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For investigation regarding the impact of planning policy on spatial planning implementation, International Community of Spatial Planning and Sustainable Development (SPSD) seeks to learn from researchers in an integrated multidisciplinary platform that reflects a variety of perspectives—such as economic development, social equality, and ecological protection—with a view to achieving a sustainable urban form.

This international journal attempts to provide insights into the achievement of a sustainable urban form, through spatial planning and implementation; here, we focus on planning experiences at the levels of local cities and some metropolitan areas in the world, particularly in Asian countries. Submissions are expected from multidisciplinary viewpoints encompassing land-use patterns, housing development, transportation, green design, and agricultural and ecological systems.

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Content

Special Issues on the horizontal of research and methodologies on Sustainability in Asia

Editorial introduction

Overview: Special Issues on the horizontal of research and methodologies on Sustainability in Asia

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The eight papers in this special issue touched a variety of issues and took many approaches to deal with the new sustainability problems in East Asia. The cities and regions being introduced in mainland and Taiwan in China and Korea are good representatives of those areas largely affected by the physical and social transformation in the course of urbanization. The authors have explored the related problems from a wide range of perspectives, including urban development, environment-friendly planning, eco-tourism, community development, and cross-border cooperation. The research methodologies presented in this issue also ranged from quantitative spatial analysis with the applications of GIS and RS to qualitative analysis. The findings and proposals are expected to provide insights for other cities and regions bothered with similar problems.

Han, Ma, and Li (2017) selected Hanzhou metropolitan areas as the research area, which was characterized by consistent and intensive urban expansion in recent years. The authors, with keen concern on the ecosystem service of this area, discussed the decision-making of the urban growth boundary (UGB). Upon the core area extracted from LANDSAT image data and green infrastructure information, the topography, soil and vegetation layers of the region were overlaid, enabling the mapping and evaluation of the ecosystem service level. This paper also discussed the impact of setting UGB in different ways.

Zhen, Gao, and Yuan (2017) targeted the difficulties in redevelopment of urban built-up areas, where contradictive purposes of environmental protection and economic development were sought together and it was therefore important to develop a new and appropriate rule to keep the balance. With the example of Beijing's industrial concentration area (ICA), an environmental efficiency (EE) index for assessing the external impact of any urban subarea was proposed considering its socio-economic contribution, environmental load and environmental risk. The authors also explored the appropriate spatial unit for EE assessment in the study area, and presented how the evaluation were implemented with spatial analysis method and how the findings could lead to urban planning and spatial governance of ICA.

Lee, Y. J. (2017) addressed the 'resilient city' topic, a widely concerned issue for sustainable urban development on the background of climate changes. The author proposed the basic principles for the construction of resilient city through community empowerment. An in-depth literature research had been carried out, where the author contemplated previous concepts related to resilience such as vulnerability, adaptation, governance, and so forth. The policy practices to cope with climate change and community empowerment in Taiwan were also introduced. Lee highlighted the importance of integrated urban planning and land use control, the roles of governance, capacity building and financial investments for constructing resilient urban infrastructure and the necessity of stakeholder participation.

Lee, J. H. and Son (2017) presented the lesson of government-led eco-tourism in Korea with the Maha case in Pyeongchang-gun, Korea, which once received plenty of national finance after being designated as one of ten ecotourism development model projects. From the story about conflicts between government and residents while the government was operating the site, to its eventual tuning to a resident-led ecotourism site, this paper documented the characteristics under the operation of different parties and the conflicts in different phases and compared the government-led and resident-led models with a time series Q method focusing on the intrinsic personal subjectivity. In conclusion, the authors argued that the government should not only focus on the construction of physical infrastructures for ecotourism programs but also the promotion of residents' awareness and self-regulating management by residents.

You et al. (2017) discussed the urban planning strategy for cross-border cooperation between mainland and Taiwan taking Pingtan Island in Fujian province, China, the National Experimental District for cross-strait cooperation as the study area. In line with the direction of internalization, the authors proposed the planning principles of sub-regional cooperation under different planning and legal systems. The operational frameworks were compared in terms of plan-making, plan-review and planning management. This paper provided useful ideas for planners and decision-makers of other cross-border regions.

Han and Lin (2017) addressed land use planning issue in the process of urbanization with the "scenario planning" method, whereby they attempted to identify and solve the problems with land demand and land supply in Chongqing city in southwest China. First, several scenarios were pre-set based on important factors for future city development including economic structure, land use efficiency, and land supply policy. Then, the transition of built-up area was simulated and calculated. The results of the study suggested that Chongqing should focus more on efficient land use and reasonable economic structure than the making plans of additional land development.

Li et al. (2017) explored the attractiveness of Beijing by investigating visitors' attitude to urban tourism communities. Unlike many other literature of satisfaction analysis, the authors paid attention to the 'dissatisfaction' of tourists toward Beijing. This different viewpoint brought new information for spatial planning and tourism management. With the rich information gained from new media and content analysis method, they well identified the reasons for dissatisfaction. For cities and communities aiming to become friendly and attractive places, this should be a very effective and useful approach to be adopted.

Han and Shu (2017) developed a self-adjusting approach to improve the accuracy of grid-based hot spot analysis. The authors demonstrated the scale

mismatch, shape mismatch, and location mismatch of grid analysis in detail. By using the density-based spatial clustering with a noise (DBSCAN) algorithm, the problems were effectively removed.

It could be seen that many issues being raised in this special issue, i.e., planning control for urban growth, cross-border inter-regional cooperation, redevelopment strategy of brown areas, local community empowerment, tourism development, are not specific to the study areas but common to many other areas. We hope that the perspectives, the approaches, the proposals, and the solutions being acquired from the development planning in these cases provide good lesson for other cities and regions even beyond Asia. Moreover, we hope that more developmental and thoughtful researches can be inspired by the current studies.

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Urban Growth Boundaries of the Hangzhou Metropolitan Area Based on Ecosystem Service

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Abstract: The identification of urban growth boundaries (UGBs) as components of an ecologically liveable city is rather significant in urban space management. However, the evaluation of ecosystem service in establishing UGBs as reactions to protect open spaces and ecological sensitive area are largely ignored. Furthermore, the lack of scenario analysis for urban growth patterns has made it difficult to adjust planning existed. Accordingly, in this paper, we take Hangzhou metropolitan areas (HMA) as the study area, using Landsat TM image data, and established the UGBs for the HMA based on ecosystem service by the Green Infrastructure Assessment (GIA) model with scenario analysis. The results suggested that: 1) The risk of urban development in the northern and eastern areas of the central city is relatively low, while the southern, eastern and south-western areas need intensive protection; 2) In the model of ecological management, the erosion of ecological space has increased gradually and the regional ecological patterns in the fourth scenarios have faced great challenges; 3) UGBs for the HMA were identified as the view of development and ecological space complementarily.

1.   INTRODUCTION

The most severe challenges in the current process of urban development are the big gaps between land supply and demand and the deterioration of ecological environment, both of which are mainly caused by rapid urban sprawl that occurs globally, especially in developing countries. Since the reform and opening-up in China from 1978, a series of system reforms are effectively stimulating the economic growth and urbanization, including the socialist market economy (1992), land use system (1988) and tax sharing system (1993), which has made a profound influence on urban growth (Chen & Zhao, 2016). In this process, urban growth is gradually becoming out of control in the way of sprawl and construction expansion (Wei, 2011).As we know, urban growth containment strategies that are supported by the smart growth approaches including urban growth boundaries (UGBs) are the best-known planning instruments and effective tools to contain, control, direct or control, direct or phase urban growth coping with the rapid sprawl of cities

(Liu, 2005). Actually, UGBs is widely implemented in western countries especially in the USA while in China reversely.

   As for the method of UGBs delimitation, few studies focus on the evaluations of their functions in protecting open spaces as reactions to the challenge of declining ecological environment. That is to say, the evaluation of ecosystem service in delimiting UGBs as reactions to protect open spaces and ecological sensitive area are largely ignored (Verburg et al., 2002; Tayyebi, Pijanowski, & Pekin, 2011; Arsanjani, Kainz, & Mousivand, 2011; Long et al., 2013; Zhang, Hua, & Wang, 2016). On the other hand, in most literatures and discussions are emphasized on the failure to promote compact development due to the inability to take complexity, uncertainty, and ongoing changes into account (Long et al., 2015). Furthermore, the lack of scenario analysis for urban growth patterns has made it difficult to adjust planning existed.

   Therefore, in the present paper, the Green Infrastructure Assessment (GIA) model that considers ecosystem service for regional ecological security pattern is developed to simulate future urban growth and then establish the UGBs for the Hangzhou Metropolitan Area (HMA).The "Study area and data" section introduces generalizations of Hangzhou and the data we using in this study. The "Approaches" and "Results and analysis" sections show how to use the GIA model to establish the UGBs for the HMA. The "Conclusion and discussion" section presents and concludes our findings.

2.   STUDY AREA AND DATA

   Hangzhou is located in the northern of Zhejiang province as one of central cities in the Yangtze River delta, and the other cities like Shanghai, Nanjing. Hangzhou is also famous as a historical and tourist city with world cultural heritages of West Lake and Beijing-Hangzhou Grand Canal. What's more, Hangzhou is not only the economic, financial and cultural central city in Zhejiang province, but also is the host city of G20summit in2016.In terms of ecological environment, there have complex landforms and different kinds of habitat patches that urban ecosystem service has a very high heterogeneity with various landscape elements of forest, wetland, river and farmland (Li, 2011).

   However, with the background of reform and opening-up in China, Hangzhou was experiencing a rapid urbanization because of the GDP and urban population growth within 2000 to 2015.In the one hand, the GDP in 2000 was 1382.56 billion CNY while the GDP in 2015 had quickly increased to 9206.16 billion CNY, which is about seven times than former. At the same time, the fast expansion of construction lands in the way of urban sprawl accompanying by high economic development has lead to a series of intractable problems, of which farmland shrinking and ecological environment fragmentation are the most remarkable issues that will further to make severe pressures on regional ecological security pattern in Hangzhou. Thus, it's rather necessary for Hangzhou to put urban growth management into effect for the purpose of protecting open spaces and some environmental sensitive area from ecological declining. Meanwhile, by the way of establishing UGBs that has not been widely implemented in China though, we can direct or control urban spatial structure sustainably. In this study, we take Hangzhou metropolitan areas (HMA) as the study area. HMA is an area of 4899km^2, including Shangcheng districts, Xiacheng districts,

Jianggan districts, Gongshu districts, Xihu districts, Binjiang districts, Xiaoshan districts, Yuhang districts and Fuyang districts (Figure 1).

The date we using in this study mainly contain three aspects:

1) Remote sensing image like the type of Landsat TM image date covering the area of HMA is largely needed. The image date with the resolution of 30*30m can be freely downloaded from Geospatial Date Cloud (GDC), which is built by Chinese Academy of Sciences. And the track number of the image data collected on Aug 16th, 2015 is (119, 39). However, to improve the identification precision of data, those original images should be pre-treated correctly. The procedures are atmospheric correction, geometric correction, image cutting and others needed.

2) Digital elevations model (DEM) data in the HMA will be used to describe the features of topography, such as the land slope or Relief degree landform surface (RDLS). In addition, administrative boundaries data from digital or paper map should be coincide with study area of HMA according to the digital or paper map. Lastly, some related social-economic statistical data for construction lands, industry or urban population since 2000also are incorporated essentially. Those statistical data can be easily accessed from the website of Hangzhou Statistical Information (http://www.hzstats.gov.cn/) build by Hangzhou government.

3) Planning made by local government or superior government, such as Hangzhou master planning (2001-2020) or Hangzhou land use planning (2006-2020) for construction lands, urban spatial structure, open space and reverse planning are also necessary. Those planning will be collectively served as to adjust with UGBs, which will be established by the model of Green Infrastructure Assessment.
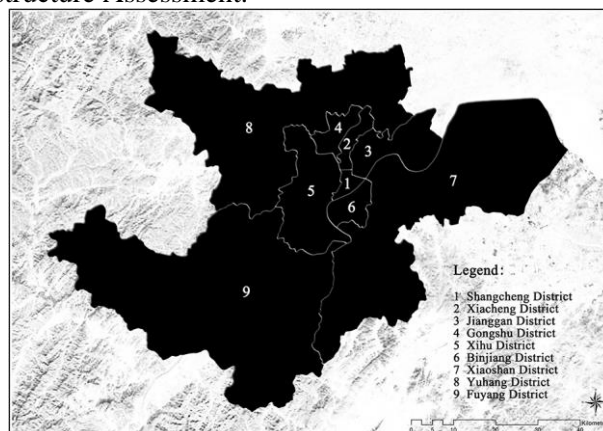
Figure 1. Study area

3.   APPROACHES

3.1   Interpretation of land use

Obviously, the accurate interpretation of land use for the HMA is the fundamental step for ecological service evaluation. According to the study purpose and scale size of the HMA, we take the land use classification standard, which is published publicly by Ministry of Land and Resources in PRC as authoritative reference. The implications of land use are as following. The Urban-rural construction land is comprised of urban-town construction lands, agricultural settlements, industry lands, railway, highway

and airport. Secondly, rivers, lakes and wetlands are attributed to the water. Forestry, grasslands and gardens are regarded as the forestry. Paddy field, vegetable field and dry land are considered as the farmland. And the unutilized land includes bare land and unused land. Finally, the land use classification of this study has been defined as five types: urban-rural construction land, water, forestry, farmland and unutilized land (Table 1).

Based on this, the corrected image data was interpreted by the method of maximum likelihood with the platform of RS. Certainly, the initial interpretation results couldn't be used to do next step immediately. By calculating separating degree and comparing image data that over the same period with the present situation, we considered that the interpretation errors were mainly caused by confusion of construction land with wetland and cloud covering. Finally, the Kappa coefficient of land use interpretation was reduced to 92.60%, so as to satisfy the accurate requirement basically after doing effective artificial corrections (Figure 2).

Table 1. Land use classification and its implication

Land use classification	Implication
Urban-rural construction land	Urban construction lands, town construction lands, agricultural settlements, industry lands, railway, highway, airport.
Water	Rivers, lakes, wetlands.
Forestry	Forestry, grasslands, gardens.
Farmland	Paddy field, vegetable field, dry land.
Unutilized land	Bare land, unused land
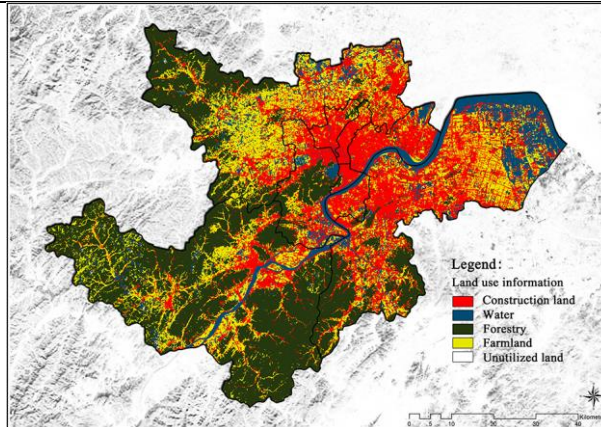
Figure 2. Land use in the HMA (2015)

3.2   Green Infrastructure Assessment

3.2.1   Identification of GI core area

As an important part of urban social-ecosystem, green infrastructure (GI) is approximate to the green networks system but not entirely.GI resources are organically formed by natural or restored ecological space and those ecological spaces always have a significant characteristic of nature. GI also will provide a variety of ecological service for citizens continually (Benedict & McMahon, 2012). In this study, we think that GI resources are composed of two parts (Fu & Wu, 2009). The first part is the vector level, including terrestrial and aquatic patch, which is defined as GI core area (Table 2).The second part is the grid level, which is defined as land resources.

In terms of GI core area, the landscape elements of terrestrial patches that will pointedly provide habitats for some large terrestrial animals and plants are mountains, forests and grasslands. Secondly, the landscape elements of aquatic patches that will pointedly provide habitats for amphibious and aquatic animals and plants are wetlands, rivers and lakes. In addition, as for the size threshold of GI core area, we suggest that the threshold of aquatic patches should be more than 100ha, and the threshold of terrestrial patches should be more than 80ha. Because it will be able to make a significant influence on ecosystem diversity conservation substantially according to the Maryland's Green Print Plan (Weber et al., 2004).Moreover, to identify GI core area accurately, it is essential to combine some same or similar GI core areas with a certain of heterogeneity that also can be feasible on the platform of ArcGIS. Based on this, the spatial distribution of GI core area in the HMA has been shown on Figure 3.

*Table 2.*Classification of GI core area

GI core area		Landscape elements and species	Ecosystem Service
Terrestrial patches		Mountains, forests and grasslands including their animals and plants.	Habitats for large terrestrial animals and plants.
Aquatic patches	Wetland patches	Wetlands including their animals and plants.	Habitats for amphibious and aquatic animals and plants.
	Aquatic patches without wetland	Rivers and lakes including their animals and plants.	Habitats for aquatic animals and plants.
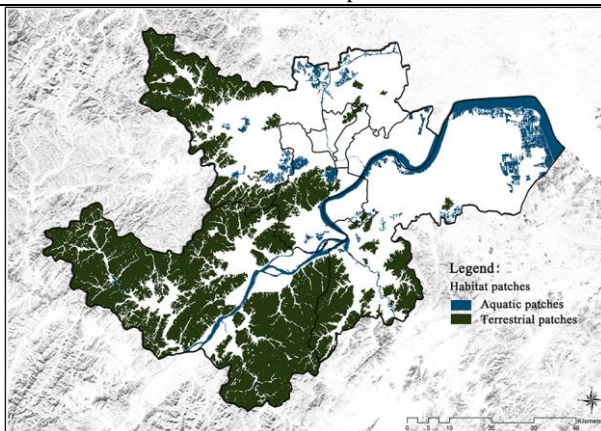
Figure 3. GI core area in the HMA

3.2.2   Ecosystem service evaluation of GI resources

Since the paper that is about the global ecosystem service value written by the scientists of Maryland University was published on the journal of Nature, the evaluation of ecological service value has become a hot issue in the study of resource environmental economics and ecological economics. It is the conditions and utilities of ecological environment are beneficial for human settlements under ecosystem and its processing that we name as ecological service (Ouyang & Wang, 2000). Urban ecosystems provide vital services for urban dwellers (McDonald & Marcotullio, 2011). It is increasingly recognized that ecosystem services need to be incorporated into urban planning (Colding, 2011). Although, the concept of GI has emerged as

a way to secure the provisioning of ecosystem services in human-dominated landscapes (Colding, 2011). At the same time, GI resources may differ in many aspects of morphology, terrain and location. In this paper, we consider that GI delivers measurable ecosystem services and benefits that are fundamental to the concept of the ecosystem conservation, which will be evaluated with certain of priority by the model of Green Infrastructure Assessment (GIA).

Based on abundant empirical evidence and existing literature (Li, 2011), we had tried building the index framework for GIA as following. Firstly, biodiversity, hydrologic and soil conservation are so important for ecosystem service evaluation that has been considerate as first-index for GI resources at vector level. Based on this, the second-index and the third-index are formed successively (Table 3). Secondly, we select the characteristics and location of land resources as first-index for GI resources at grid level. The second indexes contain land use, land slope, Normalized differential vegetation index (NDVI), distance of reserves and distance of GI core area (Table 4). What's more, the determination of weight mainly depended on the judgment of relevant experts and the method of Analytic hierarchy process (AHP).

Table 3. Ecosystem service evaluation indexes of GI resources at vector level

First-index	Weight	Second-index	Weight	Third-index	Weight
Biodiversity conservation	0.45	Habitat stability conservation	0.30	Landscape richness index (LRI)	0.50
				Total core area index (TCAI)	0.50
		Habitat complexity conservation	0.40	Boundary density index (BDI)	0.50
				Patch shape index (PSI)	0.50
		Priority conservation	0.30	Reserves priority conservation	0.50
				Mean patch size (MPS)	0.50
Hydrologic conservation	0.30	Water source conservation	0.5	Water source priority conservation	1.00
		Water storage conservation	0.5	Water size	1.00
Soil conservation	0.25	Soil sensitivity conservation	1.00	Relief degree landform surface (RDLS)	0.50
				Normalized differential vegetation index (NDVI)	0.50

Table 4. Ecosystem service evaluation indexes system of GI resource at grid level

First-index	Weight	Second-index	Weight
Characteristics of land resources	0.70	Land use	0.50
		Land slope	0.20
		Normalized differential vegetation index (NDVI)	0.30
Location of land resources	0.30	Distance of reserves (unit: m)	0.50
		Distance of GI core area	0.50

4.   RESULTS AND ANALYSIS

4.1   Analysis of GIA results

According to the Table 2 and Table 3, we got the results of ecosystem service evaluation in the HMA, including GI core area at vector level and land resources at grid level (Fig.4). Then we overlapped GI core area at vector level with land resources at grid level to achieve the final result of ecosystem service evaluation in the HMA (Figure 5).

From the view of geographical location, the southern, western and south-western of central city in the HMA have a very high value of GI resources and abundant species corridors, including a large number of landscape elements, such as mountains, wetlands, gardens. Therefore, it is unsuitable for urban development in the way of urban sprawl or enclave leading to a rather high risk. For example, the ecological space of south-western Fuyang is located in the southern of central city and the southern of Yuhang town, which includes a large area of mountains and forest supplemented by arable land, tea plantations, orchards and a small number of wetlands. The reverses here contain West Lake National Scenic Area, Zhijiang National Tourist Resort, Gudang and Laohe Mountain Ancient Tombs Areas, Zhongtai and Xianlin Forest Reverse, Longwu Forest Reverse, Huang Gongwang Provincial Forest Park and Yinming Mountain Provincial Forest Park.

Comparatively speaking, the northern and eastern of central city have a rather lower value of GI resources, which provide a substantial amount of land resources for urban growth in the future. Therefore, it is suitable to direct or promote urban development. However, besides the potential construction lands, there also exists some high value habitat patches, including Big Jiangdong coastal wetland, Ban Mountain Forest Reverse, Qiantang River Reverse. Thus, as for this valuable landscape elements and reserves, we need to protect correctly to maintain the balance of regional ecosystem from ecological declining. And any urban development or planning aiming to expand construction lands should not be permitted. Generally speaking, the potential urban development positions for urban growth in the HMA are northern and eastern. While the southern, western and south-western in the HMA should be focus on conservation carefully.
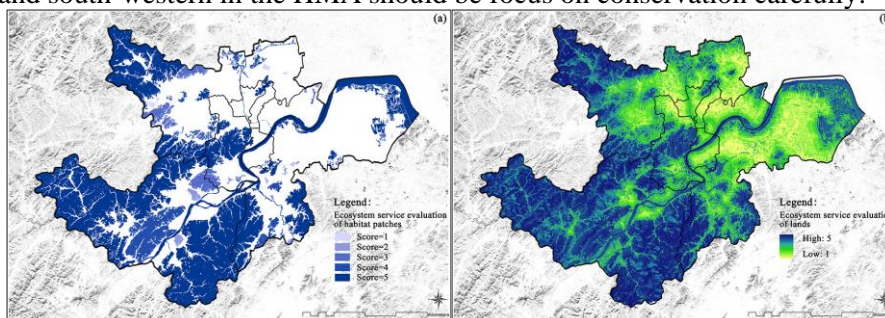
Figure 4. Ecosystem service evaluation of GI core area at vector level (a) and land resources at grid level (b) in the HMA
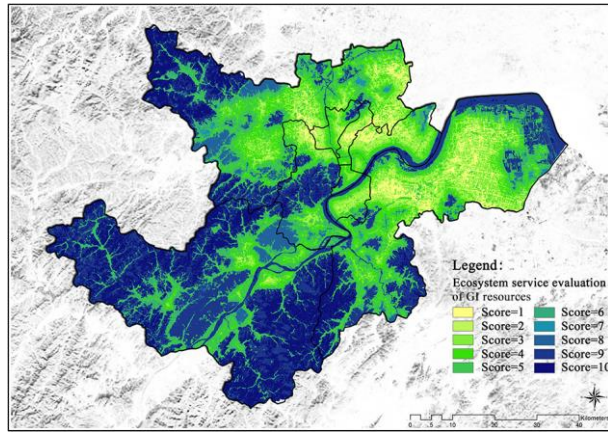
Figure 5. Ecosystem service evaluation in the HMA

4.2   Analysis of ecological management scenarios

Scenario analysis is an important tool for urban planning decision-making or urban growth policies formulating. In scenario model, we always should take some important impact factors that will make influences on planning results into the analysis processing compared with urban problems existed, and then make a try to simulate the future scenarios under difference of urban spatial structure. Using this method, we can evaluate the planning implemented or not, then to put forward a new strategy, planning or action plan for urban growth. Consequently, scenario planning may be a good choice to cope with urban growth when facing uncertainties or unpredicted planning conditions.

In this study, we take the study of urban development boundaries in the HMA, which have been delimited by local planning authorizes as urban development reference (Zhang, Hua, & Wang, 2016). So we defined the 50% and 20% of the study area as construction lands limit for urban growth in future. We set 20% construction lands of study area is that to ensure the regional ecosystem security pattern in the HMA avoiding environmental problems caused by violent urban growth. While we set 50% construction lands of study area is to coordinate with local government's planning goals including economic development. And the ecological management scenario between 20% and 50% is 30% and 40% with every 10% interval. Based on the result of ecosystem service evaluation in the HMA, we finally got the ecological management scenarios respectively, including their ecological conservation propriety of GI resources, area size and spatial distributions of potential construction lands (Table 5, Figure 6). In all, we consider that there is a negative correlation between ecological conservation priority and conservation area size, while there is a positive correlation between ecological conservation priority and construction lands area size. Secondly, in the model of ecological management, the erosion of ecological space has increased gradually from first-control to fourth-control scenarios while the regional ecological patterns in the forth scenarios has faced great challenges.

Table 5. Analysis of ecological management scenarios

Ecological control scenarios	Ecological conservation priority	Control area size	
		Conservation area size	Construction lands area size
First-Control	1~2	Total area size is	Total area size is

		3919.20km², accounting for the study area of 80%.	979.80km², accounting for the study area of 20%.
Second-Control	2~3	Total area size is 3429.30km², accounting for the study area of 70%.	Total area size is 1459.70km², accounting for the study area of 30%.
Third-Control	3~4	Total area size is 2939.40km², accounting for the study area of 60%.	Total area size is 1959.60km², accounting for the study area of 40%.
Fourth-Control	4~5	Total area size is 2449.50km², accounting for the study area of 50%.	Total area size is 2449.50km², accounting for the study area of 50%.
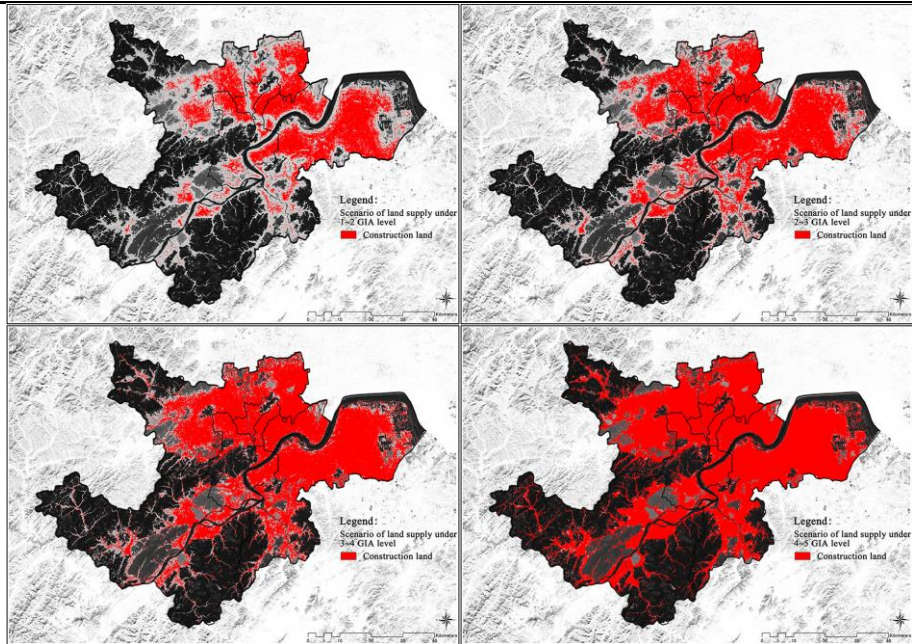
Figure 6. Spatial distribution of ecological management scenarios

5.   ESTABLISHMENT OF UGBS

5.1   Urban growth scenario in 2040

According to the Figure 6 and analysis of ecological control scenarios that how will affect regional ecosystem security pattern, we finally decided to choose the third-control as the urban growth scenarios to establish UGBs of the HMA in 2040.The urban growth form delimited in the raster format can be converted into a vector format comprised of some polygons. And those polygons with low compactness and a small area should be eliminated (<1ha), as they are not feasible for urban development. The remaining polygons then can be regard as urban growth area for UGBs of the HMA. And the spatial distribution of urban growth has shown on the Figure 7 (a). To a certain extent, the third-control urban growth pattern not only can maintain the regional ecosystem service from the point of ecological rigid view, but also coordinate with the economic development goals set by local government to the maximum extent.

According to the Figure 7, (a), the urban growth form consists of some polygons, of which the biggest polygons are on the both sides of Qiantang River. One is on the north of Qiantang River, including Shangcheng

districts, Jianggan districts, Gongshu districts, Yuhang district and some area of Xihu district. Another one is on the south of Qiantang River, including Xiaoshan districts and Binjiang district. These urban growth scenarios can be achieved to the pattern of compact city with a continuous development. And the form of urban growth is more likely to the UGBs in the USA. Besides the two polygons, the leaving polygons are mainly on the western of central city, and the vast majority of polygons are in Fuyang district except Zhijiang National Tourist Resort. These urban growth scenarios can be achieved to the pattern of decentralized city with a group development, which is quite suitable for mountain-city. In other words, it is inevitable decision-making due to the high sensitive environment in the west part of HMA. In terms of the land supply in the future, total area of urban growth scenario is about 1959.60km^2,accounting for the study area of 40%, which is about two-and-a-half times as the present.
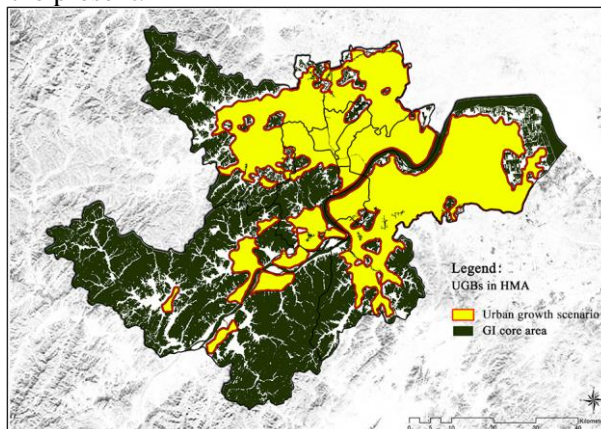
Figure 7. Urban growth scenario in 2040

5.2   UGBs as the development space to direct urban growth

Obviously, the UGBs in most metropolitan area in China are not only one or two polygons but may comprise numerous polygons, and UGBs of the HMA also contain town construction lands and agricultural settlements besides urban construction lands, which is quite different from UGBs in the USA. In order to make clear that the urban spatial and economical connection between cities, new cities and towns, we decided to overlapped the urban growth scenario in 2040 with the administrative boundaries of urban area to establish the UGBs of the HMA. By this way, the spatial distributions of UGBs have been shown on the Figure 7, (b).

