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Comparison of perceived sustainability among different neighbourhoods in transitional China: The case of Chengdu

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ABSTRACT

There have been increasing concerns about neighbourhoods’ contextual characteristics and the importance of applying integrated sustainability principles to develop sustainable neighbourhoods. Among the contextual characteristics, the role of residents’ perception of their neighbourhoods is critical when identifying various local sustainability issues and developing sustainable neighbourhood planning. However, little research has been done on evaluating residents’ subjective perceptions of different neighbourhoods’ sustainability performance, particularly in this time of transitional China. Thus, this research employed an empirical approach to investigate residents’ perceived sustainability performance in three different neighbourhoods, including the traditional danwei, resettlement and commodity housing neighbourhoods in Chengdu. Questionnaire surveys and expert interviews were conducted to analyse the sustainability performance and critical sustainability issues in different neighbourhoods. The results demonstrated that infrastructure and public engagement were two common and significant factors affecting the sustainability of all three neighbourhoods. Most importantly, the three different neighbourhoods showed different sustainability challenges which called for developing contextual framework for sustainable neighbourhood development. Several theoretical and policy implications for planning were also provided.

1. Introduction

Due to rapid urbanization in developing countries, many urban neighbourhoods have experienced profound transitions. Much research had been conducted to interpret the transition, the derived challenges and to construct a new framework for evaluating and guiding neighbourhood development. Theoretically, sustainability calls for adopting an integrated approach by considering a wide range of factors, as well as their relationships and interdependencies (Komeily & Srinivasan, 2015). To develop a sustainable neighbourhood, a systematic and scientific sustainability evaluation is critical for determining a prototype of a sustainable neighbourhood. But there are some who criticize the lack of context-specificity and doubt the actual universal effectiveness of Neighbourhood Sustainability Assessment (NSA) application in evaluating sustainable neighbourhood development worldwide (Sharifi & Murayama, 2015). The COVID-19 pandemic in 2020 has further highlighted the significance of understanding contextual variations of different neighbourhoods in fighting the virus globally. The severity of this public health disaster calls for more contextual research on developing sustainable, healthy, and resilient neighbourhood. Basically, all contextual characteristics can be categorized into two dimensions: built and natural environment and human dimension. These cover different aspects, including physical, operational, socio-economic, environmental and institutional aspects (Eschbach et al., 2004; Komeily & Srinivasan, 2016; Reisig & Parks, 2000). In fact, the variations in contextual characteristics exist among different cities, even different neighbourhoods within the same city. Although there are some studies discussing the variation of urban context in different countries, very few systematically reviewed sustainability performance using an empirical study, particularly in China.

In China, significant social-political transitions have occurred since the 1980s. To cope with many sustainability challenges that came along with the transitions, both central and local governments have begun to advocate for sustainable urban development by issuing diverse policies and guidelines. For instance, a general framework for sustainable cities and communities was firstly released in Beijing on July 13th, 2015 to guide practitioners in developing sustainable neighbourhoods (Meng, 2015). However, sustainable neighbourhood development, including
both neighbourhood planning or sustainability assessment, is at its infancy stage in China. Previous research on sustainable development approaches (Liu et al., 2014), sustainable urbanization and governance (Shen & Zhou, 2014) and sustainable housing and construction (Zhu & Lin, 2004), but few have focused on the neighbourhood level (Shi et al., 2016; Zhang et al., 2018). Moreover, neighbourhoods experienced context-specific and diverse evolutions which are very different from other countries. Thus, it is imperative to develop an adaptive sustainability framework for guiding current sustainable neighbourhood development in China. Domestically, contextual transitions occurred at different types of neighbourhoods, including increased heterogeneity due to the dissolved ‘Danwei (work unit)’ system, lost social capital in resettled neighbourhoods and weakened social cohesion in the emergent commodity housing neighbourhoods. The gap of lacking detailed comparative analysis among different types of neighbourhoods (Wu, 2012) has actually conflicted with the massive and indiscriminate efforts of the Chinese government to develop sustainable cities. As a typical western metropolis in China, Chengdu is a case in point that ‘Building Sustainable Urban-Rural Neighbourhoods’ had been practised for three years.

Thus, this study aims to examine the contextual variations in perceived sustainability performance through an empirical study in Chengdu, China. In this study, neighbourhood sustainability performance refers to residents’ perception on the identified aspects of sustainability. Three selected cases were compared to ascertain the contextual variance in Chengdu. To investigate the contextual variations among different neighbourhoods in Chengdu, it specifically poses the question: to what extent do people’s subjective perceptions of sustainability issues differ from each other among different contextual neighbourhoods? How should bottom-up neighbourhood planning be implemented given the contextual variation among different neighbourhoods? It should be noted that as extensive inter-city variations exist, this research does not aim to provide a generic model for China. Instead, it aims to highlight the significance of considering the local character of each neighbourhood in the planning of sustainable neighbourhood.

