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Special issue on Sustainability Indicators and Analysis

Additional Paper

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Editorial introduction

Special issue on "Sustainability Indicators and Analysis"

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In our long history, we human beings have accumulated remarkable wisdoms of coexisting with nature. Many of our ancestors reflected upon the human-nature relationships and knew how people should occupy the land, even in the time when people did not have too much concern about the damage that they posed on the environment. However, after the Industrial Revolution, many ugly industrial cities emerged; but the planners' prescription was only a better urban design separating the residents from unpleasant industrial hazards. It was not until after World War II when industrialization and urbanization associated with mass production and mass consumption started to prevail all over the world and the unsustainable signs became apparent, that we recognized the irretrievable damage that human inventions have brought to the ecosystem (Carson, 1962) and the limits for economic development (Meadows et al., 1972). After the World Commission on Environment and Development published the Brundtland report in 1987 and the United Nations held its historical convention Earth Summit at Rio de Janeiro in 1992, "sustainable development" or "sustainability" as a goal has begun to gain world-wide consensus. A huge amount of studies have been added to almost all research fields as well as the practices in different levels of government, involving various parties of stakeholders. However, despite decades of effort, we are still in the midst of searching for a road map towards sustainability (Biermann, 2013; Linnér and Selin, 2013). In an increasingly connected and interrelated world, it is ideal to find global sustainability in which all parts act coherently as a systematic whole. However, another way of thinking should also deserve consideration: if all the parts in the world sustain their own, we should not need to worry about our common future.

China, as one of the fastest developing economies, has drawn great attention from the rest of the world concerning its environmental impact and sustainability. Though with different research interests and perspectives, all the four papers presented in this special issue address the same question: how to contribute to a sustainable China through better understanding and better management of cities, the settlements where now more than half of its people reside in and more are predicted to reside in the coming decades.

The first paper titled "The Framework of Social Sustainability for Chinese Communities: Revelation from Western Experiences" (Wang, 2014) points out that while social sustainability has been studied and tested in both theoretical research and practical implementations in western countries, it has

not been given enough concern in China. Relevant theories and thoughts have been reviewed to retrieve how the social sustainability idea is developed, and how it has been implanted in urban planning and integrated within local community development policy, especially in the US, UK and Canada. The author argues that the western-originated social sustainability idea should be understood and redeveloped in a distinctive Chinese context. Following these findings, a framework of social sustainable communities for China is summarized which includes three layers: individual needs, social network and community development. The author concludes that future attempts in developing social sustainability indicators and the corresponding community planning mechanism should be encouraged in China.

The second paper "How Eco are China's Eco-Cities? An International Perspective" by Zou and Li (2014) focuses on the quality of China's eco-cities. To tackle the problems and challenges posed by the rapid urbanization and to purse urban development in sustainable manners, the Chinese government has taken vigorous efforts in developing eco-cities across the nation. There have been a large amount of eco-city related studies and practices addressing how the indicator system should be designed. However, the authors could not find many on the quantity or target/threshold of the indicators. To examine the quality of China's eco-cities from an international perspective, the authors selected two renowned eco-cities, Kitakyushu from Japan and Hamburg from Germany, and then compared the performances of these cities with the national eco-city standards of China. They have identified the gap between economic-related indicator values, suggesting lower economic levels and energy efficiencies of Chinese eco-cities. Targets concerning the waste sector are also lower in China than in the other two cases. The environmental indicator values show China needs to raise its standards for environmental quality. Discussions and suggestions are made based on the outcomes of comparisons in an attempt to provide reference for the future development of eco-cities in China.

From 2000 to 2010, urbanization in China experienced a remarkable growth rate, increasing from 36.22% to 49.68%. The third paper "The Research on China's Urban Spatial Expansion and Its Time-space Stability Since 2000" by Wang and Qi (2014) analyses the urban land expansion patterns in the 263 prefecture-level cities in China. Two types of urban land expansions are examined, including administrative division expansion and urban built area expansion. By plotting the increase rates for each city on maps, regional urban growth patterns are identified. The paper further standardizes the yearly change of the two types of expansion, by which the authors are able to trace the "time-space" path of the growth for individual cities in a two-dimensional coordinate system. This also enables the categorization of the 263 cities according to their growth path. Furthermore, three indicators are proposed to measure if a city's relative position among the 263 cities is stable.

The final paper "Transitional Spatial Pattern of Housing Prices in Beijing: Factors and Implications" (Wang and Gao, 2014) analyses the situation and the changes of housing prices between 2005 and 2012 in Beijing. Using GIS-based spatial analysis methods including global spatial autocorrelation, local spatial autocorrelation and spatial interpolation analysis, they are able to understand the spatial patterns and the changes of housing prices in Beijing. They find that the urban area has sprawled in line with a "pie" model, with the housing prices increasing rapidly and spreading from the urban centre to the outer areas of the central city. At the same time, some high-grade housing areas and low-grade housing areas are identified, indicating a trend of socio-

spatial differentiation. Then, a hedonic price model was conducted to find the influencing factors. The results show that besides location and environment, property rights, construction of transportation networks, and population change have played key roles in the transition of the spatial pattern of housing prices in recent years.

This special issue is one of the outputs of the biannual International Conference on Spatial Planning and Sustainable Development held on 30 August to 1 September 2013 at Tsinghua University, Beijing, China. We would like to express our sincere gratitude to the researchers who joined the conference and submitted their works to our journal. Special thanks go to the reviewers who gave us their most generous support on reading and commenting on the papers. We hope all our efforts would contribute to a more sustainable world.

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The Framework of Social Sustainability for Chinese Communities: Revelation from Western Experiences

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Abstract: The purpose of this paper is to explore the framework of community social sustainability for China. The paper gives a brief introduction to the concept of social sustainability and its core inclusions in literatures at the beginning. Social sustainability, nevertheless, has not only been tested in theoretical research debates, but also already been practiced and traced in western context. The key ideas and systems are summarized after reviewing and analysing social sustainability concerns in western countries like US, UK and Canada by several case studies. Furthermore, comparing the evolution of this concept in China, a literature-review based analysis also discusses how the western-originated social sustainability idea should be understood and redeveloped in the distinctive Chinese context. Following these findings, a new framework of social sustainable communities is summarized that includes three layers: individual needs, social network and community development. The paper finally gives some extended discussions on the current community planning system in China and related issues concerning this topic. It is also proposed that developing detailed indicators under the framework, although is insufficient at the moment, can be a systematic process integrated with the updating of community planning mechanism in future during a public-evolved social planning process, a positive attempt toward social sustainability in practice as well.

1. THE CONCEPT OF COMMUNITY SOCIAL SUSTAINABILITY

1.1 A review of sustainable development and its social dimension

In the past twenty years one significant focus in urban planning has been the key idea of 'sustainability'. Although emerged for years, this notion is still difficult to be accurately explained at present. Tracing its history, it is commonly accepted that this idea starts to make profound influences after the report 'Our Common Future' broadcasted by the UN and World Commission. It can be unscrambled as 'the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland, 1987) for that period and some common goals claimed for the

future have been initially generated as sustainable policies. However sustainable development, which is 'not only an object, but a dynamic process' (Lock, 2003), definitely requires further exploration and closer scrupling as time goes on. This all-embracing concept also needs to be decomposed and reconstructed into different dimensions for detailed study and practice. Generally sustainability can be understood by a subdivision using a three-dimension framework represented by environmental, economic and social perspectives (Jones and Evans, 2008, Jenks and Jones, 2010).

At a local scale, this planning concept has been gradually introduced and applied in the context of community planning (Lock, 2003, Rudlin and Falk, 2009, McDonald et al., 2009). Following this three-dimensional composition, it is clear that a community's sustainability should be achieved as a balance of environmental, economic and social aspects (McDonald, 1996, Roseland, 2000, Jones and Evans, 2008). However, more criticizes are upon the less of comprehensive consideration during the decision making process of planning policy, as negative social influence has gradually emerged after the construction of some community/housing projects (Page, 2000, Oliveira, 2012). Although relevant studies are abundant (Bärsch, 2002, Eastaway and Støa, 2004, Rudlin and Falk, 2009, Jenks and Jones, 2010) and complex sustainable planning methods have been discussed (Roseland, 2000, Lapping, 2006, Brownill and Carpenter, 2009), some (Marcotullio, 2001, Newton, 2012) are still criticizing that 'urban sustainability' has mainly been concerned with clear environmental and economic requirements, which however, have often neglected the vital social aspects and the new social role needed to be rediscovered (Yiftachel and Hedgcock, 1993). Furthermore, many planning concepts such as 'new urbanism' and 'compact city' are all claiming to promote the development of sustainability. However, issues also occur with great debates on the various influences from those 'sustainable' claimed planning strategies. For example, the 'compact city' has been constantly questioned in terms of the linkage with social sustainable criterion and principles and whether they have really been incorporated, implemented (Burton, 2000, Burton, 2001, Neuman, 2005, Peng, 2008). Today more social-goal oriented planning (Friedmann and Chen, 2009, Cuthill, 2010) are proposed and advocated towards the safeguard of living quality, social equity and human rights, which also makes an emphasis of planning social perspective and claims this should not be sacrificed by other perspective goals such as land economy or urban aesthetics (Roseland, 2000). In sum, 'social sustainability' has appeared to be an issue which is increasingly highlighted in both theoretical and practical explorations (Colantonio and Dixon, 2009, Dempsey et al., 2011, Berkeley, 2012, Magee et al., 2012) and thus has begun to play a significant component which ought to be incorporated in revisiting and improving planning strategies.

1.2 A review of community social sustainability and its inclusions in western context

Social sustainability has emerged within a large volume of published literatures in western research. Undoubtedly, it is an extreme complicated big concept that may contain multiple layers. Some scholars have attempted to give comprehensive explanation on its definition. 'Social sustainability occurs when formal and informal processes, systems, structures and relationships actively support the capacity of future generations to create

healthy and liveable communities. Socially sustainable communities are equitable, diverse, connected and democratic and provide a good quality of life.' (Barron and Gauntlett, 2002). From a process view, 'Social sustainability is a life-enhancing condition within communities, and a process within communities that can achieve that condition.' (McKenzie, 2004, P12). Now there is a considerable amount of interdisciplinary studies on this topic (Ghahramanpouri et al., 2013), which have greatly enriched the research levels and results, however, at same time, they make mess and confusions.

Here firstly the meaning of 'community' may vary in different subjects. So when deeper explorations are made to interpret of the inclusions of social sustainability, various points of view would be generated from their diversified starting backgrounds. The planning research focus has to be narrowed to a geographical concept: urban or rural communities at a local neighbourhood scale approximately. It may be found some sociological research are also exploring sustainability of some 'vital communities', however, these may not be very helpful to planning scholars who prefer to focus on geographical communities.

Back to the key point of 'social sustainability' itself, although being a grand concept, it is not an illusory in fact. Current research results (Colantonio, 2010) have proved that it can be identified and measured by key inclusions and elements. Research under micro individual perspective mostly follows a 'basic need theory' and takes residents as their main research object. Their living quality, tested quantitatively by a 'satisfied-level' as well as their social interactions and sense of belongings are often being deemed as the core elements of social sustainability. Although 'basic needs' or 'individual quality of life' have been widely recognized and listed in literature (He and Wu, 2007, Ha, 2008), any simple equalization of these notions to the bigger notion 'social sustainability' may not be appropriate, as there is also another important view of at a higher level. On the other side, the macro perspective research would like to take some entire considerations of communities as their most important body. The infrastructure and amenities, social equity and justice, safety control and crime prevention are analysed as community 'common criterions & value'. Some (Dempsey et al., 2011) mainly discuss individual quality of life and the function of the whole community society, and thinks these two components are the core of social sustainability.

It is helpful to make reviews and analyses on the most frequent themes of social sustainability mentioned or listed in relevant academic contents, although impossible to quantitatively calculate them thoroughly. Individual part mainly contains a grade assessment on housing quality, walkability, access to facilities, average amount of green space, average possessions of public space and so on. Social activity frequency, public participation, the sense of place and the safety level of community will be the highest discussions on the community's common sense. Basic social infrastructure, resident perceptions of the quality of life, sense of the community, social interaction and networks and the whole operation of community are listed as useful ways of measurements, according to their research findings (Dempsey et al., 2011, Karuppannan and Sivam, 2011, Magee et al., 2012, Landorf, 2011).It can also be understood from literature review that although social sustainability is mostly based on human concern, differences still exist when representing the structure and inclusions of social sustainability regarding research perspective, which may also be described as research logics. And

undoubtedly this will also lead to different ways of assessing social sustainability.

1.3 Social sustainability concept in China

Although less discussed than western researchers, social sustainability is now impossible to be ignored in China, particularly considering recent new highlights on social reform and a tendency of improving national social equity in the new era. The voice of updating planning with social concern has also appeared under this background (Jin and Zhu, 2011). The following discussions from research would give some further explanations with the localization of social sustainability in the Chinese context. Concerning the quick development of new urban communities in 1990s, research (Lu, 1999) had stated some components were of high importance to community sustainability, such as the provision of necessary community amenities and the design of high-quality public space. It could be regarded as the starting stage of discussing community sustainability academically in China. However, those were found mostly about the physical factors of communities and the function-based quality of life concerns.

The research stage in the 21st century had an obvious extension on the discussions of social sustainability. One scholar argued that the community development at that time (around year 2000) in China was 'feeble and futile' considering the profit-led orientation in the massive real estate growing market and their main focus in planning and design was only on the physical environment of communities (Zhang, 2000). That research indicated that future community development should establish a higher sprit pursuit rather than the basic satisfaction on enough facilities. Also suggested as a key important planning issue in future, more considerations should be given on social justice, social capital, territorial sense and public participation; a higher standard should be set up toward sustainability and its long-term goal. A study (Yu, 2005) also reported that community planning should be designed with different layers of purpose considering social sustainability: to improve residents' life satisfaction; to promote social interactions and establish social network; to build up distinctive local characteristics; create specific social-environment factors and finally to make functional and social integration within community space.

Other Chinese scholars (Jin and Zhu, 2011) discussed that the construction of social sustainable communities should contain four components by both 'external' and 'internal' considerations: the physical design of community(which already included traditional planning method like architectural feature, the space texture and environmental atmosphere); the social organization and management of community; the customs, habits and social interaction of their residents; and the value orientation of community, like humanistic spirit and social psychological attitude. Following the grounded theory, one study (Wang, 2012) made a new conceptualization and decomposed social sustainability into three parts: continuation of tradition, connotation of development and transformation of process and this research wished to show the importance of the agreements and common goals of a whole community. More practical planning guidance on community social planning and emphasizes on public participation are also advocated by some studies (Friedmann and Chen, 2009).

2. CASE STUDY: SOCIAL SUSTAINABILITY ASSESSMENT FRAMEWORK IN WESTERN PLANNING PRACTICE

2.1 A review of sustainability assessment

In recent western planning practice there is a trend of assessing social sustainability which tries to link social outcomes with the planning inputs (Colantonio, 2008, Bramley et al., 2009, Berkeley, 2012). However, if we date back to its prototype 'sustainability assessment' we can find that it has emerged for over 20 years and has created a considerable number of different methodologies as well. Some studies (Devuyst, 1999, Jenny et al., 2004, Alwaer et al., 2008, Sharifi and Murayama, 2013) have given comparisons on their assessment methodologies and show several of distinctive ways to implement sustainable assessments. In terms of different disciplines, economists may prefer to use a 'monetary aggregation' method, whereas the adaption of a physical indicator method is more popular among most social science researchers (Rajesh Kumar et al., 2009). The assessments may be designed totally different by using 'top-down' or 'bottom-up' perspectives (also stated in this paper earlier) and can also be diverse considering their conceptual origins, driving forces and even stakeholders.

After reviewing those evaluation methods, the research suggests that the 'indicator-system' is still the most widely and effectively adopted method in assessing sustainable development at present. However, it is not easy to construct a distinctive indicator system for a reasonable assessment that could fully represent the mega concept 'sustainability' or any its special sub-three dimension. The indicator system should be able to provide visual layers or themes that could be easily understood, normally constituted by a detailed comparable 'sustainability index' at the end. The assessment systems, most of which now we could see are in western context, seem to be mostly designed quantitatively and sometimes would have a specific focus on a certain period (like past 3 years) or a certain area (like a region), if applicable.

Not only being accepted as a fundamental work of developing an useful theoretical method, in practice the establishing of sustainability indicators could also be deemed as a comprehensive construction of a statistical platform being applied in various ways of estimating, analysis, monitoring, evaluating and predicting the status of sustainable development. It can not only represent the conceptual idea of sustainability but also need to be converted into a practical framework by providing its series of indicators. What's more, it is also regarded as an important criterion to transform the principles of sustainable development into an effective public behaviour guidance.

2.2 A review of typical western systems of assessing social sustainability

It has been illustrated that there have never been any mainstream or common indicator system that could simply be applied to the entire urban context (Colantonio, 2010). Despite this, more and more indicator systems have been gradually designed and tested, especially in western context. First developed in 1993, 'Sustainable Seattle' is now a relative mature product in

the US. It is a city- level sustainable assessment which has five key components including environment, population & resources, economy, youth & education and health& community. The five parts are indicated by a series of 40 sub-indices. The selection and re-selection of the indicators of this model has become a long-term dynamical process by years-efforts with successful public participations and continuing result monitories. The Seattle model has a clear goal settled by the elites from the leader team 'S2' and this assessment mainly comes from the experience accumulated via continuing practice and feedbacks. Assessments which are similar to the 'Sustainable Seattle' have been largely increased recently (Koichiro and Aris, 2012, Vehbi and Hoşkara, 2009, Gallego, 2006) and the trend has also been extended globally with more Asian countries and cities getting evolved (Huang et al., 1998, Lee and Huang, 2007). Despite of its achieved success and wide acceptance, it must be recognized that this is an empirical plan acted under a general leading goal, which could only reflect the characteristics of Seattle local region itself. In contrast, assessment models with a 'theory-oriented' purpose seem to be more popular in recent research activities (Jenny et al., 2004, Valdes-Vasquez, 2011), because complicated mammoth work like Seattle's goal-oriented action would hardly be possible in research background. At the same time, a gap seems to lie in their viewing scale, as most sustainable assessments have only been implemented at city-level so far. The focus at the scale of local communities (the basic cell of cities), especially with a unique social perspective, is still inadequate at the moment.

After reviewing many of the western systems, this research finds that whether to follow a 'bottom-up' or a 'top-down' perspective will inevitably determine their indicator system structures, which actually will shape different research logics and further steps. In 2005, city of Vancouver enacted a social development plan for the whole city and developed an ad hoc social sustainability framework (City of Vancouver, 2005). Its overarching principles includes equity, inclusion, adaptability and security, which are then further divided into several sub-themes (Figure 4.1), also ranging from 'living' to 'moving'. This indicator system is a typical 'bottom-up' model developed from the individual perspective, like the 'quality of life' is deduced from the 'basic needs theory' and accounted for daily activities of local residents. Another social sustainability framework published in the UK contained four elements considering a community's long-term development (Woodcraft et al., 2011). It can be seen as a typical 'top-down' model that takes a community as a whole. Its key compositions of social sustainability are: amenities and social infrastructure; social and cultural life; voice and influence; and space to grow. The indices of these elements are internally linked with each other. The overall structure of this elaborate 'indicator system' has almost covered all the related social aspects of a community, also with a strong logical consideration of the basic shaping process of new urban communities, gradually developed from physically to ideologically. Some indices of this system are not clear enough. It may be further integrated to make this indicator system model more concise and convenient, such as mutual related community assets and infrastructure. What's more, in terms of practice, some indices of this model would meet difficulties on their detailed measurements. Nevertheless, this new top-down framework of community social sustainability has a highly positive significance and many detailed indicators are also quite constructive.

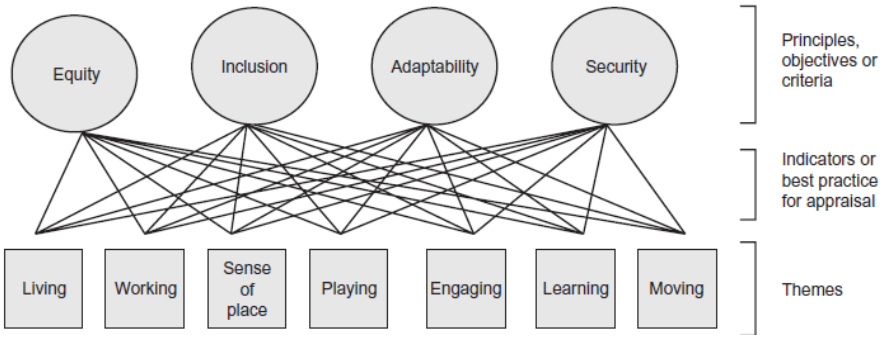

Figure 1. The Framework for social sustainability assessment in Vancouver, elaborated from GVRD (2004a, 2004b) and CoV (2005)

3. SOCIAL SUSTAINABILITY OF CHINESE COMMUNITIES: DEVELOPING A NEW PERSPECTIVE AND A NEW FRAMEWORK

3.1 The lack of a 'community-based' perspective in current planning system

The idea of urban community in China late emerged in late 1980s when more and more world knowledge exchange opportunities came in after the implementation of 'open and reform policy'. The first term used for a 'planned community' in national planning documents was called 'urban residential area'. But it has then created three levels of words to describe their size and scale (Ministry of Construction, 1993), which will be discussed in the later part of this chapter. But it seemed that the focus on the planning guide book, however, is only on dwellings, not on people at that time. It was gradually recognized that a community would be a large populated area with necessary public service and should be identified by their members, its territorial boundaries as well as their social interactions. Later some Chinese planning academic books introduced that a community referred to 'a fixed geographical area with members of society who together lives within this environment and social norms, functions and networks are created as well'(Li, 2000).

In general, the community and its planning idea are relative new concepts that need deeper understandings and further concerns. Besides the criticisms of the monotonousness of modern communities, the voices appearing on some social problems seem to express their disappointments on the lacking of human concerns in new urban area and vast real estates development torrents. Some residents have felt the obvious reducing of neighbours' outdoor activities with the disappearing of public places at the basic community level. The highly instability and the mobility of some redeveloped or resettled urban communities also have their negative social facts, such as the social unconcern and misidentification. A lot of new real estate development has destroyed the formerly rounded form of cities and shaped great distinctions between them and poor urban villages; rich gated communities also inevitably cause an isolation of social class. So far adequate reviews, inspections or examinations have been little made upon the Chinese communities' social sustainable perspective. From the value of planners, most attention had been paid to the great growth in quantity and height of our cities and towns that all could be counted when they made the

plans and construction. This had also brought in the next new confusion: the other unquantifiable variables for that stand for the dimension of human nature, the form with community's diversity and pleasant relationship between neighbourhoods were beastly neglected. It seems that in China we are under a risk of gradually losing the social goal and human value of city development.

