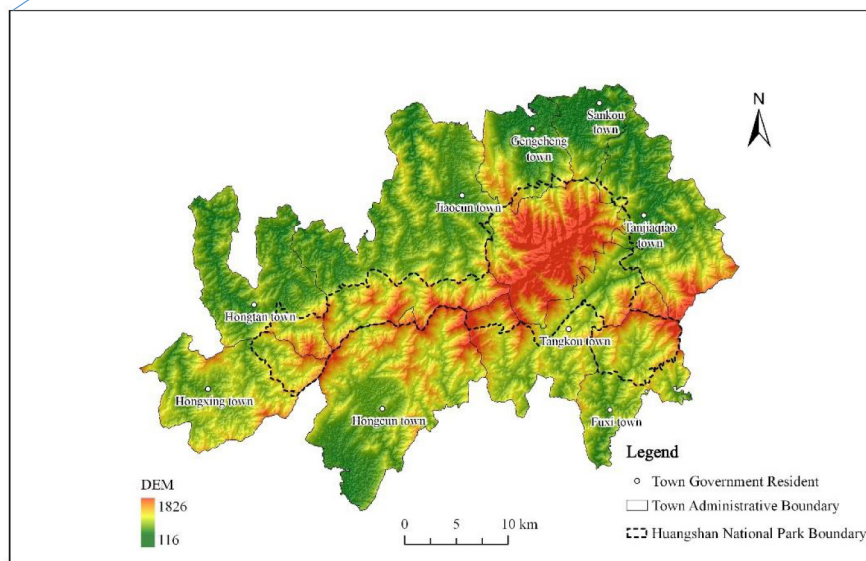
b) Adjacent towns and topographic map of Huangshan National Park

Fig. 3. Location, adjacent towns and topographic map of Huangshan National Park, China. a) Huangshan National Park's location in China b) Adjacent towns and topographic map of Huangshan National Park.

the rise; in contrast, the rates of social capital, physical capital and human capital are on the decline (Fig. 5). From 2006 to 2015, the natural capital of rural households in communities surrounding the HNP increased by 24.40%, with an annual rate of growth of 2.46%; physical capital reduced by 16.26%, with an annual rate of growth of −1.95%; financial capital increased by 17.68%, with an annual rate of growth of 1.826%; human capital reduced by 3.87%, with an annual rate of growth of −0.44%; social capital reduced by 24.20%, with an annual rate of

growth of −3.03%; and institutional capital increased by 21.88%, with an annual rate of growth of 2.22%.

Third, the structural changes of livelihood capitals show that the status of natural capital, financial capital and institutional capital in livelihood structures are promoted, which demonstrates that the structure of livelihood capitals changes from being dominated by social capital to being dominated by natural capital. One reason is that developing ecotourism is a significant way to achieve the effective replacement of

Table 2
Profile of Huangshan national park adjacent communities.

Town	Subordinate district and county	Town government resident	Distance from district and county government (km)	Administrative area of the town (km²)	Total household of the town	Total population of the town	The proportions of migrant labourers to the total population of the town (%)
Tangkou town	Huangshan district	Tangkou village	46	129.3	4385	12,138	9.24
Tanjiaqiao town	Huangshan district	Zhongdun village	27	104.5	2714	8009	27.94
Sankou town	Huangshan district	Baiguoshu village	12	60	3159	9133	21.44
Gengcheng town	Huangshan district	Jinqiao village	7	85	3187	9342	14.41
Jiaocun town	Huangshan district	Longyuan village	15	275	5286	15,066	31.14
Hongcun town	Yi County	Hong village	10	187	6936	18,427	28.10
Hongtan town	Yi County	Hongtan village	43	127.4	1875	5399	37.38
Hongxing town	Yi County	Daxing village	22	119.6	1702	4924	35.42
Fuxi town	Huizhou district	Fuxi village	35	92.8	2205	7000	26.84

the value of ecosystem services. Therefore, enhancing ecological environment protection can ensure the sustainable development of ecotourism. However, since the implementation of the Return Cultivated Land to Forest policy, the regional forest coverage has gradually increased. However, with the promotion of the orderly construction of Huangshan national park and the implementation of the strictest ecological protection policy, the utilization of natural capital by the rural households in surrounding communities will inevitably be limited. Thus, the increase in natural capital might not inevitably lead to the improvement of rural households' livelihood level.