2. Theoretical background

2.1. Sustainable neighbourhood development

A worldwide common method for developing sustainable neighbourhoods is practicing generic sustainability principles in either neighbourhood redevelopment or new neighbourhood planning. In recent decades, plenty of initiatives for appropriate planning at the neighbourhood level have been launched for local sustainability in advanced countries (Farr, 2011; Komeit & Srinivasan, 2015; Sharifi & Murayama, 2013). Currently, there is no specific criteria for neighbourhood sustainability, due to the ambiguities of both sustainability and sustainability assessment (Ness et al., 2007). But there is a wide consensus that sustainability has four main aspects in the context of urban planning: social (SC), environmental (EV), economic (EC) and institutional (IN) (Sharifi & Murayama, 2015).

In general theories, Gilbert et al. (2013) stated that ‘social sustainability requires that the cohesion of society and its ability to work towards common goals be maintained. Individual needs, such as those of health and well-being, nutrition, shelter, education and cultural expression should be met’. It includes maintaining the health (i.e., vitality, resilience and organization) and reducing the vulnerability of social and cultural systems (Bohile et al., 1994; Chambers, 1989; Ribot et al., 1996). At neighbourhood scale, it covers social interaction in the neighbourhood, safety and security, sense of place, community stability, participation in collective groups and networks in the neighbourhood etc (Berardi, 2013; Yigitcanlar et al., 2015).

Economic sustainability means using resources efficiently, wisely and responsibly for long-term benefits (Komeit & Srinivasan, 2015). At neighbourhood scale, economic sustainability includes jobs and opportunities, growing potential, smart efficiency, and so on. Zheng et al. (2015) argued that highly accessible job opportunities also foster a good self-sufficient neighbourhood. The temporal-spatial character of neighbourhood population turnover also reflects paradoxical ‘mobility-fixity tensions’ (Raco, 2007). Building modern information and telecommunication infrastructure are imperative for generating sustainable economic development and a high quality of life (Caragliu et al., 2011).

Environmental sustainability ‘seeks to improve human welfare by protecting the sources of raw materials used for human needs and ensuring that the sinks for human wastes are not exceeded, to prevent harm to humans’ (Goodland, 1995). At the neighbourhood scale, it covers site and outdoor environment, street and transport and energy efficiency, and so on. Outdoor air quality was included to relate poisonous air and uncomfortable smells threatening the physical health and safety of neighbourhood residents (Engel-Yan et al., 2005). Noise is a common and easily perceived factor disturbing people’s quality of day-to-day life (Siew, 2014) and low noise disturbance, mainly referring to traffic noise, is regarded as a good quality of outdoor environment contributing to neighbourhood sustainability (Bijoux et al., 2007) and improving its attractiveness (Williams & Dair, 2007). Access to facilities, open spaces and amenities addresses demographical equity through physical design (Kowalski et al., 2006).

Institutional sustainability refers to the agreements and strategies involved in the sustainable development concept that has been reached by institutional consensus. Institutional area include policy making, community engagement and partnership, and so forth. Following some worldwide institutional indicators, this research categorizes them into policymaking, engagement, and partnership. According to Lafferty (2006), governance for sustainable development concerns integrating core values and principles of sustainable development vertically within governments and finding effective ways to involve and mobilise civil society into the formulation and implementation of sectoral policies. For interaction between neighbourhood residents and authority, the patterns of interaction can be more contextually relevant and locally responsive in adapting to changing circumstances, which also promotes neighbourhood sustainability institutionally (Carmichael et al., 2005; Meek, 2008). Sustainable neighbourhood development cannot be limited to governments but has to be diffused into wider sectors of society through appropriate institutional agreements (Bäckström, 2006).

However, the viability of applying the existing general principles, regardless of in-depth consideration of local contextual features, has been questioned by many recent researchers (Kyrkou et al., 2011; Sharifi & Murayama, 2012). Further research advocates improving the development of neighbourhood sustainability principles by contextualizing the principles accordingly (Bond et al., 2012; Luederitz et al., 2013; Scholz & Tietje, 2002).

2.2. Residents’ subjective perception of neighbourhood sustainability

The importance of user’s subjective perception of the physical and non-physical aspects of the space or environment they live in has been highlighted in many studies (Attari et al., 2010; Campbell et al., 1976; Law et al., 2018; Wynne, 2015), in particularly on a neighbourhood scale. It is commonly recognized that the global strategy of sustainable development can only be realized if the public exactly implements the policy or behaves in a sustainable way by following the guidelines.
Specifically, neighbourhood sustainability is closely associated with people’s action and behaviour as they are closely related to people’s daily life, in particular the relationship between residential satisfaction. According to Campbell et al. (1976) and Low et al. (2018), the influence path among different attributes towards residential satisfaction on neighbourhood life and moving intention should be as follows: 1) objectives characteristics; 2) subjective perception; 3) subjective evaluation and 4) neighbourhood satisfaction. Besides, different personal characteristics may exist among the residents of different neighbourhoods. Given the above issues, investigating neighbourhood profile and the residents’ subjective perceptions on neighbourhood sustainability attributes are crucial. It is imperative to adapt and transfer the top-down sustainable plan into local actions through addressing people’s perception of sustainability. By reviewing residents’ perceptions or preferences, diverse characteristics of neighbourhoods have been ascertained for optimizing the neighbourhood planning and decision-making framework in both developed and developing countries, such as New Zealand (Saville-Smith et al., 2005), U.K. (Raman, 2010), Ireland (Howley et al., 2009), Malaysia (Azmi & Karim, 2012) and India (Bahadure & Kotharkar, 2015).