3.2 Reconstructing social sustainability framework

A systematic reconstruction of the ensemble structure and inclusions of social sustainability is necessary and crucial for community related planning research in China. Attention has been drawn to level-based focus on this context. One research (Yang, 2004) divided the community into three levels, individual social capital at microscopic level; organizational social capital at medium level and finally, group social capital at the macro level. This paper also agrees on this logic. Further more, the new framework must consider with community's shaping process. The people living inside would be the bottom cells which are all connected with complex relationships with each other; meantime the community however is also the basic unit that shapes bigger city images. From individual living satisfactions to community network built-up and finally to entire community development in the society, the framework of social sustainability can be systematically built up (Figure 2).

The first individual layer is still claimed by researchers (Zhao and Zhao, 2002) that play an important role to better promote community social sustainability; thus planning has a high priority to improve the physical environment in order to satisfy basic needs. It would be an emphasis on the necessary foundation of this comprehensive framework. This study also implies from individual to internal networks and then to the external wholeness, another two layers are even more important to the whole social sustainability concept, which may not be well considered at the moment. They are working as common rule and law behind the scenes. Good inhabitant relationship and network make the community stronger and it is interesting to identify how the social groups could be formed within a community's social networks and how they could to be promoted by planning. The community development, definitely related to the community participation what now be greatly emphasised as, 'participation approach', will benefit to establish community self-supervision and self-governance that forming a community's entire capability, credibility and reliability.

To be summarized, the understanding of social sustainability should give more attentions on the deeper lifestyle and behaviour characteristics of local community residents as well as their inner bonds and linkages in their common culture and values, and the entire operation and management of community will also be important. As a systematic reconceptualization of community social sustainability, the new framework should be able to identify the fundamental common characteristics of communities and provide the inclusions of social sustainability in a stratified order.

However, to evaluate sustainability of communities under this framework, further research works are required to follow up. It takes time to develop indicators under each themes of social sustainability. According to the discussions of indicator methods (Wong, 2006, Ghosh et al., 2006, Wong, 2003, Hemphill et al., 2004), it can be summarized that these indicators are formulated through a four-step process: determine the dimension; choose index; make evaluation method; and test results (Wong, 2006). Not to be

neglected, there is also some voice from other scholars criticizing prevalent evaluations by indicators (Lan, 2004). It is illustrated that some indicator systems seem to be too numerous and jumbled and the disequilibrium issue of evaluating indices has also been remarked frequently as well. To produce a reasonable sustainability evaluation model, there is a long way to go in future. Like the long-term developing procedure of Seattle model in the US, the progress of designing detailed indicators for social sustainability assessment Chinese communities needs great efforts in future.

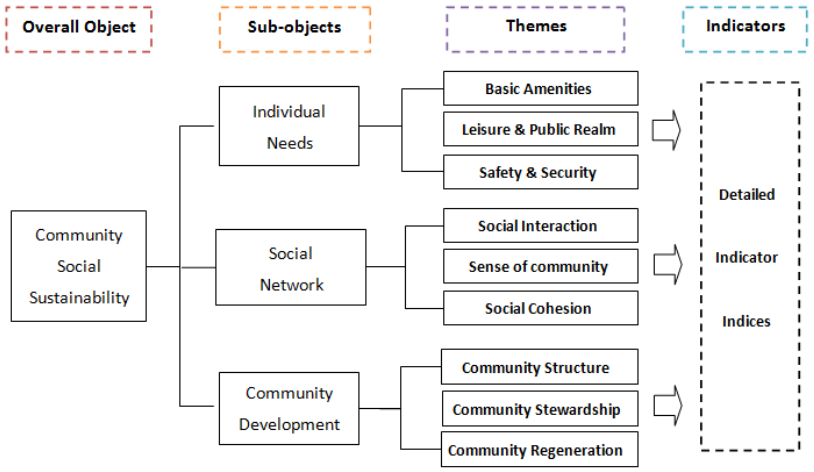

Figure 2. Community social sustainability framework by this research

4. DISCUSSIONS AND CONCLUSION: PROCESSING A NEW SOCIAL PLANNING ORIENTATION AND PLANNING MECHANISM

4.1 Issues of current planning system

There is a mechanism-based issue in practicing social sustainability in China. It could also be described as a "two schemes" phenomenon of urban community system: the big divergence exists between community's four-level urban governance system[1] and its three-level urban planning system[2]. At the bottom of this urban governance system, the community has an administrative role in China, however, whose responsibility is only limited in small pieces of social affairs like normal birth control, hukou (population registration) without getting any feedback from local community residents on their daily lives or community development. The master plans in all the Chinese cities terminate at the 'district' level, and the next stage regulatory and site plan, which control the demarcated urban blocks, roads, and building sites, have no idea of 'planning a comprehensive community'. The

[1] Overall in China there is a four-level urban government system established for years: city, district, sub-district/street and community offices with affiliated administrative officers/civil servants. At the community level, the population is theoretically around 700 households, however now in many mega cities it could be even over 3,000 households.

[2] In the three level urban planning system built up in the last century, normally urban residential space will be categorized into urban residential areas, urban residential quarters and clusters, with detailed planning regulation indices. In a population based hierarchy view, a 'residential area' plans about 30,000-50,000 population; a 'residential quarter' and a 'residential cluster' each plans about 10,000-15,000 and 1,000-3,000 accordingly.

linkage between planning and governance of community areas seems to have never been explained at all under this 'two-system' scheme. It is common to see in actual cases, the boundaries of an urban community is great different from the nearby block areas defined by planning. The great gap between community's administrative boundaries and planned boundaries not only makes ciaos in daily community managements but also influences their residents' identity and sense of belongings (Gu et al., 2008). This research would indicate that the big issue of social sustainability may be to discuss where and how to implement our suggested 'social assessment' toward social sustainability under current Chinese urban planning and governance systems.

The practical approach may be to bring in a new 'community planning' system in order to join the current two systems of different local authority departments. Presuming social sustainability is regarded by the research as a process of human ecological evolution toward justice and reform, meanwhile, the improvement from the bottom communities can be its foundation and the operational mechanism to make assessment and monitory is also essential. The framework seems to do something theoretically, however practically it call for collaborative works. It means the inevitability of reconciling of interests between different departments and different stakeholders in community planning, development and governance. So the processing of social sustainability in practice phase is definitely more difficult than our research framework phase. Nevertheless, the possibility of achieving it is not low; the performance of national political and social reforms is bringing in big hopes and chances for practicing social sustainability.

In sum, the establishing of a supervising mechanism towards open, fair and well collaborated planning targets will be of great significance to achieve the suggested social sustainability by the west. Now more and more planning information has been released to the public in China. However, it must be realized that what this system should open is not only the 'planning results' but also the 'planning process'. Improving community residents' participation via legal process could now be an early stage to promote the cities and communities' social sustainable growth. For planners, ethic improvement in daily planning works with more concern of people's lives would help planning to eventually return to the human and social community concern itself.

4.2 Conclusion

Social sustainability has become a world increasing trend in planning and community development nowadays. However, so far this issue has not been given enough concern in China either by theoretical research or practical implementation. Relevant theories and thoughts have been shortly reviewed to retrieve how the social sustainability idea is developed and implanted in urban planning and integrated within local community development policy, especially with a western research context. The paper also gives specific focus on the Chinese context, based on the new community development in China since late of 1990s.

The paper also shows that more comprehensive and balanced planning principles are proposed and advocated as social perspective has become an increasing worldwide concern compared with other goals. Impossibly to be totally and undisputedly presented, however, this has already been acknowledged and formulated as an important indicator in Europe and North

America community planning research framework. Case study is applied as a research approach to understand the development of western social sustainability frameworks, which takes several social sustainability assessment projects in the world as instances. The research has made analysis on their sustainability idea, inclusions as well as planning process, where the research has found that collaborative planning and public participation have been established and operated for years. They are proved by this paper to have a great positive impact on achieving and maintaining community social sustainability. Although similarity could be drawn from those cases, differentia should never be neglected on the case's different backgrounds, logic contract as well as and practicing mechanism.

The research has drafted an initial framework, a three-level constitution with sub-themes that present the key inclusions of social sustainability to Chinese communities. Considering the immature community planning system in China, this is only a theoretical attempt, definitely far from planning practice. Further detailed indicators are worth working to figure out a new assessment model in future. Great planning efforts in achieving social sustainability have all happened during the community planning system in the US, UK and Canada. Their contributions to planning not only lie in the initial proposals on the sustainability frameworks but also in the public involved planning process that shaped by years of constant practice. Regarding to social sustainability theoretical and practical findings, future attempts in developing social sustainability indicators and the corresponding community planning mechanism should be encouraged in China's planning battlefield.

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How Eco are China's Eco-Cities? An International Perspective

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Abstract: To tackle the problems and challenges posed by the rapid urbanization processes and to purse urban development in sustainable manners, the Chinese government has taken vigorous efforts in developing eco-cities across the nation. After reviewing the studies on concepts, frameworks and indicator systems of eco-city, we have observed a large amount of literature on the selection of indicators under a singular framework in China rather than having a quantity comparison from a broader scope. To obtain a quantitative sense of how well China's eco-cities are doing compared to the best practices in the international arena, we have selected two cases from Japan and Germany. By examining their indicator quantities under the national eco-city framework of China, we have identified the gap between economic related indicator values, suggesting lower averaged economic values and energy efficiencies of Chinese eco-cities. Targets concerning the waste sector are also lower in China than in the other two cases. The environmental indicator values show lower quality than in the other two cases as well, and the social indicators manifest a specific methodological approach for measurements in China. Discussions and suggestions are made based on the outcomes of comparisons, hopefully to provide reference for the future development of eco-cities in China.

1 INTRODUCTION

The world has witnessed the phenomenal economic achievements in China during the past few decades, at the same time, testifying to the rapid urbanization process and the negative impacts to the urban living environment. In 1978, the urbanization rate in China was merely 17.9%, but in 2011, the urban population had surpassed the rural population, and is expected to reach 77.3% by 2050 (United Nations, 2012). Serious challenges and problems occurred during the rapid urbanization process, such as shortage of housing, traffic congestion, environmental pollution, soil and food securities, public health crisis etc., which have been studied by scholars from different aspects (Shen, 1999; Chen, 2007, Gong et al., 2012).

To tackle these challenges, the Chinese government has been vigorously promoting a series of projects to pursue ecological and sustainable urban development. Several concepts have been proposed like "Green City", "Garden City", "Eco-City", "Low-Carbon City", and frameworks of national levels have been established to promote these projects, such as "the Eco-Garden City Framework" from the Ministry of Housing, Urban-Rural Development (MHURD), "the Eco-County, Eco-City and Eco-Province

Framework" from the Ministry of Environment Protection (MEP), and "the Low Carbon City Framework (in trial period)" from the National Development and Reform Committee (NDRC). Besides this, many studies are conducted to define the concepts of eco-cities and their indicator systems, which will be further elaborated in the literature review section.

According to a national survey conducted by the Chinese Society for Urban Studies (2011), 230 prefectural level cities in China have had eco-city projects or made related plans, accounting for approximately 80% of the main cities by 2011. This booming of eco-cities projects has manifested prosperities for the urban sustainable development in China.

Besides an array of concepts or features for what "eco-cities" should embrace or integrate, many studies are conducted on analyzing the quality of the indicators or their necessities in China (an in-depth review of those studies is conducted in the literature review section). However we find that few discuss how well Chinese eco-cities perform compared with those in other countries. In this paper, we compare the Chinese eco-city indicators with best practices in Japan and Germany in quantitative terms. Based on the outcomes, we wish to obtain useful insights and suggestions that would help to improve China's eco-city developments in the future.

2 LITERATURE REVIEW

2.1 Eco-city origin and concepts

The efforts to curb the negative impact of urbanization are neither new for people nor confined to particular countries. Concepts like "Garden City", "New Town" and "Techno-City" that occurred in the 19th and 20th Century are some of the major representatives (Joss et al., 2011). Later concepts or terms like "Climate-Neutral City", "Low-Carbon City", "Smart City", and "Sustainable City" can also be considered as sister terms of "Eco-City" concept that "covers various notions of, and approaches to, sustainable urbanism, rather than a conceptually coherent and practically uniform phenomenon"(Joss, 2012).

Despite the lack of a universally agreed concept or development guide for an eco-city, many scholars have offered their interpretations of how an eco-city should perform. Yanisky (1981) articulates that "an eco-city is an ideal habitat with a benign ecological circulation...and energy, material, and information are efficiently used." Register (1987, 1994) defines that eco-cities are ecologically healthy cities. Engwicht (1993) perceives of eco-city as "an invention for maximizing exchange and minimizing travel" and "in eco-city people can move via foot, bicycles and mass transit and interact feely without fear of traffic and toxins". An in-depth discussion of eco-city origin and its dimensions is reviewed in Roseland (1997), where he connects the dots of eco-city developments by exploring its conceptual evolutions from an array of sustainable development contexts.

In China, many scholars have also offered their own perceptions, such as Wang (2000) considers an eco-city to be an administrative unit that consists of high economic productions, high ecological efficiency, responsive and harmonious social cultures. Huang (1989) proposes that eco-cities should build upon ecological principles, integrate social-economical-natural systems, and apply inter-disciplinary concepts to develop sustainable, efficient and recycling human residential areas. Others scholars like Shen (1998) consider an eco-city to be an integrated system of highly developed economy, prosperous society where technology and nature are fully

converged, human creativity and productivity fully extended. Huang and Yang (2001) state that eco-city is a subsystem under the global regional eco-system, which is based on principles like natural harmony, social justice and high economic efficiency (Qiu, 2012).

2.2 Eco-city frameworks and indicator systems

"Framework" often entails principles, standards, and indicators for guiding the implementation of eco-city development. Numerous frameworks are established by various parties to fulfil the objectives for eco-cities globally. A recent study by Joss and Tomozeiu (2013) has reviewed a total of 43 eco-city frameworks based on their replicability, applicability and scope, excluding the ones that are designed for a particular case or region, such as *Vancouver's Greenest City 2020*, Copenhagen's *Eco-Metropolis 2015* and the *Curitiba Sustainability Indicators 2010*, et cetera.

Similar abundance also manifests in the eco-city indicator systems; for instance, Li and Gang (2012) have reviewed nine major urban sustainability indicators from international organizations like Siemens (European Green City Index) to national government frameworks like the UK's Eco-town Standards. The International Eco-Cities Initiative (2012) have enlisted 28 sets of eco-city indicators as a "brief summary" of the "internationally most prominent schemes" from municipal, national and international levels.

In China, there are three major types of "eco-city" frameworks in practice according to the composing bodies and targeted projects. National frameworks are established by ministry level government entities, which apply to most of the domestic cities with different focuses. The second type is composed of international joint venture eco-city projects; they often employ cooperation from international partners and target a particular area or project with higher standards for indicators, such as Sino-Singapore Tianjin Eco-City and Sino-Sweden Caofeidian Eco-City projects.

Under the national frameworks from MHURD, MEP and NDRC, specific indicators are set up to assess the performance of these eco-city programmes. For MHURD's "Eco-Garden Cities", they set up an indicator system with 19 primary indicators under three categories: "urban ecological environment", "urban living environment" and "urban infrastructures". MEP's indicator system entails three levels for eco-county (22 indicators), eco-city (19 indicators) and eco-province (16 indicators) under three categories of "economic development", "environmental protection" and "social progress". The specific indicator system is still undergoing pilot research for the NDRC's "Low Carbon Cities", and the cities or regions that participated in this programme are required to come up with their own set of indicators before the official ones are released.

Besides the indicator systems within the package of the international eco-city projects of Tianjin or Caofeidian, several sets of indicator systems are proposed to address different needs or specific goals. An in-depth review of ten domestic eco-city indicator systems from the local and institutional levels (including two sets of national indicator systems) is conducted by Zhou et al. (2012) to analyse and compare their individual categories and key elements. Research Method

2.3 Method and rationale

In this study, we aim to analyse the quality of Chinese Eco-cities in comparison with those in other counties. An effective means to have

observable evaluating results is to have quantitative analysis of the selected subjects. In our case, we design to choose one best-practiced Chinese eco-city to compare with eco-cities from international communities. However, due to the lack of consensus on the currently available best case example of Chinese eco-cities, and the potential workload to evaluate and select one with public creditability, after consideration, we have decided to select a hypothetical eco-city under the assumption that it meets all the eco-city standards (thresholds) set up by MEP. For the international comparison, we have chosen two regional leaders in terms of green and sustainable developments, namely, Japan in Asia and Germany in Europe. Another reason for choosing these two countries is due to the authors' geographical location and past experiences. In the future, we intend to include case studies of best practices from other regions.

2.4 Selection of case studies and data collection

For the hypothetical Chinese eco-city case, we assume it meets all the requirements of the MEP's eco-city framework, which consists of 19 sub-level indicators under three categories. The population of this case is set between 1 to 2 million meeting the normal size of a Chinese prefectural level city. What needs to be pointed out is that MEP's eco-city framework applies to all the cities that meet the administrative definition of a city, regardless of the actual population size.

For Japan's case, we have chosen Kitakyushu city, located in Fukuoka Prefecture, with a population of 1 million, which is famous for its cooperative environmental engagement from the local government, business sectors and residents. This former notoriously heavily polluted industrial centre has now been transformed into a recycling oriented, resource efficient industrial zone with high quality of life standards. It has been awarded or selected as a model city by the national government and international organizations including the UN and OECD (OECD, 2013).

For Germany's case, we have chosen Hamburg city, with a population of 1.8 million, which is considered to be one of the greenest cities in Europe. It was awarded the 2011 European Green Capital Award for its comprehensive approaches, policies, funding for solving the environmental and ecological challenges with integrated and participative planning and strong commitment towards a "green vision" (European Commission, 2011).

We intended to compare all the 19 indicators, but due to lack of universal methodology and credible data, some of the indicators are not compared for the time being. Two of the environmental indicators, namely, "Air quality" and "Water quality (surface water)" are compared separately with some selected indicators of measurement.

The data for Kitakyushu and Hamburg case studies are acquired or obtained from official government database or entrusted institutions that publish those data. Conversions or recalculations are conducted to unify the units for easier comparisons without considering the inflation factor. In case of the data from another language, the authors' own translations are applied where the official translations are absent.

3 ECO-CITY COMPARISON BETWEEN CHINA, JAPAN AND GERMANY

3.1 Economic aspect

For the economic aspect, the MEP framework has five indicators under the economic category and we use them as the baseline for comparison with Kitakyushu in Japan and Hamburg in Germany as is shown in Table 1.

Table 1. Comparisons of economic indicators for 'eco-cities'

Economic Development					
NO.	**Indicators**	**Unit**	**Eco-City (China)**	**Kitakyushu (Japan)**	**Hamburg (Germany)**
1	Annul net income of farmers *Developed area* *Less developed area*	Yuan/person	 ≥8,000 ≥6,000	223,790[a)]	225,488[b)]
2	Tertiary industry share in GDP	%	≥40	67%[c)]	72%[d)]
3	Energy consumption per unit of GDP	Tons of standard coal /10k Yuan	≤0.9	0.5[e)]	0.4[f)]
4	Water consumption per unit of industrial added value	m^3/10k Yuan	≤20	n.a.	n.a
	Water efficiency of agricultural irrigation		≥0.55	n.a.	n.a.
5	Compliance rate of enterprises should carry out Cleaner production	%	100	n.a.	n.a.

Sources and Notes:

Conversion rate used: 1euro = 8 Yuan, 1 US dollar = 6 Yuan, 1 Yen = 0.07 Yuan

All the web sources are last accessed on March 25, 2014.

a) Converted from 3,197,000 Yen of Fukuoka farmer income in 2011 (e-Stat Japan Official Database)

b) Converted from 28,186 Euro of Hamburg farmers net income in 2009 (European Commission FADN Database)

c) Calculated from Table 2 of the GDP Brief Results 2010 (Fukuoka Prefecture Website)

d) Calculated by service industry value divided by gross development value in Hamburg in 2011 (German Federal Statistical Office)

e) Final energy consumption per unit of GDP in 2010 of Fukuoka Prefecture (RIETI database)

f) Calculated from 2.27 MJ/euro energy consumption per unit of GDP in Hamburg (German Green City Index, 2012)

GDP is a universally recognized indicator for the economic development within given geographic boundaries. In the trial version of the MEP eco-city framework, indicators like "GDP per capita" and "Annual income per capita" were listed, but the final version only keeps the "Annual farmers' net income" as civil economic measurement. From this change, we can observe a shift from the heavy pursuit of economic prosperity to the genuine concern of a rather economically weak group – the farmers. Despite China's being the 2nd largest economy worldwide, big gaps are still seen between Chinese farmers' net annual income (8,000 Yuan for the developed areas) to those of Kitakyushu (223,790 Yuan) and Hamburg (225,488 Yuan). And the later

two cases' values come close, suggesting a similar developed stage for civil economy of farmers in Japan and Germany.

If we take a look at one of the causes for unsustainable development, the blindfolded pursuit of economic development, in another word, GDP growth is definitely on the top list. Thusly, having attainable goals for hard-core economic development, in our opinion, deserves some credits. On the other hand, it also reflects that China's economic development is still out-matched by developed countries like Japan and Germany, despite of its overall economic performance worldwide.

The ratio of the tertiary industries to GDP is rather lower for Chinese eco-cities. The tertiary industry is also known as service industries, which does not rely on raw material or material processing industries. The lower the tertiary industry ratio is, the more share for the first and the secondary industries, which can barely contribute to the overall urban sustainability.

The most relevant two indicators under this category are "energy consumption per unit of GDP" and "unit of industrial added value". The "0.9 ton/10,000 Yuan" energy consumption is also higher than Kitakyushu's "0.5" in Japan and Hamburg's "0.4" in Germany. Water consumption for industrial added value and water efficiency of agricultural irrigations are not compared due to lack of clear definition and data.

From these key indicators, it can be easily observed that for the Chinese eco-city, it still falls behind of the developed countries when it comes to per capita economic performances, industrial structural ratio, and resource efficiencies. How to develop the urban economy in a sustainable manner is of vital importance in China, but the current standards have yet to be competitive to the developed world.