4.2. Spatial distribution changes of total livelihood capital

To directly reflect the spatial distribution characteristic of livelihood capitals, this paper adopts the ArcGIS software and natural breaks (Jenks) to divide the livelihood capitals and total livelihood capital of rural households in communities adjacent to the HNP into a high zone, medium zone and low zone based on the model calculation results of livelihood capitals in 2006 and 2015, and determine the spatial distribution of livelihood capital level (Fig. 6). To further explore the differences between different towns' livelihood capitals in 2006 and 2015, this paper applies SPSS software to make a paired-samples t-test of livelihood capitals and total livelihood capital of rural households. The results show that there is a significant difference between different towns in natural capital ($p = 0.034$), while there is no significance

difference in physical capital ($p = 0.275$), financial capital ($p = 0.471$), human capital ($p = 0.848$), social capital ($p = 0.142$), institutional capital ($p = 0.335$) or total livelihood capital ($p = 0.944$).

The spatial distribution of the total livelihood capital of rural households in the HNP communities in 2006 and 2015 presents the characteristics of high in the east and south and low in the west and north. In 2006, the total livelihood capital of Tangkou town > Gengcheng town > Hongcun town > Tanjiaqiao town > Jiaocun town > Sankou town > Fuxi town > Hongtan town > Hongxing town. Tangkou town (south entrance) and Gengcheng town (north entrance), are two important gateway communities of Huangshan Scenic Area (HSA), belong to a high zone; Fuxi town and other surrounding towns of HSA belong to a medium zone; and Hongtan and Hongxing towns, which are far away from HSA, belong to a low zone. The spatial distribution shows the character of concentrated distribution of the medium zone and high zone. However, in 2015, the total livelihood capital of Tangkou town > Tanjiaqiao town > Gengcheng town > Sankou town > Hongtan town > Hongcun town > Fuxi town > Jiaocun town > Hongxing town. Only Tangkou town belongs to a high zone, while Tanjiaqiao, Gengcheng, Sankou, Hongtan and Hongcun towns belong to a medium zone. Fuxi, Jiaocun and Hongxing towns belong to a low zone.

As mentioned above, the distribution of the low zone of total livelihood capital is dispersive throughout the research area in both 2005 and 2015, while the medium zone and high zone are clustered, being mainly distributed in the communities surrounding of HSA. It can be
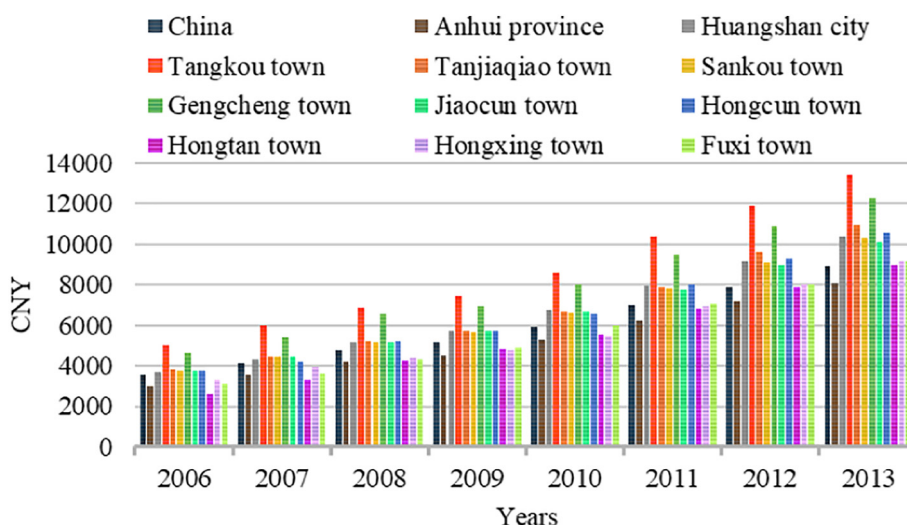

Fig. 4. Comparison of the rural per capita net income between Huangshan National Park surrounding towns and average levels of China, Anhui province and Huangshan city in 2006–2013.

Table 3
Research data sources and detailed information.

Data type	Specific content	Data source	Year
1.Remote sensing image data	Boundaries of the study areas, DEM	1) National geomatics center of China (http://www.ngcc.cn/ngcc/)	–
		2) Resource and environment data cloud platform (http://www.resdc.cn/)	–
2. Statistical yearbook data	Towns land resources, forest cover rate, fiscal revenue, rural per capita net income, total income of rural economy, tourism income, fixed assets investment completion, employees, sample survey of rural households, etc	1) China statistical yearbook (towns)	2016
		2) Statistical communique of Anhui national economic and social development	2006–2013
		3) Huangshan city statistical yearbook	2007–2016
		4) Huangshan district statistical yearbook	2007, 2014, 2016
		5) Huizhou district statistical yearbook	2007, 2014, 2016
		6) Yi county statistical yearbook	2007, 2014, 2016
		7) Huangshan district yearbook	2009, 2017
		8) Huizhou district yearbook	2006–2013
		9) Yi county yearbook	2015
3. Local literature	Socio-economic development of the towns, administrative divisions, rural electricity consumption, etc	1) Administrative code of the People' s Republic of China (Anhui Province)	–
		2) Huangshan National Park resource survey and evaluation report	2017
		3) Outline of the thirteenth five-year plan for national economic and social development of towns	–
		4) Towns agricultural production statistics annual report	2006, 2015
		5) Towns land use master plan	2006–2020
		6) Towns government work report	2016
		7) Towns chronicles	–