Although the urban spatial structure has been planned in the Hangzhou Master Planning (2001-2020) clearly, including one central city (old urban districts of Hangzhou), three new city (Linping, Xiasha and Jiangnan new city) and six towns (Linpu, Yipeng, Guali, Yuhang, Liangzhu and Tangqi town).In addition, Fuyang district has also been taken into consideration. According to the UGBs set by GIA model, we suggest that the urban spatial structure should be updated to respond to the new situations of Hangzhou, such as G20 and electric business industry. Especially in Fuyang, it is necessary not only to promote the Fuyang city as new city level, but Xindeng town and Changkou town should be added up to the new urban spatial structure system as town level to compete in functional division of

Hangzhou. Consequently, the urban spatial structure of the HMA will become a new pattern with one central city, four new cities and eight towns.

In terms of the land supply of UGBs, we calculated the development area provided of every district set by UGBs and the current construction lands area simultaneously (Table 6). The UGBs in Fuyang district will be counted alone, as it was not belong to HMA urban district before 2015.Comparatively, the land supply of town level is the most abundant with increment speed of 98.76%, while the central city is rather limited with increment speed of 15.36%. Thus, it is advised that town and new city should be encouraged to accommodate more urban industry and population escaping from the central city by local government. Notably, because of the sensitive environment, the land supplements of Fuyang districts are constrained, even are less than central city.

Table 6. UGB areas of central city, new cities and towns in the HMA (unit: km^2)

Name	A: Current construction lands	B: Development area set by UGBs	A-B	(A-B) / A (%)
Central city	252.80	291.64	38.84	15.36
New cities	263.32	358.12	94.80	36.00
Towns	254.77	506.39	251.62	98.76
Fuyang	136.71	150.51	13.80	10.09

5.3 UGBs as the ecological space to conjugate urban growth

From another perspective, UGBs can also be considered as the ecological space getting rid of the construction lands to control or conjugate urban growth. The area of ecological space in the HMA is about 2939.40km^2, accounting for the study area of 60%.Therefore, we can also defined UGBs as ecological space named as Ecological Belts (EB). The EB consists of two parts: one is the restricted construction area; another is forbidden zone (GI core area).

In this study, we can take the Northern Linpin EB (NL-EB) and Southern Linpu EB (SL-EB) as examples:

1) Northern Linpin EB is located in the north of central city and the south and west of Linpin city, including Yuhang district and Jianggan district. The landscape composition of it is farmland, forest, canal waters and wetland. In addition, NL-EB contains Chongxian, Tangxi and Jianqiao town-village, including Chao Mountain Provincial Scenic Area, Mid-ancient Tombs and Liangzhu Culture Site, Ding Mountain Lake, East Pond Wetland Protection Area, Gaoting Hill, Hwanghak Mountain Scenic Area, Pengbu Transportation Corridors and Linpin Hill Ecological Conservation.

2) For another one, Southern Linpu is located in the south of central city and Jiangnan City, including Linpu town, Xiaoshan district and Fuyang district. The landscape composition of it is mountains, forest, farmland and Xiang lake and Bama Lake. In addition, SL-EB contains Heshang, Louta and Longmeng town-village, including Qinghua Mountain Reverse, Mujian Mountain Reverse, Shiniu Mountain Reverse, Xianghu Tourist Resort, Longmen Forest Provincial Reverse.
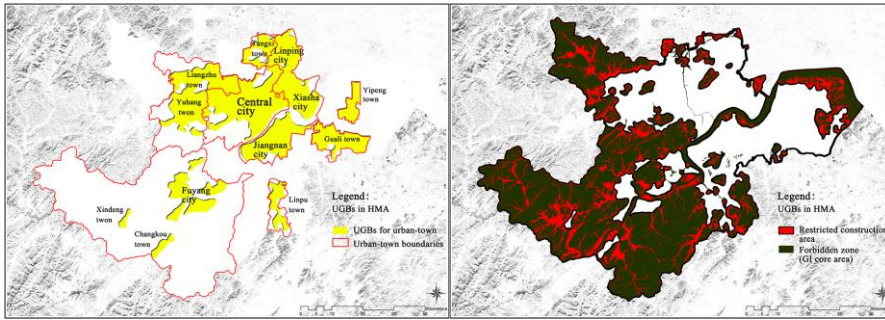
Figure 8. UGBs for **the** HMA

6.   CONCLUSION AND DISCUSSION

The identification of UGBs as components of an ecologically liveable city is important in urban space management. However, the evaluation of ecosystem service in delimiting UGBs as reactions to protect open spaces and ecological sensitive area are largely ignored. Furthermore, the lack of scenario analysis for urban growth patterns has made it difficult to adjust planning existed. This paper take HMA as the study area, using Landsat TM image data, and delimited UGBs based on ecosystem service by the model of GIA with scenario analysis. According to the result of GIA, we conclude that the risk of urban development in the northern and eastern areas of the central city in the HMA is relatively low, while the southern, eastern and south-western areas need intensive protection. In addition, in the model of ecological management, the erosion of ecological space has increased gradually and the regional ecological patterns in the forth scenarios have faced great challenges.

A case study in the HMA demonstrates that the UGBs could be established by GIA model. And we respectively defined UGB as the development space to direct urban growth and the ecological space to conjugate urban growth. In contrast to the conventional UGBs delimitation methods employed by planner with background in architecture, the GIA model makes a more stress on the ecosystem service, which is significant in urban growth management. Through maintaining regional ecological security pattern further to control the urban growth with sprawl or enclave reversely. At the same time, this paper proves that using a GIA model can provide the Chinese theoretical and technical support for establishing and improving UGBs in Chinese cities or metropolitan areas.

However, for the future studies, much remains to be explored deeply. For example, the ecosystem service evaluation indexes of GI resources need to be further corrected for different regions in HMA. Secondly, the hubs of GI core area just contain habitat patches as the view of ecology, and some humanistic elements such as historic conservation area or scenic area are not included. What's more, the ecological control scenarios set in this paper is not enough, so applying GIA model to simulate different growth scenarios based on other urban development strategies is necessary. Through the analysis and comparison of different scenarios, a preferable scenario can be selected as the recommended UGBs and the corresponding policy package for decision-making by local government.

ACKNOWLEDGEMENTS

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An Empirical Study on Environmental Efficiency Assessment in Urban Industrial Concentration Areas

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Abstract: Many urban industrial concentration areas are becoming mixtures of intensive industrial and residential land use. While they play important roles in urban economy and employment, the energy consumption and pollution discharge in the process of industrial production bring mang negative effects on surrounding people and environments. In this paper, a tool is proposed to evaluate the environmental efficiency (EE) of the industrial concentration areas in order to coordinate the functioning of economic activities and environmental protection. Based upon discussion on the principal and significance of EE assessment in urban industrial concentration areas, an empirical study is conducted in Fengtai district, Beijing, to elaborate the idea from three aspects: socio-economic contribution, environmental load, and environmental risk. The study area was divided into 1379 grids of 500 m*500 m as the basic spatial unit while the spatial size effect and its rationality of the environmental functions have been testified. As the result, it turned out that the amount of the low EE grids account for 71.15% of the total districts while the rather high environmental load grids 20.18%. In the meantime, we found out that the area of low EE value grids have the tendency to aggregate towards the central urban areas, along urban express ring roads and around wholesale markets. These results shed light to implementing the refined environmental spatial management and control.

1.   INTRODUCTION

Since the reform and opening up in early 1980s, Chinese economy has maintained a very high growth rate. From 2000 to 2013, the gross domestic production increased from 9.8 trillion Yuan to 56.7 trillion Yuan, with an annual growth rate of above 10% on average. Meanwhile, the growth rate of resources and energy consumption is also very high. The energy consumption increased to 3.75 billion tons in 2013 from 1.46 billion tons in 2000, with an annual average growth rate as high as 8%. Along with the swift economic development and incremental energy consumption, urban environment has been constantly worsened. What concerns more is that, with the promotion of large-scale urbanization, the aggregations of industries and

population in large cities has become more and more obvious, and the imbalance of economic activities in industrial concentration areas among the overall spatial layout is the most intensive (Bai et al., 2004).

In practice, industrial concentration areas (ICAs), including various kinds of industrial parks, economic development zones, high-tech industrial areas, have not only become the most important carriers for cities and regions to attract economic elements (Cohen & Paul, 2005; Casper, 2007), but also made huge threat to the health of urban population and ecosystem due to the extensive aggregation of heavy and polluting industries and the mixture of them with people's living space.

In existing studies, researchers presented two perspectives to define ICAs: the first focuses on industrial elements. That is, ICA is mainly dominated by one or several leading industries, and the enterprise cluster is formed due to the chaining relationship of upstream and downstream enterprises (Martin & Sunley, 2003; Hannigan, Cano-Kollmann, & Mudambi, 2015). The second defines ICA according to the geographical features. That is, ICA refers to the special area with many firms of the industrial and service sectors gathering within a certain region. In particular, the agglomeration of industries with pollution characteristics in ICA is focused in this paper, where the air pollution, solid waste pollution, soil pollution, degradation of ecosystem and other urban environmental problems are apparent. In practice, the problems with ICA have affected the stability of ecological environmental system at different spatial scales and become the restrictive condition of urban and regional development, (Ren, Yu, & Wang, 2009; Zeng & Zhao, 2009; Liu, Dong, & Li, 2011; Ma, Jin, & Liu, 2012). According to Gowd, Reddy, and Govil (2010), the main reason of heavy metal pollution of soil in Jajmau and Unnao in India is the waste discharged from 450 leather manufacturers. Virkanen (1998) showed that the ICAs in the south of Finland were the main source of heavy metal pollution in water and air pollution. de Leeuw et al. (2001) proved that the change of air quality of more than 200 high-density urban areas in EU (European Union) is closely related to the large scale clustering of industrial productions in these regions.

In ecological economy field, ecological efficiency has drawn considerable concern as an analysis tool of sustainable development (Schaltegger & Synnestvedt, 2002; Bleischwitz, 2003; Reith & Guidry, 2003). With a focus on the combinational relationship of economic and ecological impact, indices of social service and ecological load were composed to ecological efficiency, in short, in order to boost up the idea of using as few as resources and making as little as environmental impact to create the maximum amount of product and services (Maia, Silva, & Costa, 2016; Yuan, Huang, & Xu, 2016). Apparently, the ecological efficiency can be improved either by both raising the economic production or by reducing the negative environmental impact of human activities (Huppes, 2009). This general idea is quite similar to the assessment of environmental efficiency (EE).

Based on previous studies, the object of environmental impact assessment can be divided into four types: product, enterprise, industry and region. At present, most of EE indicators focused on the performance of enterprise and product. For example, Kerr and Ryan (2001) conducted the research on EE of Australian Branch of Fuji Xerox and found that the role of implementing recycling production in duplicator industry was not obvious

for the improvement of EE. Lately, more research work has been emphasized on the environmental performance of production process of goods at a micro scale and the environmental impact of certain region at a macro scale. Because it is difficult to acquire detailed and reliable pollution data of each factory in a industry, environmental assessment are studied only for a limited number of industrial fields such as power plant, petrochemical, mining industry, papermaking industry and some other heavy pollution industries (Peng et al., 2005; Kuosmanen, 2005; Shi et al., 2012). For example, Nguyen and Hens (2015) conducted environmental impact evaluation for cement manufacturing in Vietnam according to ISO 14001, finding that the emission of SO_2 and NO_2 was reduced significantly after the application of ISO 14001 Certification. The research results showed that, for the developing countries, ISO 14001 could improve the environmental performance effectively. Meanwhile, the government departments and international organizations were interested in the measurement of environmental performance of a region at macro scale greatly, in order to facilitate urban construction and industrial development strategies. However, at present the research on regional EE evaluation is insufficient (Mickwitz et al., 2006). Zaim and Taskin (2000) ever formulated the indicator system to evaluate the environmental performance of OECD countries and compared them with the panel data in different periods. With a similar purpose, Färe, Grosskopf, and Hernandez-Sancho (2004) proposed to compare the evaluation indicator of OCED countries with a DEA (data envelop analysis) method.

The concept of EE was introduced to China at the end of 1990s, and the theoretical system of western countries was adapted to reflect the environmental and resources characteristics of China and meet the domestic development needs. In recent years, Chinese geographers paid more attention to the regional pattern and spatial differentiation of EE. Up till now, some comparative researches were conducted on the environmental and economic efficiency with the spatial unit of province or larger economic zones, such as the North and Northeast Economic Zones (Gai, Lian, & Tian, 2014; Fei, Liu, & Yang, 2015). For example, Wang et al. (2010) used the data envelopment analysis model to analyze and evaluate the EE of 31 provinces in China, and the results showed that the overall level of provincial EE was low but it was improving gradually. In general, the current researches on EE focus on micro level of individual products, enterprises as well as macro-level provincial or national comparison. On the other hand, research on the meso level centering on different urban functional areas were few, though this is significant for the optimization of urban structure. In view of this, in this article, we attempt to investigate the spatial needs of environmental protection and socio-economic development in ICAs and to raise solutions to the key problems in this kind of urban areas.

So far a holistic theoretical framework for EE in urban ICAs has not been founded. This is mainly reflected in two aspects: Firstly, the system for EE evaluation has not been established. In ICAs, although the contradictions between the industrial production and urban population aggregation are prominent, it is difficult to accurately quantify the negative effects on residents' life and ecosystem, let alone to justify them. Secondly, the scale effect of EE evaluation is short of profound research. While there were many studies on the evaluation of environmental impact or associated economic performance at regional scales, few have investigated the issue of

appropriate scales for identifying and summarizing the environmental characteristics within cities, despite that people generally agree that improper selection of spatial units will bring bias to the research result.

In this article, we attempt to present a comprehensive empirical study on EE evaluation in ICAs in Fengtai District, Beijing and give suggestion to the policies of environmental management and spatial governance according to the evaluation result.

2.   DATA AND METHOD

2.1   The study area

A typical ICA in Beijing is taken as the case study area. Fengtai District is located in the southwest of Beijing, with a total area of 306 km^2. The Yongding River, the largest river in Beijing, divides it into two parts: Hedong area in the east part, which is the center of commerce, economy and industry, and Hexi area in the west part, which is an important ecological barrier of Beijing. Fengtai District governs 17 lower level administrative units including 14 Jiedaos (applied to urbanized areas) and 5 towns and townships (applied to less urbanized areas), and the number of permanent resident population is 2.32 million at the end of 2015 (*Figure* 1).

Fengtai District is characterized by the concentration of a variety of industries and urban factors. Therefore, the conflict between urban construction and the protection of ecological system is sharp. As one of the six center districts of Beijing, its environmental problem is politically sensitive. In 2013, it was established as one of the 24 national pilot areas by the Ministry of Environmental Protection for making urban environment master plan.

Generally speaking, Fengtai District is conventionally functioned for industrial production. The distribution of enterprises has the significant spatial agglomeration and mainly concentrates in the north and northeast of Hedong arear, and develops a high-grade ICA in the Fengtai Jiedao and Fangzhuang Jiedao. Besides, the industry structure of Fengtai District is complicated and many industries are pollutant industries. It has numbers of second industry enterprises，which including food (179), mechanical (1600), medical (27), chemical (282), building materials and furniture (165), paper printing (223), and is also consist of some third industry enterprises with heavy pollution covering catering, wash service and car wash. In addition, the characteristic of high risk is very obviously. There are 21 dangerous chemical enterprises, 28 printing enterprises and 31 city control monitoring enterprises. From the perspective of the overall Beijing, Fengtai District currently has the lowest land use intensity, the lowest urban population density and relatively low real estate prices among the center districts. Therefore, Fengtai has experienced a rapid urban development in the past five years, which made the negative environmental effects evidently. There is an urgent need to adjust the industrial production and spatial pattern, and strengthen controls over the environment.
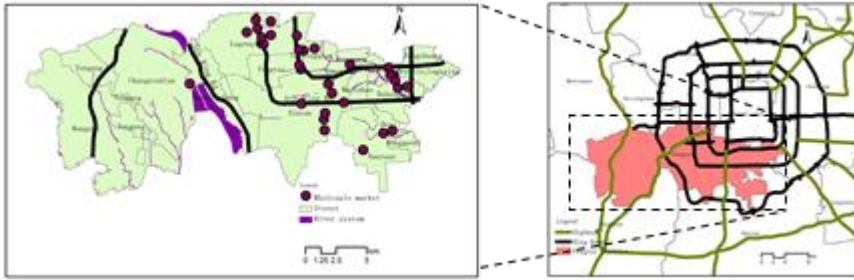
Figure 1. The location of Fengtai District in Beijing

2.2   Research data

We use POI (point of interest) data in 2011 associated with Baidu Map, the largest map service in China (http:// map.baidu.com), to get the point data of various enterprises. We acquire the emission data of polluting enterprises including waste water, waste gas and sulfur dioxide, according to Fengtai district's pollution census conducted in 2007, which covered all registered enterprises in the district. To correct the time difference, we compare the list of enterprises with the POI dataset, whereby those closed or relocated enterprises are removed, and the emissions of new comer polluting enterprises are estimated according to the average value of enterprises with the same code (indicating industrial type). Then we identify the main polluting industries with the reference of Directory of Classification Management of Environmental Protection Verification Industry of Listed Companies (HBH No. [2008] 373) issued, the urban environmental statistic data and the polluting resources census data. Finally, we get the list and attribute data of Fengtai's enterprises as well as their distribution (Figure 2). The dataset includes the annual production output value and employee number of registered enterprises in Fengtai district. In addition, based on the list, we identify 88 petrochemical enterprises, 21 endangered enterprises and 80 above level hospitals as environmental risk source.
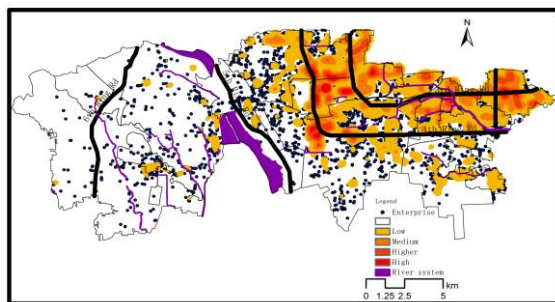
Figure 2. The distribution of industrial agglomeration in Fengtai District

2.3   The method of evaluation

In order to balance the advantages and disadvantages of the ICAs, many basic researches were conducted on the relationship of economic performance and environments. The concept of environmental performance was then formed. It can be traced back to 1970s as the concept of "environmental efficiency"(Freeman, Haveman, & Kneese, 1973; McIntyre & Thornton, 1978). In 1990s, Schaltegger and Sturm (1990) proposed the term of ecological efficiency, which to defines eco-efficiency as a

combination of economic and environmental (ecological) values, expressed by the ratio of economic value/environmental impact. Subsequently, the World Business Council for Sustainable Development (WBCSD) inherited and developed the concept, which means the ratio of the economic value of products and services to the environmental load (Schmidheiny, 1992).

The focus of the environmental management of the ICAs is the conflict of interest caused by the industrial activities between the urban residents and the ecological environment. Under the function positioning of "Industrial Concentration Areas", how to weigh the relationship between the economic development and environmental protection scientifically is the key problem to be solved by the EE evaluation. Therefore, we believe that it is necessary to consider the benefit brought by the industrial activities and environmental cost from two aspects of the production activity and urban recipient comprehensively.

In a broad meaning, ICAs reveals both positive and negative impacts. Its positive effect on urban and regional development can be summarized as socio-economic contribution, and be evaluated in two aspects, i.e., production contribution and employment contribution. The negative effects of pollution industry in ICAs on the environment include the negative effects of pollutants discharged on surrounding people and environments, which can be described from the perspective of amount, intensity and spatial distribution of various emissions. Concerning the objectivity and accessibility of indicators, we take waste water, waste gas, sulfur dioxide, industrial dust, nitrogen oxides, chemical oxygen demand and other indicators as the emission indicator. In view of special discharged pollutants generated from some enterprises, we take the heavy metal pollution, electromagnetic pollution, thermal pollution, photochemical pollution and so on as the special pollutants. Because of the technical difficulty or data confidentiality in the aspect of statistics, these pollution datas are difficult to be acquired and will not be analyzed in the following cases. On the other hand, the agglomeration of industry (especially the agglomeration of risk enterprises) increases the environmental risk with uncertainty, it will cause the great threat on the human health, ecological system and other sensitive receptors. Therefore, the environmental risks caused by the industrial on the residents and ecological environment also constitute the important contents of EE evaluation of ICAs.

According to the theoretical construction above, to objectively and comprehensively weigh the pros and cons of ICAs on the urban and regional development, we think that the EE evaluation of ICAs should be done in three aspects of socio-economic contribution, environmental load, and the environmental risk, from which the evaluation model for EE index of the ICAs is proposed:

$$BEE_i = \frac{C_i}{\sum (L_i, \ R_i)} \tag{1}$$

where, BEE_i indicates the EE level of spatial unit i, the numerator C_i is the social economic contribution index of i, and the denominator is constituted by the environmental load index (L_i) and environmental risk index (R_i) which are generated by social and economic activities in the spatial unit. Upon investigation to the availability of data, we propose the evaluation indicator system as shown in Table 1.

Table 1. Indices for EE assessment in urban industrial concentration areas

Component	Evaluation index	Variable
Socio-economic contribution	industrial contribution	GDP or output value
	employment contribution	employment population
Environmental load	waste water	Amount of waste water produced in production process
	waste gas	Amount of vehicle tailpipe emission, and waste gas in production process
	solid waste emissions	Solid waste from living and production activities
	sulfur dioxide	Amount of sulfur dioxide produced in the process of firing coal and other fuel burning
	Oxynitride	Amount of oxynitride produced in production process
	COD	Amount of COD in waste water
	industrial dust	Amount of dusts and particles produced in production process
	specific pollutant	Amount of heavy metal, electromagnetic, thermal, and photochemical pollutant
Environmental risk	risk factor	number, intensity, and distribution of risk factors
	Exposure	Size/density of surrounding residents/vulnerable population; distribution of sensitive and important ecological areas

2.4   The choice of spatial unit

Considering the spatial distribution of pollution enterprises, we compare the grids of 1000 meters, 500 meters, 200 meters. With 1000 m * 1000 m, we divide the area into 384 grids. the pattern of pollution is rough, and it is hard to make clear distinction of grids of industrial function. With 200 m mesh, the number of grid reaches 8067. The excessive fragmentation of the spatial distribution may bring difficulties to the regulation of the grids. By comparison, the spatial patterns of pollution emission of 200 m * 200 m grid and 500 m * 500 m grid are similar relatively, but once the grid is larger than 1000 m * 1000 m, the resolution of detected extreme value points would reduce significantly (Figure 3). This result has a strong correlation with the scale of land use and the size of manufacturing enterprises. For the spatial distribution of polluting enterprises in Fengtai district, it is appropriate to select 500 m * 500 m grid，which not only allows for precise evaluation result (the accurat distribution of environment load and environment risk), but also helps to identify the spatial pattern of environmental problems and heavy polluting enterprises.

As a result, Fengtai District is divided into 1379 grids of 500 m*500 m as the basic evaluation unit. Taking the emissions intensity of chemical oxygen demand (COD) for example, our comparison of different sized spatial units in Figure 3 shows, in the Jiedao scale, the distribution patterns of emissions intensity of COD has a huge difference. In the 1000 m grid, the distribution of COD is too coarse and can not reflect the internal differences. In the 200 m grid, the number of grids is too much. Based on the 500 m grid scale, the evaluation is much more refined and well reflected the characteristics of

spatial differentiation of pollution emissions.

a. Jiedao   b. 200m grid

c. 500m   d.1000m grid
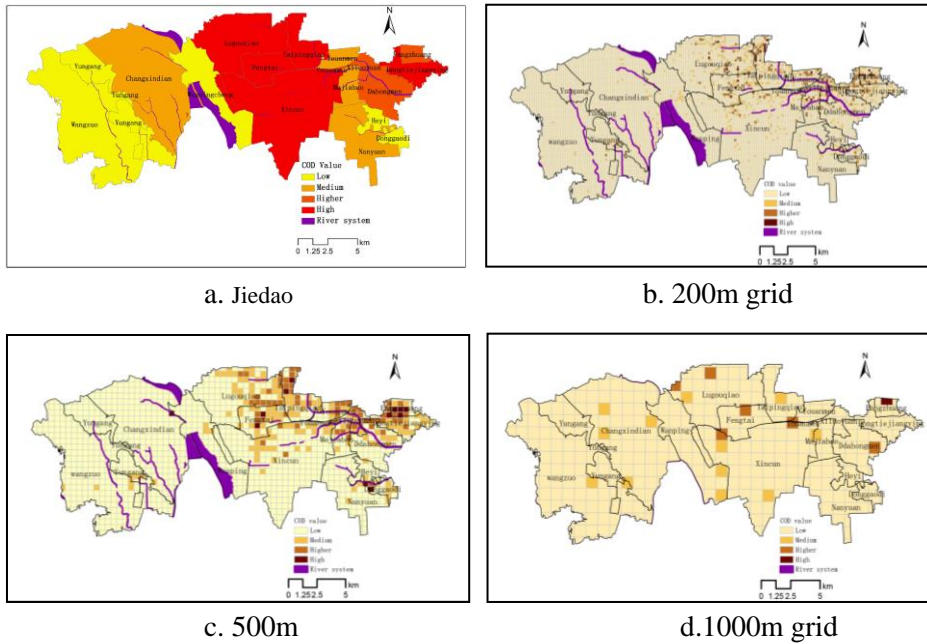
Figure 3. Intensity of COD discharge at different grid scale in Fengtai District

3.   RESULTS

3.1   Evaluation of social and economic contribution

In this study, socio-economic contribution of the ICAs is measured from two aspects, i.e., with the annual turnover of enterprise as the output value contribution index, and with the number of employees as the indicator of employment. We estimate the output and employment indices of each spatial unit, and then sum up the standardized indices to get the socio-economic contribution of each unit. The equations are as follows:

$$W_i = \sum_{j=1}^{n} w_{ij} \tag{2}$$

$$E_i = \sum_{j=1}^{n} e_{ij} \tag{3}$$

where, W_i is the sum of enterprise output in unit i; w_i is the output of the j-th enterprise in unit i; E_i is the sum of quantity of employment in unit i; E_{ij} is the quantity of employing of the j-th enterprise in unit i.

From Figure 4-a and Figure 4-b, we can find that, the high-grade grids of the output value and employment contribution are relatively consistent with each other in the spatial distribution, basically covering the northeast Jiedaos such as Fangzhuang and Dongtiejiangying, and the central regions such like Fengtai and Lugouqiao. Summarizing data in accordance with the grid, and then analyze the principal components of output value and employment contribution, the first main content is contribution rate of "economic contribution" factor, reaches 80.7%. Based on the statistical distribution features of this factor, with Natural Breaks classification method to divide the socio-economic contribution of each grid into four grades (Figure 4-c).

The results show that the social-economic contribution degree of different areas presents obvious spatial differences, the economic contribution degree such as Fangzhuang, Youanmen and Majiabao are relatively high with multiple extreme value grids. These regions have a quantity of large-scale industrial enterprises, which provide more jobs and meanwhile the industrial economic strength of enterprises in these grids are stronger than other areas. On the other hand, the mid-high grades of the grids in Hexi area show the "scattered" distribution, with relatively less enterprise output and jobs. It can be seen that functional orientation and functional division of different urban areas have a significant impact on spatial distribution of industrial development and employment.

a. Aggregated employment

b. Aggregated output value

c. Comprehensive contribution value
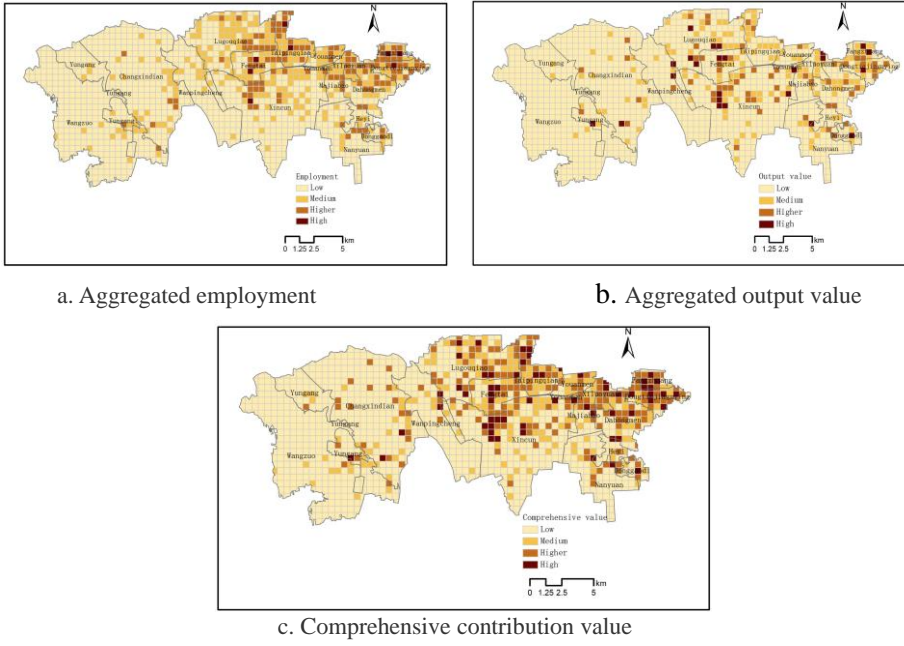
Figure 4. Social and economic contribution by grid

3.2   Environmental load evaluation

We select waste gas, waste water, sulfur dioxide and other indicators as the main pollution indicators, according to the environmental pollution characteristics of Fengtai. We further obtain emissions data of Jiedaos and primary monitored enterprises on the basis of the pollution source census and environment statistics And we distribute the known data of the key monitoring enterprises with large emission to all the grids through the spatial matching. The remaining part of the emission data will be allocated, taking into account of the pollution emission conditions (productivity and total emissions of the enterprises, etc.) and the pollution volume will be distributed to the enterprises. Summarizing the grids of pollution emissions (waste water, waste gas, waste residue), it can get the class of various spatial pollution degrees. According to the value of from low to high, assign the value 1,2,3,4 respectively, the equation is as follows:

$$L_i = \frac{\sum_{i=1}^{n}(M_i \times W_i)}{n} \quad (4)$$

where, L_i is comprehensive environmental impact of unit i, M_i is population

density of unit i, W_i is emissions intensity level of the pollutant factor, such as chemical oxygen demand (COD), ammonia nitrogen, sulphur dioxide and nitrogen oxides, and n is the species of pollutants. At last, through the Natural Breaks method, severity for environmental pollution can be divided into 4 grades, that is, low, medium, high, very high.

(1)Spatial distribution of population density

In this article, we adopt the population density to represent the exposure of sensitive receptor. Taking into account that it is difficult to reflect the spatial distribution features of population within the administrative region, while using traditional administrative unit to represent the population spatial information. This article will discuss the negative impacts of environmental pollution and environmental risk on the population under the micro scale. Therefore, the first step is to solve the problem of population data gridding. On the basis of the existing academic research on population density gridding (Yue et al., 2005; Ding et al., 2014), we using GIS spatial analysis technology to carry on the gridding of Fengtai population density (Figure 5), We find that the population of Fengtai District is mainly concentrated in the northern and eastern, especially in Jiedao like Dongtiejiangying, Fangzhuang, and Ma Jiabao, where have many grids with high level of population density. As the core of Fengtai District, with the highest population density, it leads to the concentration of sensitive receptors, and pollution created in the process of residents' lives and enterprise production also has quite a big influence. In addition, the tourist area and rural area of Hexi area have little population distribution, because of the western area lies in the ecological conservation area, with A large number of mountains and farmland. In general, the spatial distribution of population from northeast to southwest presents a significant decline trend from urban core to urban fringe areas and to the suburbs. In particular, the population of the outer suburbs in Wangzuo and Changxingdian are small, and there is no high density grid.
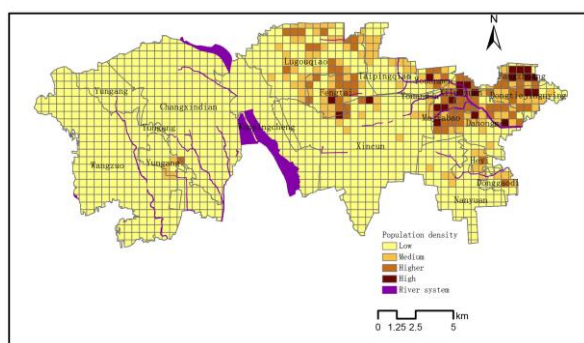
Figure 5. Distribution of population density

(2) Evaluation of environment loads

In order to grasp the impact of the evaluation scale on the spatial differentiation pattern, we conducted the summary statistics and comparison for the emission of pollutant in 500m grid and Jiedao unit. What follows in this article are the analysis results taking waste water and sulfur dioxide as

examples.