3.2 Environmental aspect

Environmental protection is one of the core elements for urban sustainable development; as a result, the related indicators can be seen as the most relevant measurement of the "eco" attainment level for eco-cities. We presented all the 11 indicators under this category for comparison (see Table 2). What needs to be pointed out is that for air, water, noise and waste categories, each of them needs to comply with the Chinese national standards with dozens of specific indicator measurements. So we have taken the most common ones for separate comparisons, instead of listing all of the items.

*Table 2.*Comparisons of environmental indicators for 'eco-cities'

Environmental protection					
NO.	**Indicators**	**Unit**	**Eco-City (China)**	**Japan (Kitakyushu)**	**Germany (Hamburg)**
6	Forest coverage *Mountainous areas* *Hilly areas* *Plain areas*	%	≥70 ≥40 ≥15	38%[a)]	6%[b)]
	Percentage of the forestry and grass coverage in alpine area and grasslands		≥85		
7	Proportion of protected areas in total land area	%	≥17	n.a.	34%[c)]
8	Ambient air quality	Meet the national standards for functional areas		Compare separately	Compare separately

9	Water quality Coastal water quality	Reach the standard of functional area and exceeds Class V of water quality		Compare separately	Compare separately
10	Emission density of key pollutants *Chemical oxygen demand (COD)* *SO2*	kg/10k Yuan（GDP） Within national limits	＜4.0 ＜5.0	n.a.	n.a.
11	Water quality compliance rate of centralized drinking water source	%	100	n.a.	n.a.
12	Centralized municipal waste water treatment	%	≥85	100%[d)]	100%[e)]
	Industrial water reuse rate		≥80	n.a.	n.a
13	Environmental quality of noise	Reach the standard of functional area		n.a.	n.a.
14	Waste	Urban garbage treatment rate (%)	≥90	100[f)]	100[g)]
		Industrial solid waste treatment & utilization rate. (%)	≥90	n.a.	n.a.
15	Urban public green area per capita	m^2/person	≥11	12[h)]	17[i)]
16	Environmental protection investment share in GDP	%	≥3.5	2.9%[j)]	0.4%[k)]

Sources and Notes:

All the web sources are last accessed on March 25, 2014.

a) Forest statistics of Kitakyushu City in 2012
b) German Federal Statistics Office 2012
c) Calculated based on data from protected area in Hamburg from Parks.it Database and German Federal Statistics Office
d) Year Book of Fukuoka Prefecture, 2010, p.227,
e) Water Management in Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2011
f) National law in Japan mandates to have 100% waste treatment and it is considered to have been achieved
g) National law in Germany mandates to have 100% waste treatment, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2013
h) Kitakyushu Environment White Book, 2010, p.91
i) European Commission Webpage
j) City budget published at Kitakyushu city official website
k) Calculated based on Hamburg environmental investment in 2011

China's "green area" consciousness is more practiced especially under the influence of "garden city" initiatives, which have been undertaken nationwide since the early 1990s, which is indicated by the "Forest coverage rate" of 40 % (Hilly area) compared to Kitakyushu's 38.3% and 15% (Plain area) to Hamburg's 6%. 11m^2/person in "Urban public green area per capita" is very close to Kitakyushu's 12 m^2/person, a bit less than Hamburg's 17m^2/person, which is rather satisfactory given the population in most Chinese cities.

Categories of "Air" "Water" and "Waste" are the most important aspects to any city, which is universally acknowledged and accredited as the major

components of an urban environment. By comparing these indicators, we can obtain the most direct impression of a city's ecological level. Air pollution in many Chinese cities is already in a crucial condition for urban environmental development. Beijing for example, among many other mega-cities has been tortured for its air related problems, causing severe public health concerns and indirect economic damages, besides the environmental impacts.

It is worth noting is that, the "eco-cities" standards set by MEP do not bring out new sets of indicators nor thresholds, all their standards comply to the "Ambient air quality standards" (GB3095-1996). This set of standards was renewed in 2012 (GB3095-2012), so the figures that were included for comparison were taken from the 2012 standards instead of the 1996 ones. Moreover, the eco-city standards trial version requires the number of days in a year to meet the Class 2 standards (of "Ambient air quality standards"), for north of China – no less than 280 days, south of China – no less than 330 days. This might lead to the suspicion more "loosened requirements" for the northern cities than for the southern ones due to industrial development needs and population growth patterns. What is worse, it allows a time window (85 out of 365 days, 35 out of 365 days) for the eco-cities not to meet the air quality standards, causing possible ill implementation of air pollution on a macro-level. However, during the revision version, the number of days is removed, eliminating the loop holes mentioned, indicating the government has been gradually improving their requirements for air quality.

To compare the air quality for the three cases, four major indicators for measuring air quality are chosen among several dozens of measurements, namely, the daily mean for annual nitrogen dioxide, ozone, particle matters (such as PM10, PM2.5), and sulphur dioxide. The results reveal that the thresholds are several times more than that of Kitakyushu and Hamburg (refer to *Table 3*). This suggests a huge gap between the Chinese eco-cities and developed nations for air quality.

Table 3. Selected indicators for air quality comparisons

Air quality	**Selected indicators**	**Eco-city (China)**	**Kitakyushu**[a)] **(Japan)**	**Hamburg**[b)] **(Germany)**
Standards for 2nd Class functional areas (residential and commercial area)	Annual mean for SO2 (μg/m³)	60	11 (0.004ppm)	4.24
	Annual mean for NO2 (μg/m³)	40	39 (0.019ppm)	26.08
	24-hour average for CO (mg/m³)	4	0.5 0.4ppm (Annual)	n.a.
	1-hour average for O3 (μg/m³)	200	81 0.038ppm (Ox)	n.a.
	Annual mean for PM 10 (μg/m³)	70	16.8 (0.026ppm)	25.03
	Annual mean for PM2.5 (μg/m³)	35	18.2	n.a.

Sources and Notes:

All the web sources are last accessed on March 25, 2014.

Conversions of ppm to μg/m³ formulate (mg/m³=M/22.4*ppm) are employed to unify the units

a) Observed values in 2011 from Fukuoka Prefecture Web Site
b) German Green City Index, 2012

Water is also an essential resource for human survival and development, and a huge challenge in China due to its severe shortage and pollution. It is also regarded as one of the key factors that affect the ecological development of cities, which is reflected by the quantity of indicators. From Table 4, we can observe that the pH range is rather similar and natural in terms of acidity and alkalinity. The COD value is 5 times higher than Kitakyushu, suggesting more pollution contents in Chinese water bodies than in Japan. The other thresholds of BOD5, Nitrogen (NH3-N) and Phosphorus (P) are all higher than in Kitakyushu, indicating the overall quality of water is out-performed by Japan. A more subjective comparison is that the tap water in both Japan and Germany is directly drinkable, while few people in China would drink water straight from a water tap. Most people in China, if not all, at least boil tap water before drinking, just to avoid unnecessary health risks.

Table 4. Selected indicators for water quality comparisons

Water quality	**Selected Indicators**	**Eco-city (China)**	**Kitakyushu**[a] **(Japan)**	**Hamburg**[b] **(Germany)**
Standards for 3rd Class functional areas (residential and commercial area)	pH	6-9	7.1	6.5-9.5
	COD (mg/L)	≤20	4.1	n.a.
	BOD_5 (mg/L)	≤4	1.3	n.a.
	NH_3-N (mg/L)	≤1	n.a.	n.a.
	P (mg/L)	≤0.2	0.014	n.a.
	Cadmium (μg/l)	≤5	<1	0.08-0.25
	Lead (μg/l)	≤50	<5	7.2
	Mercury (μg/l)	≤0.1	Not Detected	0.05

Sources and Notes:

All the web sources are last accessed on March 25, 2014.

a) Observed values in 2011 in a point near the center of Kitakyushu City, from Fukuoka Prefecture Web Site

b) Germany average surface water value

China's "urban waste water treatment percentage" target is 85%, which is considerably less than that of Kitakyushu and Hamburg. Moreover, law and regulations pertaining to wastewater treatments mandates no discharge of untreated wastewater in both countries, which would offer a good reference for the future related legal frameworks in China.

Waste is a serious problem in many developing countries and China is no exception. On the other hand, "waste" has become a booming industry to produce "added-value" products rather than "value-consuming" waste to be rid of. There is only one category with two indicators from MEP's standards – "Urban Garbage Harmless Treatment Rate" (≥90%) and "Industrial Solid Waste Treatment & Utilization Rate" (≥90%). Both of the laws in Germany and Japan mandate that all the urban wastes must be treated before disposal in landfills. Industrial wastes are not compared due to differences in definitions and calculation method.

There are several major approaches for urban garbage or waste treatment, for example, recycling, landfilling, incineration, MBT (mechanical and biological treatment), et cetera. 100% of treatment by landfilling is far from 100% treatment by incineration and MBT in terms of environmental soundness. In many developed countries, landfilling is getting less and less popular given its eco-and-environmental threats (landfill gas emission and leakage to soil and underground water body among others). In this sense, a better approach would be for MEP to come up with specific indicators for waste recycling, treatment mechanisms and so forth. The gross amount of

Chinese waste generation is astonishing, but if properly dealt with, this also embeds huge potential for eco-performance improvements and business opportunities.

3.3 Social aspect

As one of the three pillars for human development, "social aspect" is the most commonly included but yet least commonly standardized and reached consensus upon, for the vast diversity in geographical, cultural, political and institutional features worldwide. Even for the same category, due to the methodology adopted, the results can be quite different sometimes. It should be noted that the 'central heating rate' indicator applies only to the many cities in the northern part of China, thusly not applicable in either Japan or Germany.

*Table 5.*Comparisons of social indicators for 'eco-cities'

Social progress				
NO.	**Indicators**	**Eco-city (China)**	**Kitakyushu (Japan)**	**Hamburg (Germany)**
17	Urbanization rate	≥55%	89.9% a)	73.9% b)
18	Centralized heating supply rate in heating region c)	≥65%	n.a.	n.a.
19	Public satisfaction rate on the environment	≥90%	61.6%d)	88%e)

Sources and Notes:

All the web sources are last accessed on March 25, 2014.

a) Calculated based on Population Census 2010, at e-stat database
b) Germany average, World Bank Online Database, retrieved in 2013
c) This item is unique for only Chinese northern cities, not applicable to neither Japan nor Germany
d) According to a survey conducted by the Green Master Plan for Kitakyushu
e) Converted from a rated score of 8.8 by a scale of 1-10, OECD Better Life Index, retrieved in 2013.

According to the World Population Prospect (2011), China's urban population exceeded 50% in 2011. Over half of the world's population is currently living in urban areas, and more than two thirds of the population in the developed countries lives in urban areas. However, for many developing countries, pursuing urbanization is still a major driving force for social development. The effort of maintaining a stable urbanization pace in China can be detected by this 55% urbanization target, which is much lower compared to Kitakyushu's 89.9 % and 73.9 % average in Germany. This obvious gap in percentage indicates that China has still a long way to catch up with the urbanization levels of the developed world. Just by setting up an "urbanization rate" target, however, does not guarantee its development in a sustainable manner. It is the "means" – the path we adapt for realizing the development goal, rather than the "end" – the goal itself that really contribute to sustainability.

Now, one of the most ambiguous indicators occurs during this study - "Public satisfaction rate for the environment". China's MEP has a high target of more than 90%, which completely outperforms the 61.6 % in Kitakyushu and 88% in Hamburg. The methodology provided by MEP states

this value is determined through conducting "on-site questionnaire survey", but so far we could not find if they have specified the details about the sampling method and questions to include. Undeniably, the result can be as high as 90% or more, based on the questions for such subjective opinions. More investigations are needed to see why the Chinese standard has to be set this high.

Having a high threshold should contribute to overall achievement of making eco-cities truly ecological, but sometimes this unrealistic goal could play no part or even have a negative effect in realizing the original intentions.

4 CONCLUSIONS

Based on the quantitative comparisons between the indicators for eco-cities from China's MPE standard and the two selected case-studies of Kitakyushu in Japan and Hamburg in Germany, we can come up to the following conclusions tentatively:

i. Averaged economic level is still lower than in Japan and Germany. Especially from the "Annual net income for farmers" indicator, we can observe that considerable significance is given to ensure the welfare of farmers in the cities. But to what extent should this level be elevated is yet to be determined.
ii. Efficiency target like Energy Consumption is still lower than in the other two countries, indicating a higher waste of resources when creating the same unit of value.
iii. Green area/space related indicator thresholds are nearly the same as in the other two countries.
iv. Environmental related standards for "water" and "air" are behind those of Japan and Germany, indicating Chinese eco-city environmental standards are slightly worse than those in the developed countries. However, these "slightly worse" standards would make no difference if not met properly in reality.
v. Too little content is given to the "waste" sector, which could have helped more to urban sustainability if proper mechanism is included.
vi. Social aspect related indicators like "urbanization rate" is rather reasonable in terms of China's current development stage, which should have taken a steady not rapid approach.
vii. A subjective indicator like "Public satisfaction rate for the environment" is considerably high, indicating possibly ambiguous methodology for conducting such samplings.

When it comes to answer the research question of "How 'eco' are China's eco-cities", the answer is not a straight "Yes" or "No". Compared to the two leading countries in eco-city development, China's eco-cities seem less "eco", and many aspects could be improved and revised to better suit the sustainable urban development. It is less convincing to reach a definite superior or inferior conclusion for the Chinese model compared to the developed world, however, by setting up loosened standards or thresholds, unrealistically high targets could not efficiently help develop "eco-cities" in essence but in name. What can be definitely opined is that China's eco-cities have a long way to go, much room for improvement in terms of their framework, indicator systems among others. And urban sustainability is a process that makes the cities more ecological and more liveable.

There are some limits concerning the key indicators selected for comparison due to data availabilities and the different measuring systems. Some data values we used are recalculated and need to be further confirmed with the authoritative bodies of the case study cities. The lack of case study for Chinese eco-city leads to a substitute of "ideal" eco-city in theory. We intend to tackle these difficulties in our future studies.

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The Research on China's Urban Spatial Expansion and Its Time-space Stability Since 2000

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Abstract: Municipal district expansion and built-up area expansion are two main forms in urban spatial expansion. In China, the two processes are very drastic and unstable under high-speed urbanization. Geographical time-space stability emphasizes both time and space. With the help of geometry, this paper constructs a coordinate system of the standardized built-up area and municipal district area. Furthermore, the paper draws the spatial expansion path of some main prefecture cities from 2000 to 2010 and classifies the paths by the standardized mean value. Finally, three indexes called mov, tor and sd are given to calculate time-space stability. The study shows (1) Since 2000, municipal district expansion mainly happens in Yangtze River Delta, Pearl River Delta, southeast of Fujian and the provincial capitals of mid-west areas as well as the surrounding cities which are close to these capitals. However, built-up area expansion doesn't show the obvious polarization effect and each urban agglomeration's own high speed. (2) The types of time-space path can be divided into stable type and crossing type. Most of the stable types are Low-Low which means both municipal district and built-up area are under the mean value. And most of the cities which transfer its type only have one time change among four types. (3) Those cities which are high ranked are sensitive to mov and sd, both of which keep consistent characteristics between the cities and the whole nation. But those cities which are middle ranked are sensitive to tor which reflects an obvious change when a city carries out an administrative division adjustment in different years.

1. INTRODUCTION

With the acceleration of urbanization, the urban space has expanded rapidly. Under the background of the strictest land control system, the steadiness and ordering of the urban spatial expansion becomes an important issue to current academic circles and governments. Steadiness can often be seen statistically as time steadiness, meaning that the random character in the random process doesn't vary from time to time (Li and Sun, 2001). As for the geographic space, steadiness reflects not only the process of steadiness on the time series, but also zone bit steadiness on space sections. Thus the time-space steadiness is formed. Since 2000, China's urbanization level has steadily risen,

which increases the demand of urban land utilization. Competition between the urban-use and rural-use of lands becomes more intensified, and urban spatial expansion becomes the most striking features of cities of different grades. The urban spatial expansion mainly has two forms: administrative division spatial expansion and construction land spatial expansion. The administrative division spatial expansion is to add the administrative area by administrative division adjustment, mainly meaning the area expansion of the municipal districts under China's administrative division system; the construction land spatial expansion refers to the process of transformation from the agriculture land to urban land, which is a form of entity in urban expansion. From 2000 to 2010, the population urbanization in China has increased from 36.22% to 49.68%, putting itself in a high-speed developing level, and this period of time is also an active stage for urban spatial expansion. Meanwhile, the researchers are also paying more attention to the current surpassing administrative division urbanization and the wave of new district or new town construction (Zhou, 2006; Dai et al. 2010). Therefore, exploring the steadiness of urban spatial expansion is helpful to deepen the research on the spatial pattern of urban development and the regional effect of the administrative division adjustment, thus to provide references when developing the urban areas healthily and making relative policies.

Currently, there is little research on the time-space steadiness of urban spatial expansion, and the research of steadiness mainly focuses on the research of time steadiness in econometrics with methods including DF test, ADF test, PP test, Hall Instrumental Variable Method, DF-GLS test, KPSS test, LMC test, et al (Yi, 2011; William, 2011). But the traditional econometrical methods take less consideration of the geographic spatial autocorrelation features, and they are not fairly applicable to research the time-space features of urban development (Shen et al. 2011; Wang et al. 2005). While in the field of urban spatial expansion, a lot of good research has been done. On the aspect of administrative division expansion, researchers like Wang and Chen (2011) concluded the experience of administrative division adjustment in foreign countries; Qu (2012) concluded the modes of administrative division adjustment in China's urbanization process. On the aspect of land expansion, researchers like Liu et al (2008) summarized the spatial patterns of changes in urban land use into historic morphology pattern, location economics pattern, decision behaviour pattern as well as political economy pattern; Batty made use of the fractal and shoe-shaped automata model to carry out an empirical study on the urban land expansion (Batty et al. 1997; Batty, 1998); Zhang et al (2011) used the rank-size rule to explore the driving mechanism of the urban land expansion. Thus, it can be seen that more attention is paid to research on urban land expansion in the time-space perspective than on the time-space steadiness.

Therefore, this paper brings in the geometric method to the research of urban time-space steadiness, and it is not a new way to reflect the time-space features of space with the help of geometrics in the area of geography, such as the geographic orthocentre loci method. Researchers like Fan et al (2010) just used the two coefficients of spatial overlay and variation consistency as the measurement of geography orthocentre loci to measure its time-space feature. The application of the geographic polygon method is another example. Researchers like Qi and Wang (2010) used the polygon method to show the time-space features of city competiveness during the study of zone-city mode construction in Jiangsu Province. In addition, GIS and its administrative division also attach importance to geometrics. When Rey (2004) structured the LISA time-space evolution path through spatial autocorrelation features, they put forward some measurements targeting at time-space paths and time-

space steadiness to characterize the time-space dynamic process of the regional economic development (Rey and Janikas, 2006; Anselin and Rey, 1991). The paper tries to adopt a similar method, through the standardization to structure a coordinate system to reflect the urban spatial expansion, and then to analyse the time-space path and its steadiness features of urban spatial expansion in China in the most recent 10 years, in order to offer a reference to the research and practice on the urban spatial regulation and administrative division adjustment.

2. DATA SOURCES AND RESEARCH METHODS

2.1 Overview of the research areas and data sources

The research areas are 263 prefecture cities under the administrative organization system in 2000 and 2010. The space data adopts the 1:1000000 national boundaries (Albers Equivalent Intersection Conical Projection) provided by the National Geomantic Centre of China from the year of 2000 to 2010, and the main data comes from the China City Statistic Yearbook from 2001 to 2011. Because of the inter-annual difference of the statistical calibre, part of the data is revised according to the China City Statistic Yearbook and the Administrative Division Book of the People's Republic of China.

2.2 Structure of the time-space path

In order to show the time-space features of urban spatial expansion, this paper uses urban built area to measure the urban land expansion, and uses municipal district area to measure the administrative division expansion, both of which together form the measurement of the urban spatial expansion. Generally the built area and municipal district area of a city both keep in a relative position compared with the national level, and the yearly variation of this relative position is an important direction index to reflect the time-space steadiness of urban spatial expansion. According to this, the paper firstly standardizes the built area and municipal district area of every city in every year, and adopts maximum and minimum values to process the non-quantization. The processing result can not only guarantee the comparability between each year, but also reflects the variation of a city's spatial expansion compared with other cities in the country. The specific standardized method is as follows:

$$Y_i = \frac{X_i - \min(X_i)}{\max(X_i) - \min(X_i)} \quad (1)$$

In Equation (1), Y_i is the value coming from the standardization of the city i index factor; $\min(X_i)$, $\max(X_i)$ relatively correspond to the minimum value and maximum value of the city i index factor. We construct a standardized coordinate system with built-up area standardized coefficient as the Y-axis, and municipal district area standardized coefficient as X axis. To each city, there is a corresponding point in each year in the coordinate system. By linking these points into a polygonal line, it forms the time-space path of spatial expansion in the urban built area. If all the cities' time-space paths are put into this standardized coordinate system, a collection of time-space paths of urban spatial expansion is formed. The spatial expansion of a city itself and other cities will all affect its position in this standardized coordinate system. The

more the time-space path varies, the less the steadiness is; otherwise, it is more stable.