3. Neighbourhoods in China

3.1. The urban neighbourhood types in transitional China

‘Transitional China’ has become a popular term in both practical and academic domains of urban development since early 21st century. It spanned from urbanization, economic development, institutional reform and population growth, and so forth (Fan, 2003; Huang & Clark, 2002; Li et al., 2015). Particularly, the housing market reform has contributed to the emergence of a more mobile, heterogeneous and economically independent urban population (Bray, 2006). This transition has paralleled rapid urbanization from 20% in 1980 to 56.1% in 2015. Consequently, challenges such as declining social capital, urban sprawl, traffic congestion, environmental deterioration, declining urban culture, land overdevelopment and social inequality, etc., have put neighbourhood sustainability issues in the spotlight (Ma & Li, 2012; Shi et al., 2016). This highlights the urgency for advancing neighbourhood sustainability evaluation with the aim of enhancing sustainable development at the neighbourhood level.

Under dramatic economic reforms and rapid urban transformations, urban residential areas have undergone profound transitions in the past few decades. Due to the simultaneous comprehensive institutional reform and rapid urbanization, the transition of neighbourhood development had been gradually boosted as the mirror of a shifting housing system, local governance and urbanization demand. Since the reform and transformation occurred along different paths through different stages, Chinese cities are currently characterized by the coexistence of different housing types (Breitung, 2014). Generally, the types of urban neighbourhoods in transitional China include: Work-unit or Danwei compounds, commodity-housing estates and resettlement neighbourhoods (Li et al., 2012; Zhao & Zou, 2017). One of the major transitions is the ongoing diminishing of the old ‘Danwei (work unit)’ system, which is a planned economy era institution and a place of employment which provides working stations, as well as living accommodation. Commencing in 1998, the allocation of Danwei-based associated living spaces as welfare-oriented housing was terminated (Liu & Gong, 2015). To date, there are still large amounts of Danwei neighbourhoods accommodating staff from different organizations, such as the government, research institutes, universities, military and state-owned companies. Concurrently, there is evidence showing the increased adoption of the marketized commodity housing system in China since the central government announced the housing policy in 1979 (Zhou et al., 2016). As a result, the role of the state government in influencing urban residents’ social lives has been weakened since the dismantling of the Danwei system (Huang, 2006). Meanwhile, the mobility of urban residents from old traditional neighbourhoods to new commodity housing has increased.

Another transition of residential forms has been the emergence of resettlement neighbourhoods. As urban spaces have rapidly expanded, a large amount of rural land has been developed. Consequently, the original farmers have lost their farmlands and passively became urban citizens. A large number of resettlement neighbourhoods have been built to accommodate the affected ‘new urban citizens’ (Zhao & Zou, 2017). As a result, resettlement neighbourhoods extensively exist in newly urbanized, especially urban fringe, metropolitan areas. Some scholars argue that resettlement is a kind of involuntary or passive urbanization where the whole procedure is dominated by governments and the opinions of affected residents on critical issues such as relocation destination and neighbourhood planning are not taken into consideration (Zhang et al., 2017).

3.2. Study area

The city of Chengdu was selected for this study. This is not only because of its cultural and environmental representation as a traditional Chinese western metropolis, but also because of its outstanding political and pioneering position in contemporary urban development and its prestigious image as the ‘most liveable city in China’. As the capital of Sichuan Province, its history as a stable millennia civilization makes Chengdu a useful reference for investigating its urban planning and development throughout China history (Qin, 2015). In 2007, the central government launched the National Comprehensive Reform Pilot for Coordinated Urban–Rural Development and designated two pioneering cities, Chengdu and Chongqing, as pilot cities others could learn from (Abramson & Qi, 2011). Regarding population transition as an urbanization process, prior to 1978 when the reform began, urban-rural mobility was strictly limited due to the ‘urban-rural’ segregation of the Hukou system. The Hukou institution is a household registration system which categorizes citizens into urban (non-agricultural) and rural (agricultural) residents and stipulates the associated rights and welfare (Afridi et al., 2015). After the reform and opening-up, the urbanization pace began to boom and the Chengdu government was determined to integrate urban and rural development. The metropolitan area had been constantly expanding, especially in the past two decades (as shown in Fig. 1), with a greater population mobility to the central city of Chengdu. The proportion of population in different tiers of the Chengdu administrative area is shown in Table 1, which indicates the tendency of centralization of population during 2000–2007.