The results are shown in Figure 6-a and Figure 6-c. The areas concentrating the sources of pollution include: Taipingqiao, Xiluoyuan, Fengtai, Majiabao, Nanyuan, Fangzhuang, and the EE of these Jiedaos are relatively low, and they are the focus of environmental regulation. From the perspective of the spatial differentiation of various pollutants, the northern Jiedaos are the relatively rapid development area of Fengtai District, gathering many industries which cause a large amount of pollution emissions. In addition, in the Yungang Jiedao and Changxindian Jiedao of Hexi area, the amount of emissions sulfur dioxide, nitrogen oxides and soot are quite large, which should be paid a special attention.

Because the spatial scope of Jiedao is fairly large, it is difficult to identify the extreme value of pollution, and this may bring some barriers to the actual environmental management. Therefore, we conducted the more detailed analysis by the unit of grid. Figure 6-b and Figure 6-d show the hot spots of the distribution of different pollution with 500 m * 500 m grid respectively. In Figure 6-b, for example, the Yungang and Changxindian marked with a circle existing in the pollution extremum point in wastewater discharge. The extreme value of Yungang is mainly caused by the intensive wastewater emission of the Beijing No.27 Vehicle Factory of China South Railway, and the extreme value of Changxindian is caused by the high intensity emission of wastewater of the China North Railway and two subsidiaries of the Capital Iron and Steel Corp.

a. Wastewater discharge at Jiedao scale   b.wastewater discharge on 500m grid

c. SO₂ emission at Jiedao scale   d. SO₂ emission on 500m grid
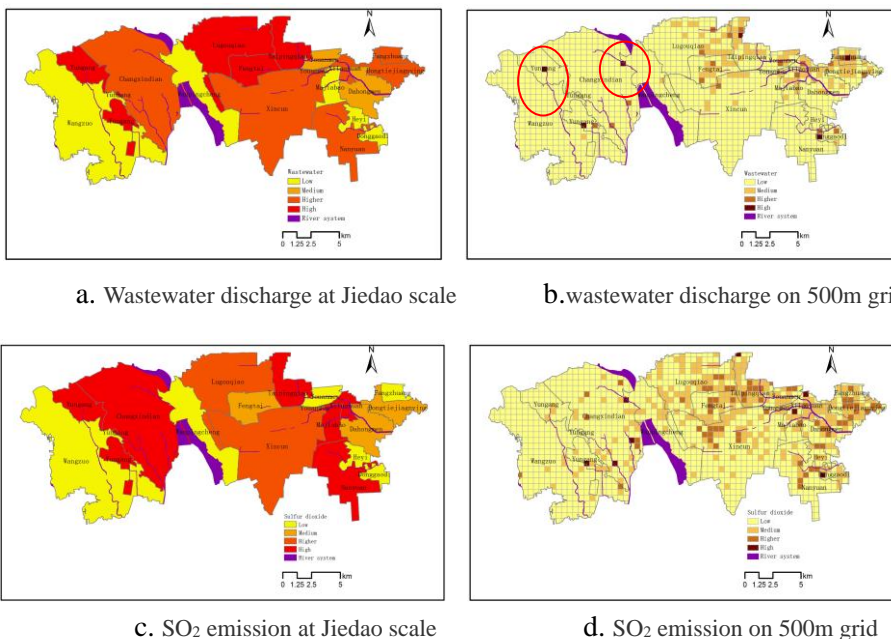
Figure 6. Comparison of the spatial pattern of pollutant emission at different scales

Table 2 shows the high intensive emission of pollution source of each Jiedao in Fengtai District. Taipingqiao, Xiluoyuan, Dongtiejiangying, Majiabao, Fangzhuang, and Donggaodi, are the hot spots of distributing many pollution sources, with the high environmental load. In general, compared to the Hedong area where pollution is relatively concentrated, the distribution characteristics of pollution sources of Hexi area is overall scattered, but it also has some grids with extreme value, which have a huge impact on the environment.

It can be seen that through the comparison of different spatial scales, there is obvious consistency on the evaluation results of the spatial distribution of pollution intensity in grid scale and in Jiedao scale. For example, Taipingqiao is characterized by high environmental pollution both in Jiedao scale and in grid scale, while Wanpincheng shows low pollution emissions in the aspect of the Jiedao and the grid. On the other hand, it also has some extreme points to cause that the intensity of pollution and pollution volume of Jiedao are not matched, such as Majiabao Jiedao. Obviously, when there are a large number of extreme value points, it would benefit for spatial environment control to explore the spatial difference pattern based in a more refined grid scale.

Table 2. Statistics of pollution discharge at Jiedao and extreme point

Name of Jiedao, town, and township	Waste water	Waste gas	Sulfur dioxide	Dust	Industrial dust	Nitrogen oxide	COD
Taiping qiao	●	●	●	●	●	●	●
Xiluoyuan	●		●	●		●	●
Majiabao		●	▲	●		●	
Dongtiejiangying			●		●	●	●
Fangzhuang	●	●					●
Donggaodi	●		●			●	
Fengtai	●	●					●
Lugouqiao		●			●		●
Youanmen		●					
Yungang	▲		●	▲		▲	
Changxindian			▲	▲		▲	
Dahongmen					●		●
Xincun	●	●			●		
Nanyuan			●				
Wanpingcheng							
Heyi							
Wangzuo							

Note: "●" represents that it is subject to certain kind of pollutant; "▲" represents that existence of extreme point in the grid.

We calculate the integrated environmental load of all kinds of pollutants with formula (4), and the comprehensive evaluation results are shown in Figure 7. In terms of the spatial distribution, the pollution sources including wastewater, waste gas, sulphur dioxide and nitrogen oxides are mainly concentrated in the north of Hedong area, while the distribution of pollution sources in Hexi area are scattered, but it also needs to be monitored because of the existence of extreme value points.

Figure 7. Distribution of the impact of environmental pollution in Fengtai District

The statistics in Table 3 show that the number of grids with high and

very high-level environmental load accounts for 20.2% of the total area, and that of moderate level accounts for 8.7% of total area. If effective environmental control is absent, the moderate-level grids are likely to become high load area in the future. These areas are mainly distributed in the east of Yongding River with high concentrated population and intense pressure for land use in the process of urbanization. Many Jiedaos will still face with the environment pressure in the future.

Table 3. Statistics of areas with different impact level of environmental pollution

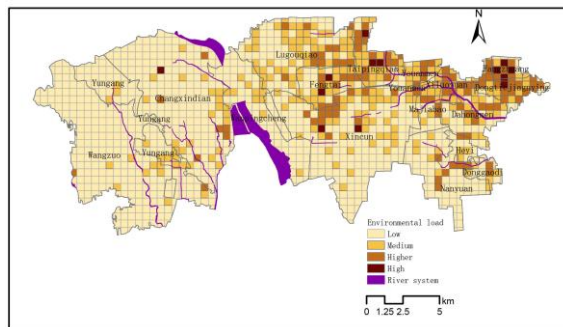| Level of environmental load	Number of mesh	Rate of number (%)	Covered area (km^2)
Mild	1008	71.15	217.28
Moderate	243	8.67	26.58
High	114	19.13	58.53
Very high	14	1.05	3.24
Total	1379	100	306

3.3   Environmental risk evaluation

The receptors of environmental risks in ICAs include residents and natural ecological system. We adopt the following equation to estimate R_i, the environmental risk of spatial unit i:

$$R_i = P_i \times F_i \qquad (5)$$

where, R_i is the level of environmental risk in unit i, P_i is the exposure of environment receptors and F_i is the risk level associated with unit i.

In view of the data limit, we primarily consider health risks of the population of residents, and evaluate the population risk caused by enterprises based on the quantity of enterprises and distribution of residential area. According to the pollution source census data and list of pollution sources of Fengtai District, we screen industries of poisonous, harmful, flammable and explosive, including petrochemical, chemical fuel, dangerous chemical production, storage and transportation, as well as hospitals as environmental risk source. Taking the level of risk source number in each grid as the substitute index of the level of risk source, based on the quantity of residential area in the grid. According to the number of residential districts in each grid, and refine the space for the resident population data to get the number of resident population in each grid to represent the sensitivity of receptor. According to equation (5), we get the spatial distribution of environmental risks of population (Figure. 8).

The results indicate that high environmental risk grids are primarily located in the northeast Jiedaos, such as Youanmen and Xiluomen, where are the economic development core of Fengtai District with large population, and would lead to a great loss in the event of sudden environmental risk events. Due to a certain spatial inertia of residential and business location, although the environmental protection department established the environment negative list, however, plenty of high-risk enterprises outside of the list, such as gas stations are still playing an irreplaceable role in the whole area with the difficulty to evade environmental risk by relocation in the short term. Aiming at this situation, the key in the urban planning is to define a reasonable protective distance, control the population density of the protection zone surrounding, strengthen the ability of prevention and supervision with the risk source, as well as to conduct the risk education to

the surrounding residents.
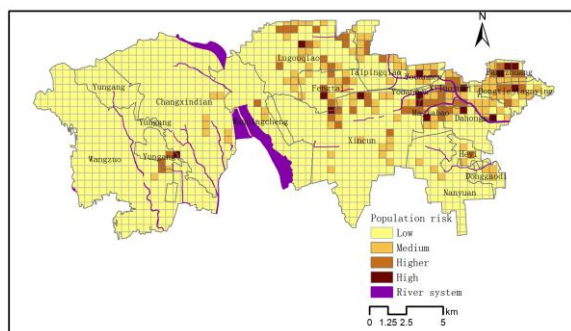
Figure 8. The spatial variation of population risk in Fengtai district

4.   COMPREHENSIVE EVALUATION AND SUGGETION

4.1   Integration of the indices in three aspects

In the above sections, we evaluate the socio-economic contribution, the environmental load and environmental risks at the 500m*500m grid network. The EE of the ICAs can be comprehensively evaluated based on the above three aspects. Due to different measuring scales, it is hard to estimate EE by summing up directly each value in the grid. Therefore, we firstly standardize environmental pollution and environmental risk indices, including enterprise output, employment, waste water, waste gas and sulphur dioxide, respectively, and transform them into four hierarchies. According to the aggregated score of each grid, we can get the grid values of socio-economic contribution, environmental load and environmental risk respectively. On the basis of equation (1) and with a Natural Breaks method, we get the EE score of each grid. The ultimate spatial distribution of EE is shown in *Figure 9*.

It can be seen that the spatial layout of EE in Fengtai District has three characteristics. The first is that the low EE grids have the tendency to agglomerate towards the eastern central urban areas. The Jiedaos in the Northeast, such as Fangzhuang and Dongtiejiangying have multiple low value grids of EE. This indicates a certain relationship between EE and the behavior of enterprises, which would prefer some location at the edge of core urban areas in order to achieve a balance of convenient transportation, proximity to urban market and easy access to information. The second is that low value grids obviously concentrate along urban express ring roads. In particular, the low value areas in the Hedong area are mainly distributed between the fourth and the fifth rings of Beijing, highlighting that traditional manufacturing industries with high levels of pollution (chemical, furniture, beverages, metal processing) have strong transportation dependence. The third is that areas with low EE accumulate around wholesale markets. For example, there are many low-end industries in the Dahongmen wholesale market with high pollution, and they make the place difficult for environmental management. Overall, as the center of economic development, Hedong area has higher concentration of industry and population than Hexi area. Despite of a high economic contribution, the score of environmental load and environmental risk is quite high, resulting in

poor EE in parts of Jiedao. As an important ecological barrier of the city center of Beijing, the Hexi area has carried out strict entry permission for industries for years, so the socio-economic contribution and environmental pressure of existing enterprises are relatively satisfactory.
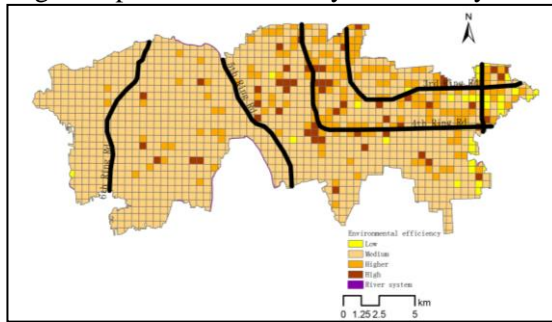
Figure 9. Spatial difference of EE in Fengtai District

4.2   Suggestions for environmental regulation in Fengtai district

The analysis of EE has provided a variety of viewpoints to deal with the spatial planning and environmental problems in ICAs. From a new perspective, it can help local decision makers to understand and measure the social, economic and environmental performance of ICA areas, and provide basis for developing planning policies to reducing the environmental load and risk of specific areas.

According to spatial features of EE in Fengtai District, we propose the following policy suggestions on environmental control.

First, it is important to adjust the industrial distribution and increase environmental compatibility. The evaluation results of EE clarify the location of enterprises with high intensity pollution. The distribution of these pollution enterprises should be re-examined, in order to avoid the exacerbation of environmental problems because of unreasonable planning. It is necessary to study the environmental compatibility of existing land use types, and adopt methods of segregation to separate living space and sensitive ecological space with specific production space such as petrochemical, metal products and chemical industries, which may yield harmful or poisonous substances.

Second, it is necessary to apply fixed-spot environmental management, i.e., setting sub-station and appointing managers to the lowest EE areas in ICAs. It is necessary in the pollution concentration areas and wholesale markets, it is anticipated that shrinking the unit of environmental management would improve the efficiency of environmental governance, such as for conducting in-depth analysis on the cause of conflict in each spot, and applying place-sensitive countermeasures.

Thirdly, according to the spatial characteristics of low EE areas, including center city-orientated, along urban express ring roads and market-orientated, some ecological corridor could be planned. Green space should be set up in a certain range, to form a spatial structure suitable to the mixture degree of ICAs so as to spatially prevent the negative effects of waste water, waste gas etc. on the living space and ecological space.

Finally, appropriate control on population increase should be implemented, especially in identified areas of high environmental risks brought by industrial concentration. Given the fact that polluting enterprises

may be difficult to relocate in short term, it is needed to make up supplementary plan to control the excessive mixture with population.

5.   CONCLUSION

In china, the contradiction between economic development and environmental protection is very prominent. One of the important scientific problems needed to solve is how to design goals of environmental protection rationally according to the functions of different urban areas, and how to promote displacement of stock space and improve its function and efficiency through the assessment and space governance based on the evaluation for ICAs, where have the most sharp contradiction among the living space, ecological space and the industrial space. The existing planning and governance mode which relies on the land use and development intensity (volume ratio) control is difficult to realize the environmental control. In this paper, we put forward an evaluation system of EE for ICAs, through spatial analysis and semi-quantitative assessment, it could located and diagnosed environmental problems in ICAs. Main contributions in this paper including: The first is that construct a theory model of urban EE evaluation for ICAs. The concept of urban EE puts more emphasis on general urban areas, and paying attention to application of the evaluation results in the environment governance policies. Secondly, this paper presents a medium scale evaluation index system and technical process for EE assessment of ICA, and proposes the evaluation index system of three dimensions including socio-economic contribution, environmental load and environmental risk. Especially, through the empirical analysis, it reveals the scale effect of EE evaluation. Taking Fengtai District as a case, it demonstrates the superiority of 500m*500m grid for EE evaluation with rationality compared with the administrative boundaries. In addition, based on the Beijing Fengtai case, this paper expounds the space control method on the basis of comprehensive EE evaluation results. The area of low EE value grids have the tendency to aggregate towards the central urban areas, the characteristics of distributed along urban express ring roads, the low value areas in the Hedong area are mainly distributed between the fourth and the fifth rings of Beijing, and the characteristics of distributed accumulate around wholesale markets, such as Dahongmen wholesale market area, the largest wholesale market of costume and cloth in Beijing and Hebei province. These conclusions provide a scientific basis for developing plans of spatial adjustment, environmental management, and population regulation.

The above research reveals the spatial characteristics of environmental efficiency brought by the industry and spatial structure, and it contributes to the planning policies of ICAs. A deficiency of the current study is that the evaluation index system and the method to integrate different indices need to be further improved. In addition, it is necessary to solve the bottleneck of the spatial resolution of EE assessment through integration of a wider range of data sources.

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Building Resilient Cities through Community Empowerment: Principles and Strategies for Taiwan

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Abstract: IPCC AR5 notes that since the 1950s, changes in climate systems, ocean, sea levels, icebergs, carbon and other biochemistry have been unprecedented. If the emission rate of greenhouse gases remains constant or increases, then the effects of climate change will become severe. Accordingly, research on vulnerability, mitigation and adaptation of climate change is required. With respect to those considerations, development of the concept of resilience and the construction of resilient cities has become a critical and important task for sustainable urban and regional development. This study begins by providing a brief introduction of the significant impacts of climate change globally and, in particular, in Taiwan. The second section analyzes concepts related to resilient cities, including vulnerability, adaptation, resilience, governance and community empowerment. The third section proposes principles to govern the construction of resilient cities through community empowerment, based on a literature review and documentary analyses. The final section presents conclusions and suggestions.

1. INTRODUCTION

Climate change has brought new challenges, including uncertainty in climate change and various impacts on everyday life (Andersson-Sköld et al., 2015; Archer et al., 2014; IPCC, 2014; UNEP FI Principles for Sustainable Insurance Initiative, 2014; The Royal Society, 2014). In the upcoming decades, the major driver of damage and losses that are caused by associated disasters will be the growth of populations and assets in harm's way, especially in urban areas (IPCC, 2012; Revi et al., 2014). Therefore, interest in urban resilience is growing (Chelleri, 2012; Kernaghan & da Silva, 2014; Lee, 2015; The Royal Society, 2014). Cities, municipalities and counties may also use climate change-related strategies to achieve such objects as sustainable and efficient energy use and renewable energy production, and provide a context within which both relevant behavioral and relevant technical innovations may arise and spread (Burch, Herbert, & Robinson, 2015; Lee, 2015). Cities are centers of innovation, which is a key component of resilience (Kernaghan & da Silva, 2014; Rose, 2014).

Often located along coastlines, in flood plains, or on seismic rifts, cities with their concentrations of assets and people are vulnerable to disasters (Jha, Miner, & Stanton-Geddes, 2013). They must adapt to past and future effects of climate change, despite related uncertainty and unknown risks and its local effects (Andersson-Sköld et al., 2015; Archer et al., 2014; IPCC, 2012; Pelling, 2010). Cities must constantly improve their communication and management of risk, early warning systems, emergency contingencies, evacuation plans, and recovery plans. While long-term trends in losses have not yet been attributable to natural or human-made disasters, climate change adds to city planning and management a dimension of additional risk and uncertainty (IPCC, 2012).

Numerous contexts of climate change that have been studied in the literature suggest that a holistic framework is required to address both urban sustainability and urban resilience (Kernaghan & da Silva, 2014; Rose, 2014). The goal of these studies is to elucidate policies and strategies in which flexible and "low-regret" measures can be cost-effective even when risks, of which many must be faced, are uncertain (World Bank, 2012). Considering the existence of unknown risks and uncertainties, resilience depends on redundancy (Marcotullio & Price, 2015). Cities that are facing difficult decisions concerning limited resources and investments must strive for efficiency, and consequently make trade-offs between resilience and redundancy (Montenegro, 2010; Jha, Miner, & Stanton-Geddes, 2013).

Taiwan is located in the Western Pacific Region, which is an area that is hit by frequent typhoons and under the influence of many meteorological effects. The presence of short rivers with narrow mouths and ongoing reduction in green open spaces contribute to low water drainage rates and reduced capacity for lands to contain and store water, promoting disasters such as floods and mud landslides. Since the 1980s, the urban population has exceeded the rural population. In 2014, Taoyuan Municipality became the sixth largest municipality in Taiwan by population. Since then, people who live in the six municipalities have come to represent more than 70% of the total population, making Taiwan an urbanized island state. As the massive rural-to-urban migration continues, cities are increasingly becoming the focus of attempts to transition to sustainability (Nevens et al., 2013).

Taiwan is facing a great challenge from climate change and inappropriate land development. Floods and debris flows that are caused by torrential typhoon rains have become increasingly common, resulting in severe loss of land, soil and water resources, and environmental degradation (Council for Economic Planning and Development (CEPD), 2012). Climate change is also likely to have a large impact on urban populations in Taiwan (Lee, 2014). Therefore, adaption to climate change is a growing concern in Taiwan. In 2012, the government of Taiwan issued the national adaptation plan, Adaptation Strategy to Climate Change in Taiwan (Council for Economic Planning and Development (CEPD), 2012). In 2014, the National Development Council (NDC) identified three metropolitan areas (Taipei, Taichung and Kaohsiung) as the primary focus for urban climate change adaptation plans and strategies.

Appropriate responses to the climate change impacts, keeping in mind the limited resources, and maintaining a stable balance of natural ecosystems will ensure the security of Taiwanese people and help move toward sustainable development (Lee, Lin, & Chen, 2016). These responses include the establishment or modification of the relevant Acts, collecting and analyzing all kinds of disasters' big data, effectively controlling urban population density and managing growth in the city, increasing the ability to

integrate and to allocate disaster prevention and rescue resources, building more effective disaster warning systems, and reviewing the current disaster-related financing measures of reconstruction and restoration. In addition to these top-down responses, bottom-up community empowerment can reflect local characteristics and community needs and further reduce the transaction costs of implementing climate change policies and help move toward a more resilient society.

In response to increasingly severe impacts of climate change and emerging demand for resilient cities and communities, this study firstly introduces significant impacts of climate change both globally and particularly in Taiwan. The second section analyzes concepts related to resilient cities, including vulnerability, adaptation, resilience, governance and community empowerment. The third section descries the mechanisms for resilient community development in Taiwan. The fourth section proposes principles, guidelines and strategies for constructing resilient cities by community empowerment, based on a review of the literature, in-depth interviews, focus group discussions and documentary analyses (concerning local climate change adaption plans). The final section draws conclusions and offers suggestions.

2.   CONCEPTS OF RESILIENT CITY AND RESILIENT COMMUNITY

Resilience is the ability of a system, community, or society that is exposed to hazards to resist, absorb, accommodate, and recover from the effects of a hazard promptly and efficiently by preserving and restoring essential basic structures and functions (United Nations International Strategy for Disaster Reduction (UNISDR), 2011). The IPCC (2014) has defined resilience as "the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation." The Royal Society (2014) has defined resilience as "the capacity of individuals, communities and systems to survive, adapt, and grow in the face of stress and shocks, and even transform when conditions require it."

Resilience can be specific or general (The Royal Society, 2014). General resilience and specific resilience must be consisted together because being highly resilient to one stress or shock can increase vulnerability more generally (Folke et al., 2010). In the context of cities, resilience is evolving as a new paradigm for urbanization and affects our understanding and management of urban hazards, as well as urban planning in general (Jha, Miner, & Stanton-Geddes, 2013). A resilient community can respond positively to a stress or shock and thereby retain its basic structures and maintain the provision of services (Resilience Alliance, 2002).

The concept of resilience can be applied to any community and any type of disturbance - natural, man-made, or a combination of the two. Examining disaster risk in the context of resilience helps urban planners to elucidate the many impacts of disasters and determine the long-term capacity of communities both to adapt to and to cope with uncertain risks (Jha, Miner, & Stanton-Geddes, 2013). Briefly, resilience can be used as an umbrella term

that dynamically links existing concepts of risk and sustainability (The Royal Society, 2014).

All levels of government (central, regional and local) have an obligation to protect their citizens. However, since local governments are the first institutions to respond to disasters, they have a particular obligation to reduce risk and build resilience within their communities (United Nations International Strategy for Disaster Reduction (UNISDR), 2011). Governments are responsible for managing and communicating risk. Constructing and enforcing the responsibility of city and municipal governments to manage and communicate risk effectively can be challenging, in part because doing so requires a perspective that temporally extends beyond elected terms (Jha, Miner, & Stanton-Geddes, 2013).

Policies, planning and construction in all city or municipality districts must take resilience into account to ensure that enhancements in resilience are gained across whole cities or municipalities, rather than in one community at the expense of another (Arup & Siemens, 2014). Resilience goes beyond risk management and mitigation: it increases not just preparedness but also the capacity to respond to disasters and rapidly recover from them. Resilience must be part of everyday urban development, short-, medium- and long-term investment and planning, hazard management, and urban governance (Jha, Miner, & Stanton-Geddes, 2013).

Community-based solutions that build social capital can be an important part of generating urban resilience (Revi et al., 2014). Community-based adaptation refers to the participatory identification and implementation of community-based development activities that increase the capacity of local people and community to adapt to climate change, and building on communities' expressed needs and perceptions to address local development concerns that are related to vulnerability (Ayers & Forsyth, 2009). Civil society can have a role in preparing for climate change, both through local non-governmental organizations (NGOs) and local communities, which integrate adaptive governance methods with tools for participatory planning (Archer et al., 2014).

3.   MECHANISMS FOR RESILIENT COMMUNITY DEVELOPMENT IN TAIWAN

It is critical to point out that the historical development of empowerment in development theory and practice is related to that of participation since the two concepts are products of social movement and struggle for liberation toward transforming prevalent social (Pettit, 2012), economic and political structures. Individuals must be involved proactively in solving problems rather than only opposing governmental policies. Such involvement requires self-sustaining, bottom-up participation (Grimm, 2011). Community participation in policy and plan formulation and/or implementation has received growing interest worldwide (Bailey & Pill, 2011; Eversole, 2011; Grimm, 2011; Pettit, 2012; Rahman, 2015). Although participatory communities may be communities of interest and/or communities of place, the focus is typically on place-based communities, based on their local knowledge and related policy insights (Grimm, 2011).

Given the significance of community participation and cross-sector collaboration in sustainable and resilient community development, the Taiwan Government enthusiastically encouraged community residents to

become involved in planning and designing sustainable and resilient community practices. As an empowerment process, community planning and design focused on individuals in place can benefit communities of any scale, from neighborhoods to districts to towns/cities to regions (Grimm, 2011). Take Taipei City as an example, since 1996, the Taipei City Government has disseminated environmental reform programs to improve communities via spatial strategies as the primary focus of community building programs in order to enhance the quality of living. Since then, the Taipei City Government has enacted community planning and empowerment programs, including a community planner system and numerous educational programs for young community planners. The Government further strived to achieve community empowerment by establishing the Community Empowerment Network, Taipei (CENT) in 2003 (Lee, 2017).

CENT functions as a platform to facilitate communication between citizens, community organizations, industries and governmental sectors. In addition to assisting citizens in holding community planning and environmental reform activities, CENT also serves as an important platform for sustainable and resilient community development and empowerment in Taipei. Following the establishment of branch offices in 2011, CENT has coordinated with these branch offices in holding diverse activities such as helping communities to achieve sustainability goals and to become resilient communities.

Sustainable and resilient community selection in Taipei was conducted by CENT. Various organizations and agencies, including community planners, neighborhood leaders and other NGOs, also promulgated sustainable and resilient community selection information and instructions to communities in Taipei. CENT invited proposals from the communities. Following several working meetings and inspections of the proposals, the reviewing committee assessed and ranked the candidates for planning and devising sustainable and resilient community practices. CENT continued to provide counselling services to those communities not selected for the demonstration projects of sustainable and resilient community development (Lee, 2017).

For example, in 2013, 14 communities were selected to participate in community empowerment building programs. In 2014, 26 communities participated in sustainable and resilient community building, focusing on issues such as aging society, environmental friendly design, creative community design and sustainable community construction. In 2015, there were 18 communities engaged in community empowerment practices. In addition to the existing programs, a new dimension (resilient community construction) was promoted. During the three-year period, the 58 communities have helped the Taipei City Government to move toward sustainability and resilience goals through bottom-up community empowerment.

4.   PRINCIPLES FOR CONSTRUCTING RESILIENT CITIES

Since urban adaptation to climate change is a relatively new field, and adaptation activities must be context-specific, no standards currently exist for planning and adaptation on the city scale, and various cities have used different approaches to planning and implementing adaptation-related

activities (Anguelovski & Carmin, 2011; Jha, Miner, & Stanton-Geddes, 2013; Archer et al., 2014).

Planning for climate change may involve vulnerability analyses, risk assessments and mitigation strategies, including at the community level (Jha, Miner, & Stanton-Geddes, 2013). However, significant gaps remain in inclusive approaches to urban adaptation that can only be filled by community-level knowledge and adaptation activities (Archer et al., 2014).

In the field of urban planning, decision makers face a trade-off between adequate preparedness and the potential future costs of response, recovery, and reconstruction after a disaster. The aftermath of a natural disaster frequently provides an opportunity to decision makers to take corrective and even preventive actions. A World Bank report on the economics of natural disasters provides empirical evidence of large returns from preventive measures (World Bank, 2012).

A recent review of the resilience literature distilled ten core characteristics of resilience that pertain to climate change and related disasters, including high diversity; effective governance and institutions; the ability to work with uncertainty and change; community involvement and the appropriation of local knowledge; preparedness and planning for disturbances; high social and economic equity; robust social values and structures, acknowledgement of non-equilibrium dynamics, continual and effective learning and the adoption of a multi-scale perspective (Bahadur, Ibrahim, & Tanner, 2013).

However, technology alone cannot make urban infrastructure resilient, and it will not be at all in the absence of suitable climate for the required investments. Technology can provide benefits only if system operators are equipped to use and act upon the information and controls that it can provide. Changing social, political and economic conventions are as essential to the success of city resilience initiatives as is upgrading physical assets. Based on a review of the literature, local climate change adaptation plans in Taiwan, in-depth interviews and focus group discussions, this work identifies five aspects of city governance and operations that together provide the important "enabling framework" for planning, investment and action to improve urban resilience.

Taiwan is composed of 22 municipalities and counties, of which 20 have issued local climate change adaptation plans and two are drafting such plans. The budget for drafting and issuing these plans was provided by the Council for Economic and Planning Development, started in 2012 after Taiwan's government published the Adaptation Strategy to Climate Change in Taiwan (Council for Economic Planning and Development (CEPD), 2012). For this work, three expert workshops were conducted in Northern, Central and Southern Taiwan in 2014. With help from the Community Empowering Society (a national NGO), various in-depth interviews and focus group discussions with governmental organizations, local NGOs and local communities were conducted in four counties (Chiayi, Yunlin, Taitung and Hualien County) to work out principles for building resilient cities.