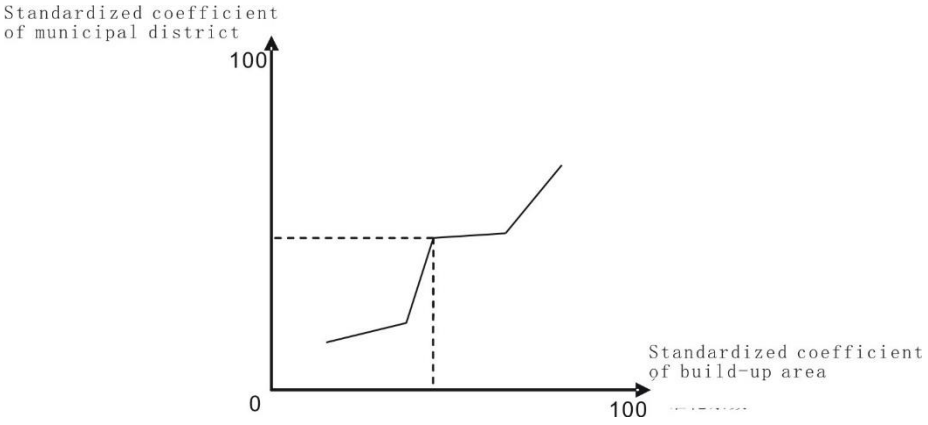


Figure 1. Time-space path diagram for urban spatial expansion

2.3 Measurement of the time-space steadiness

In order to further quantize the features of time-space steadiness of urban spatial expansion, this paper brings in 3 indexes from the geometric aspect to demonstrate the time-space path features of the urban spatial expansion, which are Index mov, Index tor, Index sd:

$$mov_i = \frac{N * \sum_{t=1}^{n} d(L_{i,t}, L_{i,t+1})}{\sum_{i=1}^{N} \sum_{t=1}^{n} d(L_{i,t}, L_{i,t+1})} \quad (2)$$

In Equation (2), $L_{i,t}$ refers to the point location of city i at time-point t in the time-space path diagram; $d(L_{i,t}, L_{i,t+1})$ is the segment length between the two points; N represents the total city number, which is 263; *n* represents intervals of the time points, namely, 10; $mov_i > 1$ shows that the moving length of the city at this period of time exceeds the national average value, and when it is less than 1, the length is under the average value. mov_i reflects the time-space steadiness of city i comparing with the total number of cities.

$$tor_i = \frac{\sum_{t=1}^{n} d(L_{i,t}, L_{i,t+1})}{d(L_{i,1}, L_{i,n+1})} \quad (3)$$

In Equation (3), the meanings of indexes are the same as those in Equation (2), while tor_i represents a city's curvature degree of its time-space path. The bigger the value is, the greater the curvature degree is. tor_i reflects the time-space steadiness of city i itself on a time series.

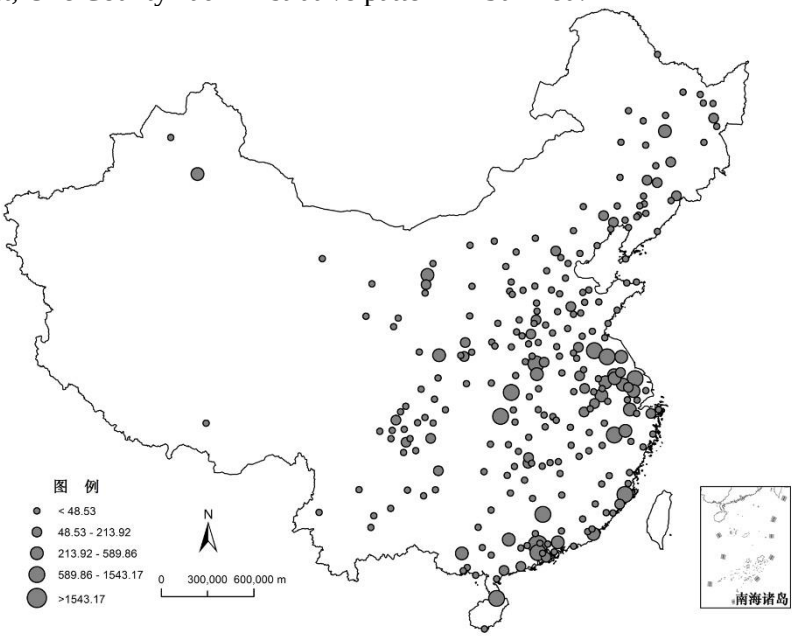
$$sd_i = \frac{N * \delta_i}{\sum_{i=1}^{N} \delta_i} \quad (4)$$

In Equation (4), δ_i refers to the standard deviation of each neighbour time points' length $d(L_{i,t}, L_{i,t+1})$ of each city, sd_i represents the fluctuation degree of the city compared with all cities, sd_i reflects the steadiness of city i's time-space moving speed.

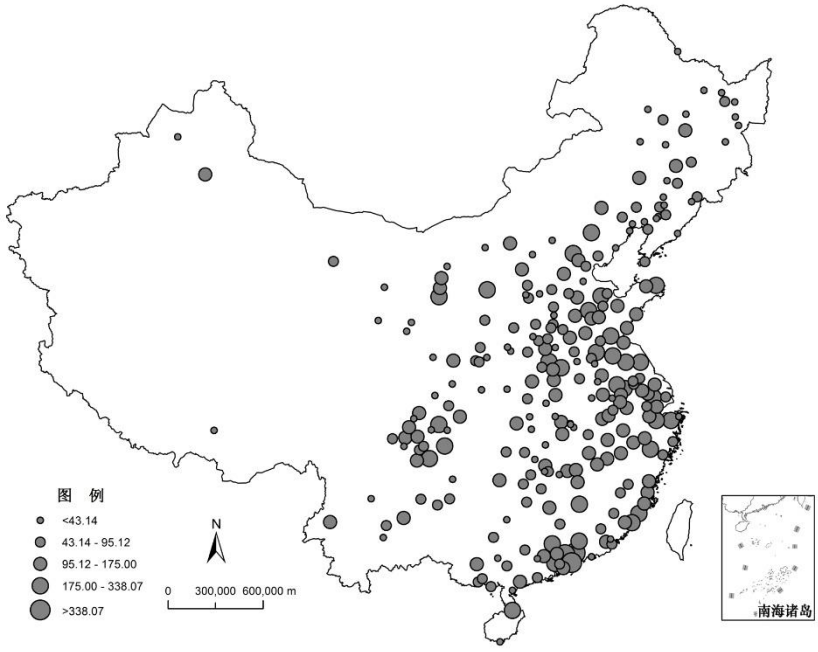
3. RESULTS AND ANALYSES

3.1 The basic pattern of urban spatial expansion

Applying breakpoint method, the increasing rate distribution characteristics of the urban municipal district areas of above of prefecture-level cities is analysed from 2000 to 2010, which can reflect the basic urbanization pattern of the urban administrative divisions in China. From 2000 to 2010, the average value of the 263 cities' municipal district area increased from 1664.94 km^2 to 2099.40 km^2, and the maximum value of the cities' municipal district area appears in Yichun City, not Chongqing. As is showed in the Figure 2 (a), the main active regions of administrative division urbanization appears in the Yangtze River Delta, the Pearl River Delta, South-eastern of Fujian province and central regions such as Henan, Hubei, Anhui etc. Meanwhile Beijing and Tianjin provinces, the North-East coastal area and the alongside area of "Harbin-Dalian" railway, part of western China, also appear to have the active characteristics. It can be concluded that in the most recent 10 years, China's administrative division urbanization was demonstrated with a pattern of thickness in the east and sparseness in the west. In those eastern cities with higher regional economy levels, the "point-axle" system of the cities has been networked. Many cities' existing municipal district areas suffer a bottleneck period. On the one hand, the dependence of city development on land and water resources is growing. On the other hand, cities in the east area are relatively densely located, whose industrial chains and traffic lines promote the integration between regions, so the demand of the urban-rural areas integration and city-town systems integration is relatively strong. However, in the west region, "point-plane" pattern is still the main pattern of regional development. But on the important point, there is also similar demand for municipal district expansion. In addition, there are also municipal districts of some special cities with their increasing rates in negative values, such as Suizhou City in Hubei province. In 2009, part of the administrative division area of the original Zengdu District in Suizhou City was lined out to set up Sui County, achieving the optimum of the "One District, One County" administrative pattern in Suizhou.



(a). Urbanization in China by the adjustment of administrative divisions



(b). Urbanization in China by the expansion of built-up areas

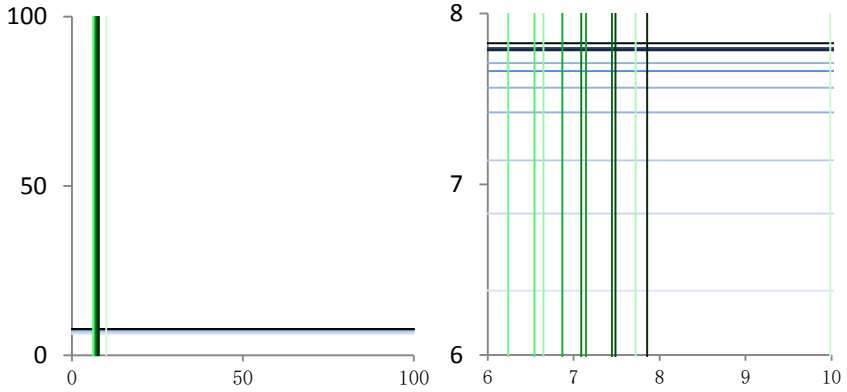
Figure 2. The basic pattern of urban spatial expansion

Also, the increasing rate distribution characteristics of the urban built areas of cities at the prefecture level and above is analysed from 2000 to 2010, which can reflect the basic pattern of the urban built land urbanization in China. The difference is that the whole increasing range of the spatial expansion for the built area of the 263 cities is not as large as the spatial expansion range of the municipal district. As is shown in Figure 2 (b), the polarization degree of the spatial expansion in the construction land is not as prominent as that in the municipal district. The eastern coastal areas generally showed higher increasing rate, especially the cities in Shandong Peninsula. In the west and central areas, the active regions of built area expansion are not only located in those provincial capital cities. The Chengdu-Chongqing Metropolitan Area, the Central Henan Urban Agglomeration, the Wuhan Urban Agglomeration, the Changsha-Zhuzhou-Xiangtan City Group, the Poyang Lake-Surrounding urban Agglomeration and Northeast "Harbin-Dalian" Axle also have high growing rates. To those traditional "monopole" increasing areas, there is still active construction and land expansion around them, such as in Yinchuan and its surrounding cities, Yunnan and its surrounding cities. However, it is not difficult to find that there is difference between the east and the west in the spatial expansion of built areas.

From 2000 to 2010, urban construction in China had experienced rapid development. On the one hand, the improvement of population-urbanization level and the development of urban economy increased the demand of urban land. The administrative division adjustment in some regions provided urban construction with enough reserved land, by including the construction land in non-municipal districts before moving into the urban construction system. However, there are also some cities without a very prominent expansion of built areas. These cities are mainly located in the central and western areas as well as Northeast China, with features of strong dependence on regional development and increasing polar and a low equilibrium level of regional economic development. Especially in the western areas, some cities suffer the bottleneck of the bearing capacity of environmental resources; so many cities are still lacking driving forces to develop themselves.

3.2 The space-time path and form of urban spatial expansion

The paper has calculated the average values of the municipal district area and the built area in 263 cities every year from 2000 to 2010, respectively, and also calculated the standardized value of the relevant average value according to the Equation (1). It depicts the standardized average values of each year in the space-time path coordinate system, as is shown in the *Figure 3*. The y-axis refers to the standardized value of municipal district area, and the x-axis refers to the standardized value of built area, so the mean value line perpendicular to the y-axis represents the standardized values of municipal district area every year, and the mean line perpendicular to the x-axis represents the standardized values of construction land value every year. The lines with deeper colour are closer to the year of 2010, while the lighter, closer to the year of 2000. *Figure 3(a)* shows that the average values of municipal district area and built area are both low, with standardized values almost always under the value of 10. In addition, from the perspective of time series, both of the average standardized values show a growing trend from 2000 to 2010. In fact, the absolute values of these two average values are also increasing year by year. If magnifying the interval between 6 and 7 on the y-axis and 6 and 10 on the x-axis, as is shown in *Figure 3(b)*, the variation characteristics of these two mean values' standardized line can be explored. It can be found that the average standardized values in some years are lower than the year before them. For example, the average value of built area in 2000 is 9.98, and in 2001 it is 7.72, and in 2002 it decreases to 6.65 and then it begins to rise back gradually. Although the absolute value of the mean value is rising, the standardized average value in every year still relates to the maximum and minimum values. If the difference between the maximum and minimum values of the built area or the municipal district area is low in a certain year, the average standardized value of that year will be high. In other words, space-time unsteadiness of the average standardized value exists.

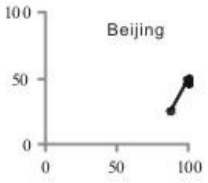
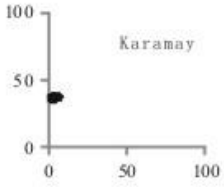
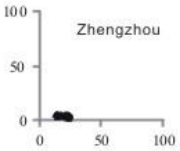
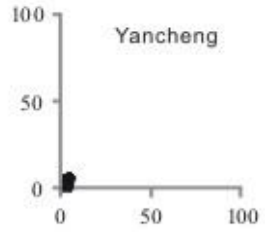


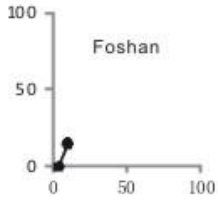
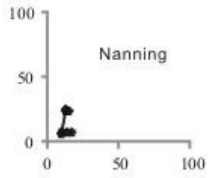
(a). *(b).*

Figure 3. The changes of average standardized line for urban land

Setting the average standardized values of the municipal district area and the built area as boundaries, the standardized coordinate system can be divided into four sectors: ① High-High quadrant (HH), both of them are higher than the average value. ② High-Low quadrant (HL), the standardized value of the municipal district area is higher than the average value, while the standardized value of the built area is lower than the average value. ③ Low-High quadrant (LH), which is contrary to the HH quadrant. ④ Low-Low quadrant (LL), both of them are lower than the average value. Because the average value lines of each year are different, the quadrants of each year are also unsteady.

Table 1. The types of space-time path of urban spatial expansion

The types of time-space path	City name		The typical city of time-space path
Stable type	Stable type of HH	Beijing, Shanghai, Wuhan, Guangzhou, Chongqing, Tianjin, Shenyang, Jinan, Xi'an, Dalian, Changchun, Kunming, Urumqi, Guiyang, Zibo, Yantai, Jilin, Baotou, Qiqihar, Daqing, Yichun, Dongguan (22)	
	Stable type of HL	Tianshui, Hegang, Nanchong, Chifeng, Huludao, Changde, Laiwu, Luzhou, Xinyang, Tongliao, Jingmen, Lu'an, Chenzhou, Fuzhou, Yongzhou, Longyan, Baiyin, Guangyuan, Suihua, Yichun, Karamay, Nanping, Pakistan, Guigang, Yan'an, Ankang, Qinzhou, Bozhou, Huangshan, Shuozhou, Yulin, Xuancheng, Jiayuguan, Fangchenggang, Jinchang, Zhangjiajie, Chizhou, Baoshan (38)	
	Stable type of LH	Qingdao, Shijiazhuang, Taiyuan, Wuxi, Zhengzhou, Lanzhou, Changsha, Nanchang, Tangshan, Hefei, Fuzhou, Suzhou, Anshan, Fushun, Xiamen, Weifang, Luoyang, Liuzhou, Wenzhou (19)	
	Stable type of LL	Maoming , Liaocheng , Shangqiu , Yangzhou, Pingdingshan , Huaibei , Yancheng, Jinzhou , Xinxiang , Fuxin, Jieyang , Heze , Mudanjiang , Yangjiang, Bengbu , Jiaozuo , Jingzhou , Huangshi, Mianyang , Zigong , Guilin, Xianyang , Taizhou , Dandong, Zhenjiang , Xiangtan , Xingtai , Lianyungang, Jining , Qingyuan, Siping , Changzhi , Panjin, Yangquan , Ma anshan, Zhaoqing , Binzhou , Shanwei, Cangzhou , Shiyan , Jiujiang, Langfang , Shaoxing , Anqing , Luohe , Pingxiang , Mountains, Zunyi , Huzhou , Dezhou, Ezhou, Puyang , Xuchang , Shaoyang , Tonghua , Tongling , Weinan, Liaoyuan , Jiaxing , Chengde, Ganzhou , Huanggang, Hebi ,	

Leapfrog type	One time leapfrog	Jingdezhen, Linfen , Tieling , Yibin , Zhangzhou, Chaozhou , Neijiang, Chaoyang , Xiaogan, Matsubara , Deyang , Meizhou , Hengshui , Jinzhong , Meishan, Heyuan , Yunfu, Wuzhou , Beihai, Zhoushan , Loudi , Zhumadian, Jincheng , Hanzhong , Xianning , Qujing, Dazhou , Zhoukou , Chuzhou , Huaihua, Guang'an , Ji'an , Yuncheng , Sanmenxia , Yulin , Sanming , Shangrao , Ziyang, Wuzhong , Lhasa, Ya'an , Yingtan, Yuxi , Heihe , Ningde, Lishui (109) Shantou, Nanjing, Chengdu, Foshan, Harbin, Hangzhou, Shenzhen, Xuzhou, Zhanjiang, Jiangmen, Ningbo, Handan, Suqian, Huainan, Zhuhai, Haikou, Shaoguan, Hohhot, Benxi, Zaozhuang, Qinhuangdao, Zhongshan, Jixi, Zhangjiakou, Xining, Yichang, Anyang, Yingkou, Tai'an, Quanzhou, Jiamusi, Liaoyang, Rizhao, Zhuzhou, Kaifeng, Yueyang, Baoji, Anyang, Panzhihua, Fuyang, Weihai, Hakusan, Shuangyashan, Wuhai, Putian, Suzhou, Tongchuan, Suining, Shizuishan, Yiyang , Suizhou, Xinyu, Taizhou, Sanya, Quzhou, Chaohu, Anshun, Xinzhou (58)	
	Multiple leapfrog	Linyi, Nanning, Changzhou, Datong, Huai'an, Wuhu, Xiangyang, Nantong, Hengyang, Dongying, Leshan, Jinhua, Baicheng, Huizhou, Baoding, Yinchuan, Qitaihe (17)	

Putting the space-time tracks of the urban spatial expansion from 2000 to 2010 into the standardized coordinate system of the space-time path, and overlaying them onto the average standardized lines of each year, we can make a classification of the space-time tracks of urban spatial expansion: ① steady space-time path: its track stabilizes in the same type quadrant, and the standardized line doesn't span over the boundaries. ② spanning space-time path: the track appears in at least two of the four quadrants during the 10 years, and the standardized line spans over the boundaries. The specific classification result is illustrated in *Table 1* with two broad headings and six subclass types.

The first type is steady HH. The cities of this type always have their built area and municipal district area stabilizing above the average value, most of

which are cities with high primacy ratio in China, such as Shanghai, Beijing and Guangzhou, which are the central cities of the Yangtze River Delta area, Beijing-Tianjin-Hebei region and the Pearl River Delta area, respectively. Wuhan, Chongqing, Tianjin, Shenyang, Jinan, Xi'an, Changchun, Kunming, Urumqi and Guiyang are also important provincial capital cities, which mainly are the provincial capitals in the western area. Those cities' developing patterns are always "monopole core" in their corresponding provincial area. The organization systems and development of these cities have already gained a certain scale. Other cities are not the regional central cities, but also have high urban development levels. For example, Baotou, Tsitsihar, Daqing are historical large-size industrial and mining cities, and Dongguan, as one of the few prefecture-level cities without county-level cities in China, has witnessed a rapid expansion of the urban space driven by the policy of Three-processing and One-compensation since the reform and openness.

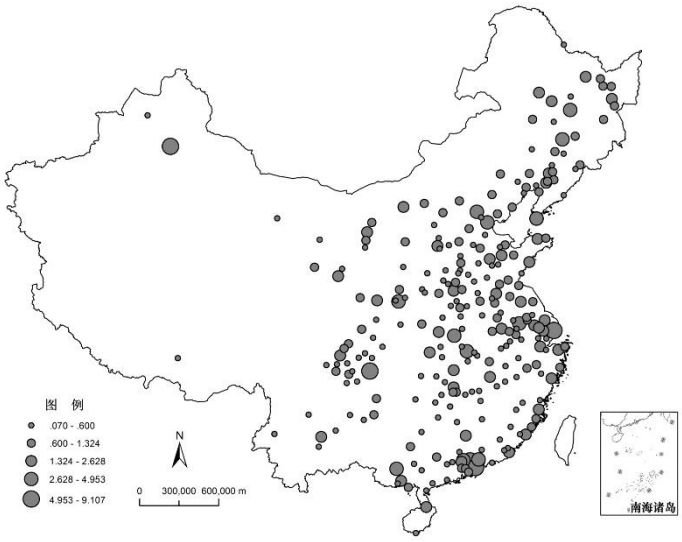
The second type is steady HL. The cities of this type have a large administrative area in the organization system, but most of them belong to second-tier cities in China's regional development pattern, specially located in the western and central areas of China. On the one hand, these cities keep the same pace with the whole county on the administration organization system, and municipal districts are also separated from the original "region" administration organization system. On the other hand, influenced by the nation's "gradient transfer mode" regional development pattern, these secondary cities in the western and central areas have a relatively weak competiveness and limited urban expansion.

The third type is steady LH. The region of this style has a lower municipal district area, but these cities have already achieved certain urban developmental level, with high rankings in China's city list. Many of them are provincial capital cities in western and central areas such as Zhengzhou, Shijiazhuang, Taiyuan, Changsha, Nanchang, Hefei, Lanzhou, and some secondary central cities in the east such as Qingdao, Wuxi, Tangshan, Suzhou, Xiamen and Wenzhou. The fourth type is the steady LL, cities of this type are scattered over the whole country. They are mainly middle-sized and small cities with weak city competiveness and secondary position in every urban agglomeration system. The fifth type is the once spanning type, namely only having one transformation of types. Many cities transform to HH or LH. The transformation process is realized by the expansion of the administrative division. Provincial capitals like Nanjing, Chengdu, Hangzhou, and Harbin all transformed from LH to LL. There are also many cities transforming to LL because of the expansion of the built areas or municipal district areas, such as Rizhao, Kaifeng, Fuyang, Yiyang, Chaohu, Xinzhou. Taking the typical city Foshan as an example, in 2002, Foshan modified its escrowed county-level cities Nanhai, Shunde, Shanshui and Gaoming into its municipal district. Therefore, its municipal district area gained more than 40 fold increase, and its construction land also leaped from 38 km^2 in 2001 to 115 km^2 in 2002, which was mainly due to the large built areas owned by the four county-level cities. Due to this administrative adjustment, Foshan transformed from LL to HH. The sixth type is the multi-spanning type, with at least two types of transformations. From the aspect of the average values of the whole country, these cities show a great unsteadiness on the space-time level. Taking the typical city Nanning as an example, in 2000 and 2001, as the municipal district area and construction area of the whole country were in a low level, Nanning as the capital city in Guangxi Province stayed in the HH type. However, with the adjustment of municipal district and expansion of construction land in other cities (especially eastern cities), the integral level of the country's urban space had ascended, and Nanning gradually became the city of LH type with

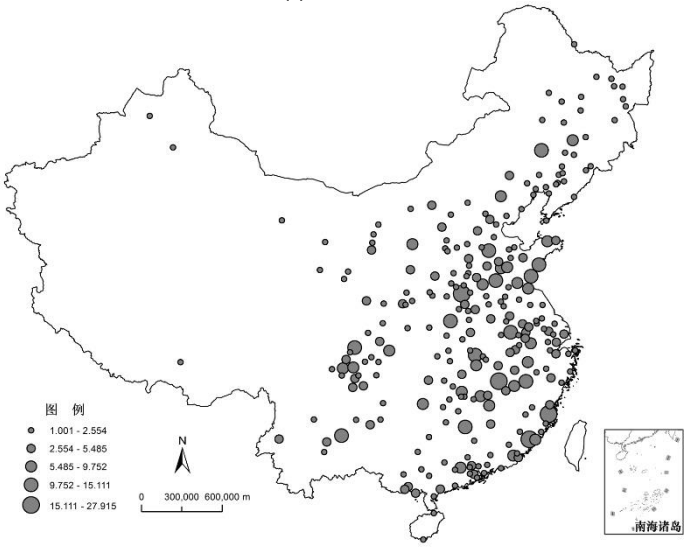
a lower municipal district area. In 2004, Nanning adjusted its administrative division by including its Yongning County into the municipal district. After that, the city's municipal district area gained more than 4000 km^2, which made it back to the HH type.