On the issue of neighbourhood development, the Chengdu municipal government initiated the ‘Building Sustainable Urban–Rural Neighbourhoods’ project to optimize neighbourhood development and governance and address local issues by utilizing local resources. The neighbourhood committee and social institution jointly apply for the project funding, which is less than 100,000 RMB (14,514 USD), from the Municipal Civil Affairs Department. The joint project team would be given one year to promote the sustainable neighbourhood development, and especially to cultivate social capital and promote public participation, with the aid of allocated funding. The Chengdu was the first and only metropolis in China where the project was undertaken. Since 2016, the Chengdu municipal government has invested around 20 million RMB (2,902,800 United States Dollar) to support more than 200 neighbourhoods in fostering sustainable neighbourhoods (Wu, 2018).

3.2.1. The selection of three different cases

These selected neighbourhoods are three of one hundred neighbourhoods that received municipal funding to practise ‘sustainable neighbourhood building’ as pilot projects in Chengdu. Generalizability of case studies can be increased by the strategic selection of cases (Ragin, 1992; Rosch, 1978). For purposive sampling, Seawright and Gerring (2008) argue that ‘diverse cases’ should be adopted as case selection methods if the research aims to illuminate the full range of variation of...
X, Y, or X/Y (X is the independent variable of theoretical interest and Y is the dependent variable of theoretical interest. Therefore, this study selected the most diverse and representative cases to reflect the general trend of transitional neighbourhoods in Chengdu, China. Given the three major types of transitional neighbourhoods stated above, two major criteria were adopted for the selection of the case study neighbourhoods for this research:

1) They should represent the types of transitional neighbourhoods in China as stated in 3.1
2) They should be one of the neighbourhoods where the pilot project ‘Building Sustainable Urban-Rural Neighbourhoods’ was implemented or being practised

Thus, Yulin, Xinyue and Jinyang were selected for the subsequent empirical study. They are typical neighbourhoods but vary in their periods of construction, size and location within the city (Fig. 2).

The Yulin neighbourhood is located in the downtown Wuhou district between Chengdu’s 1st ring road and 2nd ring road. It covers an area of 45 ha and consists of 11,027 inhabitants. As an old, traditional yard-form neighbourhood in southern Chengdu, Yulin encompasses 14 Danwei and 51 yards where employees from different Danwei and their families live. The origin of Yulin dates to the 1970s–1980s when the construction of building clusters started. However, it was not until 2001 that the Neighbourhood Residents Committee was established and started governing the neighbourhood.

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Table 1
Population (percentage) distribution in the three tiers of Chengdu. Data source: Chen and Gao (2011).

| Three tiers of Chengdu                  | 2000  | 2003  | 2007  |
|----------------------------------------|-------|-------|-------|
| Metropolis (first tier)                | 23.4% | 25.8% | 27.4% |
| Peripheries (second tier)              | 31.2% | 30.6% | 30.7% |
| Remote counties and towns (third tier) | 45.4% | 43.6% | 41.9% |

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Fig. 1. Satellite maps of the Chengdu metropolitan area on 1996/12/31, 2005/12/31, 2016/12/31. Data Source: Google earth.

Fig. 2. The location of the three neighbourhoods within Chengdu (2018). Source: Google Maps.
The Xingyue neighbourhood is located in a suburban area near the Chengdu Shuangliu International Airport. It is a typical resettlement neighbourhood constructed mainly to accommodate relocated residents after large-scale land acquisition or urban renewal. Due to its special background, the floating population, which refers to those citizens who left their original homes and live in other places, accounts for more than half of the total original population. Xingyue covers 39 ha and accommodates over 3000 inhabitants, among which 1100 households are resettled families. Prior to the urban renewal project, there were three different villages, including Wuduolian, Yue'er, and Sisheng (total 3.1 square kilometres) accommodating approximate 5000 affected residents. The majority of them chose to stay and wait for moving back to the original living place and only very few of them chose to move away when they were provided the compensation policy.

The Jinyang Northwest neighbourhood is located in western Chengdu, between the 2nd ring road and the 3rd ring road. It covers an area of 26 ha and accommodates 9794 inhabitants. It is a typical high dense commodity-housing neighbourhood. The ground floor shops are also diverse and provide a wide range of commodities and services. Most of the commodity-housing estates are gated communities built after 2000, which differ from the other two neighbourhoods. For the land use intensity, the plot ratio ranges from 3:3 to 4:1, which is the highest among the three neighbourhoods.

The physical transition of the Yulin neighbourhood in the past two decades was not as significant as the Xingyue and Jinyang. Its urban form in 2018 is almost the same as it was in 2000 except a cluster of newly built high-rise buildings at the bottom right corner. Xingyue, as a resettlement type neighbourhood, was built on a land slot that was previously farmland and is now surrounded by two arterial roads and nearby parks. Jinyang also experienced a significant transition from its origin as half farmland and half small clusters of traditional low-rise buildings to a mixed cluster of commodity housing properties. Fig. 3 illustrates the physical changes that have occurred in the three neighbourhoods in the past two decades.

Fig. 3. A satellite map of Yulin, Xingyue and Jinyang (from top to bottom) in 2000, 2009, 2018 (from left to right). Source: Google Maps.