4.1   Integrated urban planning, land use control and urban design

Policies and strategies related to urban resilience and sustainability must address multiple sectors and dimensions, including land use planning, energy management, ecosystem services, housing and transport, among others

(Kernaghan & da Silva, 2014). Integrated policies and strategies for upgrading public infrastructure can increase resilience across sectors and balance the preservation of local identity with the mitigation and management of risks faced by the city. Proper incentives can facilitate actions and investments toward urban resilience goals (Arup & Siemens, 2014). Cities can be made less vulnerable to disasters by the deconcentralization of key infrastructure services, the reduction of transportation bottlenecks and the provision of more rapid emergency response systems (Kernaghan & da Silva, 2014; Rose, 2014). Participatory planning resembles the approach toward sustainability because it seeks to integrate social, nonphysical or "soft" dimensions (Lee, 2014). Furthermore, participatory planning and the development capacity of local authorities must be improved to make resilience against the impacts of climate change a main component of local development plans (Khailani & Perera, 2013)

4.2   Governance

Climate has a significant impact on urban areas because they concentrate population, infrastructure, assets and economic activities (Kernaghan & da Silva, 2014; Khailani & Perera, 2013; United Nations International Strategy for Disaster Reduction (UNISDR), 2010). Therefore, cities have become critical focuses of governments that are facing climate change (Bulkeley, 2010; Jabareen, 2013; Lee, 2014; The Royal Society, 2014). Governance should take a whole-system approach to city management. Governance structures can support a rapid, accurate and decentralized emergency response (Arup & Siemens, 2014). Coordinating and enabling activities across multiple levels of governance is a critical theme in most city, county and municipality adaptation planning (Leck & Simon, 2013; Lee, 2015; Bahadur & Tanner, 2014).

4.3   Capacity Building

Resilience goes beyond risk mitigation to the building of adaptation capacity (Jha, Miner, & Stanton-Geddes, 2013). Social systems on various geographical scales must develop their own capacities to respond to the impacts of, and harm caused by, extreme climate change; only by so doing can they build social capacity as part of a long-term adaptation strategy (Lee, 2014). Additionally, improvements in knowledge and capacity can help city stakeholders plan and design for, and recover from, emergency situations (Arup & Siemens, 2014).

Not every city, county and municipality has the technical capacity to produce a geospatial description of hazards, harms and social vulnerability. States are responsible for providing technical support for mitigation planning, risk analysis and adaptation planning, but many face the same deficiencies of capacity as the cities, counties and municipalities, as they are unable to specify in detail local mitigation strategies, vulnerabilities and adaptation actions (Tate et al., 2011). To solve this problem, bottom-up methods that involve all stakeholders can help to clarify the causes of local patterns of vulnerability and to build urban resilience (Lee, 2014).

4.4 Financing investments

Appropriate financing mechanisms are required to support investments in, and the maintenance of, resilient urban infrastructure. Project appraisal processes should be utilized to elucidate the lifecycle benefits of investments in urban infrastructure (Arup & Siemens, 2014). Disaster risk financing – the shifting of the economic burden of loss to other sectors, through risk sharing or risk transfer mechanisms such as insurance, should be investigated (UNEP FI Principles for Sustainable Insurance Initiative, 2014). Additionally, the impact of a natural disaster can be felt long after the event: global economic losses due to natural disasters in 2013 amounted to US\$ 131 billion, or almost 2% of global GDP (Swiss Re, 2014). In fact, the World Bank has stated that up to US\$ 100 billion annually in climate adaptation financing will be needed in developing countries alone over the next 40 years (World Economic Forum, 2014). Most guidelines, strategies and plans do not consider funding requirements and sources, but financing remains an uncertain factor in adaptation planning and urban resilience efforts (Lee, 2015).

4.5 Stakeholder participation

Where local communities are well-informed and able swiftly and effectively to participate in, and shape, local planning processes, they can hold local bodies to account, and their doing so can represent the beginning of a transformative process of social and political change (Archer et al., 2014). Governments should engage widely with experts, scholars, local NGOs and local communities, and increase the likelihood that additional consequences of climate change are identified (The Royal Society, 2014). However, small localized stand-alone initiatives are not enough to respond to these challenges (Reid, H, 2014; Schipper et al., 2014), and stronger engagement with a wider group of stakeholders, particularly governments, provides more opportunities to move away from isolated pilot projects and to integrate community-based adaptation into policy and planning to an extent that NGOs cannot (Reid, Hannah & Huq, 2014). Moreover, participatory planning and the development capacity of local authorities must be improved to make resilience against disaster a main component of local development plans (Khailani & Perera, 2013). In short, top-down priorities must be aligned with local-level needs.

Any attempt to build resilience must consider social factors and use local knowledge as well as community and NGO networks to manage and reduce risk (Jha, Miner, & Stanton-Geddes, 2013). Additionally, institutional adjustment and reformation is the critical basis of implementing eco-spatial governance. Issues related to climate change are cross-disciplinary, cross-sectoral and cross-territorial. Therefore, a transformational, multi-sector, multi-scale and collaborative approach must be taken to efficient governance (Archer et al., 2014; Crist et al., 2013; Eversole, 2011; Leck & Simon, 2013; Lee, 2015; World Economic Forum, 2014).

5. CONCLUSIONS AND SUGGESTIONS

Although the conceptualization and operational definition of resilience vary among disciplines (as discussed in, for example, (Taubenböck & Geiß,

2014)), the broad underlying concept is overcoming adversity (Buikstra et al., 2010). The literature elucidates three attributes of resilience, which are (a) recovery, which is the capacity to recover from an adverse event and return to the original state; (b) stability, which is the capacity to cope with adverse changes with minimal disruption, and (c) transformability, which is the capacity to adapt to changing conditions (Dhakal, 2015). The third attribute, transformative resilience, is particularly important in organizational systems (Edson, 2012). Transformation can involve a long-term shift or occur swiftly in response to a triggering event. Like adaptation, transformation can be negative (unintended) and positive (proactive). In general, the focal point is on positive adaptation and transformation (The Royal Society, 2014).

Improving resilience involves integrated actions and responsibilities at local, national and international levels, by the public and private sectors, local communities and NGOs (The Royal Society, 2014), which have the potential to restructure economic, social, and political institutions. Briefly, urban climate-focused governance remains an emerging climate change adaptation planning dimension (Archer et al., 2014). Experience has demonstrated that community-based adaptation can remain centered on the priorities and processes that are selected by community without all adaptations' having necessarily to be implemented at the level of the community (Reid, H, 2014; Schipper et al., 2014).

Although inclusive, integrated and deliberative methods of urban climate governance are preferred, in practice their implementation is constrained by capacity gaps, power relations, and political struggles, which may limit the transformative potential of such methods in an urban context (Archer et al., 2014). However, coordinating and enabling the actions of multiple stakeholders provides opportunities for effective urban climate governance (Leck & Simon, 2013; Lee, 2015; Bahadur & Tanner, 2014). Additionally, a robust top-level policy structure is essential to shaping the mainstreaming of community-based adaptation into local- and national-level planning and design (Archer et al., 2014; Council for Economic Planning and Development (CEPD), 2012).

Resilience-building is a relatively new area of activity for cities (Anguelovski & Carmin, 2011; Archer et al., 2014). An ongoing process involves the use of new information and evaluation of existing measures to update regularly resilience-related plans and decisions (The Royal Society, 2014). However, no "one-size-fits-all" solution exists, and relevant action must be context-specific. Planning activities must take into account local priorities, which may not be climate change, and so integrate adaptation into the prevailing development paradigm (Council for Economic Planning and Development (CEPD), 2012). Furthermore, authorities must clearly understand the relationship between the vulnerability of local administrative regions to climate change-induced disasters and the resilience of those areas against such disasters (Jabareen, 2013; Khailani & Perera, 2013; Lee, 2014).

Building adaptive capacity both increases resilience and reduces vulnerability to many hazards (Lee, 2015). Broad responses to climate change in Taiwan, such as those aimed at urban resilience seem to be more open to participation and contributions from numerous stakeholders on various geographical scales. In 2012, the government of Taiwan set the national adaptation policy. Since then, cities, counties and municipalities had drafted plans to adapt locally to climate change. However, no community-based adaptation policies, plans or actions have been proposed. Building a resilient society requires top-down policy guidelines from the government,

bottom-up community empowerment and the participation of local communities. In the near future, the focus should be on helping communities to develop the principles that will govern their adaptation strategies and related guidelines, and, further, to implement them. Only by so doing can a resilient society be realized.

Although the city's needs can be met through community empowerment to build sustainability, resilience and adaptability, the community level cannot grasp the enough power, resources needed are very limited, and locality and characteristics of each community are so diverse. Moreover, the planning systems and implementation mechanisms of Taiwan, Asian, European and American countries are not similar, how to obtain effective results is very complicated and difficult and therefore warrants further in-depth analyses.

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Government-led Ecotourism and Resident-led Ecotourism

Time Series Analysing Stakeholder Subjectivity in Maha Ecotourism Site in Pyeongchang, Korea

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Abstract: Government-led ecotourism has advantages including a clear vision and quick outcome; nevertheless, it has stimulated conflicts between government and residents, owing to environmental degradation, stringent regulations, and operating deficits. Consequently, resident-led ecotourism, based on residents' opinions, has emerged as an alternative to construct ecotourism sites; however, this has stimulated chaos owing to the presence of numerous stakeholders. It is thus necessary to develop a collaborative management plan between two systems. This study analyses the subjectivities of the stakeholders of Maha Ecotourism Site, Pyeongchang, where the operating rights have been transferred to residents owing to the recent conflict between the government and residents. The findings reveal the issue of facility development in government-led ecotourism and the absence of an actual goal and consequently chaotic management in resident-led ecotourism. Furthermore, both the systems face the issue of consensus with regard to the management of regulation, space, safety, land price, and industrial structure.

1.   INTRODUCTION

Ecotourism began in the late 1900s as a way to activate the economy by bringing tourists to an ecologically sensitive region. It has since then been utilised in many regions (Su, M. M., Wall, & Ma, 2014). Developing countries in East Asia actively introduced ecotourism and applied it in many regions within their boundaries. In the process, a form of government-led ecotourism emerged and contributed to the rapid spread and development of ecotourism (Moswete, Thapa, & Child, 2012).

As ecotourism rapidly spread, government-led ecotourism, however, became centred on the construction of facilities for ecotourists. Consequently, there was a lack of sufficient consideration of ecological resources and the regional residents (Poudel, Nyaupane, & Budruk, 2016), which often brought about negative effects such as damage to resources and the migration of regional residents (Steelman & Maguire, 1999). Ecotourism

should be the sort of tourism that teaches tourists the value of ecological resources and respect for the regional residents' ecological lives (Coria & Calfucura, 2012). Therefore, as an alternative to government-led ecotourism, resident-led ecotourism emerged, wherein the local residents participated in the planning and operation of ecotourism, thereby conserving and delivering to the tourists the micro ecological resources that local residents are aware of and also their ecological lives. Although this form of operation started with such desirable objectives, confusion has arisen due to the residents' conflicting interests and insufficient perception of ecotourism (Cairns, Sallu, & Goodman, 2014).

This study attempts to explore possible alternatives to the two forms of ecotourism. Specifically, this study chose the case of the Maha ecotourism site located in Pyeongchang, Korea (the host city of the 2018 Winter Olympic Games), in which the operating rights were transferred from government to residents due to a recent government-residents conflict, and conducted a comparison analysis on the stakeholders before and after the transfer of the operating rights.

2.   LITERATURE REVIEW

2.1   Government-led Ecotourism

As government-led tour sites were constructed, many previous studies were conducted to understand which form of government structure would be efficient and sustainable. With regard to the role of the government, some authors were of the opinion that the government should work on environmental conservation and resource management, play a role of adviser, provide study and collaboration support, etc. (Wight, 2002), while some others argued that the government should present a blueprint and provide infrastructure from long-term perspectives (Ruhanen, 2013). Still others tried suggesting the role of the government through not just one but various role models (Su, D., Wall, & Eagles, 2007). All these studies argue for the absolute role of the government's participation in the tour site, and therefore have a limitation in that the opinions of other stakeholders, who would actually experience the various issues addressed in the studies, were relatively neglected.

2.2   Resident-led Ecotourism

Subsequently, many studies were conducted to complement the limitation and to explore alternatives to operate the ecotourism site by considering the opinions of the stakeholders including the residents, and then qualitatively (Pappas, 2008) or quantitatively (Boley et al., 2014; Sirivongs & Tsuchiya, 2012) analysing their various responses. An advantage of these studies was that the complex replies of various stakeholders were systematically organised. Furthermore, an opinion recently emerged that the residents and stakeholders should participate in leading the operation of the tour site (Buultjens, Shoebridge, & White, 2013). To implement the operating form, the stages (Lawton & Weaver, 2015) or processes (Boley & McGehee, 2014) of residents' participation were discussed. Additionally, a natural or compulsory composition of a council was comparatively analysed and the pros and cons of each were discussed (Zahra, 2011). In addition, to broaden

residents' participation, education or counselling were stressed through an analysis of residents' awareness (Liu et al., 2014), and a need for monitoring and evaluation was suggested (Holladay & Powell, 2013). The pros of the studies are that they discussed the advantages of resident participation in ecotourism and the methods to implement it. Nonetheless, the abovementioned studies have a limitation of neglecting the role of the government by emphasizing only the participation of residents rather than discussing the perspective of the coexistence of the government and residents.

2.3 Limitation of Government-led Ecotourism & Resident-led Ecotourism Studies

Ecotourism has a characteristic of public goods, and therefore it cannot be achieved by the government alone or by the residents alone. Therefore, it is necessary to research on the relationship between and the role functions of the two bodies, government and residents, and on how they should work together in harmony. Accordingly, this study aimed to determine the kind of relationship the government and residents should have and the role that each body should play in the operation of ecotourism, by using the case of the Pyeongchang Maha ecotourism site, whose main operating agent recently changed from the government to residents.

3. METHODOLOGY

3.1 Study Area
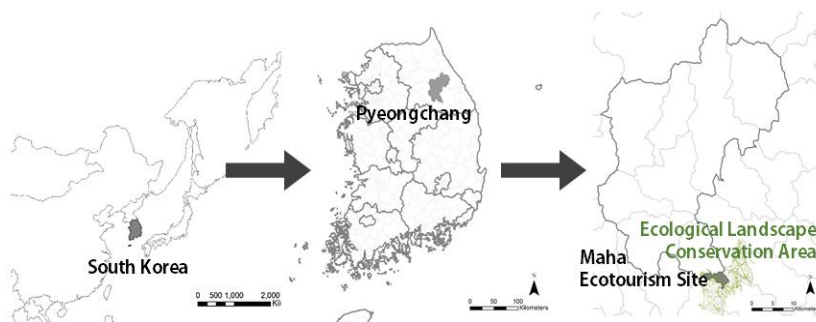
Figure 1. Location of Study Area (Reconstruction of Lee, Jae Hyuck and Son (2015) P6)

The study area of this study was the Pyeongchang Maha ecotourism site in Korea (See Figure 1), wherein the operating system recently changed from being government-led to being resident-led. The geology beneath the Pyeongchang Maha ecotourism site is limestone, and the site has special geological landscape features such as the Dong River and Pyeongchang White Dragon Cave, preserved as a landscape ecological conservation region. There was an attempt to build a dam in the Dong River in the 1990s because of frequent floods. However, the local residents and academics opposed the plan and, as an alternative, the government determined the area as an ecotourism region. In the process, various ecotourism facilities, including a freshwater ecology centre, were constructed under the jurisdiction of regional officers with support from the Ministry of

Environment, the Ministry of Agriculture, Food and Rural Affairs, and Gangwon Province. However, environmental degradation and many regulations resulted in a great deal of complaints and, more critically, led to a huge financial loss. Amidst all this, regional residents formed a residents' cooperative, which was given the operating rights as it promised to operate the site at an economical pricing.

3.2   Time-series Q methodology

The study used a time-series Q method to compare government-led ecotourism and resident participation ecotourism. Q method is a research methodology in which real field issues are selected as survey statements by interviewing people in the field, and it is very effective in analysing conflicts (Phi, Dredge, & Whitford, 2014). Therefore, the study utilized a time-series Q method to systematically organise and comparatively analyse the conflicts and confusions during the two operating terms (Davies & Hodge, 2012). Based on the findings, this study discussed the difficulties and alternatives in the two terms. The interviews and surveys were conducted in April 2013 and in November 2014, which were before and after the transference of the operating rights respectively (See Figure 2). The present study focused on the analysis of Distinguishing Statements and Consensus Statements in order to identify an option for an effective collaborative operational system.

4.   TRANSITION OF OPERATION IN MAHA ECOTOURISM SITE, PYEONGCHANG

4.1   Government-led Ecotourism

The Pyeongchang Maha ecotourism site is a region with excellent ecological resources due to its special geological features. From an early point in time, many tourists have been visiting the region for white-water rafting. As floods occurred in the 1990s, there was a plan to build a dam in the Dong River, but regional residents, together with the academics and environmental NGOs, desperately opposed the plan. The opposition's view was eventually accepted and the plan to build a dam in the Dong River was nullified in the 2000s, after which an alternative was suggested, which was to plan ecotourism in the area. Subsequently, in 2007, a freshwater fish ecology centre and basic tourism facilities were constructed. While such efforts were underway, the region was selected as one of the top 10 Korean ecotourism models in 2010 and one of the top 12 Korean ecotourism regions in 2013, receiving a large sum of financial support.

In the beginning, the government managed the financial support. Government officers are evaluated on short-term outcomes and are supported again based on the evaluation results, and therefore, they focused on the construction of facilities, as the outcome would thus be visible. In addition, because of a lack of sufficient experience in performing the job functions involving facility construction, they relied on consultancies with relevant expertise of construction and management. In the process, consulting companies who competitively bid for lower costs were more likely to be selected, which meant that for efficiency, they would uniformly build ecotourism facilities all over the country. Residents protested against such facilities, because they thought it would not help the region's
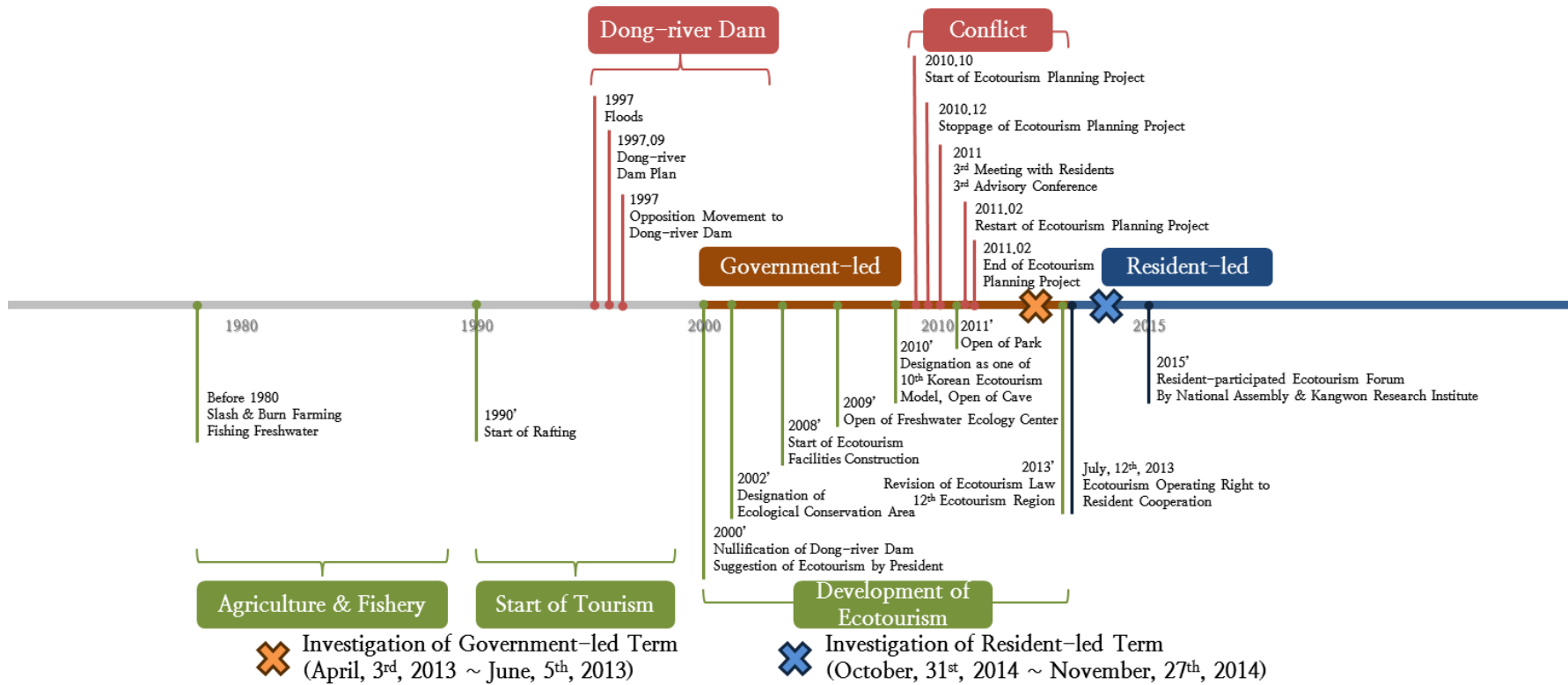
Figure 2. Transition of Maha Ecotourism Site, Pyeongchang & Investigation Time (Reconstruction of Lee, J. H. (2016) P12)

ecotourism, would destroy the regional environment, and haphazardly waste the government grant.

Subsequently, a fish monument became a critical issue. The concerned village is famous for Korean barbel fish, and therefore the government officers asked a construction company to build a fish monument as a way to advertise the region. However, the residents hated the fact that a strange looking fish monument was erected, because according to their belief, fish should only be observed in their natural habitat. Further, they protested that more than 30 million won was spent without their consent, while they always worked on facility management jobs at a low wage due to budget constraints. Residents started to protest against various other facilities besides the fish monument. As, in this context, the number of tourists did not increase, the Pyeongchang county became concerned about it and considered new strategies.

4.2   Resident-led Ecotourism

The residents formed a residents' cooperative to make tourism profitable on their own. As the Pyeongchang County was worried about the financial loss of the Pyeongchang Maha ecotourism site, the residents' cooperative suggested that they would efficiently operate the site at a lower cost and they were thus given the operating rights in the form of a trust operating system. The residents' cooperative became more interested in the development of various programs that could actually bring in tourists rather than in facility construction. Additionally, they were aggressive in gaining more knowledge, by visiting other, more advanced ecotourism sites. Despite the efforts, they underwent trial and error because of their lack of experience in building management, financial management, advertisement, etc. A more serious difficulty was the divergence of opinions. Various opinions were present, e.g., the opinion that ecotourism should be run by supplementing it with leisure facilities and programs, the opinion that more investment should be made to develop the workforce required in the field, a scepticism that there may not be any change even if they take on new challenges, and so on.

5.   Q ANALYSIS SETTING FOR TWO TERMS

5.1   Q statements

For statement selection, interviews were conducted by selecting the units responsible for the areas of ecology, economy, governance, local culture, education, and construction, which were the components of ecotourism. The results of the interviews showed that construction-related matters were the main issues in the government-led term, whereas diverse opinions in all areas were derived in the residents-led term. Based on the results, the following statements were selected (See Table1).

Table 1. Q statements between two terms

Division	Government-led Term	No.	Resident-led Term	No.
Ecology	Degree of Environmental Damage	1	Environmental damage by tourists, limited number of visitors at Baengnyong Cave, returning uninhabited buildings to grasslands, afforestation of cliffs for rockslide prevention, greenbelt area	5
Economy	Increase of Income	1	Salary of the director, land price, income, government investment, small-scale tourism, consulting companies	6
Governance	Degree of Resident Participation	1	Outsourcing workforce, meeting with officials, regular village cleaning activities, environmental organization, residents' participation, supporting the young workforce	6
Local Culture	Restoration of Traditional Culture	1	Cultural heritage, festival, leisure sports, domestic and overseas cases of restoring cultural heritage	5
Resident Education	Satisfaction about Ecotourism Education	1	Inviting experts as guest speakers, domestic or overseas field trips to ecotourism sites, giving the young generation priority for education	3
Construction	**(Constructed Ecotourism Facilities)** Size & Shape of the Freshwater Fish Ecology Museum, Size of Parking Lot, Location & Size of Fishing Monument, No. & Size of Village Pension, Length of Dong River Rider **(Development Plan of Ecotourism)** Renovation of Freshwater Fish Ecology Museum, Camping Location, Open Public Space of Village, Roads to Other Cities, Dam, Road to Cave, Fly Fishing Facilities by Renovation of Abandoned Trout Farm **(Connection with Other Sites)** Pyeongchang Olympic Winter Games, Pyeongchang Campus of Seoul National University **(Relationship with Other Industries)** Buck Wheat Sprout Farm, Dog Farm, Trout Farm	20	**(Constructed Ecotourism Facilities)** Fresh Water Ecology Centre, parking lot, fish monument, Jintan Naru Park, ecology pension **(Connection with Other Sites)** connecting with the Yeongwol area, the road to Baengnyong Cave and the Fresh Water Ecology Centre, the road to the Pyeongchang Winter Olympic Games site **(Relationship with Other Industries)** buckwheat sprout farm	9

5.2   P sample

Government officers were included in the P sample for the 2013 investigation, and mainly entrusted regional residents were selected in 2014. Surveying the same people both times would have been desirable, but in the case of officers, some were transferred to other regions, and the people who actually operated the ecotourism site were not the same either. Therefore, it was impossible to conduct the study with the same individuals. However, more than half of the people still overlapped between the two rounds of interviews (See Table2).

The result of a scree plot to examine the main factors showed that there was a large effect of factors with a value of 1.5 or more. Therefore, Q analysis was performed on the factors with a value of 1.5 or more, and based on the results of this analysis, three factors were extracted from the government-led term, and four factors were extracted from the resident participation term. The study concentrated on Distinguishing Statements and Consensus Statements from Standard Deviation of Survey in order to explore ways to reduce conflicts between the government and residents and identify strategies for collaboration, rather than to understand the nature of the factors based on the Q analysis results.

Table 2. P sample between two terms

Government-led Development			Resident-led Term	
Division	Stakeholder	No.	Stakeholder	No.
Officials		Public Official(Male), Public Official(Female)	2	-	-
Reside nt	Village Leader	Youth Leader(Male), Village Manager(Male), Resident(Male), Resident(Female)	4	Head of Freshwater Ecology Center(Male), Village Manager(Male), Village Deputy-Manager(Male), Related Organization(Female), Village Foreman(Male) Employee of Freshwater Ecology Center(Female)	6
	Tour Compa ny	Boss of Dong-river Leisure Company(Male), Employees of Dong-river Leisure Company(Male) 2 People, Taxi Driver(Male)	4	Employee of Dong-river Leisure Company(Male), Taxi Driver(Male) 2 People, Restaurant Owner, Private Pension Owner(Male) 2 People, Public Pension Owner(Female)	7
	Tour Guides	Tour Guides(Male) 4 People, Tour Guides(Female) 3 People	7	Tour Guides(Male) 3 People, Tour Guides(Female) 3 People	6

6.   RESULTS

6.1   Distinguishing Statement

In the government-led term, construction-related matters were found to be the main issues. In order to focus on the conflicts by term, we examined 10 statements with a 2 or more standard deviation of a factor value, as they

would show the greatest difference in opinion. The results showed that the issues causing conflict in the ecotourism construction process were about the construction of facilities. There were different opinions on the recently constructed facilities and the regions with a potential for future development. Based on the findings, we believe that the construction of an ecotourism site with a focus on facilities can cause many conflicts in the study area (See Table 3).

Table 3. Distinguishing Statement in Government-led Term

Statement	Standard Deviation
The size and structure of the freshwater fish ecology centre is suitable.	3.51
The road from the fresh water ecology centre to Baengnyong cave should be improved.	3.05
Tourism development should be linked with the Pyeongchang Olympic Winter Games area.	3.05
The dog farm must be maintained in the village.	3.05
The construction of Dong River Dam must be opposed.	2.89
Traditional forest lodging and restoration of roads are needed.	2.65
The freshwater fish ecology centre must be redesigned.	2.52
A fishing area should be built in the village.	2.31
The fish monument was well built.	2.31
The size of the parking lot built by the government is appropriate.	2.08

The main issues during the resident participation term were found to be operation-related matters. There were large differences in the opinions on the operating rights for ecological pensions, the direction of development, consulting companies, etc. Furthermore, among items related to facility construction, there was much discussion about public lands such as roads and limited development areas but not much about already constructed areas or areas with new plans for development (See Table 4).

Table 4. Distinguishing Statement in Resident-led Term

Statement	Standard Deviation
The operating rights to ecology pension should be given to the village.	3.59
Revenue should be created via leisure sports development rather than through restoring traditional culture.	3.55
Consulting companies take the entire government fund.	3.46
The road from the Fresh Water Ecology Centre to Baengnyong Cave should be improved.	3.41
There are too many development restriction areas mandated by the government policy.	3.31
Domestic and overseas field trips to ecotourism sites are quite helpful for learning about ecotourism.	3.20
It is necessary to establish a strategy to connect leisure sports to cultural heritage.	2.89
Uninhabited buildings should be restored as hills and grasslands.	2.63
Despite many tourists, due to good ecology management, there has not been much environmental damage.	2.52
Small-scale and high-yielding tourism should be prioritized.	2.5
It is necessary to limit the number of people who enter Baengnyong Cave in order to protect the ecological resources.	2.38
Systematic resident-led operation is needed.	2.16
Regular village cleaning activities vitalize the ecotourism village.	2.08
More resident educational support should be given to young people.	2.06
More foreign ecotourism cases should be explored.	2.06

6.2   Distinguishing Statement

To examine the items for which the opinions converged, the items with less than 2 standard deviation and strongly in the same direction were extracted (See Table 5). For item extraction, we selected the statements that included at least one item with an absolute value of 2 or higher and no opposing opinion.[1] An examination of the consensus statements across the two terms revealed items regarding overall management.

Table 5. Consensus Statement in Government-led Term

Statement	Standard Deviation
The village public announcement must be used.	0.58
The buckwheat farm must grow.	1.00
The level of resident education for ecotourism is suitable.	1.00
The number and size of the village pension is appropriate.	1.15
Length of Dong River Rider is suitable and safe.	1.53
The buckwheat farm must be actively linked with ecotourism.	1.53
The environment has deteriorated because of ecotourism.	1.53

In the government-led term, all agreed to using the village's public land that was not meant to be used due to strict regulation. Moreover, they were hostile toward buckwheat farms that were doing business other than ecotourism, wanted more education to be provided, and had positive attitudes toward accommodation-related items. They were hostile toward rides which were facilities without guaranteed safety, and had the opinion that ecotourism had not damaged the environment. Given the findings, what the stakeholders wanted was strategic alternatives for the spaces which could not be used due to strict regulation, businesses other than ecotourism industry, and a higher level of educational support. Nevertheless, their need for facilities seemed to be satisfied just by ecological pensions. Additionally, they denied environmental degradation due to ecotourism; however, whether it causes environmental degradation or not cannot be determined in the present study because the issue would require an ecological investigation. What this study suggests is that ecological monitoring should be frequently performed to prevent damage to ecological resources.

Table 6. Consensus Statement in Resident-led Term

Statement	Standard Deviation
Environmental NGOs should have more interest in this area.	0.58
Opportunities of resident education should be offered to young people.	0.96
It is good that land price continues to go up.	0.96
Alternatives to prevent falling stones are needed, such as a green wall.	1.15
A young workforce should be brought to the area even if they are not from the region.	1.26
The road should be connected to the Yeongwol region.	1.26
Jintan Naru Park, which is a part of the development restriction area, and has been an empty lot since long, should be utilized.	1.83
The fish monument was well built.	1.92

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1 We extracted either items from three groups with the same direction (with an absolute value of 2 or higher), or items from two groups with the same direction (with an absolute value of 2 or higher) and one neutral group (with an absolute value of 0).