On the whole, among cities of steady types, there are less HH and LH cities and more HL cities, and the numbers of cities of LL types is the most, which almost always accords with the "ranking-size" of the urban systematic structure. Among cities of spanning types, there are mainly cities of one spanning type and fewer cities transforming their types. In the perspective of the types, the cities of spanning types and their space-time paths of spatial expansion can be considered unsteady.

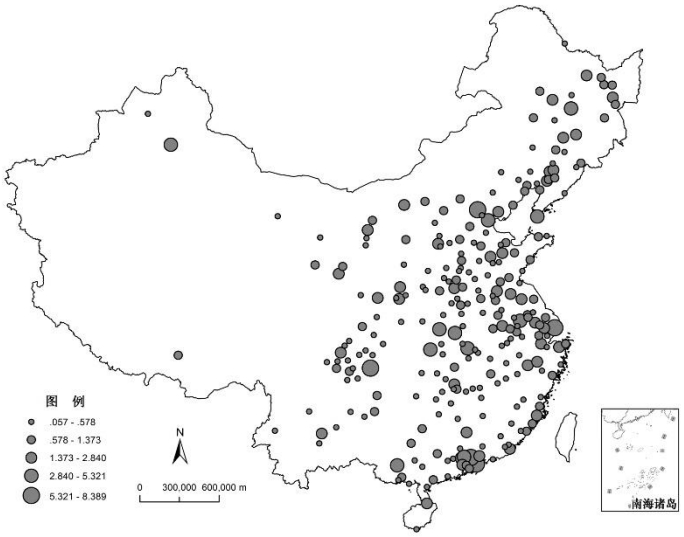
3.3 Space-time steadiness of urban spatial expansion



(a) mov index



(b) tor index



(c) sd index

Figure 4. The spatial distribution of urban space-time stability index

The paper further explores the space-time steadiness of urban spatial expansion which, as it is shown in *Figure 4*, calculates the mov index, tor index and sd index by the Equation (2), (3), and (4), according to the space-time path of every city's spatial expansion, and then classifies them with the natural breakpoint method. The top 10 cities of the mov index are Shanghai, Chongqi, Urumqi, Dongguan, Shenzhen, Nanjing, Wuhan, Tianjing, Haerbin, and Dalian. Almost all the mov indexes of provincial capitals or metropolises are among the top 30. In addition, cities with high economic development levels such as Dongguan, Shenzhen, Dalian, Foshan and Ningbo are also among the top. The only exception is Suizhou, which is because of the lining out of Sui County. The mov index reflects the total length of space-time path relating to the average value of the whole country. The provincial capitals and other developed cities have large basic values of municipal district and built area themselves, and are also the most active regions on urban construction, with prominent changes and variation ranges in value between years and after being standardized. Furthermore, these active regions also see the expansion of administrative division, making the space-time path between years gain an outstanding lenghtening, so their mov indexes are higher and mainly focus on the "coastal-reverside" T-axis and knots of the provincial capital cities. The unsteadiness of these cities can be explained as their active behavior on urban development. But other middle-sized and small cities are on the contrary, so they get lower mov indexes.

The top ten cities of the tor index are Zhengzhou, Nanchang, Fuzhou, Zhangzhou, Hefei, Nanyang, Qingdao, Qujing, Mianyang, Jining, among which are both some provincial capitals and middle-size and small cities. The tor index is used to reflect flexing degree of each city's inter-annual variation. On the one hand, the development of the city itself will increase the flexing degree. On the other, the variation of the upstream cities in high development level and downstream cities in low development level areas will also make standardized values of these cities' municipal district and built area flex, and these cities are more sensitive to this kind of external flexing. From the spatial distribution, cities with higher tor indexes are mostly located in the central areas, for example Chengdu Plain, coastal southeast Fujian and Shandong peninsula, which are also the intensive areas for cities in the middlestream of developmental level. Of course, not all cities in these areas have higher tor indexes. From the distribution features of lower tor index, cities with lower

tor indexes are distributed all over the country, which shows that the spatial expansion fluctuations of most cities are still steady.

The top ten cities of the sd index are Chongqing, Shanghai, Shenzhen, Beijing, Dongguan, Suizhou, Urumqi, Wuhan, Nanjing, Nanning, which are almost all similar with the order and spatial distribution characteristics of the mov index. This is because both the two indexes reflect relative situations relating to the average values path of the whole country, while the sd index attaches more importance to the variation degree of every path segment between every year and reflects the fluctuating degree on the time sequences. Therefore cities with high path variation range have stronger fluctuations.

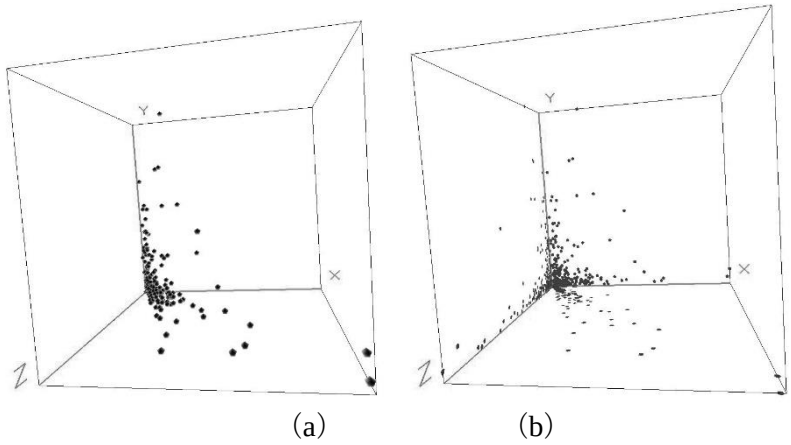


Figure 5. Three-dimensional coordinate system of space-time stability index

On this basis, the paper puts the three indexes into the same three-dimensional coordinate system, as it is shown in *Figure 5*. Coordinates x, y and z represent the mov index, tor index and sd index respectively, and the diagram on the left is a 3D scatter diagram, and on the right is a 3D projection chart. It is not difficult to find that the 3D scatter diagram is almost all on one section of the 3D coordinate system. This is because the mov index and sd index are similar to each other. Seen from the x-z coordinate system's projection, the two indexes are in a positive corelation relationship. But the distribution of the two indexes are not totally the same. For example, Beijing, Nanning have higher sd indexes, while Guangzhou, Nanjing have higher mov indexes. On the y-axis cities with a high tor index always have low sd and mov index, with the subpoints of x-y coordinate, y-z coordinate almost all in the inclined half area, which shows an inverse correlation. Above all, the "ranking-size" structure of cities in China's urban system has influenced their spatial expansion scale. Those developed eastern and central cities in the "polar nucleus" positions of the western areas have relatively high degreed of economic agglomeration and urban competiveness, so the spatial expansions in both municipal district and built district are fairly active. And with their own large basic values, their variation shows a more prominent unsteadiness on the mov and sd index. The cities, with their own specific situations, also have differences in their mov and sd values; while those cities in the middle of the "ranking-size" level system also have an active urban spatial expansion as well as a high sensitiveness to the variation in the national city rankings due to their high tor index; cities in the downstream of the "ranking-side" level system are located all over the country, most of which are in western and central areas. Because they have small basic values, the variation ranges are relatively low, and their expansions of municipal district and built area are also limited.

4. CONCLUSION AND DISCUSSION

Based on the two important variables which are municipal district expansion and built area expansion, this paper establishes correlation models reflecting the urban spatial expansion and its steadiness, and draws conclusions as follows:

(1) From 2000 to 2010 China stepped into an active stage with rapid urban development. During this period of time many cities expanded their municipal district areas and got enough reserve land resource through the administrative division adjustment. These cities are mainly located in the areas of Yangtze River Delta, Pearl River Delta, Beijing-Tianjin Region, southeast Fujian or surrounding the provincial capitals of the western and central areas. With rapid economic development, urban constructionis also developing quickly. As for the pattern of the built area expansion, its agglomeration characteristics are not as polarized as that of the municipal district, but it has a rapid development scale in each large urban agglomeration. The pattern almost always accords with China's fundamental realities in the times of rapid urbanization development.

(2) The method of structuring coordinate system with the standardized built area and municipal area to draw the space-time path diagram of spatial expansion in each city can satisfy not only the comparability of a certain city relating to other cities in the country, but also the comparability between each year. The result shows that basically both average lines rise year by year, while few years get a short period of decrease influenced by the national maximum and minimum values. With the average lines as boundaries, the urban spatial expansion tracks can be divided into four quadrants. The result shows that there are more cities stablizing in the four quadrants, with most cities in the LL quadrant, and cities that show unsteadiness and span over quadrants are mainly within the once stepping type. Every city has its own characteristics of the spatial expansion. The conflict between the municipal district areas and built land areas has become an acute probelm during the rapid urbanization period. Cities should be fully aware of the demand of the urban development. They should firstly consider the rankings and positions of the city in its urban system or urban agglomeration, should meet the demand of the built up area saturation through administrative division adjustment, and at the same time should avoid the overexpansion of the municipal district and thus enter into the HL development pattern, in order to guarantee the order and healthy spanning over the types.

(3) According to the geometric property of the fold line, the paper uses mov, tor and sd indexes to explore the space-time steadiness characteristics of the urban spatial expansion. The result shows that the space-time steadiness characteristics in different "ranking-size" levels have a large discrepancy, as the cities in the east coastal areas and center of western and central areas are more sensitive to the mov index and sd index of the national level, for which there are obvious changes both in the absolute lengths and the variation degree of interannual segmentation. Meanwhile, those cities which are middle ranked are sensitive to tor which reflects an obvious change when a city carries out an administrative division adjustment in different years. Apparently, the regional developmental pattern in China has deeply influenced the spatial expansion in urban areas. In the eastern areas the point-axle net system has been increasingly improved, while in the western areas there are still many regions with a point-section pattern, and the functional position of each city to its surrounding areas is greatly different. The space-time path of spatial expansion in urban areas themselves becomes dependent on the regional economic background.

This paper studies the space-time path of spatial expansion in urban area and its steadiness with the help of geometry, which is a new attempt and exploration, in order to offer a reference to the administrative division adjustment and urban construction. However, the process of spatial expansion in urban areas is a complex systematic process, so there are still many driving factors behind the municipal district expansion and built up area expansion. Therefore, exploring the mechanism of the urban spatial expansion and its space-time steadiness considering multi-elements including society, economy, eco-system, agriculture, et cetera, is the key issue for the future research.

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The Transitional Spatial Pattern of Housing Prices in Beijing: Factors and Implications

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Abstract: The shift from the free-allocation housing welfare system to a market system was one of the most important parts of the economic system reform implemented in China from 1998 onwards. In recent years, however, soaring housing prices have become a serious public concern. In this study, we explored the spatial characteristics of housing prices, using spatial data on the average transaction price of Beijing's housing blocks from 2005 and 2012, in order to reveal the factors influencing changes in housing price and address the way in which such changes in turn can affect land use, transportation, the living environment, and quality of life.

The analysis revealed that the spatial autocorrelation effects associated with housing prices (and their increase) became significantly stronger between 2005 and 2012, especially in the central part of Beijing. Autocorrelation was, however, identified for both years. This finding explains the emergence of sub-area markets in recent years. It also provides evidence which suggests that developers or real estate agencies may have boosted housing prices purposely, which can lead to a biased market environment. Targeted policies are required in order to address, and avoid, this problem in the future.

The spatial patterns of housing prices in different parts of Beijing were examined in detail. The differentiation of housing prices showed that Beijing has, in the past decade, gradually become a polynuclear city. By comparing the data for the two years using a multivariate linear regression model, the factors influencing housing price growth were analyzed. Besides location and the environment, it was found that housing policies related to property rights, the construction of the transportation network, and population change all played a key role in explaining changes in the spatial pattern of housing prices in Beijing in recent years.

1. INTRODUCTION

The top priority for every family, housing constitutes an issue that is also relevant to the welfare, social stability, and economic development of a nation. From 1998 onwards, China has undergone intense urban housing system

reform and accelerated real estate development, following the abolition of the free allocation of apartments to employees through their work units and the subsequent replacement of that system with the allocation of housing subsidies. In fact, by 2003, most families in China had either purchased or were renting commercial housing stock; a "housing market" had thus been fully implemented. At the same time, excessive increases in the price of housing have made access to housing increasingly difficult. Gradually, housing has thus become a serious social issue. Whilst from 2005 onwards, the Chinese government has worked to strengthen macro-control over the real estate market and increase housing security, housing prices have not been controlled successfully and are still increasingly rapidly, especially in China's capital, Beijing (Gao and Asami, 2011; Li and Yuan, 2012).

The existing literature in this field primarily focuses on the relationship between housing price fluctuations and macroeconomics (Bramley, 1993; Kim, 2003), the link between real estate and the harmonious development of national economy (Zhang and Sun, 2006; Liang et al. 2006), and housing price fluctuations and their causes (Bolton et al. 2006). Research addressing the spatial patterns seen in housing prices can be divided into two types. The first concentrates on establishing spatial econometric models, for instance through the use of hedonic models to assess the value of housing (Xu, 1997; Wang and Huang, 2007), or through the use of space-extended models and geographically weighted regression (GWR) approaches in order to reflect spatial heterogeneity (Dong and Zhang, 2011). The other group of studies within existing research on the spatial patterns of housing prices relies on techniques of spatial analysis. Scholars have used spatial analysis techniques in relation to housing prices for a number of decades now, and have accumulated a wealth of research results. The Kriging method was used in research into accessibility effects from as early as 1992 (Dubin, 1992). Spatial analysis techniques have also been used in relation to real estate markets (Pace et al. 1998) and to reveal the spatial characteristics of housing prices in different regions (Gillen and Thibodeau, 2001; Chhetri et al. 2009). Spatial interpolation analysis has also been used – for instance, in a study of housing prices in the city of Albaccte in Spain (Gamez et al. 2000).

Scholars have studied the spatial differentiation of urban housing prices in China since the middle of the 1990s. For instance, Xu et al. (1997) analyzed the spatial distribution of commercial housing prices in Shanghai through contour analysis, using a regression model in order to discuss the factors influencing that distribution. Semivariance analysis has also been used in this field – for example, through the isotropic and anisotropic variability analysis of house prices in Beijing (Wang and Zhu, 2004). Other key studies within the field include Meng et al.'s application of spatial analysis to the research of real estate (2005), Mei and Li's (2008) analysis of housing prices in Guangdong based on ESDA and kriging techniques, and the analysis undertaken by Liu and Zhang (2011) of the distribution pattern of newly constructed residential space in Changchun, using geographic information systems (GIS) techniques. While spatial analysis can generate in-depth visualizations and summarize complex spatial patterns, studies that use it tend to ignore temporal effects – a problem which in part results from data availability issues. Consequently, the temporal dynamics of changes in spatial patterns over time remain underexplored. Existing research has also largely ignored the impacts of the spatial pattern of the housing market on housing prices.

China's real estate market has, since 2005, been characterized by a series of bubbles, with housing prices soaring in particular in 2007 and 2009. This study focuses on the time period 2005-2012, exploring the space-time

evolution of housing prices in Beijing and the factors influencing that evolution. The paper first addresses the transitional spatial pattern of housing prices in Beijing in 2005 and in 2012, exploring the spatial autocorrelation of housing prices. Secondly, it details the use of a hedonic model in order to analyze influencing factors (in particular, space structure factors). Thirdly, we then put forward a series of relevant suggestions in relation to urban planning and construction based on the preceding analysis. The objectives of the study were two-fold: (1) to research real estate development in Beijing from an objective point of view; and (2) and to provide a useful reference for future urban planning and real estate management.

2. RESEARCH METHDOLOGY

2.1 Study area and data selection

Beijing, the capital city of China, evidences some of the highest housing prices in the country. This study addresses the area of Beijing that lies within the boundary of the Sixth Ring Road, which demarcates the core area of Beijing (Figure 1). The major part of the study area lies within the six central districts in Beijing, and it also includes a number of other large residential areas, such as Fengtai district, Tongzhou district, etc.

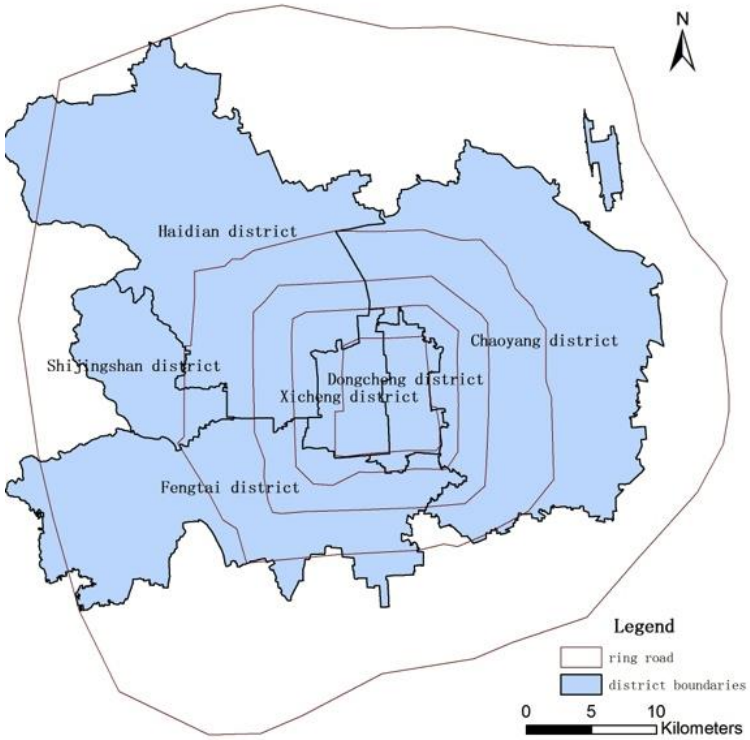


Figure 1. Location of the study area

Since the second-hand housing market in Beijing is very active, we took second-hand houses as a basis for our sample, and took the "housing block" as the study unit. We selected two cross-sections of data – 2005 and 2012 – and collected data for all the housing blocks in Beijing from the largest two real estate information websites – Anjuke (www.anjuke.com) and Soufang (www.soufang.com) – including average list price, location, property type, plot ratio, and so on. Using LocoySpider software, the records of housing

blocks listed on website pages were automatically collected and the accuracy of information was crosschecked with data from two different websites. As a result, a database comprising 806 housing blocks for 2005, and 8677 housing blocks for 2012, was established. Because of the incompleteness of information on the websites, some attributes of some of the housing blocks were missing. In order to preserve the data, this paper used the classification interpolation method to replenish the plot ratio and greening ratio in accordance with the property types of housing blocks. Then, through further screening, we removed those samples for which the attributes were still incomplete or contained errors. Finally, we ended up with a sample of 5023 housing blocks for 2012, and 779 housing blocks for 2005. Moreover, we transferred the housing prices for 2012 to 2005, making them the constant price for 2005, in order to offset the change in price, which is necessary to obtain the contrast between the two years.

In addition, we also collected the locations of subways and subway stations (in 2005 and 2012), bus stations, parks, third-level hospitals (including Grade A and Grade B, which represent the highest level of hospitals in China), key high schools (including city-level key high schools and district-level key high schools in Beijing), and the population density of streets in 2005 and 2012. We then digitized the data in order to give attributes to the housing blocks that formed our sample.

2.2 Methods

2.2.1 Spatial autocorrelation analysis

(1)Global spatial autocorrelation

Global spatial autocorrelation is a measure of overall clustering, and is assessed by means of a test of a null hypothesis of random location. The most familiar test for spatial autocorrelation is Moran's I. Moran's I is defined as follow:

$$I = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}(Y_i-\bar{Y})(Y_j-\bar{Y})}{S^2 \sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}} \quad (1)$$

Where I is the Moran's I index, n is the number of objects, i and j index the areal units of which there are n, and wi j is a spatial weight (≤1) defining the connection between areal unit i and areal unit j. S2 is the mean square deviation. The maximum and minimum possible values of Moran's I are not constrained to lie in the (−1, 1) range. Positive values of Moran's I suggest spatial clustering of similar values. Negative values suggest that high values are frequently found in the vicinity of low values. When the Moran's I statistic is close to the expected value of -1 / (n - 1), the observed values are randomly distributed in space (Griffith, 2003).

(2) Local spatial autocorrelation

Compared with the global indicator, Local Indicators of Spatial Association (LISA) indicate the presence or absence of significant spatial clusters or outliers for each location. The formula is as follow:

$$I_i = \frac{x_i-\bar{x}}{S^2}\sum_j W_{ij}\left(x_j-\bar{x}\right) \quad (2)$$

Where I_i stands for the local spatial autocorrelation index, X_i is the attribute value of unit i, and W_{ij} is a spatial weight.

2.2.2 The spatial interpolation analysis

Kriging, which was originally developed for mining purposes based on core samples (Matheron, 1963; Cressie, 1990), is a method of interpolation, which predicts unknown points from observed points at known locations. This means that two closely neighboring points are more likely to have similar values than two data points farther apart (spatial autocorrelation). This could be expressed as the following equation:

$$Z(S_0) = \sum_{i=1}^{N} \lambda_i Z(s_i) \quad (3)$$

Where $Z(S_0)$ is the predicted value, $Z(s_i)$ is the known location value, λ_i is the weight of location i, and N is the number of given points.