concluded that the spatial relationship between communities and RERA of national parks, and the ecotourism development level of communities are important factors that influence the total livelihood capital of rural households. The low zones, including Hongtan, Hongxing and Fuxi towns, are traditional farming communities that are far away from HAS and whose community tourism income accounts for almost none of the total income of rural economy. However, the communities surrounding HSA, belonging to the medium zone and high zone, have good opportunities for tourism development, especially the gateway communities of HSA. The tourism income in these communities accounts for a high proportion of the total income of the rural economy. For example, in Tangkou town (south gateway of the HSA), tourism income accounts for almost 80% of the total income of the rural economy, making Tangkou community with the highest total livelihood capital. The major reason is that approximately 80% of tourists enter HSA through the south gateway every year, while few entre through other gateway communities; thus, ecotourism development has the most

Table 4
Livelihood capital of rural households and its changes between 2006 and 2015.

| Town Livelihood capital	Tangkou	Tanjiaqiao	Sankou	Gengcheng	Jiaocun	Hongcun	Hongtan	Hongxing	Fuxi
Natural capital									
2006	0.351326	0.306231	0.18319	0.338244	0.395988	0.300089	0.527508	0.441897	0.616125
2015	0.296235	0.462847	0.358378	0.300421	0.526854	0.347833	0.736339	0.673779	0.602147
Difference	−0.055091	0.156616	0.175188	−0.037823	0.130866	0.047744	0.208831	0.231882	−0.013978
Physical capital									
2006	0.819570	0.429995	0.119180	0.624387	0.281017	0.587013	0.010855	0.026758	0.120607
2015	1.01	0.470269	0.059201	0.423474	0.118665	0.321006	0.040936	0.016438	0.068411
Difference	0.19043	0.040274	−0.059979	−0.200913	−0.162352	−0.266007	0.030081	−0.01032	−0.052196
Financial capital									
2006	0.90665	0.3041	0.171925	0.972	0.2369475	0.3152	0.01	0.0899	0.11905
2015	1.01	0.319456	0.317192	0.529736	0.265524	0.649332	0.01	0.051104	0.526144
Difference	0.10335	0.015356	0.145267	−0.442264	0.0285765	0.334132	0.00	−0.038796	0.407094
Human capital									
2006	0.340217	0.361164	0.619274	0.286225	0.266149	0.681179	0.376727	0.33	0.696301
2015	0.726346	0.101414	0.656900	0.427655	0.211026	0.424786	0.668790	0.260043	0.327163
Difference	0.386129	−0.25975	0.037626	0.14143	−0.055123	−0.256393	0.292063	−0.069957	−0.369138
Social capital									
2006	1.01	0.28714	0.67571	0.894345	0.56503	0.384035	0.261275	0.306265	0.21288
2015	0.623894	0.387805	0.699727	0.577417	0.306617	0.181717	0.573619	0.038002	0.095298
Difference	−0.386106	0.100665	0.024017	−0.316928	−0.258413	−0.202318	0.312344	−0.268263	−0.117582
Institutional capital									
2006	0.799925	0.311504	0.039346	0.297493	0.204137	0.342404	0.115334	0.066903	0.035194
2015	0.770852	0.680488	0.211796	0.138788	0.159148	0.279292	0.187428	0.2089	0.059544
Difference	−0.029073	0.368984	0.17245	−0.158705	−0.044989	−0.063112	0.072094	0.141997	0.02435
Total livelihood capital									
2006	4.227688	2.000134	1.808625	3.412694	1.9492685	2.60992	1.301699	1.261723	1.800157
2015	4.437327	2.422279	2.303194	2.397491	1.587834	2.203966	2.217112	1.248266	1.678707
Difference	0.209639	0.422145	0.494569	−1.015203	−0.3614345	−0.405954	0.915413	−0.013457	−0.12145
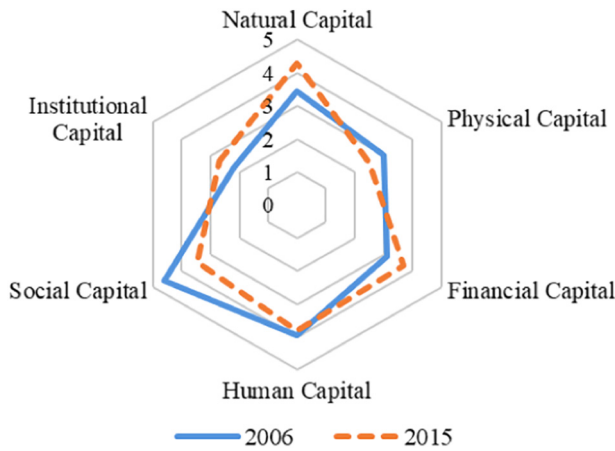
Fig. 5. Temporal changes in the livelihood capitals of rural households in Huangshan National Park adjacent communities in 2006 and 2015.