The results of the analysis of the resident participation term showed that all were negative toward the statement regarding environmental NGOs' participation and preferred the statements about learning opportunities for young people (See Table 6). Further, negative attitude was observed toward rising land price because there would be no capital gain, as they are permanent residents. Positive attitudes were also observed toward the alternative use of places with the danger of falling rocks, migration of a young workforce, connecting with other regions, and use of Jintan Naru Park (empty space), whereas the attitude toward the fish monument was negative. Given the findings, what the stakeholders wanted in the operation process was not new facilities, such as a fish monument, or interference from environmental NGOs, but educational support, migration of a young workforce, and an alternative for Jintan Naru Park which was under strong regulation. However, they wanted some physical facilities and found a way to prevent rocks from falling by constructing a green wall system and a system connecting to the region of Yeongwol. Finally, they were concerned about the land price, which demonstrates a need for strategic alternatives in the region rather than the construction of physical facilities.

7.   DISCUSSION

The results of the comparison analysis across the two terms showed that conflicts present during the government-led term involved facility construction, and those present during the resident participation term involved operating rights and the direction of development. The conflict during the government-led term can be viewed as having started with the construction of numerous facilities. There was a need for alternatives for the spaces under strong regulation, for outbound migration of businesses other than ecotourism (which had little to do with the ecotourism industry), for education, etc., rather than building facilities. If facilities must be constructed despite other needs, a minimum number of facilities must be located for a maximal effect and safety too must be guaranteed. Further, in the process of ecotourism construction, spaces should be designed in a way that preserves ecological resources in the study area and benefits the lives of regional residents, and support for relevant education should be strengthened before the facilities are built. In this regard, although Ruhanen (2013) argued that a government's role was to construct basic facilities, the present study confirmed that efforts should be made to guarantee safety, while minimizing the construction of basic ecotourism facilities.

Conflicts during the resident participation term seemed to have stemmed from different opinions regarding operation methods (such as an expansion of the residents' operating rights) and the direction of development (such as the construction of ports or a focus on traditional culture). It would appear that before considering an operation method or direction of development, matters that can be foundations in activating the region, e.g., the migration of workforce, regulations of the region, alternatives for the increased land price, and reinforcement, should be first pursued. In other words, rather than letting different opinions on specific strategies to activate the village economy grow into conflicts, a young workforce and facilities should be reinforced in order to build unity. Therefore, it would appear that first, support, education, and consultation should be strengthened to help a young workforce migrate and work in the study area, rather than well planned ecotourism programs.

Additionally, upon examining the statements of commonly perceived problems, it was found that there was a request for non-physical matters. The finding suggests that a government's role should be to support not physical facilities but non-physical issues, and among the non-physical issues, especially through education, residents' awareness of the goal should be raised. In these processes, the government plays the role of providing a field for residents to act on their own. Further, residents should be made aware that immediate gains, such as the operating rights, could be a cause of conflict. They should first receive education to help them set their goal of ecotourism and develop the ability to operate, before the operating rights can be transferred to them. It means that an education to solidify residents' awareness of the goal should precede an overall education (Wight, 2002; Lawton & Weaver, 2015) regarding residents' participation in ecotourism.

8.   CONCLUSION

An ecotourism site is for everyone. Collaboration is hence necessary to create an ecotourism site that everyone likes. The present study analysed the case of the Pyeongchang Maha ecotourism site with time-series Q method to investigate the status of collaboration between the government and residents. It was clearly demonstrated that the role of the government is to provide a field for the residents to act on. From this perspective, ecotourism facilities should be constructed with a high level of residents' awareness, and facilities that the residents do not ask for should not be constructed. First, sufficient education and support should be provided so that the residents can build the facilities they want, and help should be offered so that they can conduct the overall management of the facilities. In addition, residents should be able to determine their desired goal of ecotourism and should try to achieve it, rather than trying to gain benefits such as the operating rights. In the process of collaborating and performing the role given to each, an ecotourism site will become a place that everybody loves.

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Prospects for Sub-Regional Cooperation in Fujian and Taiwan from Perspective of Urban Planning System：A Case Study of Pingtan Experimental Area

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Abstract: The pace of cross-border sub-regional cooperation is accelerating in the worldwide; ways of institutional cooperation guided by policy has become the trend of regional development gradually. The collaborative development of urban planning system is one of deciding factors in sub-regional cooperation. Fujian and Taiwan have deep connections and the strategic visions of cross-strait cooperation was formed. The approval of Pingtan Experimental Area provided conditions and spaces for the realization of cooperation and it proposed a new pattern of joint planning, development and management in the same year. Based on that, this study attempts to find and analyze the collaboration points which are significant to promote joint management by making a comparison of system of laws and regulations, system of operation and system of administration in urban planning system between the mainland China and Taiwan. Then we will build an operational framework of sub-regional cooperation based on the method of shift-of-context analysis. Related references are including: (1) Add necessary control requirements of building and land use into legal aspects; (2) Strengthen the connections between master plan and detailed planning; (3) Set up special departments for planning review under legal management in administrative cooperation; (4) Implement management for various lands in the same way to promote overall effective development of Pingtan.

1.   INTRODUCTION

With the trends of economic globalization and regional integration are developing in parallel, cross-border sub-regional cooperation is speeding up gradually (Cheema, McNally, & Popovski, 2011; Wang, Yuejuan, 2014). Sub-regional cooperation is a concept relative to region, it refers to a regional cooperation between adjacent areas in a country and the contents and projects are more flexible (Qiu, 2015). Urban planning system is the mechanism in sub-regionalism cooperation and the guarantee of its policy function is to make fair and reasonable allocation of social resources and public interests orientation (Wang, Yu, 2009). Since A.D. 230, there are deep roots and exchanges between the Mainland China and Taiwan (often

referred to as "both sides"), and their five geographical advantages (close in geographic sites, blood related, cultural background, commercial intercourse and laws) and complementary requirements of current development are promoters in cooperation. After 2000, both sides made great strides in relationship and economic cooperation. The growth of trade volume increased more than tripled in just ten years (Economic and Social Survey Team of Pingtan Experimental Area; Statistics Office of Pingtan Experimental Area, 2014). In 2003, China proposed the strategy concept of 'Economic Zone on the West Side' (shortly for 'Economic Zone') and the construction of Economic Zone launched officially. In 2009, The State Council (2009) promulgated 'Opinions about Supporting to Accelerate the Construction of Economic Zone on the Western Coast of the Taiwan Strait in Fujian Province' (shortly for '*Opinions*') and Economic Zone was upgraded to a national strategy. In 2010, both sides signed the 'Economic Cooperation Framework Agreement' (shortly for 'ECFA') which means a new channel of economic cooperation was opened. Since then, how to open up a path to promote regional coordination development has been in-depth discussed by scholars on both sides. Finally, the path of 'selecting an appropriate region as pilot area of cross-strait cooperation to provide a reference for joint development' was formed gradually. Pingtan Experimental Area (shortly for 'Pingtan') emerged at a historic moment and proposed a grand plan of 'joint planning, joint development, joint operation, joint management and share earnings'.

Sub-regional cooperation theories have been discussed in the context of regional development. Some scholars considered that 'Sub-regional Economic Zone' was more suitable for areas which had geographical proximity, historical connection, close in culture but separated politically and easier to establish cooperative development with different institutional background (Rakhimov, 2010). Chi and Li (1992) took Tumen River as a representative of 'Transnational Economic Zone' pattern which was taking export-oriented economy as the goal to joint development and this pattern explored an open institutionalization cooperation actively that excluded the impacts of partial political factors (Chi & Li, 1992; He, 2005). David (2015) explored the 'New Regionalism' in the new situation which was facing to social conflicts and physical planning cohesion in regional co-regulation and it made a close coordination between physical planning and development plan of social and economic in different levels (David, 2015; Wu & Wei, 2004). From these studies we can find, ways of institutional regional cooperation has become a hot topic and indicates the trend of sub-regional cooperation. As a significant determinant in sub-regional joint development, the collaborative of urban planning system is gaining more attention. The urban planning system in Fujian and Taiwan have distinctive characteristics respectively especially in the system of laws, operations and administration. Hence, there are existing various planning phenomenon (or means) under respective contexts.

Therefore, this study attempts to find and analyze the collaboration points which are significant to promote joint development and management in the case study of Pingtan by making a comparison of system of laws and regulations, system of operation and system of administration in urban planning system between the mainland China and Taiwan. Then we will build an operational framework of sub-regional cooperation based on the method of shift-of-context analysis. It may give references to decision-makers by providing inspirations to promote joint development and management on both sides effectively.

2.   STUDY AREA

Pingtan County belongs to Fuzhou city, Fujian Province (Figure 1). After the whole county was planned to build Experimental Area (the only one national experimental area in China), it obtained administration privileges of cities under the jurisdiction of Fujian province directly. Thus, the overall development of Pingtan is managed by district council and should be reported to the State Council for approval under the system of urban planning of Fujian and local development requirements. Due to the location of remoted island and front frontier on both sides, the economic development and urban construction of Pingtan was lagging behind and lack of appropriate guidance policies. Based on 'The Urban Master Plan of Pingtan County (2008-2020)', the planning area of Pingtan is only 26.12 km^2 which was less than one-tenth of total area.
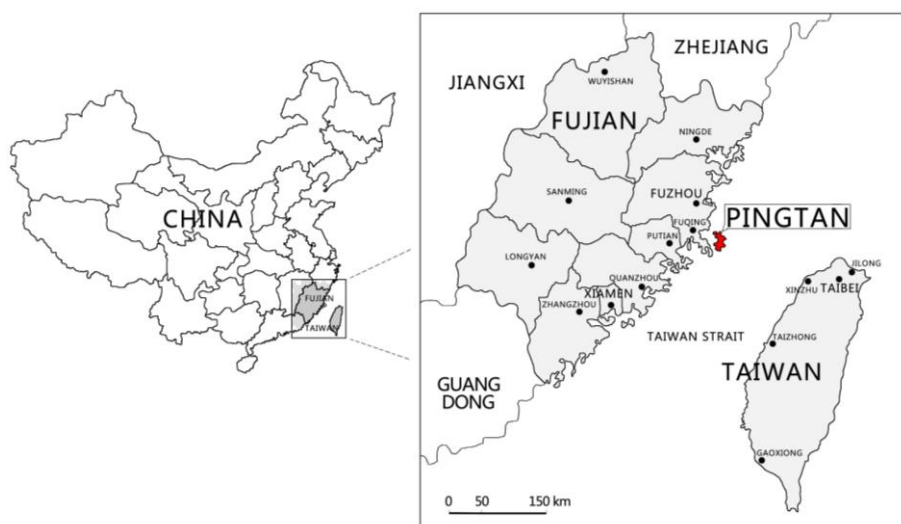

Figure *1*. The location of Pingtan Experimental Area

In 2009, the master plan of Pingtan County was invalided which had been implemented for only one year and the new master plan of Pingtan Experimental Area started to formulate. In July, the State Council issued 'Opinions' (The State Council, 2009) and proposed to 'promote construction of Pingtan and makes it possible to build an experimental area that try first in cross-strait exchanges and cooperative and scientific development on Economic Zone'. In next years, both sides signed 'ECFA' (The Chinese Mainland's Association for Relations Across the Taiwan Strait (ARATS) & Taiwan's Straits Exchange Foundation (SEF), 2010) and 'Service Trade Agreement' (2012) (shortly for 'STA') which negotiated basic principles and working mechanisms in economy, trade, investment. Etc., and broadened channels of economic regional cooperation.

In order to implement these macro policies, the State Council approved 'The Master Plan of Pingtan Experimental Area (2010-2030)' (Management Committee of Pingtan Experimental Area in Fujian, 2010) and put forward a new cooperative of 'Five Joints'. Its contents include a space framework of 'one city, multi regions and groups aggregation' and short-term construction plans were focusing on developing port-based economic and trade zone, central business district and tourism and leisure area in the southern of island. In 2011, the National Development and Reform Commission announced 'Development Plan of Economic Zone on the Western Coast of

the Taiwan Strait' (The National Development and Reform Commission (NDRC), 2011a) and 'Master Development Plan in Pingtan Experimental Area' (The National Development and Reform Commission (NDRC), 2011b) that carried out cross-strait regional cooperation in Pingtan and explored a new pattern to develop a common home that joint construction, try first and scientific development in Pingtan by both sides. It also agreed to implement 'Open Island' and gave Pingtan more unique and preferential policies than any other special economic zones. Such as the pass model (risk classification management for customs check of goods, etc.), fiscal support (be duty-free or bonded for the goods from overseas which are related to the production, etc.), investment access (relax market access conditions for Taiwanese, etc.), finance and insurance (support to set up joint ventures, etc.), cooperation with Taiwan (allow to set up service institutions of Taiwan, etc.) etc. (Figure 2)
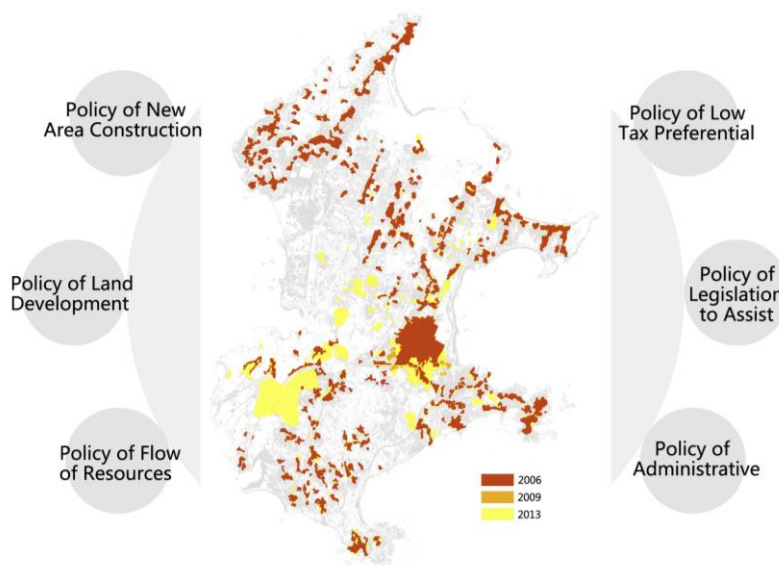
Figure 2. Land expansion of Pingtan Experimental Area and its policy-driven

Guided by the 'Master Development Plan in Pingtan Experimental Area' (The National Development and Reform Commission (NDRC), 2011b), Fujian provincial government design special policies in new area development, land, transportation and trade, tax, laws and management, etc. In particular, Fujian encourages Pingtan to learn advanced experience from Taiwan or the other countries, organize planning agencies on both sides to formulate special planning, establish a sound mechanism for regional cooperation to break the limit of administrative regionalization; gives priority to construction land and ensure land demands, especially the industry land for modern service; builds ports and provides convenient port services to move faster toward flow of people and goods, gives more preferential terms to Taiwan enterprises and products; implements fiscal and taxation independent and low tax regime in Pingtan and reduces business tax or preferential treatment for partial special enterprises; gives appropriate legislative authorities to Pingtan to make local laws and regulations, builds a green channel of judicial assistance between Fujian and Taiwan; sets up cross-strait cooperative commissions by agreement and confirm power sectors through legislation which including economic and social, development and construction, etc.

Fujian government issues a series of preferential policy and management details to thoroughly apply national policies. It supports the development of key industries and encourages intensive land use actively by the ways of preferential land price. In industry development, Fujian gives construction projects at most 70% of land use right price according to 'National Standards for the Minimum Transfer Prices of Land for Industrial Purposes' which meeting to national industrial policies, encouraged by Fujian and belong to major projects or provincial key projects in industry revitalization planning adjustments. About intensive land use, Fujian gives construction projects which meeting the relevant provisions of urban planning, using advanced technology or land-saving measures in designs or construction technique or investment intensity exceeding 10% of standards prices preferential from 3% to 10% according to saved land area or improvement of FAR. For general projects beyond the concentration areas planned by government, the minimum standards of selling lands will go up 10%.

All these system contexts support Pingtan's development in the phase of start-up. Because the development of Pingtan is accelerating under the guidance of policy documents which focusing on the joint construction and development on both sides, the collaboration of urban planning system of two places is inevitable to a great extent. Mainland also gives sufficient relaxation of policy and freedom to explore. These basic contexts call for analyzing differences of urban planning system in Fujian and Taiwan and finding collaboration points to improve the environment of a large number of state-owned and Taiwan-funded enterprises are drawn into Pingtan.

3.   METHODOLOGY

3.1   Sub-regional Cooperation Theory

Sub-regional cooperation theory is an extension of traditional regional cooperation in a new phase of development. The prime minister of Singapore Zuodong Wu first proposed the 'Growth Triangle' theory in 1989 for the construction of multinational economic development zones (Ooi, 1995). American scholar Scalapino (1999) put forward a concept of "Natural Economic Territories" in the case of economic cooperation between the Pearl River Delta and Hong Kong, etc. According to related studies, in this paper, sub-regional cooperation means two or more countries or regions set a certain geographical area aside and created an organism of highly economic coordination to promote economic development (Nadalutti, 2014; Katircioglu, Kahyalar, & Benar, 2007). Conditions of forming the sub-regional cooperation among different areas were including geographical proximity, economic complementarity and possibility for mutual coordination among governments (Yu, P., Cai, & Lu, 1999; Chou, 2006). The relationship between the Mainland China and Taiwan conforms to basic conditions and ideas of sub-regional cooperation theory, which can be used to promote regional integration and joint development.

3.2   Shift-of-Context Analysis

In this paper, the core of sub-regional cooperation is the coordination in institutional aspects according to literature review. The contents of analysis for this study are urban planning system and the range is two provincial

regions which cross administrative boundaries. Relevant principle data sources for determining urban planning system on both sides come from district government materials and rigorous literature review. Meanwhile, Shift-of-Context Analysis (Leung, 2003) is used as a basic method in this study.

The Shift-of-Context Analysis is a kind of comparative method focusing on relationships between planning phenomenon (or referred to means, hereafter called means) and contexts in two or more countries and regions. The key point of comparison between two places is the process of shifting one means to another. The context of different places has particularity and they are not easy to change. The operation relations can be described as followed. Place A and place B have different planning means in their contexts. It is necessary to make an appropriate research for plasticity and some planning means need to be adjusted when use it in place A from place B. Because of contexts of place A is hard to change in this process, the special region background and policy become significant basis and criterion of analysis of plasticity. Revised planning means is the key point for studying from one another and planning collaboration between place A and place B (Table 1.):

Table *1.* The relevant variables, relations and process in brief

Variables

• **Four variables:**
  1. Phenomenon (means) of place A
  2. Context of place A
  3. Phenomenon (means) of place B
  4. Context of place B
• **Two relations:**
  1. Relationship between phenomenon (means) and context of place A
  2. Relationship between phenomenon (means) and context of place B

Operational Modes
Basic process

1. **Confirm the means of place A**. Distinguish every details and level of this means and decide which one is most important.
  2. **Identify the context factors of place A that related to its means**. Distinguish the nature and impact of every factor and decide which one is most important.
  3. **Analyze the relationships between the means and background of place A**. Focus on the fit, conflict and tension between means and background.
  4. **Move the means of place A to place B just as it was and distinguish which context of place B will be led or depended on when the means of place A is used in place B.** This part usually called as mental experiment.
  5. **Analyze the 'possible relationship' between the means of place A and the context of place B**. Especially the possible fit, conflict and tension.
  6. **Research for the 'plastic' of the means**. Find out the limitation that can be amended on the premise of not changing the particularity of this means.
  7. **Shape a means that fit for the context of place B**. Make an assumption that the background factors are not change and shape a means that best fit, least conflict and lowest tension for the context of place B.

By using this method in the research for cooperative development in Fujian and Taiwan, the basic framework and process can be organized as followed (Figure 3)：

1. Determine the overall objective of cooperative development by Fujian and Taiwan in Pingtan: joint planning and construction. Find key differences of urban planning system on both sides by the comparative analysis.

2. Analyze key context factors behind the differences of urban planning system and their relationships.

3. Make a hypothesis of 'possible relationship' after the shift of key points in urban planning system and research for 'plasticity' according to the special region background and policy in Pingtan.

4. Build the framework of cooperative development in Pingtan based on the shift of feasible urban planning system which is both advantageous to the optimization of urban planning system in the context of mainland and meet the planning means of Taiwan properly.
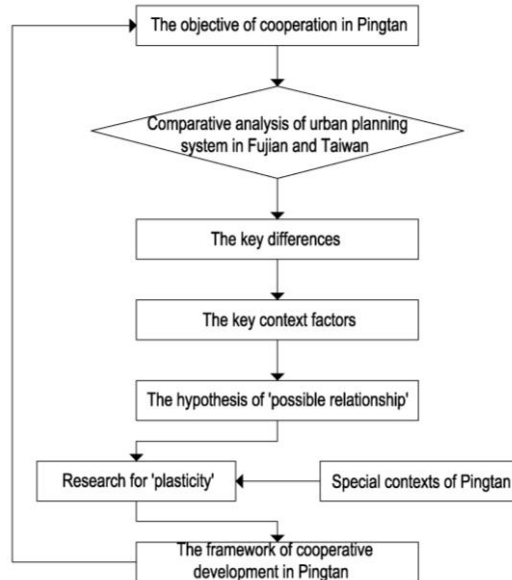
Figure 3. The Basic Framework of Cooperative Development in Fujian and Taiwan

4.   RESULTS

4.1   The Comparative Analysis in Taiwan and Fujian

4.1.1   The System of Laws and Regulations

The system of laws and regulations is the basic guarantee of urban construction and its characteristics are mainly embodied in structure, functions, purposes and core contents.

The planning system of laws and regulations in Fujian is composed of two levels from central to local in a centralized system. In national level, Fujian follows a horizontal system which consisted of basic laws, matched laws, related laws and corresponding technical specifications and it is a basis to build local planning regulations. In particular terms, Fujian takes the *'Urban and Rural Planning Law'* as the basic law to direct lower regulations and involving principle provisions that covering planning formulation, management, operation and development control, etc. This part is assisted with administrative regulations and measures on planning formulation, approval and management to improve detailed rules by making related technical specifications and standards. In addition, some related laws are also significant legal basis in urban construction. Like laws involving the land ownership and management: *'Land Administration Law'* and *'Cultural Relics Protection Law'* etc.; construction of important urban facilities:

'Regulations on Administration of Urban Roads' and *'Construction Law'* etc.; environment and social security in urban: *'Environmental Protection Law'* and *'Civil Air Defense Law'*, etc. Under the national macro-control, regions develop appropriate local planning regulations according to local needs to improve the management of urban planning. Like in Fuzhou, the capital city of Fujian Province takes '*Regulations of Fuzhou Municipality on Administration of City Planning*' as the core of local regulations and assisted with management measures and technical specifications which contains cultural preservation, roads and greening construction, land and new area development to constitute the mainly regulatory network system that from top to bottom at present stage. In this system, planning regulations are defining two planning acts: urban planning operation (formulation and approval) and administration to achieve the purposes of strengthen urban planning management.

Different from Fujian, the system of laws and regulations in Taiwan has three main parts: urban planning, architecture management and land use control. Based on the '*Urban Planning Law*' , '*Building Act*' and '*Regional Plan Act*', Taiwan takes a large number of urban planning laws, building construction laws and land use laws as auxiliary laws. Related laws are concerning on the environmental protection, housing and common pipeline. Eventually Taiwan makes detail operating requirements of laws' contents by related enforcement regulations. All these formed a specific system of urban planning laws (Han, Shi, & Hu, 2001). Local governments in counties or cities set appropriate autonomous regulations of urban planning implementation to fulfill requirements of laws system. For example, Taipei City obeys the '*Autonomous Regulations of Urban Planning in Taipei*' to assist the implementation of basic laws and enhance the environmental quality of city life. Taiwan takes three basic laws as a basis of laws system in urban planning at the same time and focusing on the relationships among urban planning, building management and land use control. According to '*Urban Planning law*', urban planning should be implemented the buildings management in accordance with '*Building Act*' after it was announced and the land use or zoning plans should be controlled by the license requirements and building tools. In land use control, Taiwan has introduced dozens of special decrees that covering all aspects of land expropriation, registration, planning and management and highlights the protection of non-urban land and agricultural land released in urban planning. The urban planning system of laws in Taiwan is more detailed in regulations of resources management and covering more spaces that reflecting the tendency of urban planning (Figure 4).
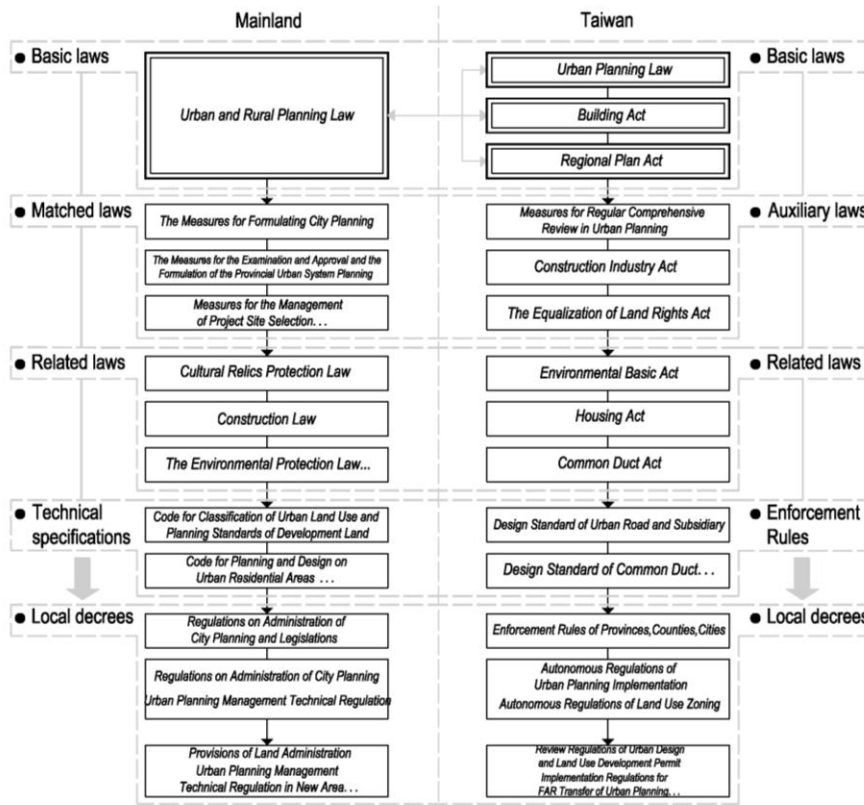
Figure 4. The comparative of urban planning system of laws and regulations in mainland and Taiwan

4.1.2   The System of Operation

The urban planning system of operation has mainly two parts: planning formulation and planning review. Its characteristics will be comprehended from planning types, function effectiveness and the process of administrative review in formulation.

4.1.2.1   Planning Formulation

Contents of urban and rural planning in mainland include urban system planning, urban planning, town planning, township planning and village planning. Urban planning and town planning are consisted of master plan and detailed planning. The backbone system of formulating in Fujian is a statutory planning system of 'Urban Master Plan----Zoning Plan----Detailed Planning' and make guidelines and rules of regulatory detailed planning in each zone. In practice, Fujian establish planning support system which involve previous surveys and subsequent constructive planning. Therefore, the way of 'master plan----detailed planning' is used in planning formulation in Fujian. First, the master plan determines the planning natures, scale and spatial development strategies. Then it takes administrative areas as the special units of planning and management. Finally, the control requirements of these units will be broken down into each block. The regulatory detailed planning and site detailed planning are used to determine the indexes of develop control and guidance of urban design respectively in this process. In current system of formulating, approved detailed planning and statutory plan are legal basis of guiding urban construction and new area development

directly and implement urban planning management through the full coverage of regulatory detailed planning to all blocks. The deadline of master plan is normally 20 years and it takes a long time to complete it from formulation to approval generally.

Taiwan's urban planning development turns to improving the efficiency of formulating and approval after the technological transformation and post-industrial economy (Xie, 2012). It formed an urban planning formulation system of 'Comprehensive Development Plan in Taiwan----Regional Planning and Department Construction Development Plan----Comprehensive Development Plan in Counties, Cities and National Park Plan----Urban Planning'. In this system, regional planning was separated from urban planning formulation system and used as upper planning to guide the comprehensive development plan of counties, cities and urban planning. The scope of urban planning is covering city (town), township (streets), special area and all these plans need to follow the program from main plan to detail plan (in the case of township, streets and special plan, main plan and detail plan can be merged together). Master plan is development visions and detail plan is practice standards. They have nearly the same operation procedure and detail plan increases concerns in urban design and land use management. As the basis for the implementation of urban planning, detail plan must be completed within two years after master plan was released. The ways of formulating from master plan to detail plan have some features especially in programming. Only when the relevant indicators of public facilities land (such as parks, playgrounds, green area, squares, children's playground, etc.) in master plan reaches the legal target, the detail plan can be organized. The construction of public facilities must be completed within five years after detail plan was released. Taiwan gives sufficient attention to needs of daily life and the improvement of overall function in urban. Another characteristic of Taiwan's urban planning is the mechanism of 'Comprehensive Review' in the process of formulating. Planning authorities need to operate it in at least three or five years and carry out relevant land use changes according to development situation, especially the land of public facilities. Changes need to be written into current plans in the form of provision. The main plan and detail plan are joined closer whether in time or contents and space scope is contained layer by layer which makes relatively clear corresponding relationship between upper and lower plans (Figure 5).
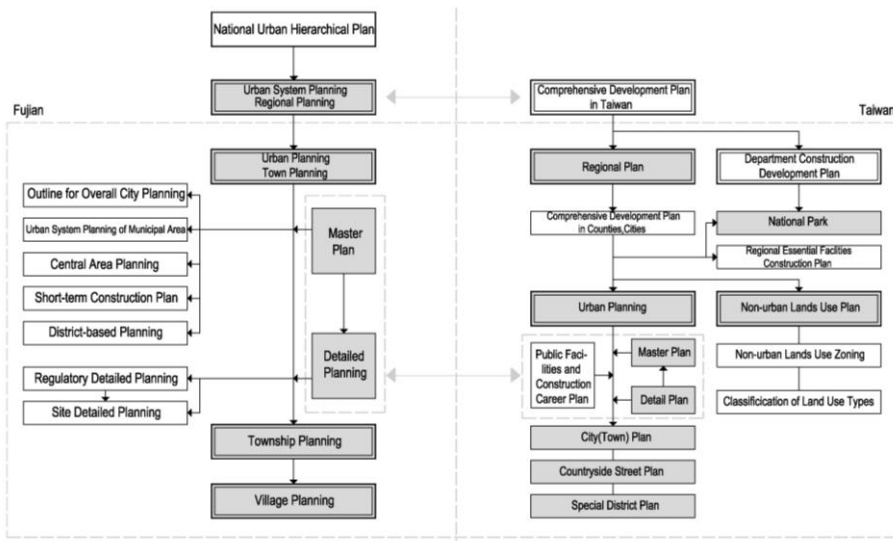

Figure 5. The comparative of urban planning system of formulation in Fujian and Taiwan

4.1.2.2   Planning Review

The urban planning administration system of Fujian is in the framework of state administration. Governments set up departments of urban planning, urban construction, land management, etc. Local development and reform commission or urban and rural construction committee are mainly in charge of establishing related policies. Functions of land and resources bureau and urban and rural planning bureau are practicing formulation of land and urban resources, the supervision of planning management and implementation is consulted with the other relevant departments, like environmental protection bureau, etc. Under the approval mechanism of government-led and multi-sectoral participation, planning administrative departments in government at all levels are responsible for the formulation and review of urban planning in the administrative range (master plan and detailed planning). The review process contains the sector review by relevant sectors and technical review by experts and reported to upper governments for approval. For unqualified results will be sent back to formulation organs to adjust and reorganize reviews regularly.