2.2.3 The hedonic pricing model

The hedonic pricing model is a kind of econometric method. This model, usually employed in the evaluation of recreation resources, typically uses multiple regression techniques to relate housing price details to diverse characteristics of differing housing blocks, and to sort out the different contributions (Freeman, 2003). In empirical research, the model generally takes the form of a linear model, a semi-log linear model, or a log linear model (Gao and Asami, 2002; Ma and Li, 2003). In this paper, based on iteration calculations, we chose to use a semi-log linear model, which was specified by a natural log transformation of the housing price in the hedonic regressions. The model is as follow:

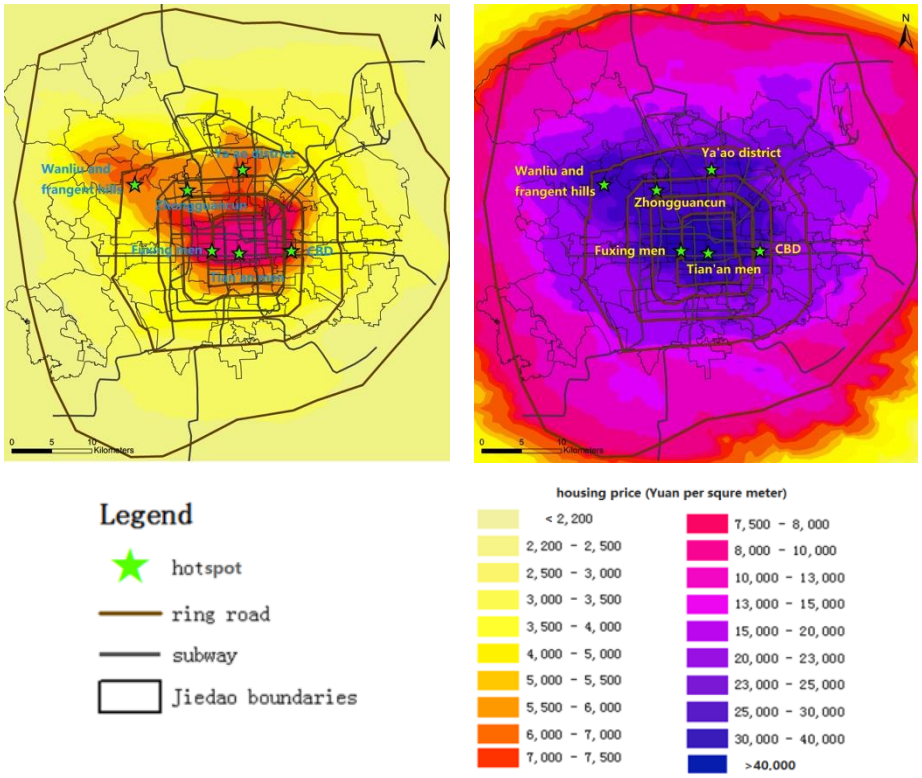
$$Ln(P)=a_0+\sum a_i C_i+\varepsilon \quad (4)$$

Where P is a vector of mean housing price, a_0 is a constant term, c_i for i = 1, 2…, m are explanatory variables, and a_i is the coefficient of c_i to be estimated. ε is an error term.

3. THE TRANSITIONAL SPATIAL PATTERN OF HOUSING PRICES

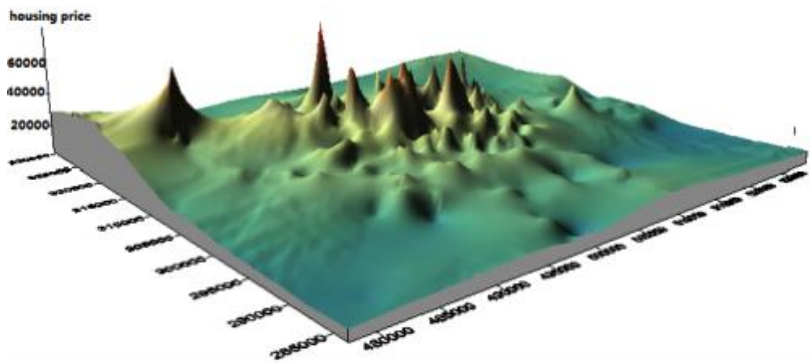
3.1 The spatial pattern characteristics of housing price

Firstly, we tested the sample data of the two years – 2005 and 2012 – finding that both obeyed the log-normal distribution. We were then able to use the interpolation method in relation to the housing blocks for the two years, and thus we could observe the spatial distribution pattern of housing prices in Beijing intuitively. Secondly, through a trend surface analysis we found that the trend followed by the housing price exhibited a quadratic function in both of the two years in the direction of north-south and east-west. We removed the quadratic function trend when we conducted the ordinary kriging method of spatial interpolation through ArcGIS 10.0 software. We then conducted a 3D process using Surfer 10.0 software. The spatial pattern characteristics of housing price are as follows:

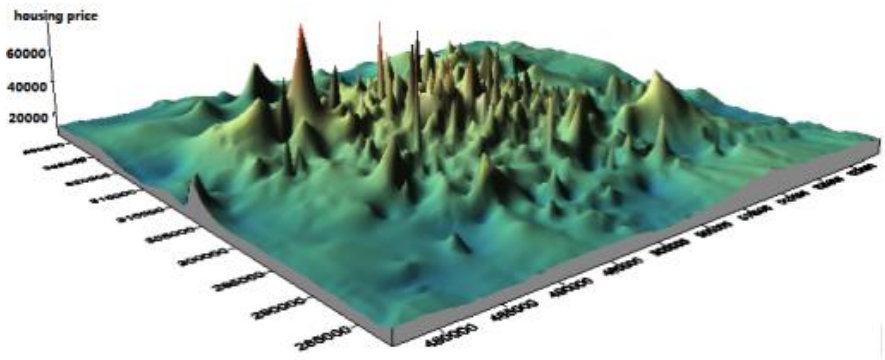


a. 2005 *b.* 2012

Figure 2. The spatial pattern of housing price in Beijing



a. 2005



b. 2012

Figure 3. 3D analysis of housing price in Beijing

3.1.1 Housing price increases and spreads rapidly

From the housing price spatial pattern, the price equivalent was observed to have spread from the city center to the outer areas of the city - for instance, the 7500-8000 yuan / square meter equivalent district spread from within the Second Ring Road in 2005 to beyond the Fifth Ring Road in 2012. Further, housing prices in both 2005 and 2012 were found to decrease as one moves from the urban center to the outer parts of the city, although the two patterns present a kind of irregular polycentric form. Thus, whilst the phenomenon of suburbanization has been very significant in Beijing, from the point of view of urbanization the urban center is still highly active (Meng, et al. 2009). The urban center is still attractive for residents, due to its good infrastructure and convenience; as such, housing prices are still very high there. From the ring road distribution of the housing prices (*Table 1*), the prices decrease from the Second Ring Road to the Sixth Ring Road; the mean price within the Second Ring Road is more than twice that found outside the Fifth Ring Road. Moreover, the standard deviations of the two years become gradually smaller as the housing blocks get further from the urban center. This means that while housing prices are not stable in the center of the city, the housing blocks outside of the urban center have relatively stable housing prices.

Table 1. The condition of housing prices in different ringed lines in Beijing

Ringed lines	Mean		MAX		MIN		Std.Dev	
	2005	2012	2005	2012	2005	2012	2005	2012
Within the Second Ring Road	8815	31089	20750	73456	4834	2644	3421.3	8835.8
Within the Third Ring Road and outside the Second Ring Road	8083	27642	21000	114266	3950	2655	3071.3	7708.3
Within the Fourth Ring Road and outside the Third Ring Road	6402	24161	19067	84602	2450	3660	2552.4	7668.4
Within the Fifth Ring Road and outside the Fourth Ring Road	5624	22598	16600	84602	2080	3625	2014.6	7814.4
Within the Sixth Ring Road and outside the Fifth Ring Road	3624	14838	24000	68252	1250	2115	1989.1	5623.5

3.1.2 Obvious spatial differences in housing prices

Obvious spatial differentiations exist in the housing prices of different regions. Overall, we found that if we divided the city into two, along the subway of Line 1, the average housing price for the northern part of the city was much higher than that of the southern part. The housing prices also exhibited obvious differences between the central districts (*Figure 4*), with the Dongcheng district and the Xicheng district being far ahead of the average housing price for the central districts, the prices in Fengtai district and Shijingshan district being relative low, and the Haidian district and the Chaoyang district being in the middle of these two groups. These results can be attributed to the uneven social development of Beijing, as well as the uneven development of the regional housing market. For instance, due to historical roots and natural causes, the pace of development of the southern part of the city has not been able to keep pace with that of the northern part. The southern part of the city is at a disadvantage, because of its relatively poor infrastructure and services, resulting in a relatively low mean housing price.

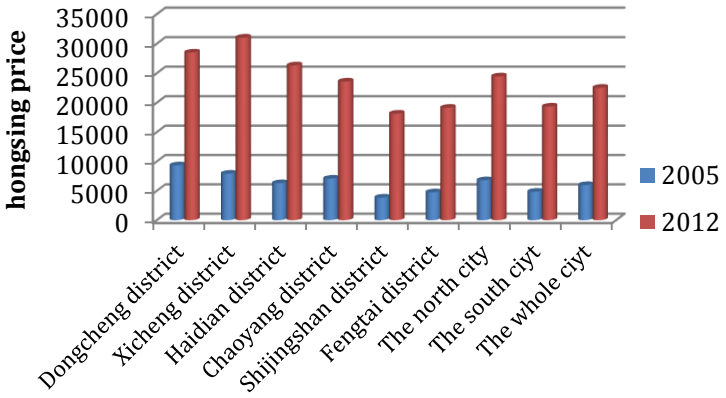


Figure 4. The mean housing price of different district in Beijing

3.1.3 Housing prices show a flattening tendency, and sub-centers have a significant positive impact on housing price

The multi-center spatial pattern has become a main design in Beijing's city planning and development under the current spatial planning guidance for the city. Whilst some projections show a polycentric trend in the spatial pattern whereby housing prices decrease as one moves outwards from the urban center, this study revealed a general tendency for housing prices to flatten in recent years (*Figure 3*). The peaks in housing prices experienced within the city have increased gradually and spread to the periphery. Among these peripheral districts, the Ya'ao district, Wanliu and the fragrant hills district, Zhongguancun, the Fuxingmen district, and the CBD have formed island and peninsular regions of high housing prices (*Figure 2* and *Figure 3*). Further, this "multi-center" characteristic was found to be more obvious in 2012 than it was in 2005, demonstrating that the influence of sub-centers is expanding.

The results indicate that, whilst the urban center still dominates the development of Beijing, with the rationalization of urban functional structure, the sub-centers are also developing quickly. These sub-centers have relatively good commercial conditions, transportation conditions, entertainment conditions, and educational facilities. As such, the housing prices seen in these sub-centers are higher than those observed in other areas. This is a result

of both the better living conditions, and the contribution made by price increases in surrounding areas (for instance, in the case of the Ya'ao district, where the government increased the investment in infrastructure and environment owing to the Beijing Olympics, which boost housing prices).

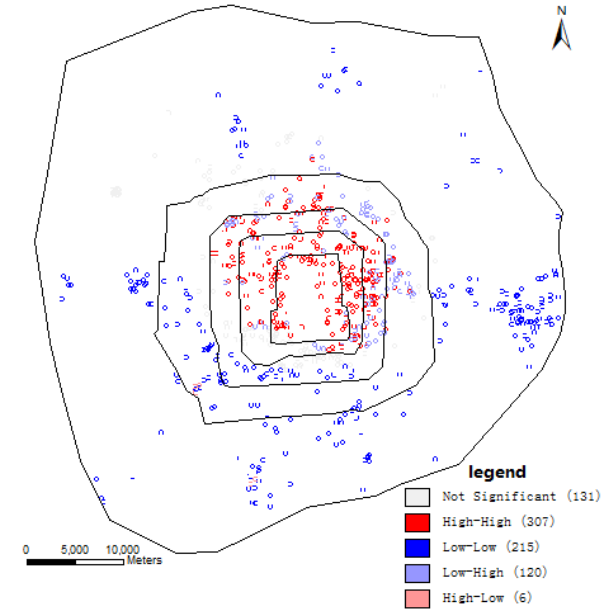
3.2 Autocorrelation analysis

Global autocorrelation is assessed by the global Moran's I statistic. Using the formula (1) and setting the distance matrix, we obtained the Global Moran's I statistic results for housing prices in Beijing (*Table 2*). The Moran's I statistics are greater than 0, and the test results Z (I) values are very significant in both 2005 and 2012. As such, the results show a significant positive spatial autocorrelation of housing prices in Beijing – namely, the spatial clustering of similar values.

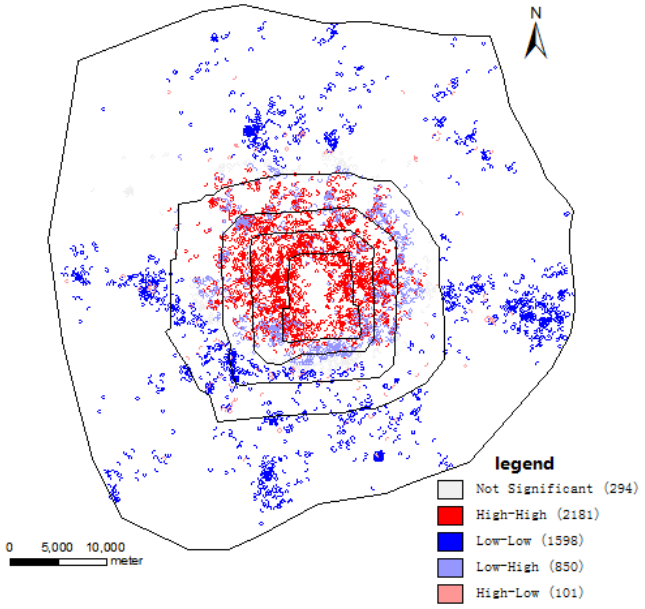
Table 2. Moran's I statistics for housing price in Beijing

Year	Moran's I	E(I)	Z(I)
2005	0.4282	-0.0013	53.4224
2012	0.4044	-0.0002	363.9963

A LISA cluster map can be generated at each year showing the housing blocks with cluster LISA values. Influential observations (hot spots) can thus be identified on the map by using OpenGeoDa (*Figure 5*). The resulting map shows that more than 65% of housing blocks belong to the "high-high" or "low-low" types, both in 2005 and 2012, indicating that the housing prices show a tendency of region agglomeration effects. The "high-high" type – that is, where the housing prices and the surrounding housing prices are both higher than the mean price – are mainly located within the Fourth Ring Road and in the northern part of the city. The "low-low" type exhibits a reverse trend – blocks where housing prices and the surrounding housing prices are lower than the mean price of all the housing blocks are mainly located in the southern part of the city and outside the Fourth Ring Road (especially in districts outside the Fifth Ring Road). In 2012, the presence of "high-high" and "low-low" types increases from 67.0% (the situation in 2005) to 75.2%, of which the "high-high" proportion rises from 39.4% to 43.4%, expanding from the urban center to the surrounding districts, especially in the northern part of the city. This indicates that the housing market is active in some hot spots, especially in the northern part of the city. This pattern can be attributed to two factors. On one hand, some real estate developers have been known to push up housing prices on purpose, a practice which damages the real estate market environment and puts more pressure on ordinary residents. On the other hand, similar grades of housing tend to locate close to each other, which results in socio-spatial differentiations. Subsequently, such trends form "rich people's regions" and "poor people's regions" within the city, even gradually producing the phenomenon of residential segregation.



a. 2005

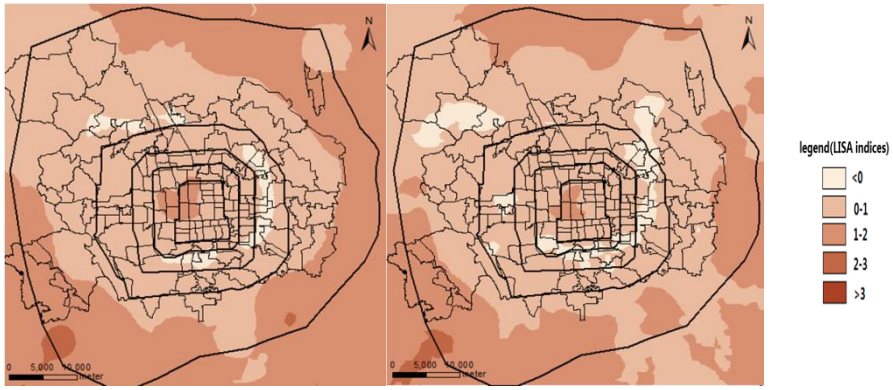


b. 2012

Figure 5. LISA cluster map of housing prices in Beijing

To further determine the spatial clustering of housing prices, we made use of LISA indices for spatial interpolation analysis (*Figure 6*). The given Equation (2) shows that the LISA index for each observation gives an indication of the extent of significant spatial clustering of similar values around that observation; and the sum of LISA indices for all observations is proportional to a global indicator of spatial association. The higher the LISA index, the higher the extent of spatial clustering of similar values around the housing block becomes. As shown in *Figure 4*, the highest extent of spatial clustering of housing prices in Beijing occurs in the areas surrounding Jinrong Street, Yuetan Street, and other similar areas – areas which are mainly located within the Second Ring Road, close to the urban center. These areas, where high-value housing prices gather, are very likely to form a "rich people's area". In addition, the areas around the Sixth Ring Road, especially in the southern parts of Beijing, also demonstrate a high extent of spatial clustering with

respect to housing prices – highest in the Fangshan district – however it is a spatial clustering of low, rather than high, housing prices. As a result, these areas are very likely to form "poor people's areas". Generally, the areas where the LISA indices are greater than "1" were found to be smaller in 2012 than in 2005, indicating that the degree of cluster of housing prices decreased slightly in the seven years addressed by the study.



a. 2005 b. 2012

Figure 6. LISA indices of housing prices in Beijing

4. INFLUENCING FACTORS BASED ON HEDONIC HOUSING PRICE

4.1 The selection of characteristic variables

In the hedonic pricing model, the housing price is considered to constitute a regression function that contains a series of intrinsic characteristics. In correlative studies, housing characteristic variables usually include three aspects, i.e. building features, neighborhood characteristics, and location characteristics. In this paper, 15 variables were chosen in the construction of hedonic price indices according to the correlative research and the availability of the data. On the basis of the spatial pattern characteristics of housing price, we added a variable to indicate the distance to the nearest sub-center. The variables, with detailed descriptions, can be found in *Table 3*.

Table 3. Characteristic independent variables of housing and their measurement

Types of independent variables	Independent variable	Variable description
Location characteristics	Urban center distance (km)	Distance to urban center
	Sub-center distance (km)	Distance to the nearest sub-center
	Number of bus station	Number of bus station within 800 m of the housing block
	Subway station	A dummy variable taking a value of 1 if the housing block has a subway station or stations within 1500 m; otherwise 0
Neighborhood characteristics	Property costs	Property costs per square meter per month
	Greening ratio (%)	Percentage share of the site area that is covered by greenery

	Plot ratio	The ratio of total floor area of the entire development to its site area
	Third-level hospital	A dummy variable taking a value of 1 if the housing block has a third-level (Grade A or Grade B) hospital or hospitals within 1000 m, otherwise 0
	Park	A dummy variable taking a value of 1 if the housing block has a park or parks within 1000 m, otherwise 0
	Key high school	A dummy variable taking a value of 1 if the housing block has a key high school or schools within 1000 m, otherwise 0
	Population density	Population density of the street where the house is located
Building features	Building age	The age of the building
	Building type	A dummy variable: cottage, apartment, common residence all take the same value of 1, while the indemnificatory apartment taking a value of 0

Table 4. Summary statistics of variables

Variables	Mean		Std.Dev		Min		Max	
	2005	2012	2005	2012	2005	2012	2005	2012
Housing price	5982	22532	3089.12	9153.29	1250	2115	24000	114227
Urban center distance	11.36	11.28	6.33	6.29	1.46	0.72	29.50	33.83
Sub-center distance	6.95	6.93	5.14	5.13	0.10	0.07	27.38	27.38
Bus station	3.29	12.52	4.58	9.8	0	0	41	41
Subway station	0.33	0.73	0.47	0.44	0	0	1	1
Property costs	2.30	1.89	1.59	1.89	0	0	17.07	32
Greening ratio	35.84	33.15	8.14	8.62	5.00	5.00	85.00	90.00
Plot ratio	3.40	2.63	2.52	2.10	1	1	5	5
Third-level hospital	0.20	0.22	0.40	0.41	0	0	1	1
Park	0.28	0.25	0.45	0.43	0	0	1	1
Key high school	0.16	0.17	0.37	0.38	0	0	1	1
Population density	14053	16367	11125	11448	405	307	57714	73510
Building age	5.13	11.65	2.15	6.39	1	1	12	57
Cottage	0.01	0.04	0.12	0.20	0	0	1	1
Apartment	0.25	0.14	0.43	0.34	0	0	1	1
Common residence	0.70	0.82	0.46	0.38	0	0	1	1

4.2 Linear regression model

This study used a semi-log linear regression model, which has a better imitative and interpretation quality. Regression analysis was conducted, and multicollinearity detected by a stepwise regression technique (significance level is 0.05) in the SPSS16.0 (*Table 5* and *Table 6*) using the data from 2005 and 2012, respectively. The results show that 13 variables entered the model in 2005 and 14 variables in 2012. Whilst both models have good explanatory power (adjusted R^2=0.771 in 2005, adjusted R^2=0.549 in 2012), the imitative quality was found to be better in 2005 than in 2012, probably because the influencing factors were more complicated in 2012. Not all the variables entered into the model in 2005 had strong multicollinearity. In 2012, the three property levels in the variables had good multicollinearity. However, through testing – by changing the variables randomly in the model – the three property types were all found to have strong significance and their regression coefficients were found to change little. As such, the models are considered reliable.