influence on the improvement and promotion of the total livelihood capital of rural households in Tangkou community.

4.3. Spatial distribution changes of livelihood capitals

HNP is still in the stage of construction at present, and the constructing area of HNP mainly refers to the spatial scope of one national scenic area and four provincial natural reserves. The protection of national scenic areas is stricter than the protection of provincial natural reserves. The closer to HSA (research, education and recreation area of the HNP) communities are, the stricter the ecological protection is, and the more limited the community's use of natural resources. Therefore, the natural resources are "locked". In addition, the ecotourism development of the HSA surrounding the community greatly influences land utilization. The arable land, woodland and garden land coverts into urban or rural construction land, causing natural capital reduction. The degree of change in natural capital between 2006 and 2015 demonstrates that Sankou town (95.63%) > Hongxing town (52.47%) > Tanjiaqiao town (51.14%) > Hongtan town (39.59%) > Jiaocun town (33.05%) > Hongcun town (15.91%) > Tangkou town (−15.68%) > Gengcheng town (−11.18%) > Fuxi town (−2.27%). There are significant differences in natural capital between different towns.

The natural capital of the south gateway community of HSA (Tangkou town) residents has the highest degree of decline, followed by the north gateway community (Gengcheng town), which demonstrates that such kind of land use conversion is mainly distributed in HSA gateway communities with high levels of community tourism development. With the decline of natural capital, such as arable land, woodland and garden land, the increase in urban or rural construction land, and the constant improvement of the community public infrastructure and tourism service facilities, physical capital also has the tendency to increase. Thus, in both 2006 and 2015, in communities with high levels of tourism development, such as Tangkou community, rural households' physical capital represents a high zone, while in communities with low levels of tourism development, such as Hongtan, Hongxing, Fuxi and Sankou town, rural households' physical capital represents a low zone.