The administrative system of Taiwan is relatively streamlined and practicing a vertical leadership. According to the '*Urban Planning Law*', the urban planning authorities from top to bottom are the ministry of interior, special municipality or county (city) government and township, town or city office. All levels of authorities set urban planning commissions to take responsible for planning review works of Taiwan, county, city, township and town. Special types of land use are coordinated by zone development authority (Shi, Liao, & Qin, 2009). The urban planning reviewed by committee will be sent back to governments for checking in two ways: passed after revised and passed as original. Finally it will be reported to committees at higher level for deliberation. It is a basic flow of urban planning formulating and review in Taiwan (Figure 6). The biggest feature is that the work of planning formulating and review are separated by governments appropriately and review works are focusing on public display and community participation in planning period. Staffs of constituting the urban planning commission are including governments, elected and business representative, scholars or experts and the other social groups that formed an urban planning mechanism of economic, urban and land experts are responsible for reviewing and making decisions (Zhu, 1999).
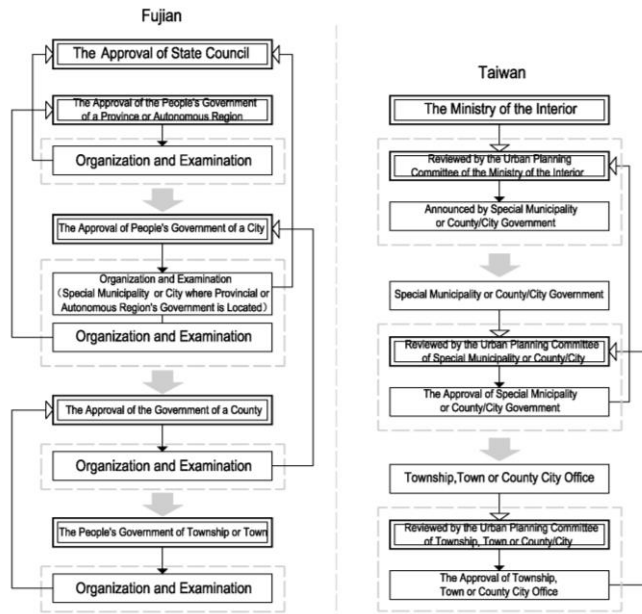
Figure 6. The comparative of urban planning system of review and approval in Fujian
and Taiwan

4.1.3   The System of Administration

The core of urban planning management is the system of reviewing
development projects based on various types of urban planning and it
focuses on discussing issues about land development, public interest, etc.

The urban planning management in Fujian is a permit system called 'One
Proposal, Two Licenses' to reach the control and guidance for various
development activities. It is nearly all development activities involving
location for construction project; land use plan and building construction
need to apply for corresponding planning permissions through multiple
review and approval by different levels of urban and rural planning
authorities. Types of permits are proposal for site-choosing, license for
construction planning and license for project construction planning. The
main targets of development permission have two categories, construction of
new area, expansion, renovation and buildings or structures and construction
of infrastructures including roads, pipelines and the other facilities. Detailed
contents are following local regulations and technical documents (Xiao &
Zhao, 2005). The system of 'One Proposal, Two Licenses' is a kind of
planning tool to realize space adjustment in the level of detailed planning
(regulatory detailed planning and site detailed planning) and urban planning
administrative departments are responsible for the implementation of
development permission. Due to specific contents of permissions are not
very clear at the statutory level that give departments wide discretions in
planning review which increase the flexibility of planning control but a low
administration efficiency and impacts on human factors.

Taiwan chooses different system of planning management for urban land
and non-urban land based on land classification. Within the scope of urban
planning, Taiwan implements control of land use zoning which is mainly
used in detail plan according to urban planning law and local planning rules.
The contents of land use zoning control are using zoning (residential area,
business district or industrial site...), control of building density (the highest
building density, the tallest building height, the maximum FAR...), control of

using characters (compatibility assessment...), activities do not comply with zoning restriction (repair, change, migration...) and the other aspects (parking lot, advertising signboard...) (Yu, X. & Peng, 2001). Any developments in territory need to confirm with the regulations in land use management to achieve expected land use type of original plans that benefit to orderly development to a certain degree and avoid overmuch human manipulations in land use development. For the system of non-urban land management in Taiwan is similar to Fujian, but still some differences in specific arrangements. The stage of development permits can be separated into three steps based on development process and the division of labor that in accordance with time strictly. Land developers need to apply for 'planning permission' when they change land function or intensity. Approved indicators are properties (public service, commercial projects or both), regional conditions, scale, intensity and impacts to public facilities, social economy and natural ecological environment. The second stage is 'development permission' which contains construct required public facilities; fill excavation, street or blocks design and boundaries, etc. The final part is 'building permit' which can be applied after the front two licenses are satisfied (Jin & LV, 2013). This kind of system of land use management which different from urban and non-urban land is easier to build different landscapes in urban development (Figure 7).
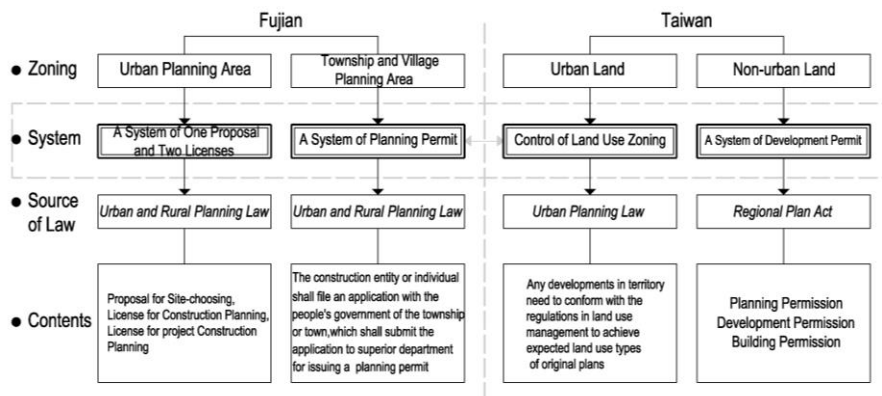
Figure 7. The comparative of urban planning system of administration in Fujian and Taiwan

4.2   Context Factors and Relationships

Based on the differences analysis, the key points of planning means in Taiwan are mainly in planning laws and regulations, ways of planning formulation and review, land use control which corresponding to context factors.

1. Pay attention to building and land use control in the system of laws and regulations. The percent of residential land, commercial land and industrial land in urban land use constitution of Taiwan is lower (less than 20%) which brought high FAR and multiple function in the limited land resource utilization which caused the corresponding building and land use control is particularly significant in urban planning.

2. Focus on time limit and planning preconditions (public facilities) in the process from main plan to detail plan. Taiwan adopted capitalist institutions and private ownership of land which caused the land development must give priority to the construction of public facilities land after requisitioning land from citizens. At the same time, the purposes of implementing strict

requirements on time limit in urban planning is to satisfied the demands for communal enterprise and protect public interest.

3. Work of planning formulation and review are separated appropriately. Taiwan government implements the management system of separation of legislative and execution and balance of power. The planning authority is led by local governments and used as auxiliary way of giving guidance to achieve the decentralization of power. That is why Taiwan using a way of setting up specialized urban planning committee to improve the scientific of planning.

4. Give play to land use control of non-urban and urban land respectively. More population with less land and the tensions between population and land are the current situation of Taiwan. Taiwan emphasizes the sustainable utilization of soil resources and divides most of lands into non-urban land. Especially nature and living environments in Taiwan are frequently threatened by disaster in recent years which brought continuous improvement of urban and non-urban land control methods. The system of land use zoning is used strictly in urban land to achieve the implementation of statutory planning and intensive land use.

4.3   Analysis of 'Plasticity' Based on Policy

'Plasticity' is the core of the shift-of-context analysis and is analyzed for the purpose of institutional cooperation. It means the possible points that can be combined in policies of two places based on various urban planning systems. Shifting the idea of urban planning formulation and management from Taiwan to Pingtan, some changes will appear between planning means and contexts and the special background and development policy of Pingtan will become basis and criterion of analysis of plasticity (Figure 8).
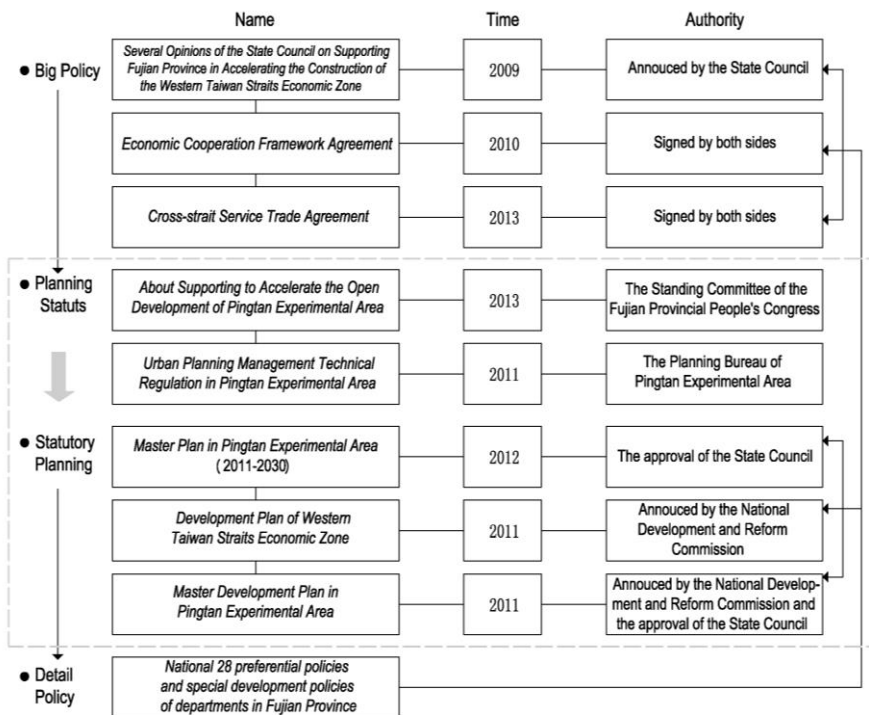

Figure 8. The structure of mainly development policies of Pingtan Experimental Area

First, urban development of mainland gives priority to the construction land and the percent of residential land, commercial land and industrial land are relatively high. Land use types are comprehensive covered and called for integrated mixed land use moderately and slightly which cause stress on land functional organization and less attention is paid to building and non-construction land. As a new area which located in Remote Island, Pingtan has much in common with Taiwan in development conditions. It is necessary to improve the system of laws and regulations in planning, building and land control in the early days of development. When using the concept of variety regulations in Pingtan, the strategy of 'Try First' and administration privileges of city furthers its legislation and take different approaches in the level of urban planning according *to the 'Decisions About Supporting to Accelerate the Open Development of Pingtan Experimental Area' (shortly for 'Decisions'))*. The Management Committee of Pingtan Experimental Area can apply to local legislation by the way of drawing attention to Fujian Provincial People's Government.

Second, urban statutory planning in Pingtan is following the patterns of mainland and distributed into three levels of master plan (including short-term construction plan), regulatory detailed planning and site detailed planning. Pingtan implements the public ownership of land and it is not free to use unless applying for approval. But its land development emphasizes on public interests under socialism. According to the present '*Urban Planning Management Technical Regulation in Pingtan Experimental Area*' (shortly for '*Technical Regulation*'), the main contents of short-term construction plan is important infrastructure and public facilities building and keeping a defined sequence. It is feasible for Pingtan to give priority to construct public facilities in land development to improve whole function and quality of life. The other hand, the relationship between master plan and detailed planning can be standardized in the guarantee of local legislation, especially the management of time limit.

Third, the administrative of mainland relies on omnipotent government and planning review and approval are full organized by governments at all levels and departments. Before the '*Pingtan Experimental Area Ordinance*' is formally publicized, the major provision of Pingtan is the '*Decisions*' which was constituted by Fujian Provincial People's Conference of Representatives. It is presented to explore various managing patterns to improve management efficiency and scientific, especially the breakthrough in administrative system and set up departments according to actual demands. It can be considered to separate parts of technical functions from the administrative commission of Pingtan and establish special departments dealing with planning review in the future directions of reform. This will give full play to involvement of Taiwan and improve management effectiveness.

Finally, Pingtan and Taiwan have similar development conditions in land control, like land resource constraints. As a Remote Island, Pingtan needs to consider about disaster prevention in the urban development. The land use classification in Fujian is far from Taiwan according to basic laws in mainland; the mode of non-urban land use control of Taiwan is difficult to be copied. But lessons about land use intensively and efficiently can be shifted to land use control of Pingtan under the support of local legislation. It is encouraged to learn the mode of city governance from Taiwan. According to management methods of non-construction land in '*Technical Regulation*', refines types of land conservation and special land use area appropriately. It

is necessary to enhance the implementation of statutory planning strictly in construction land management and optimize the license system.

5. DISCUSSION

5.1 Basic Idea

Building the sub-regional cooperation framework is mainly based on the differences of urban planning system in Fujian and Taiwan and their 'possible relationship' and 'plasticity'. Fujian's planning management is combined with central control and local auxiliary through links of the system of laws, planning formulation, review and implementation management. The urban planning system of laws and regulations in Fujian is a national four-class horizontal system which based on '*Urban and Rural Planning Law*' and guided by local regulations. Planning formulation is using the way from master plan to detailed planning and achieves planning management by the full coverage of regulatory detailed planning. Planning achievements are inspected and reviewed by urban planning departments of government and all projects are implemented according to development permits of 'One proposal and Two Licenses'. The central government has strong and direct impacts on system building and policy guidance for local governments and management, but also leaving some rooms for special administrative units.

Taiwan takes statutory regional plans as upper guides for local planning and following '*Urban Planning Law*', '*Building Act*' and '*Regional Plan Act*' as bases to build the system that from regions to locals. Planning formulation is using the way of 'Master Plan----Detail plan' and guiding area development through the time limit and a set of temporal constraints clearly. Planning achievements are reviewed by urban planning commissions after formulating by departments of government and using the control of land use zoning and development permit to urban and non-urban land respectively. In overall, the urban planning system in Taiwan has many similarities with Fujian but existing differences in contents of special operation because of the social system, local characteristics and stages of development, etc. The development of Pingtan is in the background of Fujian's planning system. Therefore, integrated differences of planning system in Fujian and Taiwan into Pingtan's planning system construction appropriately and learn from each other in the operation will provide an enabling environment of joint planning, development and management.

5.2 Construction of Cooperation Framework

5.2.1 Improve the Guarantee of Local Laws and Regulations

Strengthen the legal construction is a necessary means to ensure the joint management and improve planning effectiveness. The localization of laws is the guarantee for the construction of system of laws and regulations in Pingtan. List related contents to clear legal provisions of planning system which including planning formulation, review and administration in the level of local laws by using administration privileges of city. Pingtan has similar development conditions with Taiwan. It should reflect the importance of intensive development in the process of optimizing local regulations. By adding necessary control requirements of building and land use into legal

aspects, especially for the joint participatory building control in height, roads, distance etc. and multifunctional land use zoning development, etc., which is benefit for providing mechanism protection of cooperative development in Pingtan.

5.2.2   Adjustment of Operation Mechanism

5.2.2.1   Strengthen the Connection of Planning Formulation from Master Plan to Detailed Planning

The planning formulation of Pingtan under the background of sub-regional cooperation should meet requirements of regional development based on the connection with planning system of Taiwan. Fujian can learn several planning means from the way of 'master plan----detail plan' in Taiwan under the system of formulation and many mandatory indicators should be emphasized in the preparation of master plan. Meeting requirements of whole functions before formulating detailed planning (especially for regulatory detailed planning) to enhance the flexibility of lower plans. For example, relevant local regulations about indicators of public facilities in master plan are forced to reach the legal target before detail planning is organized. Strengthen the connections between master plan and detailed planning, such as taking strict management of time limit from completing master plan to detailed planning and leading development stages in regulatory detailed planning that meeting the ways of Taiwan's planning and improve the efficiency of Pingtan's construction.

5.2.2.2   Take Relatively Independent Planning Review

The process of reviewing and approval after the planning formulation also has significant impacts on improving planning rationality. Taiwan's planning administrative departments are relatively streamlined which belongs to linear vertical leadership. But two important sectors of planning formulation and planning review are separated appropriately. Governments set up special urban planning committees for planning review and focus on the diversity of members. It is a way to improve the management effectiveness, but it is difficult to arouse the enthusiasm of local authorities for development. Fujian carries out a multi-sectoral management which regards local governments as the corpus. But there existing opposite results: high enthusiasm of departments but unclear responsibilities and low efficiency. Pingtan needs to consider about setting up special departments for planning review under legal management in administrative cooperation and improve the scientific and public participation of planning formulation and review, especially for the full participation of Taiwan's representatives actively.

5.2.3   Implement Unified and Strict Land Use Management

Management system is a key point of planning implementation smoothly and effective management after formulating and review. Due to the land use development mode of planning-central, Fujian easily emerges problems of actual constructions break through existing planning without necessary legal protection. Taiwan implements unified management of urban and rural land. According to regional planning, land resources are divided into urban and non-urban lands and managed by different system. Especially in urban land,

all development projects must be conducted in accordance with land use control and whatever goes against expected land use types of existing planning are not allowed. This way is benefit to the urban construction defers to statutory planning but easily causes the excessive diversity of urban landscape. Hence, the management of Pingtan should keep principles of reasonable statutory planning and increases the general formula requirements under the management pattern of case basis appropriately by setting up standards. Implementing management for all kinds of land in a same way to promote overall effective development of Pingtan (Figure 9).
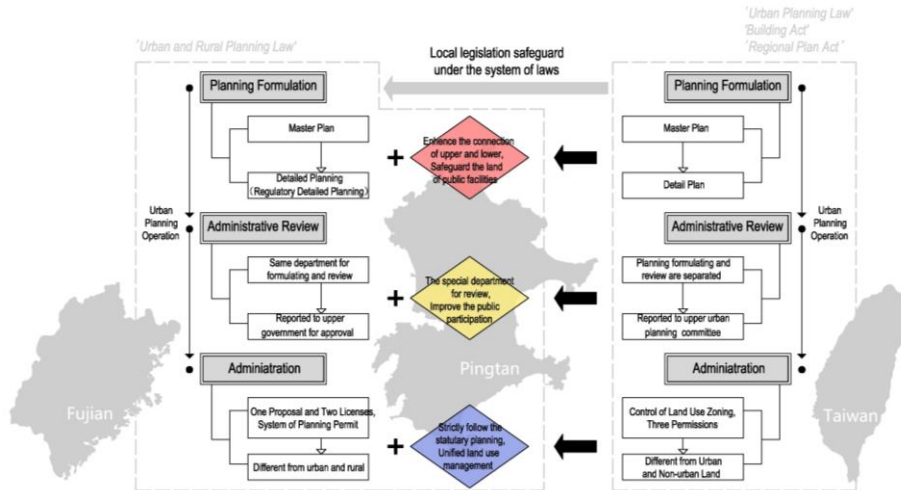

Figure 9. The framework of cooperative development of Pingtan Experimental Area

In addition, Pingtan needs to guarantee the effective operation by deepen following aspects in the guidance of sub-regional cooperation framework. It is necessary to make a combination with Fujian and vast heartland in industrial development on the basis of economic cooperation; inheritance Pingtan's historical and cultural traditions to achieve the depth of docking of both sides; combine with goals of building smart city in Fujian province and fully embodies the importance of the idea of wisdom in Pingtan; finally protect Pingtan's great natural environment and put some sustainable development suggestions like economical or intensive into practice when Pingtan is in rapidly construction to realize mutual benefit of new area development on both sides.

6.   CONCLUSIONS

This paper takes Pingtan as a case study and analyzes the specific circumstances of cross-strait urban planning system. It also conducts beneficial research on the sub-regional cooperation and joint construction of new area which provides the theoretical support to cross-strait joint development in Economic Zone on the West Coast of the Taiwan Strait. The construction of Pingtan should start with urban planning system, especially in the initial stage of development of new area and provide excellent environment and system safeguard for expanding cross-strait cooperation and moving into a large number of Taiwanese businessmen. By building the cooperation framework which including urban planning system of laws, operation and administration to promote rapid prototyping of sub-regional cooperation and improve the efficient use of regional resources. Finally

achieve the sustainable collaborative development of Pingtan Experimental Area and Economic Zone on the West Coast of the Taiwan Strait.

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Predicting Growth of City's Built-up Land Based on Scenario Planning

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Abstract: In this paper, method of scenario planning is applied to the study of land use planning, putting forward a new approach to analyze future growth of city's built-up land in the context of future uncertainty. By introducing economic and policy factors into land use system, a calculation model of urban built-up land is built based on the correlation between industries and land use. And using Chongqing Municipality from China as an example, we establish 6 different scenarios and simulate future development of city's land use from 2015 to 2020 under each scenario. The results indicate that Chongqing will meet fast urban expansion according to current trend and is in urgent need to improve its land use efficiency which shows strongest effect in controlling city size.

1.   INTRODUCTION

At present, the overall planning of urban land use in China adopts the traditional method based on the "land use zoning and indicator controlling"(Cai et al., 2006), which lacks flexibility to respond to possible changes. Planning of urban size is highly linked with predicted size of population and constructional investment, which means that if there is discrepancy between prediction and actuality, planning will fail to play its guiding role and must meet frequent adjustments. While China's economy and society has entered a period of accelerating transformation, the contradiction between land supply and demand have become increasingly prominent in the rapid development of industrialization and urbanization, and uncertain factors of market economy have more and more influence on land utilization. Thus the traditional pattern of planning is unable to give adequate guidance and control on land use (Liu, Y. et al., 2008). Therefore, we are in an urgent need to find a new method of land use planning for modern China to improve its flexibility and adaptability to external environment.

Scenario planning is a planning method which specifically deals with environmental complexity and uncertainty, and is capable of comprehensively considering all kinds of factors and targets by describing the possible path of a system's future development with logic combination of

variables. Different with traditional planning method that generates an isolated and ultimate blueprint, it can build a set of future scenarios that are systematic, coherent and dynamic. It does not require accurate prediction of the future, but analysis of possible paths so as to provide reference for plan-makers.

Scenario planning was firstly a military strategic planning method used by America in World War II (Zegras, Sussman, & Conklin, 2004). In 1967, Herman Kahn refined it into a business forecasting tool and gave definition to scenario analysis for the first time in *The Year 2000* (Kahn & Wiener, 1967). And since Royal Dutch Shell successfully avoid the impact of oil crisis in 1970s and 1980s by using scenario planning, the method has been widely used in business community (Chermack, Lynham, & Ruona, 2001). Afterwards, scholars gradually applied this method to the study of social and natural science, such as industry planning, transportation planning, land use simulation and other related fields. And scenario planning have become more mature from simple prediction of future possibilities and started to deeply explore the driving forces and key factors of social changes as well as the logical relationship inside. Many scholars have presented general method of scenario planning (Peterson et al., 2003), which are similar in essence: firstly, determine the core problem of a system; secondly, analyze key factors and driving forces of the system and their uncertainty; and finally, build and evaluate different scenarios.

In recent years, in the context of spatial and social dramatic changes, scenario planning has been valued and used by researchers of urban planning. In the field of urban planning, economic and social factors like population, policy and economy are often defined as main factors affecting land use, and based on different decision-making objectives and development directions of driving forces, correlation between factors and land utilization is built by econometric model, discrete dynamics model or others, according to which simulation of different future scenarios is conducted to analyze the possible development of land use (Dan & Xong, 2010; Zhou et al., 2012), demand of urban land (Sun & Yang, 2012), urban spatial strategy (Luo, Zhen, & Wei, 2008) and other key issues. Many researchers have used GIS technology as a tool to realize spatial visualization of land use scenarios, mostly based on system dynamics model (Deng et al., 2004; Han, H., Yang, & Song, 2015; He et al., 2005; Oana et al., 2011; Han, J. et al., 2009) and cellular automata model (CA) (Barredo et al., 2003; de Nijs, De Niet, & Crommentuijn, 2004; Hoogeveen & Ribeiro, 2005; Verburg et al., 2006; Wu & Webster, 1998) to simulate dynamic evolution of land use under the effect of driving factors. In addition, multi-criteria evaluation (MCE) (Niu, Song, & Gao, 2008; Pettit & Pullar, 2004; Plata-Rocha, Gómez-Delgado, & Bosque-Sendra, 2011), spatial regression (SR) (Hu & Lo, 2007), neural network (NN) (Almeida et al., 2008), agent-based model (ABM) (Valbuena et al., 2010) and other methods are also commonly used in quantitative simulation of future scenarios. So far, scenario planning has been successfully applied in urban planning of some cities but has not been introduced into practice in China. Existing researches in China mainly aimed at concept planning or quantitative study considering one factor among population, land use structure, economic development and ecological environment.

Since land use has numerous influencing factors that of high complexity and uncertainty, it should be studied as a dynamic system in which land use interacts with nature, society and economy. Taking the case of Chongqing Municipality from China, this paper attempts to use the method of scenario

planning and probe into the evolution of urban size under comprehensive effect of key factors, so as to explore a new method of quantity control on built-up land for urban planning.

Main contents include: (1) system description: key factors and driving forces that affect the amount of built-up land are recognized and a set of future scenarios are designed considering different possible states of driving forces; (2) scenario simulation: a calculation model of urban built-up land is built based on the correlation among key factors of land use system and the development of built-up land in 2015-2020 under each scenario is simulated; (3) scenario analysis: the results of different scenarios are comparatively analyzed and suggestions about future land use are provided for Chongqing.

2.   STUDY AREA

Chongqing, one of the four direct-controlled municipalities in China, consists of 24 districts and 14 counties, covering a land area of 82,402 km^2 with a population of more than 30 million. In the past decade, economic and population growth in Chongqin led to a rapid urban growth. Influenced by a number of push factors like high housing price, rapid industrialization, industrial suburbanization and weak planning, the city constantly expanded outward into the urban fringes and the size of built-up land has grown to about 6,800 km^2 by 2014. From 2003 to 2014, approximately 1,400 km^2 (including 756 km^2 of agricultural land) were transformed into constructional use in which about 25% were for industrial use, 22% for transportation, 17% for residential use and 15% for public service.

According to Overall Planning of Urban Land Use in Chongqing (2006-2020), the size of built-up land cannot be more than 7,044 km^2 by 2020, which shows limited scope for further increase in land of constructional use. However, rapid population growth and city expansion represent a daunting challenge to control the total quantity of built-up land.

3.   SYSTEM DESCRIPTION

The change of land size in a city is a dynamic equilibrium under the interaction of land supply and demand which is influenced by population, economy, policy and so on (Liu, T. & Cao, 2011). By certain analytical method, future development of land supply and demand within a certain period of time can be approximately predicted. So the future scale of city's built-up land can be estimated by predicting land supply and demand.

The supply and demand of land resulted from the comprehensive function of various environmental and social factors. Based on previous studies and analysis on historical data of Chongqing, we found that there are mainly four key factors which have crucial influence on the amount of built-up land (as shown in Figure 1):

(1) Economic gross (GDP) is generated mainly through input and output on built-up land and its trend determines the future demand of built-up land.

(2) Land use efficiency has direct influence on demand of land and is mainly affected by technological development and policy guidance. For example, if policies lead to a land use pattern of high intensity or land use technology makes significant progress, rise of land use efficiency will be accelerated. Generally, land use efficiency of service and high-tech

industries are higher than others. And In this paper, GDP per area is used to gauge this factor.

(3) Economic structure refers to the composition of various sectors and industries of the economic aggregates, where there is intersectoral transformation among industries. It directly results in the structure of land use, thus has effect on land demand. Since different industries vary in land use efficiency, when industries with small occupation of land and high output take larger proportion, the demand of land will decrease to a certain extent.

(4) Supply policy of constructional land is established by state and local governments in China. Since under the current administration system in China, governments have a monopoly over supply of built-up land, supply policy directly determines the actual increment of land.
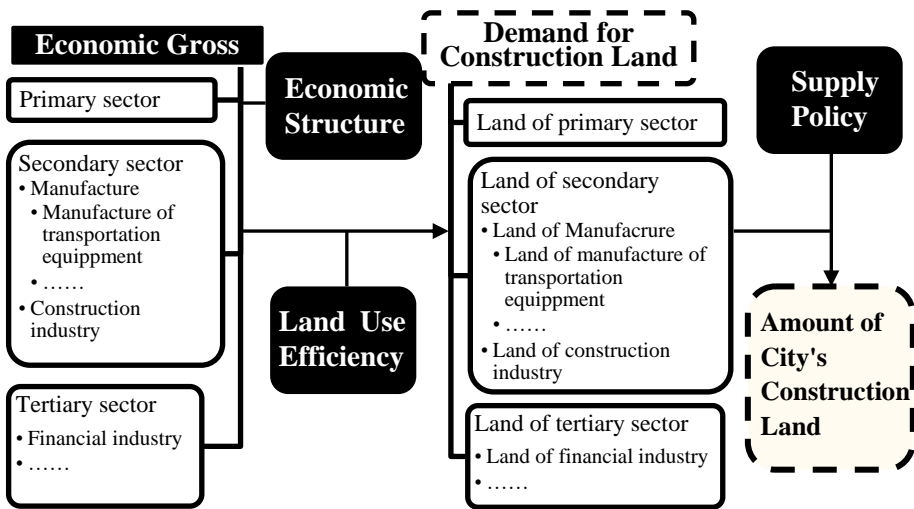

Figure 1. Influencing mechanism of key factors on size of built-up land

3.1   Uncertainty analysis

Through the analysis of existing data of Chongqing, it can be found that the growth rate of Chongqing's GDP has undergone a huge increase and gradual decline in the past decade, which makes it feasible to forecast its short-term future development by trend extrapolation. And since various situations may occur in the development of technology and government management, the other three factors all have high uncertainty. Land supply policy may be strict or loose according to the speed of land expansion. Land use efficiency may grow slowly as current trend, or rise rapidly stimulated by government guidance. And economic structure may also have substantial change if a structural adjustment policy is introduced. Several driving forces to the three uncertain factors are summarized and possible future states of each are listed in Table 1.

Table 1. Uncertainty analysis of key factors

Uncertain key factors	Driving forces	Possible future states
Economic structure	Structural adjustment	A1:no adjustment
		A2:structure adjusted (raise the proportion of industries with higher land use efficiency)
Land use efficiency	Intensive utilization	B1:no special control on land use intensity
		B2:motivation on improvement of land use efficiency

Land supply policy	Control on supply	C1:no control on land supply
		C2:control on supply of built-up land

3.2   Scenario setting

Many possible future scenarios can be formed from combination of different states of driving forces. And in this paper, 6 scenarios (as shown in Table 2) of future urban land use are selected for their relatively higher possibility of occurrence.

Table 2. Setting of scenarios

Name of scenarios	Economic structure	Land use efficiency	Land supply policy
scenario1(S1)	No adjustment(A1)	Slowly grow(B1)	loose(C1)
scenario 2(S2)	No adjustment(A1)	Rapidly grow(B2)	loose(C1)
scenario 3(S3)	adjusted(A2)	Slowly grow(B1)	loose(C1)
scenario 4(S4)	adjusted(A2)	Rapidly grow(B2)	loose(C1)
scenario 5(S5)	No adjustment(A1)	Slowly grow(B1)	strict(C2)
scenario 6(S6)	adjusted(A2)	Slowly grow(B1)	strict(C2)

3.2.1   Economic structure

In this paper, economic structure is detailedly classified into three levels: (1) the first level is consist of three sectors: the primary, secondary and tertiary sector; (2) the second level includes industry of construction and manufacture which compose secondary sector, and industries of fiancé, wholesale and retail, real estate, hotels and catering and others which compose tertiary sector; (3) the third level includes all the industries inside manufacturing industry.