4. Methodology

The flowchart of the study was shown in Fig. 4 and all methods were taken step by step and elaborated as follows:

4.1. Constructing a theoretical framework

The theoretical framework of this study was constructed through a comprehensive literature review of academic research and practical sustainability assessment tools. Among all the major NSA frameworks or tools, BREEAM (Communities), CASBEE (-UD), LEED (-ND), DGNB (-NSQ), TAHER and Beam Plus ND, see Table 2, were selected to identify themes, major factors and sub-factors, since they have been commonly used in similar research (Eith and Orova, 2015; Komeily & Srinivasan, 2015; Sharifi & Murayama, 2013; Sullivan et al., 2014). Beam Plus Neighbourhood Development (version 1.0) is an updated assessment tool developed by the Hong Kong Green Building Council for guiding the neighbourhood development project in the Hong Kong Special Administrative Region, China. It was considered because HKSAR is a part of China and its cultural context is similar to the mainland’s, even though there are differences in terms of the social-political context. Lastly, as the main comparative subject, the current Technical Assessment Handbook for Ecological Residence of China was selected as a reference for this study.

A comprehensive consolidation of all the indicators in the literature and the NSA tools was conducted. Some indicators that are for new projects were eliminated during the initial consolidation, because they cannot be used to evaluate how well the existing neighbourhood performed in enhancing sustainability. Initially, 4 main themes, 22 key sustainability factors and 98 sub-factors were shortlisted. Given the large number of shortlisted factors, the following four criteria were used to reduce or combine some of the sub-factors:

1) Mentioned in no more than two references (either academic or industrial)
The objective of criteria setting is not consistent with the research objectives
3) Not applicable to the neighbourhoods in China in terms of scale and content
4) Different sub-factors with overlapped meanings

Finally, there were 4 main themes, 17 key factors and 49 sub-factors left as the finalized research theoretical framework, as shown in Appendix A.

4.2. Questionnaire design, expert validation and sampling

The questionnaire survey was adopted as a major method for evaluating the residents’ perceptions of the sustainability performance of the different neighbourhoods. The questionnaire survey was regarded as a type of public engagement conducive to people-oriented planning, which is increasingly suggested by scholars (Collie, 2011; Gehl & Svarre, 2013). The target sampling size of the survey essentially depends on three factors: the resource available, the aim of the study, and the statistical quality needed for the study (Kelley et al., 2003). According to Kotrlik and Higgins (2001), a sampling size from 119 to 209 should be adequate for a survey study with the total population size from 4000 to 10,000.

The questionnaire survey was designed based on the sub-factors finalized above. The first part of the questionnaire consists of 40 questions, including 33 asking the residents’ perception of the sustainability performance using a 5-point Likert-scale and 7 asking the related attitudinal and frequency issues. The second part consists of 9 questions asking about the socio-demographic characteristics and overall satisfaction with neighbourhood life. Then eight experts were invited to validate the clarity, relevance and representation of the proposed questions in the survey. They were also asked to review the neighbourhood development of Xingyue, Yulin and Jinyang from the four sustainability-pillar perspectives. The profile of the interviewed experts is shown in Table 3.

4.3. Data collection

On-site interviews were adopted to collect the responses of 170 respondents in each of the neighbourhoods in April and September 2017. Random sampling was used in all three selected neighbourhoods and the selection of respondents was guided by the following criteria:
1) Aged 18 or above
2) Permanent resident of this neighbourhood and now living in this community (excluding commercial tenants or neighbourhood administrative staff)

Each questionnaire collection took about 20 min, including briefing the research background and marking his/her evaluation on the sub-factors. During the interviewing process, the interviewees and other involved neighbourhood residents were fully respected in terms of willingness and privacy protection. Those questionnaires with any missing items (not filled in by either the interviewee or interviewer) were considered as invalid and removed from analyses (Tang, 2006; Wancata et al., 2001). In addition, on-site observation of neighbourhood built environment was used to supplement the case study, particularly
discussing the results.

4.4. Data analysis

The collected data were analysed using a number of statistical techniques. These included Descriptive Statistics, Mean Score Ranking and one-way analysis of variance. The one-way analysis of variance (ANOVA) is used to determine whether there was any statistically significant differences between the means of three or more independent (unrelated) groups. IBM SPSS Statistics 19 English version was the primary software employed for dealing with the raw data.

5. Results

5.1. Comparison of respondents’ social-economic characteristics

From each of the three neighbourhoods, 170 samples were randomly drawn. The number of valid questionnaires from each neighbourhood was 160 (Yulin), 160 (Xingyue), 162 (Jinyang), and by dividing each by 170 a valid rate of 94.1%, 94.1%, and 95.3% respectively was obtained.

Table 4 shows the socioeconomic characteristics of the respondents in the three neighbourhoods. It shows that Jinyang has a larger proportion of youngsters, landlords, new inhabitants, and higher education, income and monthly expenditure among the three neighbourhoods. Yulin has a higher proportion of respondents who have lived there for longer than 10 years. Xingyue has the highest proportion of respondents with lower than 2000 RMB monthly incomes, lower than 3000 RMB household monthly expenditures and longer than 30 min of housing-job commuting time.