The ecotourism development of national parks promotes the transformation of the community industrial structure and changes in rural households' employment structure. The shorter the distance between the major gateway communities and the national park RERA, the more tourism employment opportunities there are, and the higher the proportion of tourism employment among the residents, leading fewer residents to work outside the area. In contrast, the majority of communities that are far from HSA are traditional farming
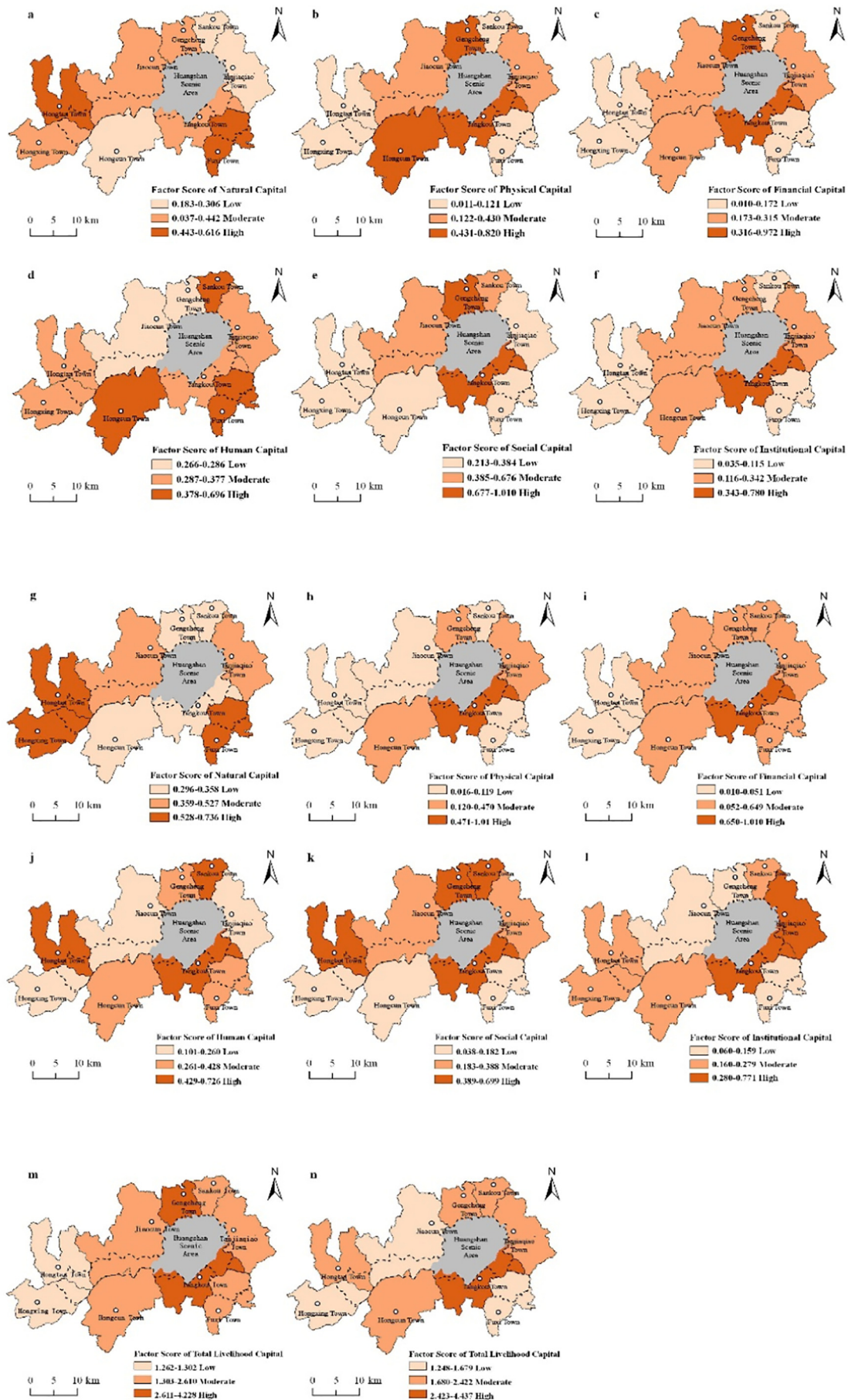
communities, and their residents have little opportunity for tourism employment. Therefore, residents have a lower proportion of local employment, and a higher proportion of outside employment (The proportions of migrant labourers to the total population of the towns are presented in Table 2). The degree of change in human capital between 2006 and 2015 demonstrates that Tangkou town (113.49%) > Hongtan town (77.53%) > Tanjiaqiao town (−71.92%) > Fuxi town (−53.01%) > Gengcheng town (49.41%) > Hongcun town (−37.64%) > Hongxing town (−21.20%) > Jiaocun town (−20.71%) > Sankou town (6.08%).

Tangkou town has the highest degree of increase in human capital, which can contribute to its having the lowest proportion of residents working outside and the majority of its residents working in local tourism industry. This demonstrates that tourism is a significant livelihood strategy for Tangkou community residents' local employment. Tourism places more demands on human capital, financial capital, social capital, etc. than does agriculture. With the influence of community tourism development, residents regard investments in human capital, financial capital and social capital as important ways to improve their livelihood adaptability and change their livelihood strategy. Therefore, in both 2006 and 2015 Tangkou town has a high level of tourism development, and its residents' financial capital, social capital and institutional capital belong to a high zones.

4.4. The effect of tourism development on livelihood capitals

Recreation and ecotourism play an important role in national park ecosystem services. Promoting the economic development of adjacent communities through tourism is an important goal of national parks (Dudley, 2008). Research shows that the development of tourism in national parks not only helps lower adjacent communities' dependency on natural resources but also promotes natural capital appreciation and increases the total livelihood capital (Sandbrook, 2010; Nyaupane and Poudel, 2011; Qian et al., 2017; Su et al., 2019; Zhu et al., 2019; Luo and Bao, 2019). The HSA is located at 118.0166675°E−118.2833345°E, 30.016667°N−30.3°N. Its central coordinate point is 118.15°E, 30.158334°N. HSA, with a core scenic area of 160.6 km², is an important part of HNP. The tourist reception and total tourism revenue of HSA have steadily increased since its opening to the public in 1979. The economic development of the surrounding communities is also effectively stimulated. HSA attracted 46.8245 million domestic and foreign tourists, and the total tourism revenue reached 22.1484 billion CNY from 1979 to 2015. Meanwhile, to protect the ecological environment of scenic areas, HNP invested a lot of material resources, financial resources and manpower to deal with tourism waste every year (Hu et al., 2019). However, the average annual growth rate of the tourism income of HSA was 12.77% in 2006 to 2015, more than 180 times of the average annual growth rate of the total livelihood capital of rural households in the surrounding community (Fig. 7). The change in total livelihood capital is smaller than the change in tourism income, which indicates that the change of livelihood capitals has the characteristic of comparatively strong rigidity. It can be concluded from the spatial distribution change of total livelihood capital that the spatial relationship between the community and the RERA of the national park is an important factor that influences the total livelihood capital of the community. To further understand the relationship between tourism development and the total livelihood capital of rural households in the HNP community, this paper takes the center point of HSA as the diffusion source of tourism impact in specific areas and towns adjacent of HNP as radiation areas of tourism impact.