According to the Chongqing's 12th Five-Year Plan (2011-2015), since 2011 the city has undergone adjustment on the second and third level of economic structure, which mainly involved an increase in the proportion of financial industry, communication equipment manufacturing and pharmaceutical industry as well as decrease in the proportion of inefficient manufacturing industries. And the 13th Five-Year year Plan (2016-2020) has similar plan about economic adjustment.

So in order to evaluate the effect of Chongqing's adjustment on economic structure on the size of city's built-up land, we set:

(1) In the scenario of "structure adjusted" (A2), all levels of economic structure will develop as the current trend (2003-2014), which simulates future development under existing policy;

(2) In "no adjustment" (A1) scenario, the second level structure inside tertiary sector and the third level structure in manufacturing industry will develop as the trend during 2003-2010, in order to simulate city's development without implementation of structure-adjusting policy with counterfactual analysis.

3.2.2   Land Use Efficiency

To facilitate our study, we have built a land-use classification by occupancy of three economic sectors, based on existing classifications and previous researches (Dan & Xong, 2010; Liu, P.-H. & Hao, 2003) and obtain statistics about GDP per area of land occupied by three sectors of 2003-2014, based on official land use data. It can be found that the growth rate of

GDP per area on land of three sectors has increased from 2003 and gradually decreased since 2010. We set:

(1)In the scenario of "land use efficiency slowly grow"(B1), GDP per area on land of each economic sector will grow at the lowest rate during 2003-2014;

(2)In the scenario of "rapidly grow"(B2), GDP per area will continue the current trend of rapid growth and increase at AAGR (Average annual growth rate) during 2003-2014 (as shown in Table 3).

Table 3. Future growth rate of GDP per area on land of each economic sector under different scenarios

Scenario	Growth rate of GDP per area on land occupied by		
	Primary sector	Secondary sector	Tertiary sector
B1	6.81%	7.66%	6.45%
B2	11.03%	11.82%	11.16%

3.2.3   Supply policy of built-up land

We set: (1) In the scenario of "loose supply policy"(C1), the demand of built-up land will be fully met;

(2) In the scenario of "strict supply policy"(C2), only 50% of land demand will be provided each year.

4.   SCENARIO SIMULATION

4.1   Model building

Based on high correlation among economic output, economic structure and land use (Wang, Ying, & Wang, 2005), we build a calculation model which is able to calculate the amount of city's built-up land with relevant data of detailedly-classified economic industries. Formulas is as follows:

(1)The demand of land for industry m in year n is:

$$L_m(n) = G(n) * \frac{W_m(n)}{E_m(n)}$$

(2)The demand of built-up land in year n is:

$$L_D(n) = L_1(n) + L_2(n) + \cdots + L_m(n)$$
$$= L_{\text{Primary sector}}(n) * \theta(n) + L_{\text{Secondary sector}}(n) + L_{\text{Tertiary sector}}(n)$$

(3)The amount of built-up land in year n is:

$$L(n) = \begin{cases} [L_D(n) - L(n-1)] * S(n) + L(n-1), L_D(n) > L(n-1) \\ L_D(n) \qquad\qquad\qquad , L_D(n) \leq L(n-1) \end{cases}$$

where the notations refer to the following descriptions:

$L(n)$: Total amount of city's built-up land in year n(km^2);

$G(n)$: City's GDP of year n(100 million yuan);

$W_m(n)$: The proportion that industry m takes in local economy in year n;

$E_m(n)$: GDP per area of land occupied by industry m in year n(100 million yuan/km^2);

$S(n)$: The ratio of the area of supply to the area of demand of new built-up land in year n;

$\theta(n)$: The ratio of the area of rural residential land to the area of land of primary economic sector in year n.

Model input $W_m(n)$: a predictive model for compositional data is used for trend extrapolation of data of economic structure, which mainly includes log ratio transformation and least squared regression analysis of data (for detailed formula see (Aitchison, 1982). History data of 2003-2014 is obtained from Chongqing's yearbook from official website (http://www.cqtj.gov.cn/).

$G(n)$: in this paper, Brown's linear trend model is used for trend extrapolation of Chongqing's GDP (history data is also from Chongqing's yearbook), and predicted GDP of 2015-2020 is obtained(as shown in Figure 2).

$\theta(n)$: by analyze official land use data from China's Ministry of Land and Resources(http://www.mlr.gov.cn/), the ratio of area of rural residential land to land area of primary sector in Chongqing can be calculated from the following formula: $\theta(n) = 5.24\% * (1 + 0.2235\%)^{n-2009}$.

$E_m(n)$: due to the lack of data about land use efficiency of industries in the second and third level in Chongqing, we borrow relevant data of other areas from previous studies (Li et al., 2008; Lu et al., 2013), and use it in study of Chongqing after adjustment which is based on regional differences in land use efficiency. The adjusting formula is as followed:

$$E_m(n_1, Chongqin) = E_m(n_2, other\ area)$$

$$/ \frac{\dfrac{GDP_{secondary\&tertiary\ sector}(n_2, other\ area)}{L(n_2, other\ area)}}{* \dfrac{GDP_{secondary\&tertiary\ sector}(n_1, Chongqin)}{L(n_1, Chongqin)}}$$

By inputting these data to the calculation model, calculated amount of built-up land in 2003-2014 ban be obtained. And after comparing calculated amount with actual one, subjective adjustment is introduced to $E_m(n)$ of time-points with large deviation for the reason of calculating accuracy. The final adjusted data of $E_m(2014)$ is as shown in appendix 1. And future $E_m(n)$ can be calculated based on $E_m(2014)$ and the growth rate (a_m) set in Table 3: $E_m(n)= E_m(2014) * (1 + a_m)^{n-2014}$.
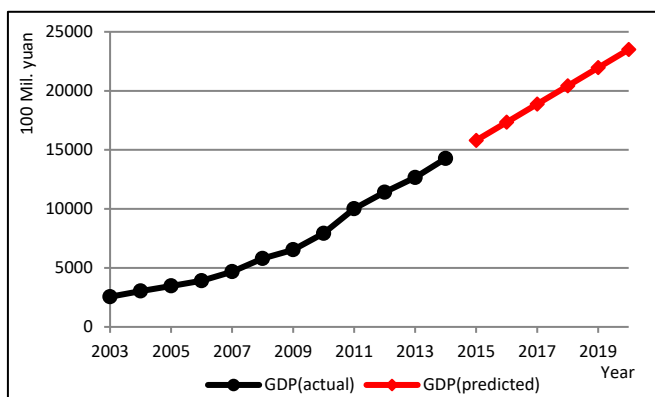

Figure 2. Predicted GDP of Chongqing in 2015-2020

4.2 Simulation results

Through the above steps, the predicted amount of built-up land and land demand of the three economic sectors under each scenario are obtained (as shown in Figure 3).

5. SCENARIO ANALYSIS

5.1 Analysis of Simulation results

From the simulated future size of built-up land (scenario 1>5>2>3>6>4), it can be found that when other factors unchanged, adjustment of economic structure, improvement of land use efficiency and strict control on land supply are all conductive to decrease city size. When land use efficiency grow slowly (scenario1), built-up land scale will continue its quick expansion before 2018 and shrink after 2018. And when land use efficiency grow rapidly (scenario2&4), the demand of built-up land shows an trend of substantial decline. By comparing scenario 3 and 4 with 1 and 2, adjustment of economic structure shows good effect on reducing increment of built-up land even with slow growth of land use efficiency. And from scenario 5 and 6, cutting 50% of supply in newly needed land only contributes to a 1-4% reduction in land size. Thus, it can be concluded that improvement of land use efficiency have the strongest effect which can substantially reverse the trend of land expansion, followed by structural adjustment and strict supply.
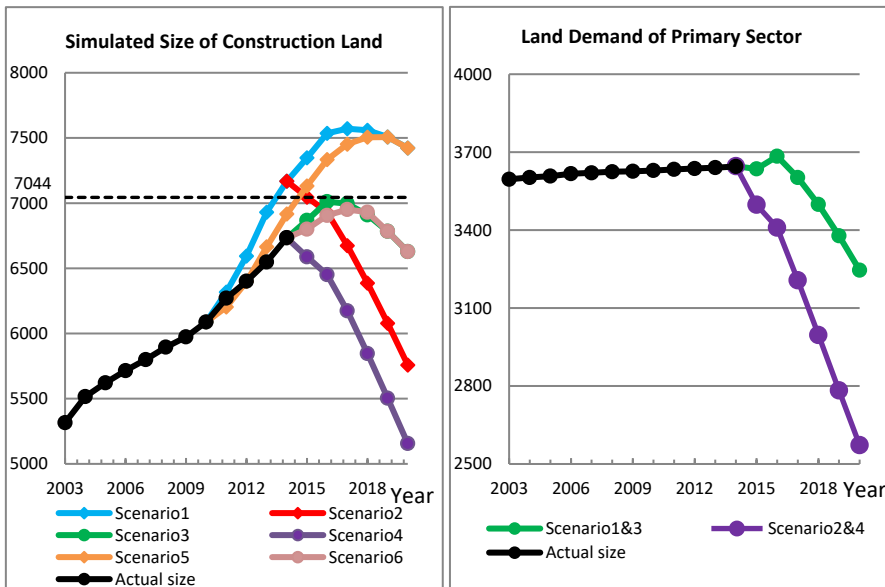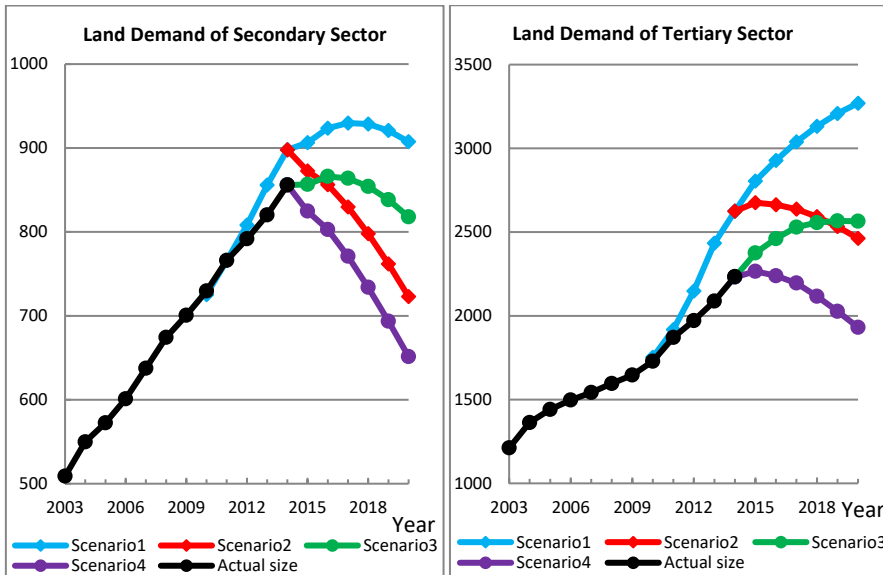
Figure 3. Predicted amount of built-up land (upper left) and land demand of three economic sectors in 2015-2020 under each scenario (km^2)

And from the simulated outcome of land demand of each sector, it can be found that land demand of primary and secondary sectors have greater reduction under the effect of improvement of land use efficiency. Especially when utilization efficiency of agricultural land increase faster, the area of rural residential land can reduce by 1/5 by 2020, even if GDP per area of primary sector. And the effect of adjustment on economic structure is mainly reflected in the decrease (about 1/5) in land demand of tertiary sector.

From counterfactual simulation in scenario1&5, if Chongqing did not implement adjusting policy in 2011, size of built-up land will grow much faster than actual size in 2011-2014, even if only 50% of demand is met. Thus we can conclude that Chongqing's policy of adjusting economic structure did have positive effect on retarding urban expansion, through elimination of inefficient industries and promotion of high-output ones.

According to Overall Planning of Urban Land Use in Chongqing (2006-2020), restricted size of built-up land is 7044 km^2. Since the irreversibility in development of built-up land makes it impossible for built-up land to convert to other utilization or shrink in a short period of time and to eliminate the negative effects of urban sprawl, such as irrational urban layout and environmental damage, we should attach more importance to the peak size of built-up land in scenarios, rather than subsequent decline. In scenario3 which simulates "business as usual" development of Chongqing, the peak size of built-up land is 7011 km^2 which is very close to the restricted size and vulerable to any uncertain change. So Chongqing is in an urgent need to take steps to control its urban expansion now.

5.2   Suggestion for Chongqing

At present, major cities in China are facing two contradictions in land use: the contradiction between hard constraints and extravagant utilization of land resources, as well as the one between constraint in urban land use and waste in rural land use. A large proportion of urban land supply was used to build industrial parks and commodity housing, where have a common phenomenon of inefficient utilization and vacancy. And in rural areas, large

amount of scattered farmland is abandoned while built-up land is inefficiently used for developing inferior industries or underletting, resulting in countless waste of land.

In the past decade, built-up land in Chongqing have undergone rapid expansion. If this expansion continues, it may lead to tension in land use, deterioration of environment, lack of infrastructure and plight of urban development. So Chongqing urgently need to transform to a sustainable way of land use.

By implementing strict supply, land expansion can only be controlled in the short term. The existing adjustment policies on economic structure have played a positive role in slowing urban expansion. So government of Chongqing should continue to make reasonable planning for economic transformation that promotes development of high-efficiency, environment-friendly industries in replace of inefficient and pollutive ones.

And to better achieve the long-term goal of sustainable development, Chongqing should also seek all kinds of innovative ways, to enhance the utilization efficiency of regional built-up and agricultural land, which can fundamentally solve the contradiction between constraints of land and needs of economic development. Basically, adjusting economic structure has effect through improving land use efficiency by transferring land occupation from inefficient industries to efficient ones. Therefore, Chongqing's government should carry out land use policy that matched the plan of economic transformation. Chongqing can learn from other cities' experience of "smart growth" and focus on activating existing stock and redeveloping inefficiently-used or wasted land. Especially for the vast rural areas, agricultural mechanization and mass production can unlease potential value of agricultural land. Through land consolidation and redevelopment, large amount of underused agricultural and built-up land can be released for the use of restoring vegetation, developing diversified economy and constructing infrastructures. Relevant regulations should also be perfected, which should include standards, evaluation and supervision of sustainable and efficient land use.

6.   CONCLUSION

The study have given a preliminary exploration on application of scenario planning on regional land use. Future scenarios of land use are simulated under comprehensive functions of uncertain push factors, providing a more forward-looking and flexible way for city planners. According to the case analysis of Chongqing, efficient land use and reasonable economic structure are important guarantee for sustainable development of the city.

Due to limitations of data, this study may be insufficient in accuracy and lack spatial analysis. If the study continues to combine scenario planning with spatial analysis in application to urban planning, more detailed and significant results may be achieved.

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Appendix 1. Land use efficiency (100 million yuan/km^2) and economic structure (%) of Chongqing in 2014 and 2020 under different scenarios

Industry	Land Use Efficiency			Economic Structure			
	2014	2020		2014		2020	
		B1	B2	A1	A2	A1	A2
Primary Sector	0.01543	0.02291	0.02890	**7.44**	**7.44**	**5.89**	**5.89**
Secondary Sector				**45.78**	**45.78**	**44.69**	**44.69**
Construction	22.809	35.516	44.588	20.73	20.73	23.76	23.76
Manufacture				79.27	79.27	76.24	76.24
Processing of Food from Agricultural Products	1.684	2.622	3.292	4.51	4.18	5.31	3.63
Manufacture of Foods, Liquor, Beverage and Refined Tea	2.621	4.082	5.124	1.13	1.05	1.14	0.95
Manufacture of Textile	8.719	13.576	17.044	1.82	0.98	1.60	0.56
Manufacture of Textile Wearing Apparel, Footwear and Caps	8.033	12.508	15.703	0.61	0.65	0.94	1.14
Manufacture of Leather, Fur, Feather and Related Products	10.114	15.749	19.771	0.62	0.89	0.57	0.90
Manufacture of Wood, Bamboo, Rattan, Palm and Straw Products	9.854	15.345	19.264	0.17	0.32	0.18	0.34
Manufacture of Furniture	4.195	6.533	8.201	0.82	0.47	1.32	0.66
Manufacture of Paper and Paper Products	2.051	3.194	4.010	1.75	1.32	2.61	1.45
Printing, Reproduction of Recording Media	4.765	7.420	9.315	0.83	0.75	1.06	0.71
Manufacture of Culture, Education, Handicraft, Fine Arts, Sports and Entertainment Articles	5.111	7.958	9.991	0.01	0.45	0.01	1.65
Processing of Petroleum, Coking, Nuclear Fuel	6.190	9.638	12.100	0.71	0.33	0.91	0.31
Manufacture of Raw Chemical Materials, Chemical Products	5.628	8.763	11.002	5.15	4.45	4.00	3.35
Manufacture of Medicines	8.748	13.622	17.102	1.32	2.11	0.67	4.12
Manufacture of Chemical Fibers	6.017	9.369	11.762	0.11	0.03	0.14	0.03
Manufacture of Rubber and	9.055	14.099	17.701	2.25	2.47	3.10	3.71

Plastics							
Manufacture of Non-metallic Mineral Products	5.140	8.004	10.049	4.84	5.41	4.49	4.90
Smelting and Pressing of Ferrous Metals	3.659	5.697	7.153	5.07	4.04	4.54	2.59
Smelting and Pressing of Nonferrous Metals	4.331	6.744	8.466	4.54	3.54	3.42	1.77
Manufacture of Metal Products	3.333	5.189	6.515	2.06	2.50	2.48	3.40
Manufacture of General Purpose Machinery	6.775	10.550	13.245	5.08	3.23	5.22	2.31
Manufacture of Special Purpose Machinery	5.867	9.136	11.470	2.91	1.79	3.54	1.00
Manufacture of Transportation Equipment	7.630	11.881	14.916	28.85	27.94	22.17	21.45
Manufacture of Electrical Machinery and Equipment	13.014	20.265	25.441	6.90	5.15	8.45	5.90
Manufacture of Computers, Communication and Other Electronic Equipment	19.888	30.968	38.878	3.66	15.37	7.84	27.02
Manufacture of Measuring Instruments, Machinery for Cultural Activity, Office Work	7.141	11.119	13.959	0.55	0.85	0.23	0.43
Other Manufacture	1.820	2.833	3.557	0.19	0.46	0.19	0.86
Tertiary Sector				**46.78**	**46.78**	**49.42**	**49.42**
Financial Industry	28.474	41.430	55.008	12.92	18.36	12.18	21.30
Wholesale and Retail Trade	6.702	9.752	12.947	16.40	18.43	14.45	16.42
Real Estate	5.306	7.720	10.250	6.18	12.25	4.46	13.67
Hotels and Catering Trade	7.496	10.907	14.482	5.72	4.82	6.43	4.81
Other Services	1.703	2.479	3.291	58.78	46.14	62.48	43.80

Note: due to the lack of data of four industries (mining of ores, manufacture of tobacco, comprehensive utilization of waste resources, production and supply of electric power, heat power, gas and water) which take very small proportion, land occupied by these industries are not considered in this paper.

SPSD

Negative Perceptions of Urban Tourism Community in Beijing: Based on Online Comments

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Abstract: The development of urban tourism community (UTC) will bring new vigor and vitality into the urban sustainable development. There are abundant tourists' comments about personal experience in UTC in online travel communities, which provide good access to the knowledge of negative perceptions of urban tourism community. Based on online comments, this paper used content analysis method to research tourists' negative perceptions about five typical tourism communities in Beijing, whereby the common problems and special problems of UTC were identified. According to the research results, the authors made suggestions to the sustainable development of UTC in Beijing.

1   INTRODUCTION

As the functions of attracting tourists and creating place identity, destination perceived image is the important source of forming destination competitive advantage in an increasingly tourism competitive environment (Crompton, 1979). Nowadays, more and more tourists want to experience the local community culture, so UTCs become the important component of the urban destination system. The term of UTC refers to an open urban recreation place where both visitors and local residents can freely access and share, and it is usually evolved from a local community. As a cultural and recreational attracts gathering zone, the UTC plays an important role in the decision process of destination choice. Research on the negative perceptions of UTCs' images can provide implications for improving the image of UTC, and optimizing destination marketing management strategy (Chen, C.-C. et al., 2016).

In 1970s, John Hunt began to research on the tourism destination image (Pike, 2002). Then, this field has become one of the hot spots of international tourism research in recent years (Chew & Jahari, 2014; Echtner & Ritchie, 1991; Gertner, 2011; Mayo, 1973). Image evaluation is the main topic of image research. The evaluation methods can be divided into three categories: quantitative evaluation, qualitative evaluation, comprehensive evaluation (Liu & Wang, 2010). The quantitative evaluations mainly include factor analysis, multidimensional scaling analysis, and correspondence

analysis and so on. Qualitative assessments include content analysis method, picture heuristic method, grounded theory method and so on. The basic idea of quantitative evaluation is to select a series of evaluation attributes, use statistical methods based on quantitative data to measure the destination image. However, the structural evaluation questionnaire will restrict the free expressions of the respondents, and it can hardly capture the comprehensive features of people's perceptual feelings. Therefore, a qualitative evaluation method would be more effective when exploring a new type of destination perceptions, such as the UTC destinations.

The Internet has become a convenient channel for tourists to express their views and impressions about the tourism destination. These comments which reflect the tourists 'perceptions are the important text materials for scholars to study the image (Dwivedi, 2009; Govers & Go, 2004; Zhou, 2014; Kladou & Mavragani, 2015). Through the content analysis of tourism brochures, Dilley (1986) revealed that the image of different countries can be divided into four categories: landscape, culture, entertainment, service. Stepchenkova and Morrison (2006) found that the Russian image descriptions on the websites in the U.S. are one-sided through the contrastive analysis of the texton Russia and American travel websites. Choi, Lehto, and Morrison (2007) researched the Macao tourism destination image through the content analysis of comments from the Macao official travel website, the travel agent website and the travel service website and so on. Govers, Go, and Kumar (2007) used the artificial neural network method to analyze seven tourism destination images. Kladou and Mavragani (2015) analyzed the online comments from the website-Trip Advisor to explore the tourism destination image. Hunter (2016) analyzed the online comments and the traditional print media reports to reveal the image of Seoul.

Previous destination image researches focus on the concept, measurement, and the relationship with the tourist behaviors, and the positive perceptions of destinations, while the negative perceptions were under-explored. Positive perceptions reflect the positive factors of attracting tourists, but the negative perceptions can provide insights in improving tourism services, and promoting destination sustainable development.

2   METHODS

2.1   Study areas

Beijing, the capital of the China, is a famous international, historic and cultural city in the world. Rooted on the diverse, profound cultures and highly developed tourism industry, there are many UTCs. In this paper, five typical UTCs were selected as research areas, which are Nanluoguxiang, 798 Art District, Sanlitun, Shichahai, Dashilan. Online comments were collected from websites of Baidu Travel, Ctrip, Qunar, Lvmama, Tongcheng, wthich are 5 major online tourism service providers in China. Among them, Nanluoguxiang is a narrow alley which was built in the Yuan Dynasty. Physically, it is composed by the traditional residential courtyards and fish-bone type roads called 'hutong'. It was elected as one of 25 best recreation places in the world by the US' Time magazine. 798 Art District was a factory, and then transformed into a modern art district. Shichahai is Beijing's largest historic conservation area with open water area. Dashilan is a large commercial district, which has 500 years history. Sanlitun is a

famous recreation areas known for its exotic atmosphere and bars. There are 77 embassies gathering around the Sanlitun area.
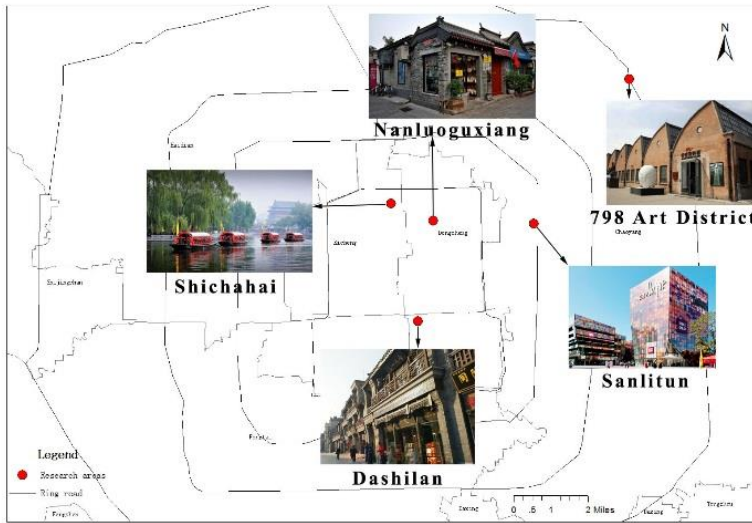

*Figure 1.*The location of five research areas in Beijing

2.2   Research data

After examined the comments from the websites of Baidu Travel, Ctrip, Youduoduo, Trip Advisor, Lvmama, Mafengwo, Tongcheng, we found that only Baidu Travel (A), Ctrip (B), TripAdvisor (C) provided the information of visitors' ratings. All ratings from these three websites were collected and then analyzed by using a descriptive statistics method. Visitors' ratings for very poor, poor, general, good, very good, were scored as 1, 2, 3, 4, 5 respectively.

Table 1. The number of different online platforms' comments

Research areas	Very good			Good			General			Poor			Very poor		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Nanluoguxiang	1613	873	244	1424	559	261	401	158	62	64	20	6	30	14	4
798 Art District	1343	354	276	1058	220	245	317	64	35	37	1	4	24	3	3
Shichahai	471	553	32	486	336	25	88	67	5	14	15	0	0	7	0
Dashilan	285	264	26	382	181	30	138	65	14	4	9	2	7	5	0
Sanlitun	500	138	44	456	75	46	140	24	14	26	2	2	8	3	3

(Data as of on October 19, 2016; A stands for Baidu Travel, B stands for Ctrip, C stands for Trip Advisor)

Table 2. The total amount of the five study areas

Research areas	Very good (5 points)	Good (4 points)	General (3 points)	Poor (2 points)	Very poor (1 point)	The Proportion of less than 3 points
Nanluoguxiang	2730	2244	621	90	48	13%

798 Art District	1973	1523	416	42	30	12%
Shichahai	1056	847	160	29	7	9%
Dashilan	575	593	217	15	12	17%
Sanlitun	682	577	178	30	14	15%

According to table 2, the degree of satisfaction of five study areas reviews can be ranked as follows: Shichahai >798 Art District > Nanluoguxiang > Sanlitun >Dashilan. The lower degree of tourists'satisfaction in Sanlitun and Dashilan showed that there would beserious problems in these two areas of tourism development.

In order to improve the accuracy of the data, the online comments were filtered following two criteria: (1) the more detailed descriptions were chose first; (2) the recording time is from June 2014 to September 2016.

2.3   Research method

The qualitative research method can reveal the overall and psychological impression of tourists, which is not easy to capture in quantitative study (Choi, Lehto, & Morrison, 2007). Content analysis is one of qualitative research method which aims to extract potential information from textual materials (Chen, Z.-Q. & Zhang, 2007).

Combining content analysis with the method of comparative analysis, both common negative perceptions and special negative perceptions in five research areas were identified and summarized. Then we proposed solutions and suggestions to improve image of UTCs of Beijing.

Specifically, based on the content analysis of online comments, the contents of negative perceptions of different UTCs were classified into four dimensions: business management, type of operations, infrastructure, and tourism environment. Furthermore, comparative analysis was conducted to compare negative perceptions among these different five UTCs.

3   RESULTS

3.1   Common negative perceptions analysis

(1) Unreasonable price

The "unreasonable price" is one of common negative perceptions in the five research areas. It includes two aspects: first, the food prices (food and drinks, etc.) are too high but the quality and taste of food is unsatisfactory; second, commodity prices are too high but the quality of goods in UTCs is unsatisfactory. Tourists complained that goods prices are much more expensive than the same items in other places. Some comments related to perceptions of "Unreasonable price" were showed as follows:

Comments on food prices:

I do not like it very much … Cheese is not as good as Sanyuan. It is too expensive.

- 2015.2.14 in Nanluoguxiang

Very noisy, boring ~ the food is not delicious but very expensive ~

- 2016.3.26 in the 798 Art District

Do remember to ask the price before you buy something in Shichahai's

drink stalls. A bottle of soda will ask you for 30 yuan.That's a rip-off!
- 2016.8.29 in Shichahai

The price is unimaginable. A bowl of Rice porridge cost me 3 yuan!
- 2016.5.14 in Dashilan

The famous bar street... But you should note that prices are quite high. A meal of 6 people cost nearly two thousand yuan.
- 2014.10.2 in Sanlitun

Comments on commodity prices:

There are a lot of tourists. Things are very expensive. There is nothing special, so I did not buy.
-2016.8.11 inNanluoguxiang

It's very expensive right now!!! It is not worthy of a visit after Dashilan was transformed ...Goods in Dashilan can be bought anywhere else.
- 2015.6.17 in Dashilan

It is a famous bar street in Beijing ...the goods in the business street is very expensive. There are some goods cost ten thousand yuan or more.
- 2016.2.6 in Sanlitun

(2) Over commercialization

It is another kind of negative perceptions in Nanluoguxiang, 798 Art District, Shichahai and Dashilan areas. Visitors can experience the local culture in the four places years ago. But in recent years, over commercialization has made much negative effects on the UTCs' cultural atmosphere, thus influenced tourists' real experience of UTCs' culture. Visitors did not mention the excessive commercialization of Sanlitun. The main reason is that Sanlitun SOHO itself is a fashionable business center.

It used to feel the style of old Beijing, but now it is over commercialized. Everywhere you look is food and drink.
- 2016.9.8 in Nanluoguxiang

... Now 798 is over commercialized. There is less good exhibitions.
- 2015.10.23 in the 798 Art District

Now the Houhai's is too much like a commercial area. I am not suggesting that you come here to eat or drink. Many shops cheat customers.
- 2015.8.16 in Shichahai

There are too many people in Qianmen Street. It has been over-commercialized.
- 2016.4.5 in Dashilan

(3) "Lack of unique characteristics", "insufficient infrastructure"

They are the common negative perceptions that existed in Nanluoguxiang and 798 Art District. Lack of unique characteristics mainly refers to the store type, the sale of goods, culture and architecture form in UTCs can also be seen in other cities. Immature physical infrastructure refers to that the rest facilities, signs, toilets and other facilities are not enough to meet the needs of tourists.

Lack of unique characteristics:

I'm very disappointed. It is short of local feature. Shopsare similar with the Kuanzhai Alley in Chengdu, but the scenery is not as good as Kuanzhai Alley (in Chengdu city).
- 2016.7.3 in Nanluoguxiang

To be honest, I think many cities imitate the 798 Art District, such as the eastern suburb of memory in Chengdu.But the building in Chengdu is more beautiful than the 798 Art District.
- 2016.4.11 in the 798 Art District

Insufficient infrastructure:

The only drawback is that there is no place to sit.

- 2015.7.18 in Nanluoguxiang

Signs of Map are not clear. It will be boring if there is no exhibition there...

- 2015.6.13 in the 798 Art District

(4) Cheating customers

It was a common kind of negative perceptions that existed in Shichahai and Dashilan. "Cheating customers" mainly refers to that tourists were charged too much money when they purchase goods or services. The consumption in bar in Shichahai, were usually complained for the higher prices. There existed fraudulent trading while tourists buy souvenirs in Dashilan.

... You should note that the wine may be charged more than the prices marked when you pay your bills. You'd better check the menu.

- 2015.5.29 in Shichahai

When you go shopping in Dashilan, you should prevent yourself from being cheated...

- 2016.6.26in Dashilan

(5) Insecurity

It was a kind of negative perceptions of Nanluoguxiang and Sanlitun. The comments showed that the public security, especially the tourists' financial security in Nanluoguxiang and Sanlitun need to be improved.