Table 5. Regression results of housing price in 2005

	B	Std. Error	Beta	t	sig	Tolerance	VIF
(Constant)	8.530	.057		149.613	.000		
Sub-center distance	-.034	.003	-.360	-12.189	.000	.338	2.955
Property costs	.079	.006	.261	12.265	.000	.653	1.530
Apartment	.416	.052	.373	8.004	.000	.136	7.371
Third-level hospital	.107	.023	.089	4.577	.000	.781	1.281
Urban center distance	-.011	.002	-.140	-4.588	.000	.315	3.175
Building age	-.025	.004	-.114	-6.429	.000	.944	1.060
Key high school	.071	.025	.054	2.801	.005	.780	1.281
Plot ratio	.013	.004	.068	3.678	.000	.864	1.158
Number of bus station	.006	.002	.058	3.141	.002	.854	1.171
Park	.060	.020	.056	3.000	.003	.854	1.171
Cottage	.373	.086	.091	4.331	.000	.661	1.513
Common residence	.169	.048	.160	3.545	.000	.144	6.939
Subway station	.039	.019	.038	2.085	.037	.897	1.115

Dependent Variable: ln (2005 housing price)

Table 6. Regression results of housing price in 2012

	B	Std. Error	Beta	t	sig	Tolerance	VIF
(Constant)	9.927	.097		102.196	.000		
Sub-center distance	-.033	.001	-.399	-24.193	.000	.330	3.031
Urban center distance	-.016	.001	-.244	-12.482	.000	.235	4.247

Property costs	.041	.002	.184	16.388	.000	.715	1.399
Cottage	.518	.092	.248	5.613	.000	.046	21.834
Building age	.005	.001	.077	7.174	.000	.787	1.271
Third-level hospital	.075	.011	.073	6.911	.000	.796	1.256
Common residence	.333	.091	.303	3.666	.000	.013	76.013
Greening ratio	.002	.000	.041	4.043	.000	.884	1.131
Population density	.001	.000	.029	2.230	.026	.546	1.830
Subway station	.038	.011	.035	3.599	.000	.977	1.024
Apartment	.282	.091	.229	3.089	.002	.016	60.963
Number of bus station	.002	.001	.047	2.833	.005	.327	3.054
Plot ratio	-.005	.002	-.026	-2.676	.007	.916	1.091
Key high school	.031	.012	.027	2.652	.008	.851	1.175

Dependent Variable: ln (2012 housing price)

4.3 Analysis of influencing factors

4.3.1 Location and traffic

Location characteristics play a very important role in determining housing prices. This study found that the housing price decreased as distance to the urban center increased; as such, prices obeyed the rent distance attenuation law. A 1-km increase in the distance to the urban center was found to lead to a 1.1% decrease in price per square meter in 2005 and a 1.6% decrease in 2012, respectively. At the same time, the variable describing the distance to the nearest sub-center also exerted a powerful, negative influence on housing prices in both of the years studied. Furthermore, the influence coefficients for the sub-center variable were greater than those generated by the urban center variable, indicating that sub-centers exert greater influence than the urban center, and thus that the polycentric pattern of Beijing has, at least initially, now been established.

In addition, variables relating to transport convenience within the location characteristics were also found to have a significant and positive impact on housing prices. The variables relating to the proximity of a subway station and to the number of bus stations were both approved in a significance test for both of the years studied. Holding all other conditions the same, the unit housing prices of housing blocks that have a subway station within 1500 m were found to be about 3.9% and 3.8% higher per square meter in 2005 and 2012, respectively, than those without a subway station (we used the subway station plan to 2015 for the 2012 subway station data). Further, each additional bus station was found to raise the housing price by 0.6% per square meter in 2005 and 0.2% in 2012. Convenient transport access is good for trade development and population centralization; as such, it will stimulate the development of commercial housing. Transport will also directly influence the level of convenience experienced in people's daily life – for instance, commuting and shopping, constituting a significant factor to consider when residents purchase houses.

4.3.2 Surroundings and infrastructure

The variable of property costs was found to be one of the most significant impact factors. The importance of this variable reflects the way in which levels of property management and service facilities partially indicate the quality and infrastructure of the housing block. As such, this variable impacts on housing price greatly. Housing blocks with a higher percentage of green space have higher house prices, with each percentage point of green space adding about 0.2% to the price per square meter in 2012. A high plot ratio makes for high-rise buildings and a high-density environment, which are commonly regarded as undesirable features. In 2012, the coefficient of the plot ratio on price is consistent with this rule, but in 2005 the result is somewhat unexpected. One conceivable interpretation is that living in tall, multistory apartment blocks connotes a high social status, which is consistent with social values held by the younger generation in China at that time.

The presence of parks, key high schools and third-level hospitals are significant and positive for housing price. If the housing block had a third-level hospital or hospitals within 1000 m, this was found to enhance the housing price by 10.7% per square meter in 2005 and 7.5% in 2012. These results suggest that the attractiveness of the areas surrounding housing blocks can, to a relatively great extent, raise the housing price.

Population is another important influencing factor in relation to housing prices. A high population density usually stands for a relatively high demand of housing. Thus, it will disturb the relation of supply and demand, and then boost the housing price. In 2012, each unit (people per square kilometer) of population density was found to add about 0.1% to the price per square meter in a given street. This variable did not, however, show significance at the 5% level, implying that the population density has less influence on housing prices compared with other factors.

4.3.3 Property type and residential condition

The coefficients generated in relation to the effect of the property type show that the typology of the residential unit exerts a fundamental influence on housing prices, as the housing price of different typologies vary widely. Overall, cottages and apartments are much more expensive than common housing blocks.

Theoretically, housing should become cheaper as it ages. In 2005, the price was found to decrease 2.5% per square meter with each additional year of building age, which is in line with this theoretical assumption. However, in 2012, the building age and the housing price exhibited a positive relationship. This may be due to the fact that second-hand buildings have better locations, sizes, etc. –they are thus endowed with a series of scarce qualities, and despite being aged, this has lead the prices of these kinds of houses to go up in recent years.

5. POLICY IMPLICATIONS OF THE RESULTS

(1) The evolution process in the spatial distribution of housing prices in Beijing shows that the urban area has sprawled in line with a “pie” model, with the housing prices increasing rapidly and spreading from the urban center to the outer areas of the central city. However, if we control this urban sprawl (for instance, by making the use of land use regulations), this generally

increases the cost of housing, because limiting the supply of a commodity usually increases its price. Empirical work by Malpezzi (1996), Malpezzi and Green (1996), Malpezzi et al. (1998), and Bertaud and Renault (1997), among others, has confirmed this unsurprising fact (Green, 1998). Since Beijing's problems with high housing prices have multiple influencing factors, a nuanced analysis is needed.

The Beijing Overall Plan (2004-2020) sets out a proposal for the development of a spatial pattern comprising of "two axes, two belts, and a polycentric pattern," the latter of which includes eight urban functional centers. Our analysis demonstrates that among the eight, only the CBD, Zhongguancun, and the Ya'ao district have achieved the scale required to alleviate the population and transportation stress. The manufacturing industry base of Shunyi, the integrated service center of Tongzhou and Shijingshan, the high-tech industrial development center of Yizhuang, and other functional centers have not yet formed fully. The housing prices within the Third Ring Road are still far higher than those observed outside of the Fifth Ring Road, and the housing prices in the northern parts of the city are also much higher than those in the south. Given these patterns, more effort needs to be directed in future urban planning and construction towards the southern parts of Beijing in order to promote the balanced development of urban space. Further, it is necessary to improve the planning implementation mechanism in order to achieve the targets proposed within the Beijing City Master Plan.

(2) The autocorrelation analysis undertaken in this study revealed a significant and positive spatial autocorrelation of housing prices in Beijing, indicating that similar grades of housing blocks tend to locate closely. High housing prices were found to be spatially clustered in areas like Jinrong Street and Yuetan Street, which are mainly within the Second Ring Road; the spatial clustering of low price housing was found to occur around the Sixth Ring Road, especially in the Fangshan district. These trends, if they continue, will lead to social polarization, as people of similar social strata and income levels gather in a certain location.

Based on the preceding analysis, we advocate that planning and construction be undertaken on the basis of a "multi-level housing blocks" philosophy. This can be argued for both from a social equity perspective and a view to restraining housing prices; it is required in order to avoid the formation of residential segregation and other attendant social problems.

(3) The regression analysis undertaken showed that the presence of transport infrastructure can improve the accessibility of the area and reduce travel costs for surrounding residents. As such, transport facilities have a significant positive effect on housing prices.

The presence of high-quality educational resources, high-level medical institutions, parks, and other public service facilities around a housing block improves the public service level and living environment, which are the important considerations when residents choose a housing block for its residential location. As such, we conclude that public service facilities can also significantly increase housing prices.

In order to promote a balanced land use, infrastructure and public service facilities should avoid centralization in urban centers; investment should therefore be made in the southern parts of Beijing and in outer suburban areas. Moreover, transport facilities also need to be strengthened. In order to change the spatial distribution pattern of housing prices, the coordination of different public facilities should be enhanced and the equalization of urban social resources should be fundamentally promoted.

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Vernacular Pattern of House Development for Home-based Enterprises in Malang, Indonesia

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Abstract: In the process of building and maintaining houses, residents as individuals and social human beings depend on their respective interests for improving their dwellings. The strength of tradition supports the element of stability from one generation to another. It indicates that there are groups of people whose traditions will generally be passed on to the next generation. Tradition is still maintained when utilizing the home as a Home-based Enterprise (HBE). HBE developments are based on a family's economic growth rate and also consider their household needs. In homogeneous houses, it appears that there is vernacular activity in building or repairing homes. As an example, in the case of HBEs, housing activities are maintained during the process of urban growth. Houses need to be expanded according to the needs of households and business activities within a limited urban area. In this research the pattern of house development based on vernacular HBEs, encompassing both living activities and business activities, has been investigated.

1. INTRODUCTION

Regarding the research related to the pattern of house development, the authors focus on changes of the spatial pattern in houses based on function from the view of Home-based Enterprises (HBEs). As a dwelling space, the houses serving as business spaces have been passed through generations; this study is expected to analyze the pattern of house development based on the needs of HBEs for their business activities. In the local community, imitation of the patterns is found in other residential places, in both physical and non-physical aspects, it is not only a shelter or home, but it can also serve as a mobilized resource for the occupants. Housing patterns are evident, not only based on home activities, but through identifying as vernacular it can be seen that the pattern is actually desired, by the occupant, to be passed to the next generation because the vernacular pattern is imitated by development in a particular area. The study of housing patterns based on income level is expected to assign a pattern appropriate for the needs of residences to be developed further, especially for HBEs.

According to Nunta and Sahachaisaeree (2012) the spatial pattern of human settlement was determined and readjusted not only by daily human needs, but also by their social norms and cultural settings. In addition, the local pattern and orientation of structural design was developed and transformed in accordance with the modern society (Saleh, 2000; Saleh 2001). The pattern of

vernacular settlement explaining the significance of social identity and livelihood in the past could be beneficial to explain the current social dynamics in the modern urban community. Vernacular patterns also show that the house has existed for at least several decades (Aziz and Shawket, 2011)

A settlement is a residential place of activities that support human life. According to Newmark and Thompson (1977) the terminology of house as a residence are shelter (as a physical shelter), house (as a place for people to perform daily activities), and home (as a residence or dwelling for a person or family who has a psycho-social environment).

Thus, the notion of house means as a place of residence (physical) for persons or families to perform activities of daily living and as a venue for self-development processes (non-physical). According to Silas (1993), the function of the house is not just for shelter, rest, and family (residential), but it also can serve as a mobilized resource for the occupants. Here is an explanation for houses with the combined functions of home and work: Home, a house used as a residence without other meaningful activities; and work, a house used for a productive or economic activity, which carries consequential aspects between production and home care.

Furthermore, there are several aspects to discuss about housing improvements such as: (1) Low building quality and slow construction evolution in the process of self-built houses (Kowaltowski, 1998; Bredenoord and Lindert, 2010; Abbot, 2002a; Abbot, 2002b; Ferguson and Smets, 2010; Shiferaw, 1998; Al-Naim and Mahmud, 2007; Kigochie, 2001; Sullivan and Ward, 2012; Tipple, 2004), (2) The ability and motivation of households to consolidate their housing situation for self-help settlements (Kellett and Granham, 1995; Ghafur, 2002; Gough and Kellett, 2001; Mukhija, 2001), (3) The symbiotic connection between house and economy, such as HBEs (Onyebueke, 2001; Sinai, 1998; Coen, Ross, et al., 2008). Laquian (1993) says that for the people who live in slum areas, the house is not just for home-life, but it is a place of production, marketing, entertainment, and financial institutions. Residential and business activities are integrated within single unit houses. Whereas, the International Research on HBEs in 2002 states that, in general, an HBE is a domestic business activity. It is basically people's economic activities run by the family in which the activities are flexible and less bound by rules. According to Ferguson and Smets (2010), resources dedicated to incremental housing have to compete with other needs of the household.

House development can not be separated from the existing resource (Silas, 1993). The aspects of productivity and the function of the home have become increasingly prominent in a variety of shapes and composition. Furthermore, Sarwono (1992) states that humans will always adjust the environment by considering the feasibility elements for human habitation, which are related to human needs.

On the other hand, Samadhi (2004) said, humans make their decisions through some cosmological process. According to aspects of the norm, it is also a consideration in determining the direction of house development. Turner (1972) explains the concept of Housing as a process which is based on three things, namely the value of a home, home economic functions and authorities of a home.

There is a lot of research associated with the pattern of building a house. Bredenoord and Lindert (2010) generally explain the main factors in the procurement of shelter in developing countries. Massive numbers of people practice incremental self-help housing because other options are out of their reach. He mentioned that, in addition to the use value that the self-built house

has for residents, the commercial value of the property is not less important and will also tend to increase. A house can be the family's moneybox, especially if the family has a high degree of tenure security and if the house is built in a durable way. Abbot (2002a) argues that house development is based upon the ability of external interventions to address the key issue of vulnerability and argues for the need to plan for the long-term sustainability of housing. In addition, Ferguson and Smets (2010) argued about finance for incremental housing, incorporating current status and prospects for expansion, as well as housing finance that encompasses individual and group savings, and also households who combine a wide variety of sources in order to build their homes.

The function of the house can be as either, or both, home and work. Some houses are used for productive activities and consequences arise in relationships between aspects of economic and house functions. This work focused on residential and business activities integrated within single unit houses. The functionality aspects of the house became clear in a variety of shapes and patterns as a form of existence and sustainability. More over, the house is intended as vernacular architecture, which is the work of the whole society and not as the choice of an individual.

According to Agenda 21 for Indonesia (1997), housing and settlement development goals are to support economic activity in a coherent system that ensures the preservation of the carrying capacity of the environment and natural resources, so that all layers and segments of society that grew and evolved by these activities are embodied in settlements which support sustainable qualities.

This paper discusses the vernacular patterns in housing that has HBE activities, and is also expected to help support the development of housing in dense areas. This paper is organized as follows; firstly, it investigates literature regarding the influence of urbanization on housing, the pattern of residential building, and motivation of residents to develop their houses, particularly in the area of the city. Secondly, it describes the research approach and reviews the patterns of house development from questionnaires and mapping of the houses within the study area. Analyses are needed to explain the physical and non-physical conditions in order to understand the pattern. Thirdly, we discuss the vernacular housing pattern based on analysis and schematic diagrams. Finally, the conclusion states the importance of this study to enrich knowledge about house development in dense urban areas.

2. RESEARCH APPROACH

In vernacular buildings it is equally reasonable for people to be in daily connection with both the built environment and the surrounding environment; the housing pattern maintains this tradition. According to Aziz and Shawket (2011), the principles of house development are sustainable, as seen in patterns of vernacular development. According to Ikuga and Murray (2012), vernacular studies offer perspectives to deal with requirements such as sustainability. Vernacular structures provide communities with shelter using indigenous natural resources and meeting economic needs, while aligning with values, lifestyle and the more symbolic functions of a culture. This makes these forms a point of reference reflecting the whole of a culture’s social structure.

HBEs allow houses to be expanded to meet the needs of business in line with the needs of the household. This development is done by mimicking what

has been done in the surrounding neighborhood. Because this housing is homogeneous, the considerations for the new construction of the house are similar. To capture the aspects that result in this similarity, questionnaires to residents were used as an investigative tool for data collection. This investigation took aspects of the tradition, business processes, and living activities into consideration. Here is the conceptual framework for conducting the data collection in order to acquire the appropriate data for analysis (*Fig. 1*)

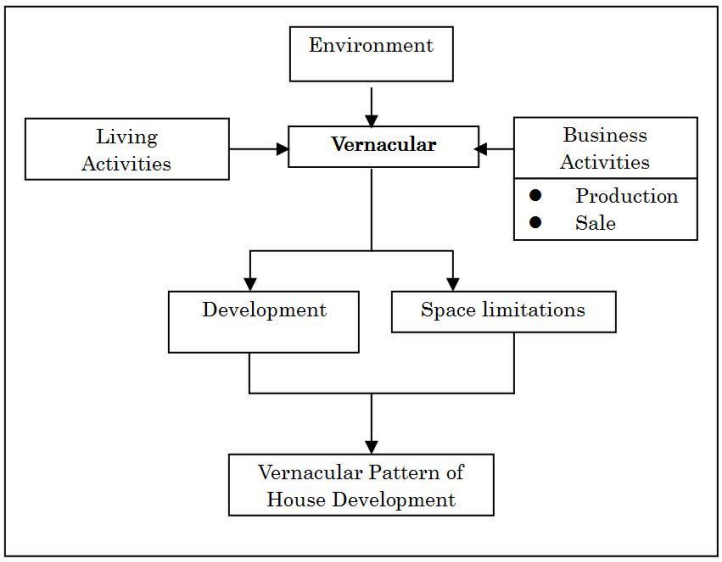

Figure 1. An Approach to the Pattern of House Development on HBE

Data were obtained from questionnaires conducted on housing development to gain insight into the housing pattern of residents who have business activities. The questionnaire enquired about living activities and business activities consisting of both productive and commercial aspects. The questionnaire aimed to acquire the data regarding basic similarities in vernacular patterns that occur in the area. In accordance with the development of family activities and business activities, there is a need for house development; this has resulted in the problem of space limitation. Analysis was conducted of the obtained housing patterns based on the level of need for the development of the living or business.

3. HBE HOUSING PATTERNS IN KAMPONG SANAN

The study area, Kampong Sanan, is located in the eastern part of the island of Java, Indonesia. The type of settlement is a kampong (urban village), which has a higher population density than the surrounding area. In Malang City, Indonesia, the place is popular for its *"tempe"*, that is famously known for being produced in Kampong Sanan. This location is a dense residential region and most people have similar daily day activities. This kampong has an area of 20Ha (*Fig. 2*) and the area is divided into four neighborhoods with a population of about 3300 people (660 households) in 2011. Based on the existing designation, the area is zoned for residential area. The North and East sides of Kampong Sanan are bounded by the river and there are many new housing developments in the area. While the position of the kampong is

surrounded by rivers, it is limited on the West side by the highway leading to Surabaya City (The capital city of East Java Province).

3.1 House Development in Case Study Area

The houses of residents who live in Kampong Sanan have two functions: home and work. The productive activity of work has resulted in a unique pattern of settlement. The preserved areas (*Kampong Sanan Tempe*) maintain the image of the area as a *tempe*-producing area where there is a tendency for integrating their living space with the business space and their patterns are influenced by their economic level. Sanan residents can not be separated by their activities of producing and selling *tempe*, this particular activity differentiates this kampong from others. The residents try to maintain their activities and this has ensured the phenomenon remains today.

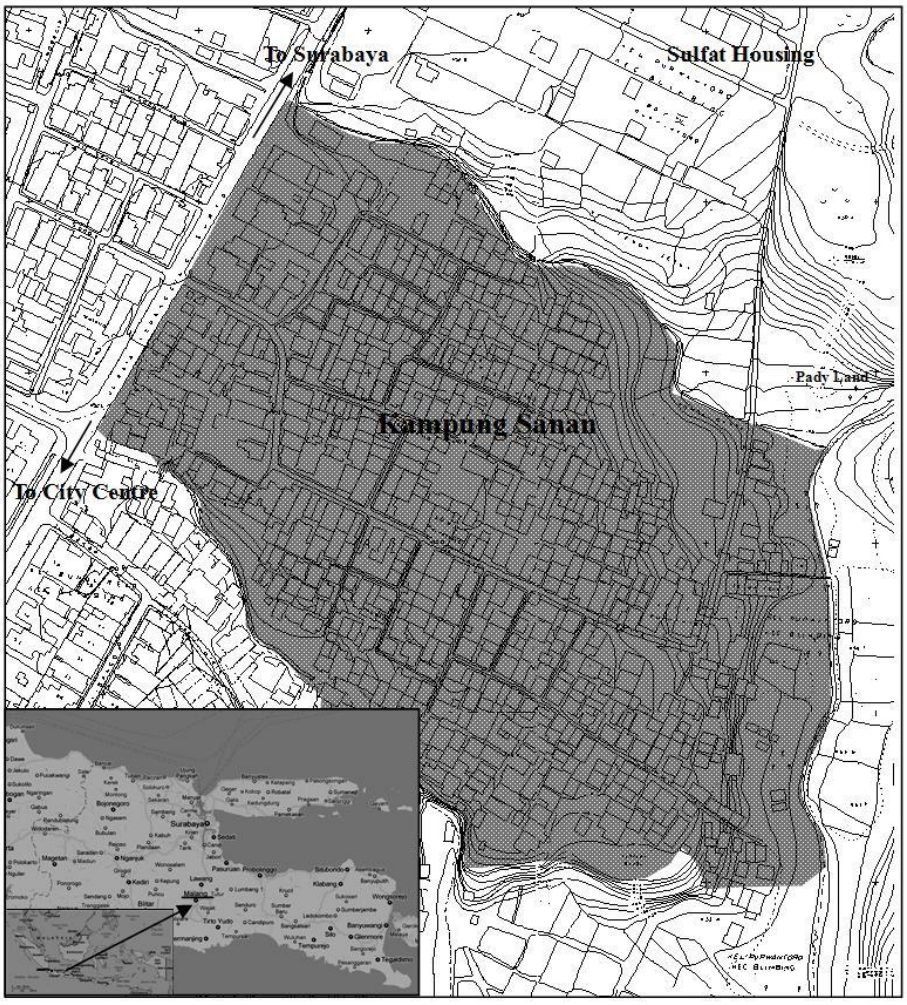

*Figure 2***.** Kampong Sanan Boundaries.

Based on field observations, residents are differentiated into three groups based on their economic level, the high level, middle level and lower level. The high level residents are on the edge of the main road and they have a good opportunity to improve the home. The middle level residents have a chance to grow because they have direct access to the main road of the kampong. The low economic level residents are on the inside; their houses are difficult to

develop because of the limitations of the land and housing density (*Table 1*). Groups of houses in this area are illustrated in *Figure 3*.