This paper adopts the coordinate system on Baidu Map to locate the geographic coordinates of adjacent town governments. The results shows that the spherical distances between the centre point of HSA and nine town governments, Jiaocun town (118.077262°E, 30.193844°N), Gengcheng town (118.154662°E, 30.243806°N), Tangkou town (118.187899°E, 30.077099°N), Tanjiaqiao town
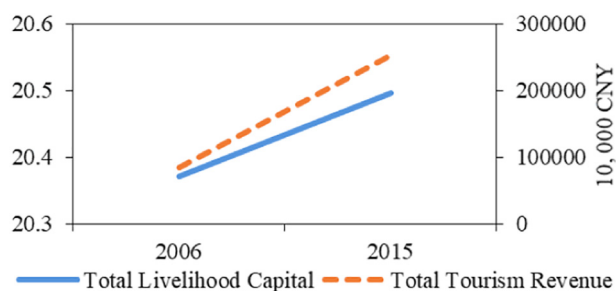
a — Factor Score of Natural Capital
0.183–0.306 Low
0.037–0.442 Moderate
0.443–0.616 High
0   5   10 km

b — Factor Score of Physical Capital
0.011–0.121 Low
0.122–0.430 Moderate
0.431–0.820 High
0   5   10 km

c — Factor Score of Financial Capital
0.010–0.172 Low
0.173–0.315 Moderate
0.316–0.972 High
0   5   10 km

d — Factor Score of Human Capital
0.266–0.286 Low
0.287–0.377 Moderate
0.378–0.696 High
0   5   10 km

e — Factor Score of Social Capital
0.213–0.384 Low
0.385–0.676 Moderate
0.677–1.010 High
0   5   10 km

f — Factor Score of Institutional Capital
0.035–0.115 Low
0.116–0.342 Moderate
0.343–0.780 High
0   5   10 km

g — Factor Score of Natural Capital
0.296–0.358 Low
0.359–0.527 Moderate
0.528–0.736 High
0   5   10 km

h — Factor Score of Physical Capital
0.016–0.119 Low
0.120–0.470 Moderate
0.471–1.01 High
0   5   10 km

i — Factor Score of Financial Capital
0.010–0.051 Low
0.052–0.649 Moderate
0.650–1.010 High
0   5   10 km

j — Factor Score of Human Capital
0.101–0.260 Low
0.261–0.428 Moderate
0.429–0.726 High
0   5   10 km

k — Factor Score of Social Capital
0.038–0.182 Low
0.183–0.388 Moderate
0.389–0.699 High
0   5   10 km

l — Factor Score of Institutional Capital
0.060–0.159 Low
0.160–0.279 Moderate
0.280–0.771 High
0   5   10 km

m — Factor Score of Total Livelihood Capital
1.262–1.302 Low
1.303–2.610 Moderate
2.611–4.228 High
0   5   10 km

n — Factor Score of Total Livelihood Capital
1.248–1.679 Low
1.680–2.422 Moderate
2.423–4.437 High
0   5   10 km

Fig. 7. Comparison of the total tourism revenue of Huangshan Scenic Area and total livelihood capital of rural households in in Huangshan National Park adjacent communities in 2006 and 2015.

(118.277476°E, 30.17003°N), Sankou town (118.225117°E, 30.268392°N), Fuxi town (118.229867°E, 30.00331°N), Hongcun town (117.989864°E, 30.004736°N), Hongtan town (117.867621°E, 30.097242°N) and Hongxing town (117.82837°E, 30.019801°N), are 8.03 km, 9.51 km, 9.74 km, 12.32 km, 14.21 km, 18.87 km, 23 km, 27.99 km, 34.57 km respectively. Based on the data of community total livelihood capital and the distance to HSA, this paper determines the unary linear regression equation after setting up the scatter diagram and trendline. According to the results, the linear regression equation of 2006 is $y_{2006} = 3.41–0.06x$, $R^2 = 0.37$; the linear regression equation of 2015 is $y_{2015} = 3.08–0.05x$, $R^2 = 0.22$ (Fig. 8).