For all three neighbourhoods, the results reveal that those residents with non-local (outside Chengdu) Hukou account for the majority of the tenants (161 out of 188), while most of the respondents who have local Hukou (Chengdu) are landlords (243 out of 293). This is an indication that immigrants are generally the major source of tenants. For commuting time, most of the respondents indicated that their housing-job commuting time was less than 30 min (73.1% for Yulin, 64.7% for Xingyue and 75.8% for Jinyang).

5.2. Respondents’ perception of different factors of neighbourhood sustainability

Table 5 shows residents’ subjective perception of the good and poor sustainability performances of the three neighbourhoods. Additionally, several factors where there are significant variations among the three neighbourhoods are also shown. To identify the tendencies, respondents who indicated they agreed or strongly agreed were separated from the others. This comparable dichotomous split for self-stated agreement is adopted to interpret the tendency of the overall results (Mohan & Twigg, 2007; Parkes et al., 2002). ‘The agreement rate’ was used in the following parts for abbreviations of ‘the proportion of respondents who indicated agree or strongly agree’. For instance, the ‘agreement rate’ of ‘I am satisfied with the overall neighbourhood life’ in the Xingyue neighbourhood was 61.3%.

In total, more than half of the respondents (52.1%) indicated that they were satisfied or strongly satisfied with the neighbourhood life. This suggests that more than half the residents had a positive attitude towards their neighbourhood living experience. However, there is a variation among the three neighbourhoods: Xingyue had the highest mean value (3.67) and agreement rate (61.3%) while Jinyang had the lowest mean (3.31) and agreement rate (39.5%), with Yulin in between. The significant difference level using ANOVA testing is p < 0.05, suggesting that different types of transitional neighbourhoods offer different levels of quality of life to their residents. Regarding specific factors, ten in which the three neighbourhoods’ performance was significantly similar or different were selected for discussion, Fig. 5 below.

Some consistent patterns were identified through descriptive analysis. The result shows that all three neighbourhoods performed better in ‘Adequate and convenient community amenities’ (SC), ‘Accessible grocery, shopping and other consumption space near the neighbourhood’ (EC) and ‘Acceptable distance to the public transport station’ (EV). For these three factors, the agreement rate was above 85% in all the three neighbourhoods. ‘Accessible grocery, shopping and other consumption space near the neighbourhood’ had the best performance by residential agreement level among all the sustainability factors in the three neighbourhoods. The figure was 4.49 (97.5%) for Yulin, 4.69 (99.4%) for Xingyue, and 4.42 (93.2%) for Jinyang, respectively.

By comparison, ‘Active participation in collective activities’ (SC), ‘Will attend economic activities within the neighbourhood’ (EC) and ‘Opportunities to attend and express myself in the neighbourhood’ (IN) reflected the worse performance. The agreement rate was below 45% in all three neighbourhoods.

For factors which have obvious variations (differences between agreement proportion >20% and mean value > 0.4) among the three neighbourhoods, Xingyue performed better than the other two in ‘Opportunity to have social interaction within and without neighbourhoods (SC)’, ‘Feeling like a big family (SC)’ and ‘Satisfaction with the methods of publicizing information (EC)’.
6. Discussion and policy implications

Following the objectives of this research, neighbourhood sustainability performance is firstly discussed according to four different aspects: social, economic, environmental and institutional. Ten factors are brought forward out of a total of 33 for further discussion, as they are the aspects which have significant similar or different performances. Then respective sustainability performance is discussed from the perspective of different neighbourhood types. Lastly, several policy and planning suggestions are also proposed.

6.1. Social factors (SC)

6.1.1. Adequate and convenient community amenities

The results reveal that all three neighbourhoods provided very satisfactory amenities in terms of provision and convenience. The neighbourhood amenities in this study refer to the nearby clinics, schools, parks, supermarkets, and so forth, which benefit neighbourhood life and improve neighbourhood value. The provision and convenience of amenities are usually affected by the urban form and location.

Yulin Neighbourhood is a typical small-street grid area, as shown in Fig. 3. The ground floor of the buildings along the grid-road mainly include a centre for the elderly, banks, bars, fruit markets, medical services and even pet clinics, which enhance the residents’ accessibility to amenities. The Jinyang neighbourhood is located along Jinyang Avenue, which is an arterial road connecting 2nd ring road and 3rd ring road. The ground floor shops are also diverse and provide a wide range of commodities. In comparison, the location of the Xingyue neighbourhood is obviously different from the former two. However, although located in a suburban area, Xingyue’s good performance shows how a suburban and self-contained neighbourhood can still meet the residents’ demand for amenities and services, as shown in Fig. 6. This provides further empirical evidence supporting the benefit of a self-contained neighbourhood in socially promoting sustainability as advocated by Cervero (1995) and Murray (2004).