Nanluoguxiang...... Many people, of course, people who steal the phone are also more...... People do not have to call the police, because the police are not there, my cell phone is lost after that police actually said that the camera is broken, cannot see the video! So we have to be careful.

- 2015.3.8 in Nanluoguxiang

What a bad place it is...... mobile phone is stolen in the first day at Sanlitun. Be careful of your properties

- 2014.12.4 in Sanlitun

Table 3. The common problems of the five research areas

Problems	Reported areas
Unreasonable price	Reported by Nanluoguxiang, 798 Art District, Shichahai, Dashilan, Sanlitun
Over commercialization	Reported by Nanluoguxiang, 798 Art District, Shichahai, Dashilan
Lack of unique characteristics	Reported by Nanluoguxiang, 798 Art District
Insufficient infrastructure	Reported by Nanluoguxiang, 798 Art District
Cheating customers	Reported by Shichahai, Dashilan
Insecurity	Reported by Nanluoguxiang, Sanlitun

3.2 Specialnegative perceptions of five UTCs

There are some special negative perceptions related to the community culture or management in the five UTCs. These special negative perceptions reminded the community to pay attention to their own problems and find suitable solutions to promote the sustainable development of UTC.

(1) Nanluoguxiang

1) Crowded

Too many visitors in the Nanluoguxiang had negative impacts on the travel experience quality of tourists. Especially during the holidays, large number of tourists has brought high pressure to the tourism community management, also affected the normal life of the residents negatively.

Nanluoguxiang is so crowded. I could not even take out the camera...

-2015.12.21

Many people there ...too crowded.

-2016.9.18

2) Unfriendly residents

Residents' attitudes are not friendly. There are a lot of old natives of Beijing in Nanluoguxiang. Due to the tourism development, some natives had rent out their houses and left the place, and some residents still live here. Residents are not welcomed because they had disturbed residents' normal life.

The old lady who sells Chinese paper cutting is particular unfriendly.

-2014.9.17

I have visited so many attractions in Beijing. Nanluoguxiang is the worst one... In particular, the resident's attitude is even worse. We were not allowed to stand beside the door of Courtyard... The tourism quality is really bad. I do not recommend you to visit.

-2015.3.22

(2) 798 Art District:

1) The Lack of unique commodities

798 Art District has strong artistic atmosphere. But some tourists thought that the place lacked unique commodities. Some same goods are sold in a lower price in other places. This phenomenon reduced the degree of tourists' satisfaction with the 798 Art District.

It is puzzling... Things inside are very common ... which are similar with other goods in other tourism spots.

- 2014.6.8

There are various kinds of handicrafts, but online prices will be cheaper...

-2015.11.17

2) Bad traffic conditions

798 Art District locates in the Dashanzi area, about 1.1 kilometers away from the subway station. Tourists can reach the place by buses, but compared with other areas such as Nanluoguxiang, Shichahai, Sanlitun, Dashilan, the traffic is not very convenient. This is one negative factor that influence the tourism development of 798 Art District.

The art district is very large... and traffic is not very convenient.

- 2014.10.1

Walked a long time from the subway station to 798... If you are stranger, you are likely to lose the way.

- 2016.8.1

3) The modern art is difficult to be understood

Visitors' comprehension abilities are different, so the perceptions of the art is not the same. The novel Art style the key to attract tourists. The art area will become more popular when the art were presented in a in an understandable way.

So many places are confused. If you can't understand, I suggest you not

to visit this place.

-2015.6.26

    I can't appreciate art.

- 2016.3.9

(3) Shichahai: Ask for tips by drivers of tricycle

Human "rickshaw" is the traditional vehicle for visitors to experience Beijing's ancient culture. But the market of Human "rickshaw" was usually complained for its lack of management and regulations. Old Beijing Hutong-Sightseeing by Rickshaw provided opportunities to visit the courtyard. However, these services had made a bad impression on the visitors because of the tricycle drivers' behaviors of asking for tips.

    I feel very disappointed... we were treated badly because we did not give tips... the tricycle driver should be more professional.

-2015.8.12

    Because I didn't give tips, the driver became so rude. And I have not experience the characteristics of Hutong. After I got out of the tricycle, the driver even abused us...

-2016.7.10

(4) Dashilan: the loss of "old Beijing"

As a traditional old commercial district in Beijing, There are a number of old brand shops in Dashilan. But Tourism development resulted in the lost of its cultural identity of "old Beijing". Unsatisfied with the qualities and cultural characteristics of goods, visitors could not feel the atmosphere of old Beijing's marketplace.

    No old Beijing features, no characteristics of the commercial street ... Usually nobody, there are too many people during holidays.

-2015.8.11

    It used to be the most characteristic areawith civil life in Beijing ...now it is a non-descript Qianmen street, full of fake antique buildings,and Snacks.

- 2016.8.3

(5) Sanlitun: fears of "soliciting"

The numbers of bars within Sanlitun area have been increasing since the late 1990s. But many tourists mentioned their fears of soliciting in the Bar Street. The soliciting would have negative effects on the tourism sustainable development of Sanlitun.

    Don't believe those who pull you to those bars! It's hard for you to go out! You would be compelled to spend tens of thousands of yuan before leaving.

- 2014.9.2

    Bar Street ...the soliciting in the street is so uncomfortable. It is Very annoying; and very necessary to be regulated.

- 2015.12.6

Table 4. The personality problems of the five research areas

Research areas	Problems
Nanluoguxiang	The number of tourists is too much

	Residents' attitudes are not friendly
798 Art District	Lack of commodity characteristics
	Bad Traffic conditions
	Cannot understand the modern art
Shichahai	Asking for tips by drivers of tourism tricycle
Dashilan	No Beijing taste
Sanlitun	"soliciting" in the Bar street

3.3   Factors analysis of negative perceptions

Based on the common and special negative perceptions identified above. The study classified the problems in Beijing urban community tourism development into four categories: business management, types of operations, infrastructure, and environmental issues:

(1) Business management problem. It includes unreasonable price, cheating customers, tips and soliciting. Specifically, the commodity prices are too high. And there existed phenomenon like cheating customers, forcing visitors to give tips, soliciting.

(2) Problem on types of operations. Five problems were identified: over commercialization, homogeneity of scenic spots, lack of unique commodities, the puzzling modern art, and the lack of Beijing feature. Types of operations are important parts of urban community tourism development, and it is also one of the main ways for tourists to feel the cultural atmosphere of the community.

(3) Problems about infrastructure. It includes uncompleted infrastructure and bad traffic conditions. The infrastructure in UTC includes the sign, toilet, rest areas and other facilities. The traffic inconvenience is mainly determined by the location of the UTC. Immature Signs, toilets, rest areas and other facilities brought some troubles to tourists. The bad traffic will reduce the number of tourists.

(4) Problems about tourist environmental issues. It includes three problems: insecurity, crowed environment, and unfriendly residents' attitudes. Visitors pursue safe, comfortable, friendly environment. The crowed environment produced negative effects on tourists' feelings. In addition, too much tourists bothered the normal life of the local residents, making residents' attitude more unfriendly.

Overall, among all problems, the business operation is the most obvious, which was accounted for 64% of the total. Infrastructure and tourist environmental was accounted for 36%. It showed that the management problems are related to the operation of businesses. The environment problems were mainly about Infrastructure and tour environment.
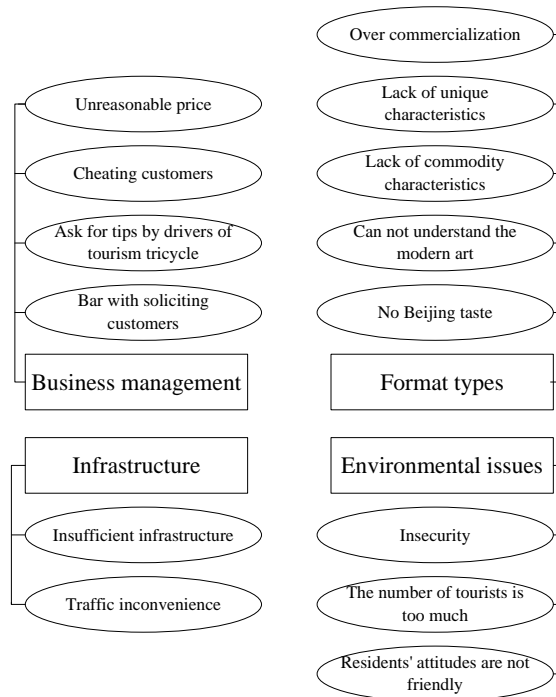
Figure 2. Summary of tourism development problems in the five research areas

4   CONCLUSIONS AND SUGGESTIONS

This study conducted a qualitative case study of online negative perceptions of UTC in Beijing. Through the analysis of online comments, problems can be summarized in four categories: business management, format types, infrastructure, and environment issues. In order to solve these problems, three suggestions were put forward as follows.

The community management institutions should be improved to solve the problems. The UTC should make relevant market admission standards of the types of operations to ensure the quality of commodities. Second, the government should create a favorable policy to support the high-quality business operators, and control the price of rents and goods. Third, channels for complaints should be established to supervise the goods and services trade.

Business owners should provide better products with local characteristics and high quality. Second, in terms of tourism services, the service attitudes should be enhanced to avoid the occurrence of using violent or threatening methods to sell goods. Finally, the relationships of businesses operators and residents should be coordinated, to create employment opportunities for local residents and best environment for tourists.

Finally, tourists should be educated to beat the crowds, not to break the local landscapes, culture, and environment and not to disturb normal life of local residents. In the case of being forced to buy, tourists should sue promptly.

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A Self-Adjusting Approach to Identify Hotspots

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Abstract: Hotspot identification or detection has been widely used in many fields; however the traditional grid-based approaches may incur some problems when dealing with point database. This article expands on three types of mismatch problems in grid-based approach and suggests a point-based approach may be more suitable. Inspired by the DBSCAN algorithm, a self-adjusting approach is then proposed for hotspot detection which overcomes the weakness of parameter sensitivity shared by most clustering approaches. Finally, the data of commercial points of interest of a city is used for demonstration.

1.   INTRODUCTION

Spatial hotspot identification or detection of point event data has been widely accepted as an integral part of exploratory spatial data analysis (ESDA) across the fields of ecology (Nelson & Boots, 2008), health (Osei & Duker, 2008; Jeefoo, Tripathi, & Souris, 2010), transportation (Anderson, 2007) and crime (Ratcliffe & McCullagh, 1999; Grubesic, 2006). Hotspot detection provides the foundation for further research on how these hotspots came to being or exert influence, which may help to bring about further scientific or policy implications. It can be concluded that the concept of hotspot is a success considering the number of situations it applies to.

However, a successful concept often means a stretched concept (Sartori, 1984; van Meeteren et al., 2016), that is to say, along with the widespread adoption of hotspot detection is the fuzziness and polyvalence of the underlying concept of 'hotspot' itself. Osei and Duker (2008) give an intuitive definition that regards hotspot as a condition indicating some form of clustering in a spatial distribution. Lawson (2010) uses the item "unusual aggregation" of events to define a clustering of a spatially-referenced featured and summarizes that intensity, spatial integrity, size and shape are usually used as the criteria to determine whether an aggregation of events can be considered 'unusual' . Nevertheless, there still needs local knowledge or prior knowledge to specify these criteria.

After reviewing indicators for assessing local spatial association and putting forward a new one, Anselin (1995) argues local spatial clusters,

sometimes referred to as hot spots, can be identified as those locations or sets of contiguous locations with statistically significant local spatial associations. This definition follows the maxim 'let the data speak for themselves' (Gould, 1981) and provides another perspective to define 'hotspot' which focuses on the features of spatial elements rather than their aggregations as the intuitive definition does.

In fact these two perspectives represent two different epistemologies about hotspot. The former one considers hotspot as a special cluster of spatial elements, while the latter considers it as a cluster of special spatial elements. Such a difference inevitably brings about different methodological axes along which the approaches of hotspot detection develop. However, many of these approaches are grid-based (Yu, W. et al., 2016), which may incur some mismatching problems when dealing with point event data.

In next section, we will expand on the underlying mismatch problems of employing grid-based approach to detect hotspots of point event data. To overcome these problems, we will propose a modified version of density based spatial clustering of application with noise (DBSCAN). This is followed by an empirical example using commercial POIs (point of interest) data of Xiaoshan, Hangzhou to detect commercial hotspots there. The article ends with conclusions and suggestions for further work.

2.   DRAWBACKS OF GRID-BASED APPROACH

2.1   Scale mismatch

The first mismatch is about the scale of grid. Fig1 (a) indicates a case where a hotspot （in the middle of the grid） is bundled with discrete non-hotspot points in an oversized grid. If this grid is identified as a (part of) hotspot, there will be an 'over-detecting' problem because it involves some non-hotspot points. Similarly, a non-hotspot consequence of identification denotes an 'under-detecting' problem because actually there is a neglected local hotspot in this grid. So oversize means problem anyhow.
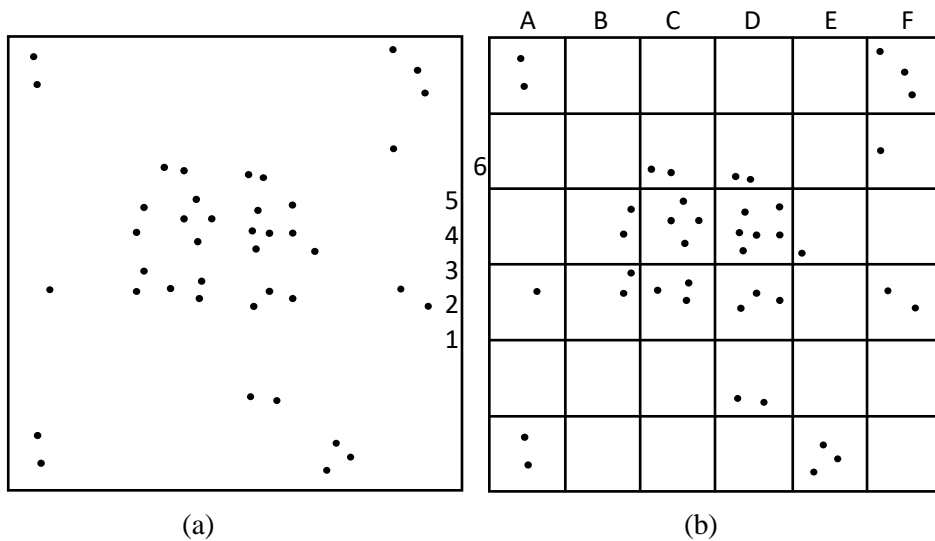

(a)   (b)

Figure 1. Scale mismatch

In an undersized case showed in Fig 1(b), a problem of either over-detecting or under-detecting is also unavoidable. In an undersized grid system, a hotspot will be divided into too many parts to make themselves distinguishable (like C-2 versus A-1 in Fig 1(b)). So again this hotspot is

bundled with non-hotspot points, and the case goes similarly with the oversized situation. A solution is to introduce more detecting criteria such as size or spatial integrity, but this will largely perplex the process of parameter calibration.

2.2   Shape mismatch

The shape mismatch occurs when the grid shape can't correspond with those of hotspots well enough to make them detectable. Fig 2(a) illustrates the difficulty for a square-grid system to detect a linear hotspot. However, linear hotspots are actually quite common such as plants along rivers, polluted air along wind, and shops along streets.

(a)   (b)
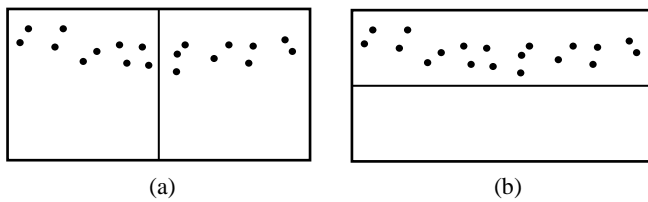
Figure 2. Shape mismatch

2.3   Location mismatch

Even eventually we manage to pick out the most proper grid scale and shape, there is still another thorny problem concerning the locations of grids.

Figure3 illustrates a case of detection failure resulted from location mismatch where a same hotspot of point events is divided by two grid systems with the same scale and shape but different spatial distributions respectively. It is obvious that Figure 3(a) is the situation where detection failure occurs more probably, because the aggregation pattern of this hotspot is "diluted" by four grids here and each grid may be unable to reach the intensity threshold. Yet a slight shift to the grid system in Figure 3(b) makes this hotspot detectable.

Besides, compared with scale mismatch, location mismatch is more locally problematic. This means a solution's validity is always localized; that is to say, a modification in one place may lead to a new mismatch problem elsewhere, so it's almost impossible to find a globally suitable solution.
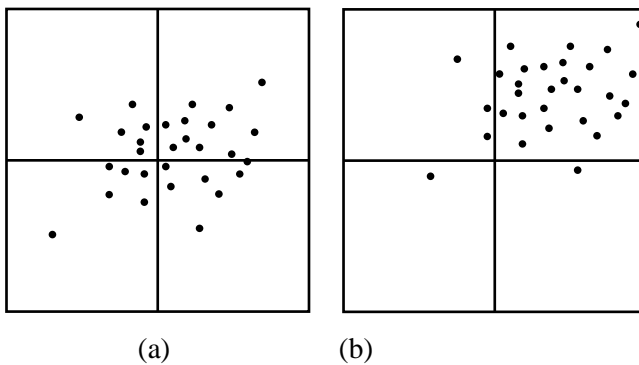

(a)   (b)

Figure 3. Location mismatch

3. OUR APPROACH

3.1 DBSCAN: pros and cons

Theoretically speaking, in hotspot detection for point event data, gridding process is something like feature extraction in dimension reduction -- usually we establish a feature to measure the aggregation degree at a lower spatial resolution with a cost of losing the information of every point's precise location. How this feature is established or extracted determines how much information we will actually lose, and all of the three types of mismatch can be attributed to the information loss caused by gridding process. Consequently an approach which clusters the original point event data directly may help to avoid the mismatch problems above.

Actually, in clustering field there is a history of decades of point-density-based approach since Ester et al. (1996) firstly established an algorithm called DBSCAN (Density Based Spatial Clustering of Applications with Noise), which is one of most common and citied clustering algorithms in scientific literature (Uncu et al., 2006; Chakraborty & Nagwani, 2014).

The DBSCAN algorithm starts with an arbitrary point p in database D, which should have at least MinPts neighbors within a distance of Eps from it. Then p (marked as a core point, otherwise as a border point) and its neighbors are assigned into a new cluster. The same searching process will be done to each neighbor of point p and if this point reaches the core-point threshold, it and its neighbors will be assigned to the former cluster, otherwise it will be marked as a border point and the searching process stops. So finally an iterative process goes on until there are no new points to be assigned. This is repeated until all points in D traversed. It can be established mathematically on the concepts and terms as follows (Ester et al., 1996).

Definition 1: (Eps-neighborhood of a point) The Eps-neighborhood of a point p, denoted by $N_{Eps}(p)$, is defined by $N_{Eps}(p) = \{q \in D | dist(p, q) \leq Eps\}$, where D is the database p and q belong to and $dist(p, q)$ is distance between points p and q.

Definition 2: (directly density-reachable) A point p is directly density-reachable from point q wrt. Eps, MinPts if

1) $p \in N_{Eps}(q)$ and

2) $|N_{Eps}(q)| \geq MinPts$.

Definition 3: (density-reachable) A point p is density-reachable from a point wrt. Eps and MinPts if there is a chain of points $p_1, ... p_n, p_1 = q, p_n = p$ such that p_{i+1} is directly density-reachable from p_i.

Definition 4: (density-connected) A point is density-connected to a point q wrt. Eps and MinPts if there is a point o such that both p and q are density-reachable from o wrt. Eps and MinPts.

Definition 5: (cluster) A cluster C wrt. Eps and MinPts is a non-empty subset of D satisfying the following conditions:

1) $\forall$ p, q: if p ∈ D and q is density-reachable from p wrt. Eps and MinPts, the q ∈ C. (Maximality)

2) $\forall$ p, q ∈ C: p is density-connected to q wrt. Eps and MinPts. (Connectivity)

Definition 6: (noise) Let $C_1, ... , C_k$ be the clusters of the database D wrt. Parameters Eps_i and $MinPts_i$, i =1,…k. Then we define the noise as the set of points in a database D not belonging to any cluster C_i, i.e. noise = {p ∈ D|$\forall$i: p ∉ p }.

Focusing on point-to-point associations, DBSCAN has the ability to detect clusters of arbitrary shape, making it possible to avoid the shape mismatch in grid-based approach. Because the 'scanning' process (searching for neighbors) in DBSCAN is always point-centered, location mismatch is also avoidable. So the shared problem is the calibration of scale (grid size versus Eps) and intensity threshold (usually density versus MinPts).

In fact, one of the main drawbacks of DBSCAN just rests with the fact that its result is highly sensitive to Eps and MinPts (Cai, Xie, & Ma, 2004). As a result, there emerge a number of studies aiming to propose a self-adjusting calibrating method for Eps and MinPts (Xia & Jing, 2009). Some studies (Feng & Ge, 2004; Yue et al., 2005) partly solve this problem by proposing a self-adjusting approach for one parameter. Uncu et al. (2006) and Mahran and Mahar (2008) both propose a self-adjusting variations of DBSCAN named GRIDBSCAN whose Eps and MinPts can be calculated automatically, but obviously they are also both grid-based, which may result in the mismatch problems mentioned above. Other self-adjusting variations of DBSCAN can be found in the work of Yu, X., Zhou, and Zhou (2005) and Liu, Zhou, and Wu (2007). These two algorithms are both based on a KNN (the kth nearest neighbors) approach, which still lack a mathematic calibration process even it is proved not strictly that the influence of k is not so considerable (Yu, X., Zhou, & Zhou, 2005; Liu, Zhou, & Wu, 2007).

3.2   To a self-adjusting approach

3.2.1   An alternative to MinPts

In DBSCAN, MinPts is set to identify those points around which the density is relatively higher, so the fundamental purpose of calibration of MinPts lies in finding a scientific and 'natural' threshold. Here calibration of MinPts is more of a tool rather than a purpose. Consequently, instead of searching for other parameters with less requirement of prior field knowledge to achieve the self-adjusting calibration of MinPts as most previous studies do, a more suitable and convenient way is to find another density indicator which is self-adjusting in itself.

The local indicator of spatial association (LISA) is a promising candidate for such an indicator. Firstly, it follows the maxim "let the data speak for themselves", which means LISA has an innate purpose to be self-adjusting. Besides, as defined by Anselin (1995), the LISA gives each observation an indication of the extent of significant spatial clustering of similar values around the observations, and if the "value" of each observation is specified as the neighboring density, correspondingly the LISA can indicate the extent to which points with plenty of neighbors clusters spatially.

The most common LISA is local Moran' I proposed by Anselin (1995), and for an observation i it is defined as,

$$I_i = \frac{(X_i - \overline{X})}{S} \sum_{j=1}^{N'} W(i,j)(X_j - \overline{X}) \tag{1}$$

$$\overline{X} = \frac{\sum_{i=1}^{N'} X_i}{N} \tag{2}$$

$$S = \frac{\sum_{i=1}^{N'} (X_i - \overline{X})^2}{N' - 1} \tag{3}$$

Where I_i is the local Moran's index of observation i, X_i is the feature value of observation i, $\overline{X}$ is the mean of X_i, N' is the number of observations which has at least one neighbor, $W(i,j)$ is the spatial weight between observation i and j, and for point event data, $W(i,j)$ is usually calculated as,

$$W(i,j) = \begin{cases} 1, if \; dist(i,j) \leq Eps, i \neq j \\ 0, otherwise \end{cases} \quad (4)$$

For ease of interpretation, the weights $W(i,j)$ should be in a row-standardized form. As for the value of I_i, a positive value means i is surrounded by similar observations ('High value to High values' or 'Low value to Low values'), and a negative value means it is surrounded by distinguished observations ('High value to Low values' or 'Low value to High values'). Higher absolute value of I_i means more significant patterns.

Now we define X_i as the number of points within a distance of Eps from point I, then I_i can be used to indicate how the points are spatially clustered. A positive value of I_i now indicates two situations, one is where both point i and its neighbors have a plenty of neighbors ('High value to High values'), the other one is where both point I and its neighbors have few neighbors ('Low value to Low values'). These two situations can be further classified according to X_i, the number of neighbors of point I.

Considering DBSCAN's similar process, we can assign points of the former type as the core point of a hotspot, and the border point can be defined as the points which don't reach the core point standard. The modified terms and definitions are as follow,

Definition 7: (directly autocorrelation-reachable) A point p is directly autocorrelation-reachable from point q wrt. Eps if

1) $p \in N_{Eps}(q)$

2) $|N_{Eps}(q)| > \frac{1}{N}\sum_i^N |N_{Eps}(i)|$ and

3) $I(q) > 0$

Definition 8: (autocorrelation-reachable) A point p is autocorrelation - reachable from a point wrt. Eps if there is a chain of points $p_1, \dots p_n, p_1 = q, p_n = p$ such that p_{i+1} is directly density-reachable from p_i.

Definition 9: (autocorrelation-connected) A point is density-connected to a point q wrt. Eps if there is a point o such that both p and q are density-reachable from o wrt. Eps

Definition 10: (hotspot) A hotspot H wrt. Eps is a non-empty subset of D satisfying the following conditions:

1) $\forall$ p, q: if p $\in$ D and q is density-reachable from p wrt. Eps, the q $\in$ H. (Maximality)

2) $\forall$ p, q $\in$ H: p is density-connected to q wrt. Eps. (Connectivity)

Definition 11: (autocorrelation noise) Let $H_1, \dots, H_k$ be the clusters of the database D wrt. Eps_i, i =1,…k. Then we define the noise as the set of points in a database D not belonging to any cluster H_i, i.e. noise = {p $\in$ D|$\forall$i: p $\notin$ p }.

3.2.2   Calibration of Eps

For a clustering algorithm, the optimal clustering result can be achieved by analyzing validity index, and at the same time the inputted parameters can also be adaptively adjusted (Feng & Ge, 2004). Here the most common validity index, DB index is employed to calibrate the parameter Eps. DB index is defined as follows (Davies & Bouldin, 1979),

$$\overline{R} = \frac{1}{N}\sum_{i=1}^N R_i \quad (5)$$

$$R_i = \max_{i \neq j} R_{ij} \quad (6)$$

$$R_{ij} = \frac{S_i + S_j}{M_{ij}} \quad (7)$$

$$S_i = \left\{ \frac{1}{T_i}\sum_{j=1}^{T_i} |X_j - A_i|^q \right\}^{1/q} \quad (8)$$

$$M_{ij} = \left\{ \sum_{k=1}^{n} |a_{ki} - a_{kj}|^p \right\}^{1/p} \tag{9}$$

where $\overline{R}$ is the DB index, N is the number of clusters, R_{ij} is a similarity indicator between cluster i and j; S_i measures the dispersion of cluster i, T_i is the number of observations belonging to cluster i, X_j is the feature vector of observation j, and A_i is the centered feature vector of cluster i; M_{ij} measures the distance between clusters i and j, n is the number of features, A_{ki} and a_{kj} are the centered feature vector of cluster i and j respectively. P and q are both distance parameters, normally equaling to 2 to derive Euclidean distances. In general, a lower value of DB index means better performance of the clustering algorithm.

In our approach, there are three "clusters", core points, border points and noise, so N equals 3. The number of neighbors wrt. Eps is the only feature for each point, so n equals 1. Eps is determined when DB index achieves minimum.

4.   EXPERIMENTAL RESULTS

In this section, the proposed approach is applied to detect the commercial hotspot in Xiaoshan District, Hangzhou. The database consists of 15432 POIs (points of interest) of shopping and food, which were collected from DaZhongDianPing by the end of 2015.

Figure 4 illustrates how DB index changes as Eps increases from 50m to 1000m by a step of 50m. Obviously, DB index achieves minimum when Eps is at 400 (m), therefore Eps is calibrated at 400. Figure 5 illustrates the detection result of the commercial hotspots in Xiaoshan. The magnified view focusing on the downtown area of Xiaoshan shows us our approach inherits the ability to detect clusters with arbitrary shape from DBSCAN algorithm.
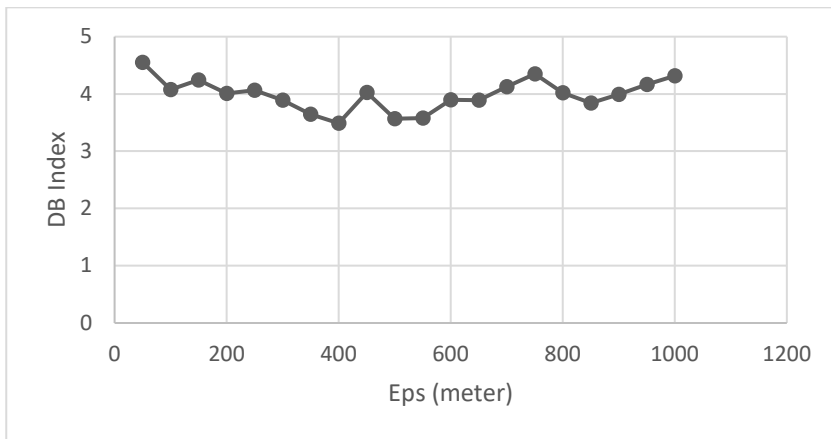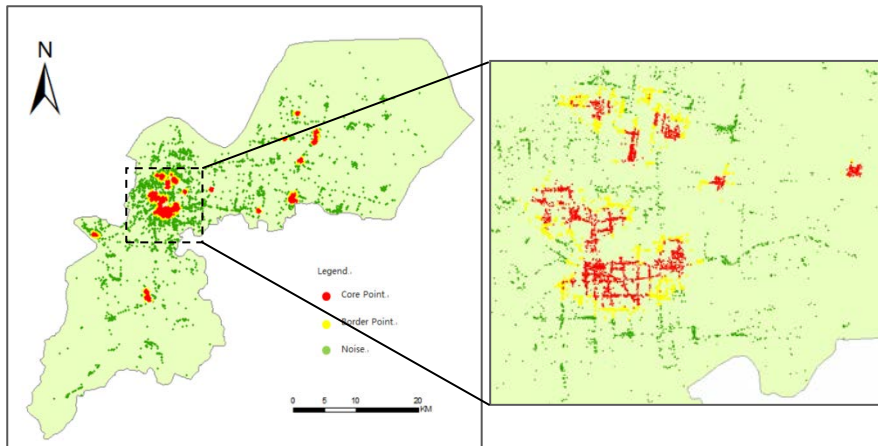

Figure 4. DB‐Eps relation

Figure 5. Commercial hotspots in Xiaoshan

5.   CONCLUSIONS AND DISCUSSION

Hotspot detection is often one of the first steps in the analysis of spatial data. Considering the inherent drawbacks of grid-based approach to detect hotspots for point event data, we propose a point-based approach inspired by DBSCAN algorithm. A local indicator for spatial autocorrelation and a clustering validity index are integrated into this approach to achieve self-adjusting parameter calibration. An empirical example is presented to show this approach's applicability.

Following the maxim 'let the data speak for themselves', our approach does help to minimize the possible human intervention which may incur mistaken detection results in hotspot detection, making it possible for comparing detection results among different regions. This does not mean, however, there is no need of prior knowledge in hotspot detection. Actually, in some fields, the performance of detection results depends a lot on prior knowledge; e.g., if we do not know well enough about which level of visitor flowrate may lead to stampede, any hotspot detection for visitors will lose its validity because of the hidden danger.

There is also much work to do to refine this approach. For example, more work is needed to accelerate the calibration of Eps and the selection of clustering validity index also deserves discussions. Theoretic efforts are needed to explore the relationship between clustering and hotspot detection.

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