Thus, in the linear regression equation of either 2006 or 2015, the correlation coefficients of the total livelihood capital of rural households in community and the distance to HSA are negative values, showing a negative correlation. In summary, the total livelihood capital of the rural households in an adjacent community decays over distance from the tourism destination as the center, and which reflects that there is a spatial attenuation effect of tourism development on the promotion of adjacent communities' livelihood capitals.

5. Discussion and conclusion

5.1. Implications and suggestions

Protecting the ecological environment of national parks, promoting the livelihood of adjacent communities and developing ecotourism are basic appeals of the sustainable development of national parks. National park is a complex system of man and nature, whose sustainable development depends on the responsible behaviors and activities of all stakeholders (e.g. tourists, residents and management organizations). Previous studies on stakeholders of national park mainly pay attention to the tourist attitude and behavior for the purpose of tourist management (Hu et al., 2019; Wang et al., 2019; Wang et al., 2020). However, few studies focus on residents, as vulnerable groups, are often in a passive position. Therefore, this study explores the level and change trend of the livelihood capitals and the influence of tourism development on total livelihood capitals in national park-adjacent communities from the perspective of local residents to promote the coordinated and sustainable development of national park protection and tourism utilization, which has theoretical and practical significance.

The measurement model of livelihood capitals introduces indicators on the macrolevel and from the institutional perspective, combining the characteristics of the political and economic systems of developing counties (regarding public ownership, collective ownership and collectivism as core values of the state) with the practical situation of the national park communities, which provides a set of systematic measurement indicators for analysis of the livelihood capitals of rural household in national park-adjacent communities in developing countries.

The empirical analysis of the livelihood capitals of rural households in communities surrounding national parks is a scientific research method used to disclose the relationship between national parks and adjacent community livelihoods. Decision-makers involved in the construction of national parks should fully recognize the reliance of adjacent communities on the natural resources of national parks, accurately evaluate community livelihood capitals and their change trends, try to promote community livelihood capital endowment, and actively improve well-being of rural households, formulate and implement inclusive development policies for community livelihood, and enhance the sustainable development of national park and community relationships.

5.2. Limitations and future research directions

The limitation of time series data of this paper needs to be overcome, and the evolution rule of livelihood capitals in national parks' different development stages needs to be explored. The diachronic analysis of the effect of tourism development on community livelihood capitals especially needs to be considered. Further studies should advance the research on livelihood capitals in small-scale research areas and especially make comparisons between different surrounding villages. For example, researchers can conduct extensive analysis considering the villages of town government resident and remote administrative villages in a community, examine the characteristics and evolutionary variation of the livelihood capitals of different rural households, and conduct further empirical research to compare the livelihood capitals of multi-type national park communities to enhance the adaptability of the research results. Further research should also conduct further relevance analysis and dynamic analysis of the relationship between the livelihood changes of different national park communities, tourism development and ecosystem services.

5.3. Conclusions

This paper makes an analysis of the change characteristics and evolution rule of the livelihood capitals of rural households in national park-adjacent communities, demonstrates the effect of tourism development on livelihood capitals in specific areas, and comes to the following conclusions.

First, the total livelihood capital enjoys annual growth, while the change in different livelihood capitals is nonsynchronous. This study verifies that the total livelihood capital of rural household in national park-adjacent communities has increased by 0.13 in the last 10 years, which is mostly in accordance with Chen et al., whose research concludes that the total livelihood capital of rural households in Gansu Baishuijiang National Nature Reserve, an important part of Giant Panda National Park, being located in China, has increased by 0.15 in the last 5 years (Chen et al., 2013). These results disclose that there is a small growth in the total livelihood capital of rural household in national park-adjacent communities, and the growth of the total livelihood capital has comparatively strong rigidity. In this regard, it is inappropriate to overemphasize the driving effect of national park on total livelihood capitals of rural household in adjacent communities.

Different types of livelihood capitals present different development trends. The average annual growth rates of natural capital, institutional capital and financial capital are on the rise; in contrast, the growth rates of social capital, physical capital and human capital are on the decline.