6.1.2. Opportunities for social interaction and networking and preference for a collective living pattern

These two factors are discussed together since Figs. 5–2 and Figs. 5–3 show that the Xingyue neighbourhood had highest score in both of them. Xingyue’s mean value and the agreement rate were significantly higher than Yulin’s and Jinyang’s, p < 0.001. This result is consistent with and can be interpreted by the circumstances described by Expert 2 and Expert 3. The experts described that most of the residents currently living in the Xingyue neighbourhood were previously farmers with rural Hukou. They once lived in a village community with strong collective sense of intimacy. Thus, many residents knew each other well before the resettlement project. In this sense, they retained the manners of old rural villages which was summarized as the ‘baseless society of acquaintance’ by Fei et al. (1992). Cumulative social capital is one of the critical elements of ‘baseless society of acquaintance’ for sustaining its normal interaction and governance. In such society of acquaintance, strong sense of collective intimacy is a critical characteristic of local governance. Most domestic affairs were ruled by traditional culture, manners and rather than by contemporary law. In the case of Xingyue, old rural manners and relationships within the new neighbourhood built a foundation for frequent social interaction and networking. According to Expert 3, although their living conditions and patterns rapidly changed to urban lifestyles after the resettlement project, their mindset and manners as well as other soft elements have not naturally and immediately adapted to an urban pattern. They still retain their rural and collective lifestyle to a large extent (Li et al., 2016), such as dropping in, chatting and playing Mah-jong together. Thus, it is reasonable that they still indicate a higher preference for a collective living style.

The Xingyue neighbourhood manifested a typical transition of living style from an older rural style to a newer urban one through resettlement. Xingyue’s best performance in this aspect of social sustainability demonstrated that urban renewal may not always lead to the destruction of existing social networks in China, although it was argued so in many previous foreign studies (Couch, 1990; Lee, 2003; Rothenberg, 1967). Thus, how the social sustainability of neighbourhoods was affected by the resettlement project can be contextual in China.

Table 5

The percentage of respondents who indicated agree or strongly agree to the different neighbourhood sustainability factors.

| Sustainability Performance                                    | Yulin (1) | Xingyue (2) | Jinyang (3) | ANOVA (Sig) |
|--------------------------------------------------------------|-----------|-------------|-------------|-------------|
| Number of valid surveys                                      | N = 160   | N = 160     | N = 162     |             |
| Social Factors                                               |           |             |             |             |
| Accessible and convenient amenities                          | 91.3%     | 86.3%       | 94.1%       | F = 7.535   |
| (percent >85% and mean value > 4)                            | (4.17)    | (4.01)      | (4.36)      | (0.001)     |
| Often participating in collective activities                 | 25.6%     | 33.8%       | 18.5%       | F = 2.794   |
| (percent <45% and mean value < 3)                            | (2.52)    | (2.68)      | (2.35)      | (0.062)     |
| Opportunity to have social interaction within and without    | 54.4%     | 75% (3.76)  | 52.5%       | F = 9.000   |
| neighbourhoods                                               | (3.30)    | (3.27)      | (0.000)     |             |
| Preference of the collective living pattern                  | 68.6%     | 78.1%       | 55.0%       | F = 10.282  |
| (percent >20% between any two)                               | (3.77)    | (4.06)      | (3.54)      | (0.000)     |
| Economic Factors                                             |           |             |             |             |
| Accessible grocery, shopping and other consumption space     | 97.5%     | 99.4%       | 93.2%       | F = 9.346   |
| near the neighbourhood                                        | (4.49)    | (4.69)      | (4.42)      | (0.000)     |
| Attending economic activities within the neighbourhood        | 15.0%     | 34.4%       | 14.8%       | F = 8.437   |
| (percent <45% and mean value < 3)                            | (2.22)    | (2.61)      | (2.07)      | (0.000)     |
| Satisfaction with public methods of information              | 38.8%     | 69.4%       | 43.4%       | F = 10.397  |
| (percent >40% or percent difference                          | (3.19)    | (3.64)      | (3.22)      | (0.000)     |
| >20% between any two)                                        |           |             |             |             |
| Environmental Factors                                        |           |             |             |             |
| Acceptable distance to the public transport station           | 95.0%     | 89.4%       | 89.5%       | F = 8.713   |
| (percent >85% and mean value > 4)                            | (4.33)    | (4.01)      | (4.30)      | (0.000)     |
| Institutional Factors                                        |           |             |             |             |
| Opportunities to attend and express myself in the            | 23.8%     | 22.5%       | 24.7%       | F = 0.759   |
| neighbourhood management meeting                              | (2.28)    | (2.29)      | (2.43)      | (0.469)     |
| Benefits of engaging external parties in neighbourhood       | 88.1%     | 90.0%       | 90.7%       | F = 1.536   |
| development                                                  | (3.45)    | (3.57)      | (3.39)      | (0.216)     |
| Overall satisfaction on neighbourhood life                   | 55.7%     | 61.3%       | 39.5%       | F = 10.731  |
|                                                           | (3.59)    | (3.67)      | (3.31)      | (0.000)     |
Fig. 5. Breakdown of respondents’ perception of different factors.
6.1.3. Active participation in collective activities