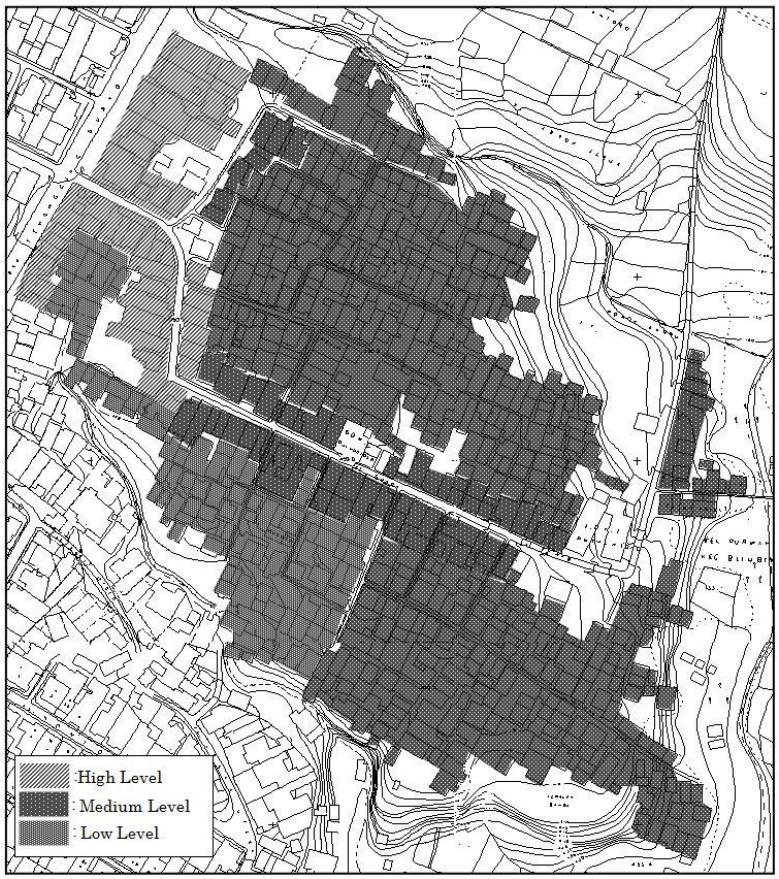

Figure 3. Three Groups of Resident in Kampong Sanan.

Table 1. The Economic Level and housing Condition (The pictures were taken in 2011)

No	Groups	Conditions		Figure
1.	High Level	Location	Located near the city's main road in front of Kampong Sanan, the appearance of the stores change completely.	
		Activities	They are focused on selling products, and have developed their entire ground floors for business activities.	
2.	Medium Level	Location	Almost all ground floors are used for economic purposes and, but the appearance of the house is still present. These houses are located near Kampong Sanan's main road.	
		Activities	The front of the house is used for economic purposes, but the appearance of the house is still present, these houses are mostly located inside the kampong.	

3.	Low Level	Location	At the rear of houses, both household and business activities (production) take place.	
		Activities	At the front of the house, there is also space used for business activities (production). There are some space limitations and conflicts between both activities.	

Residents will consider the construction of their houses relative to their economic level grouping. Their considerations are based on home ownership status, financial resources, and income per month.

Table 2. Relationships between ownership status, income per-month, and other finance

Ownership Status		**Finance**	**Average Family income per month**					
			Low		**Middle-**		**High**	**Total**
			<500.000	**500.000-750.000**	**750.000-1.000.000**	**1.000.000-1.500.000**	**>1.500.000**	
Own House	Cost Source	Savings	31.7%	39.7%	14.3%	3.2%	4.8%	93.7%
		Borrow	6.3%	-	-	-		6.3%
Lease House	Cost Source	Savings	28.6%	57.1%			14.3%	100%
Family Legacy House	Cost Source	Savings		45.0%	35.0%	20.0%		100%
	Total							

Based on the status of ownership, the largest financial resource for construction is from savings among families with a monthly income between Rp. 500,000 to Rp. 750,000 (39.7%). The main financial source for Lease House residents and Family Legacy House residents is also from savings (57.1%, 45% respectively), so people prefer to use savings rather than loans to others to improve their houses. From *Table 2*, we can conclude that the ownership status of residents living in the kampong is the most important condition to overcome obstacles in savings. The financial resource is an assurance in the process of house development.

Table 3. Relationship between Ownership status, Development Status, Income and Finance resources

Ownership Status	**Development Condition**	**Family income per month**	**Finance Resources**
Own House	Steadily	Most of the families with incomes Rp. 500.000,- to Rp. 750.000,-	Savings (59 respondents) and loans from others (4 respondents).
Lease House	Grows	Family with incomes Rp. 500.000,- to Rp. 750.000,-	Savings (7 respondents).

Family Legacy House	Grows - Steadily	Family with incomes Rp. 500.000,- to Rp. 750.000,-	Savings (20 respondents).

Based on field data in *Table 3*, the cost for the process of repair and construction of homes is funded by both residents' savings and a fraction of borrowing from other parties. In addition, comparing the ownership status and the duration of business in the kampong with the reason for doing business can be organized as below, in *Table 4*.

Table 4. Relationships between ownership status, duration of business in the kampong, and the reason for keeping the business

Ownership Status	Business activity	Years	The reasons		
			Maintaining tradition	Being familiar with the product	Supporting Environment
Own House	The duration of doing business in the kampong	<1	7.9%		
		1-5	7.9%		
		6-10	11.1%	4.8%	
		11-15	4.8%		
		>15	39.7%	19.0%	4.8%
	Total		71.4%	23.8%	4.8%
Lease House	The duration of doing business in the kampong	<1	28.6%		
		1-5	28.6%		28.6%
		>15		14.3%	
	Total		57.1%	14.3%	28.6%
Family Legacy House	The duration of doing business in the kampong	1-5	35.0%	10.0%	
		6-10	10.0%		
		>15	20.0%	15.0%	10.0%
	Total		65.0%	25.0%	10.0%

Based on *Table 4*, the residents with Own House status residing for more than 15 years prefer to "maintain tradition" to support their business activity in the house (39.7%). The Lease House status residents preferred "Being familiar with the product" and "Supporting Environment" as their reasons (28.6%) for those who have resided from 1-5 years. The Family Legacy status residents who have resided from 1-5 years preferred "maintain tradition" (35%) as a reason that supports their business.

Table 5. Summary the influence of house status, main factor, and duration of doing business to development status.

Development Status	Ownership Status	The Main Factor	The duration of doing business
Steadily	Own house	Maintaining tradition (45 respondents)	More than 15 years (25 respondents).
Grows	Lease House	Maintaining tradition (4 respondents)	Between 1-5 years (4 respondents)
Grows-Steadily	Family legacy	Maintaining tradition (13 respondents)	More than 15 years (9 respondents) and 1-5 years (9 respondents)

The development status of their houses was influenced by ownership status for keeping the business, and the duration of doing business. As shown in *Table 5*, the development status for Own House residents is 'steadily'. It is described as such because the efforts made by both Lease House and Family Legacy House residents have been made since a long time ago, despite the ownership status of the building not being their Own House. Because of this,

most of them overcome obstacles in the process of house development gradually, utilizing savings. The motivation for family members to continue production in each development status differs, but is mostly to continue tradition.

3.2 Typical Vernacular Housing Pattern

In this section, the authors try to obtain specific information about a resident's motivation to renovate their house. The selected house is a house that has limited land and a low economic level in the case study area as shown in *Figure 4*. This exploration was conducted by drawing the initial floor plan based on the explanation of the owner, then we redrew the house which is now renovated. This house plan focused on the consideration of the needs of both the living activities and business activities.

First, this study was conducted by tracing patterns of the construction of houses in Kampong Sanan. This was done to get the full background directly from residents. One family was then selected for this investigation regarding the motivation of the construction of their house, this house was located on the inside of Kampong Sanan. In this case, the motivation for the renovations was an increase of family members.

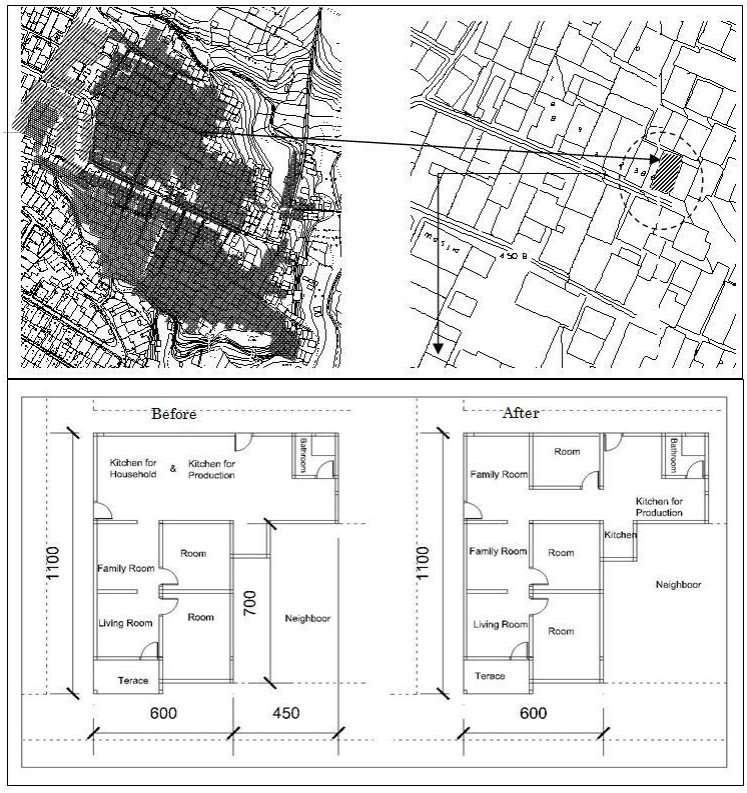

Figure 4. House Plan, before and after daughter's marriage

The pattern of house development as related to HBE changed in this house from the initial conditions to current conditions, as follows:

Previously, the house was owned by the father who was living with his children and grandchildren. His income was not enough to renovate the house. The position of the kitchen was at the back and it was last renovated in 2000 because the back of the kitchen collapsed. The results of the renovation were changes to a back room that used to be a part of the kitchen (*Fig. 4*). The reason to build back rooms was to add space for a married daughter. In the current condition, they built a room with limited funds, and although there

remains a desire to add a room again, the plan is only for adding to the front part of the house. They need a special room for "*leleran*" (a part of the production process for "*tempe*" making) and an expansion of the living room. They are currently using the corner of the family room for production and have plans to add a special space if they have sufficient funds in order to build up the floor where goods are put at the back of the house. The space between rooms is used for ironing and family gathering.

Further studies were conducted in houses of similar economic level residents. Based on the cases found different parts of the houses were taken into consideration during the renovation. Parts of the houses used included the kitchen, the appearance of houses, terraces, orientation and other parts. Through considering vernacular patterns, we studied the influence and the reason to do renovations (*Table 6*).

Table 6. The relationship between influencer, the reason for the renovation, and part will be maintained

Influencers		The reasons	The parts of house maintained					Total
			Kitchen	Building appearance	Orientation	Terrace	Others	
Family	Reason for renovation	Facilitate business	54.2%				25.0%	79.2%
		Adding to Household		4.2%	8.3%	8.3%		20.8%
Relatives	Reason for renovation	Facilitate business		100.0%				100.0%
Neighbor	Reason for renovation	Facilitate business	75.0%			12.5%		87.5%
		Adding to Household	12.5%					12.5%

Most of the reasons for doing house improvements were to facilitate economic activity rather than to facilitate household use. This is largely influenced by neighbors (87.5%) and family (79.2%). While the part of the house being renovated is usually the kitchen. The changes to house plans vary depending on what factors they prioritize. In the early development stages, they tend to improve their kitchen to support their economic activity (*Fig. 5*). Changes that occur to the houses are shown in *Figure 6* below (LA= Living Activities; BA= Business Activities).

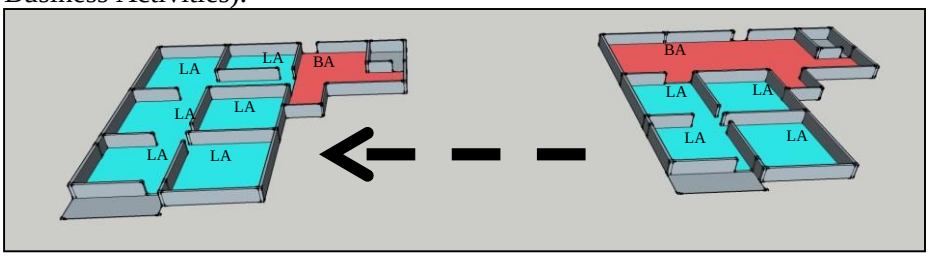

Figure 5. Figure regarding early development
Note: Red for Economic Domain and Blue for Domestic Domain

This research also asked about expectations for development when land is limited, with no possibility to buy or add to the land, and while it is necessary to remain on the same property. After expansion, followed by a period of no change, they decided to steadily develop the house more. The possibilities that occur after the economic income improves are as shown in *Figure 6*:

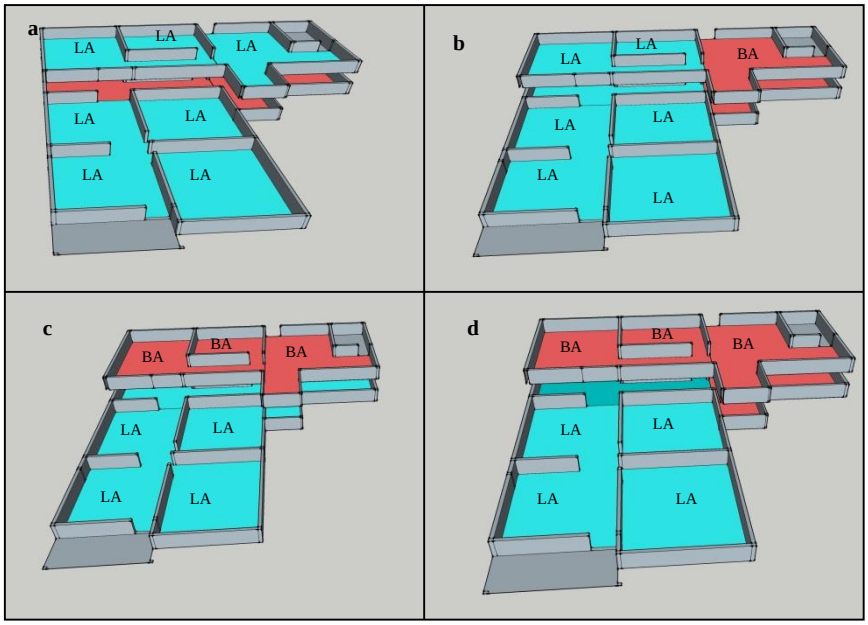

Figure 6. Figure regarding possible development; a) The back of the ground floor is used for economic purposes and an additional floor added at the rear for households. b) Both the upper and lower floors are used for the economic activity. c) An additional floor at the back of the house is added for the economic activity. d) Both the side of the house and the additional floor at the rear are used for the economic activity.

Based on these patterns, in the early stages of economic development decisions were made to maximize the rear of the house as an economic activity space. Considerations led to decisions to maintain the existence of the kitchen. The kitchen has two functions, both as a place for living activities and business activities. In the next stage of development the whole back of house is maximized, including the upper floor section for production, while the center of the house remains functioning as a living space.

4. LOCATIONS AND HOUSING PATTERNS OF HBE

Based on the analysis in above section, the locations and economic levels are important factors in determining the pattern of house development. At locations that are far away from the main road there are four alternative developments based on field observations, the pattern is often chosen by occupants. When the location is near the main road there are four developmental patterns according to the residents' economic needs.

4.1 Houses located far from the main road

In its development, the changes that occur can be of various kinds. In houses that are near the main kampong street, the front of their house is prioritized for economic activity, and the back for living activities (*Fig. 7*).

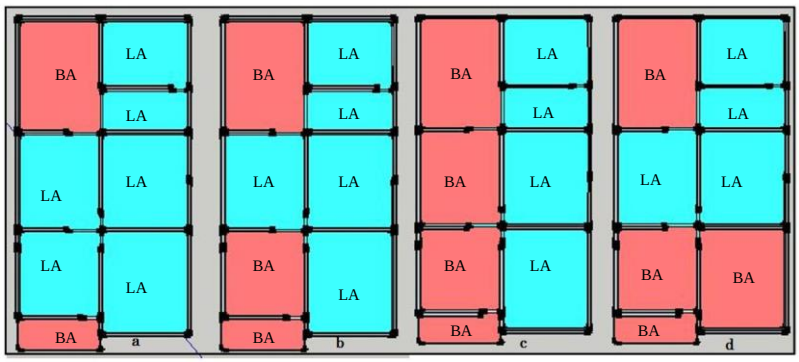

Figure 7. The kitchen is at the rear and is always determined as a business zone, in addition a) The terrace is used. b) The terrace and the living room are used, and this is often a conflicting space. c) The terrace, living room, and family room are dual-purpose, greatening the chances of conflict here. d) The terrace, living room, and front room are used, which is starting to create a business zone, distinct from the living area.

Some homes in *Figure 7a* only use the front of the house (the terrace), which is used for selling or production activities. Furthermore, the house has more rooms for living activities. In *Figure 7b*, residents use only the terrace and living room for business activities; this situation often generates a conflict of space. In *Figure 7c*, the terrace, living room, and family room are all dual-purpose, this pattern also generates the possibility of a larger conflict of space. This happens because more rooms are involved in the business thoroughfare. The pattern of *Figure 7d*, shows the business activity is carried out on the terrace, and in the living room and front room, this is caused by a business need that requires a separate room. In this pattern, the business zone is separate from the living zone.

4.2 Houses located near the main road

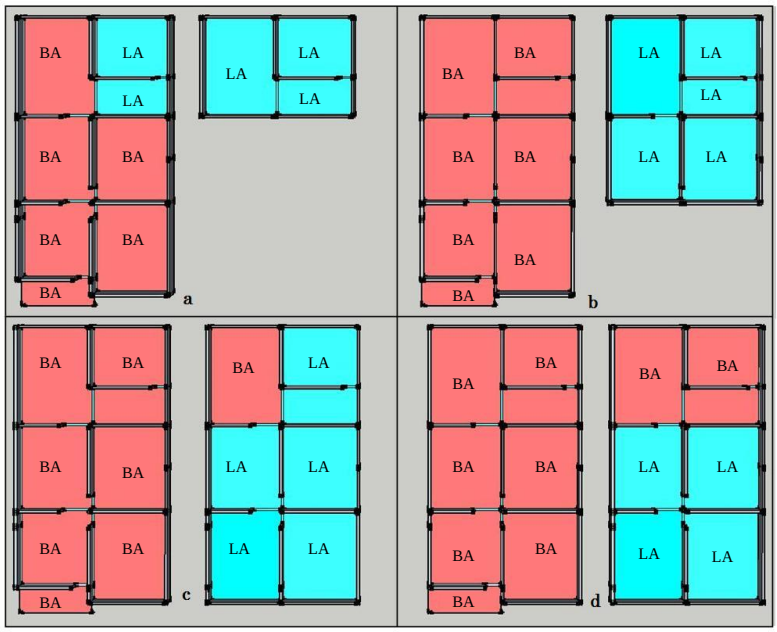

Figure 8. a) Almost all of the ground floor is used for the business and the added floor at the rear for households. b) The entire ground floor is used for business and the added floor at the rear for households. c) The entire ground floor and part of the upper floor at the rear are used for the business, while the top floor, extending to the front of the house, is used for households. d) The entire ground floor and rear of the top floor are used for the business and the front of the top floor for the household.

The houses that are located near the main street of the town utilize about 66% of the homes for economic activity; this causes the appearance of the store to change. Patterns that may occur are as follows (*Fig. 8*); *Figure 8a* shows almost all of the ground floor is used for business, while at the rear one more floor is built for living activities. *Figure 8b* shows the entire ground floor is used for business, while the upper part is used for living (50% of the house). *Figure 8c* shows the entire ground floor is used for business activities and extends to the second floor partially, while the upper floor is extended forward for living activities. In *Figure 8d*, the entire ground floor is used for business activities and extends to the back half of the upper floor, while the front of the upper floor is used for living.

In the current conditions, the front area of the kampong grew faster into a trading place. This situation resulted in a change to the shape and spatial layout of the houses, which look like stores, although the original function of the dwelling remains. The kampong tends to adopt development patterns from the surrounding area, and the rapid development of new housing in the area around the kampong also stimulates the changes.

Some assumptions about house development can be made based on the availability of resources and what kind of opportunities is created for the repair or construction of houses. Because of the inheritance of cultural values through cross-generational business inheritance, the business of "*tempe*" practices and its resources, including houses, is sustainable. The development of the house is greatly influenced by the decision of the family to make such house developments. The business activities have a great influence on the living space when the family facilitates business activities in those areas. The existence of the kitchen remains the same, and relatives have little influence on business activities and maintaining the appearance of the house. The neighbors have more influence than the relatives on the kitchen space because they live in the same place and have the same occupation, offering a perspective that can be informative to their neighbors. Most of them choose the kitchen to be maintained for business activities.

5. CONCLUSION

Through investigating the informal housing vernacular pattern occurring in the process of urban growth, Kampong Sanan has homogeneity as a village that produces and sells "*tempe*". Residents build houses in accordance with their economic level and the location of their home.

A research approach focusing on vernacular patterns is essential in order to know more about the needs and traditions of housing development. The questionnaire was an instrument in tracking and analyzing the patterns of house development as vernacular patterns; investigation in the case study area is useful to obtain detailed information on the changes, the motivation to do renovations, and the expectation of available funds to build.

The location of a house will determine the pattern of the house's development from the time of building. It can be concluded that the closer to the main road the house is, the greater the opportunity to utilize the existing land to maximize business activities. It is different for people who live relatively far from the main road, they try to maximize their houses under the condition of limited space, and the respective patterns are expected to be a reference for residents who live in densely populated areas and have limited land.

The city road is a factor that accelerates change to the housing patterns, and most changes occur near the main street. House changes that occur depend on the economic level of the residents, while the reason for changes is due to business activities rather than living activities, so the part of the house relating to business activities is the part of the house that needs to be developed. Furthermore, vernacular patterns occurred based on their traditions of home and work. The housing patterns reflected the conditions required by the household and the business activity. The respective patterns are expected to be a reference for people based on the needs of their household and the business.

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