Fig. 6. Spatial distribution of the livelihood capitals of rural households in Huangshan National Park adjacent communities in 2006 and 2015. Notes: a-f are natural capital, physical capital, financial capital, human capital, social capital and institutional capital in 2006 respectively; g-l are natural capital, physical capital, financial capital, human capital, social capital and institutional capital in 2015 respectively; m and n refer to total livelihood capital in 2006 and 2015 respectively.
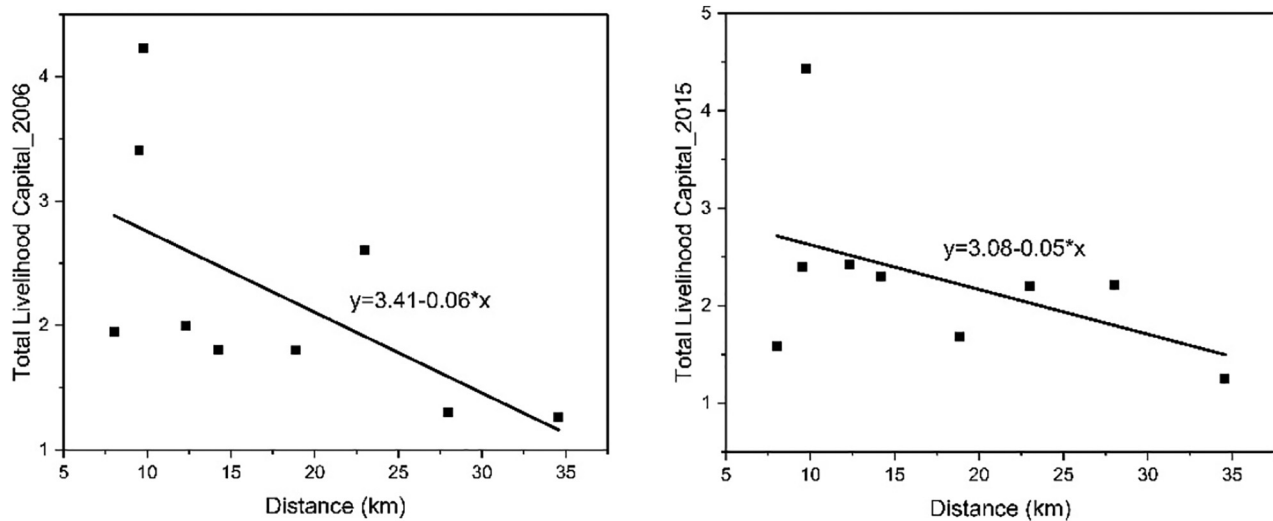
Fig. 8. Relationship between the total livelihood capital of rural households in in Huangshan National Park adjacent communities and the distance from communities government resident to Huangshan Scenic Area in 2006 and 2015.

The structural changes in livelihood capitals show that the status of natural capital, financial capital and institutional capital in the livelihood structure are being promoted, which demonstrates that the structure of livelihood capitals changes from being dominated by social capital to being dominated by natural capital. However, the increase in natural capital might not inevitably lead to the improvement of resident's livelihood level. It is necessary to increase the investment in community rural households' human capital, social capital, financial capital, institutional capital and physical capital to guarantee the constant improvement of livelihood level of rural households.

Second, the geographical distribution of the low zone of total livelihood capital is dispersive, while the medium zone and high zone are mainly distributed in the surroundings of the national park RERA. During the 10 years studied, there are spatial differences in livelihood capitals and significant differences in natural capital between different communities, while there is no significant difference in physical capital, financial capital, human capital, social capital, institutional capital or total livelihood capital between different communities.

Third, there is a spatial attenuation effect of tourism development on the promotion of adjacent communities' livelihood capitals. It can be indicated at the scale of towns that the influence of tourism development on livelihood capitals is not limited in gateway towns close to RERA of national park. Instead, a positive effect can diffuse to adjacent towns, according to the relative location advantage that allows the community to participate in tourism due to the spatial distance between the community and the RERA of national park. Generally, a shorter distance between a community and RERA of national park indicates a stronger the relationship between community and the social economy of tourism, a greater opportunity for participating in tourism, and a higher possibility that tourism development can enhance the total livelihood capital, and vice versa. Therefore, on the premise of practising the strictest protection, China's national parks should be compatible with research, education and recreation, improve the livelihood capitals of surrounding community residents with the help of national park tourism, and play an important radiation role in promoting the livelihood of adjacent community residents.

CRediT authorship contribution statement

Peng Yu: Conceptualization, Methodology, Investigation, Writing - original draft, Writing - review & editing. **Jinhe Zhang:** Writing - review & editing, Supervision, Funding acquisition. **Yaru Wang:** Investigation. **Chang Wang:** Writing - review & editing, Supervision, Funding acquisition. **Hongmei Zhang:** Resources, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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