Interestingly, the respondents in all three neighbourhoods were less likely to participate in collective activities. Only 25.6% (Yulin), 33.8% (Xingyue) and 18.5% (Jinyang) of the respondents agreed that they often attend collective activities. It should be noted that this was the factor in which all three neighbourhoods had the poorest performance. It has been demonstrated that neighbourhood participation in recreational programming and general physical activity is associated with social cohesion (Cradock et al., 2009). Social cohesion is characterized by both the presence of strong social bonds and a lack of social conflict (Kawachi & Berkman, 2000). Thus, this result may be correlated with another area of poor performance, in ‘Attractive sport and cultural facilities or space’. Only 34.4% (Yulin), 44.4% (Xingyue) and 26.6% (Jinyang) of the respondents agreed that the sport and cultural spaces are attractive. The significant role a neighbourhood’s public space plays in enhancing public participation and social network was argued by Alexander (1965) five decades ago. The less attractive sports and cultural facilities are, the less likely it is that people will go and enjoy them, which reduces the degree of participation in collective activities. Since social cohesion is an element of social sustainability, promoting public participation in collective activities by improving neighbourhood open or recreational spaces can be reciprocal with enhancing social sustainability.

6.2. Economic factors (EC)

6.2.1. Accessible grocery, shopping and other consumption space near the neighbourhood

This factor is highlighted, since it has the best performance for all the three neighbourhoods. Fig. 7 shows the shopping areas (red area) within a 500-m radius (yellow circle) from the centre of the three neighbourhoods (yellow area). A buffering area with the radius of 500 m around target subjects was often adopted in density and built environment research (Hino et al., 2014). Fig. 7 illustrated that the main shopping areas of these three neighbourhoods were all located within walkable distance of the residential accommodations. Seik (2001) highlighted that planning neighbourhood amenities within a 10-min walking distance of all flats in the neighbourhood is very important. Thus, the best performance in all three neighbourhoods proves the positive effect of allocating accessible-by-foot facilities and amenities in satisfying the residents’ demand. By field observation, we also recognized that ground floor shops were abundant and diversified along or near the neighbourhoods. The shopping areas are all on lined streets, which also serve the neighbourhood’s internal traffic. The spatial relationship between street form and the concentrated lined shopping areas roughly followed the principles of ‘design internal streets’ and ‘restrict local shopping areas to the perimeter’ which were proposed by Perry (1929) 90 years ago.

Economic activities related to job creation, training and skills development, and personal growth are argued as significant socio-economic impacts with benefits for sustainable neighbourhoods (Seyfang & Smith, 2007). Figs. 5–6 shows that the mean value (2.61) and agreement rate (34.4%) of ‘participation in economic activities within the neighbourhood’ in Xingyue was higher than Yulin (2.22, 15%) and Jinyang (2.07, 14.8%). Among all the factors, several of the lowest scores of the three neighbourhoods lied on this factor. The economic activities include professional skills training and civic law workshops organized within the neighbourhood. As Expert 3 highlighted, most of the residents in Xingyue were previously rural citizens and were not equipped with modern working skills, like typing, using the Internet or speaking...
Putonghua (standard Mandarin). Once they moved into the newly built neighbourhood, they also had to adapt to the urban working style by learning basic skills and technology. Thus, the economic activities are sensitive and significant to the economic sustainability of those resettlement neighbourhoods whose residents experienced a transition from rural lifestyle to urban one.

6.2.2. Satisfaction with the methods of information publicity

Figs. 5–6 shows that respondents of Xingyue were more satisfied with information publicity and transparency than those living in the other two neighbourhoods. The access to information includes not only the Internet accessibility but also the information publicity, especially the access to job information which affects economic sustainability (Falk & Carley, 2012). In these three cases, the economic information publicity was mainly delivered by traditional methods. According to Experts 2, 3, 6 and the author’s field observations, the information disclosure methods adopted by the three neighbourhoods are mainly noticeboards publicity and weekly briefing meetings. Selected resident representatives play a connective role in information publicity and collection between residents and the Residential Committee (or Neighbourhood Governor). All three neighbourhoods have weekly briefing meetings involving the director of the Residential Committee, major senior managers, resident representatives and social institutional workers. Key issues and problems are discussed during the weekly meetings. What makes Xingyue a better neighbourhood in this respect is possibly its better arrangement in allocating communicators and utilizing social media. Expert 3 stated that a group of communicators, usually volunteers or staff from the NGO, are allocated to communicate with residents of each building. Each building unit’s public expenditures are shown on the noticeboards. Meanwhile, tools of social media were adopted to disseminate the information on policies or regulations, such as WeChat or Tencent QQ. Thus, the information accessibility and publicity can be better improved by utilizing the advantage of modern social media platforms.

6.3. Environmental factors (EV)

It is interesting to find that, among all four sustainability elements, environmental performance is better than the other three aspects in all three neighbourhoods.

6.3.1. Acceptable distance to the public transport station

To investigate the accessibility of surrounding public transport stations, the location and number of routes of each public station located within a 500-m radius from the centre of neighbourhood was calculated and illustrated in Fig. 8 below. The blue circles with a number inside represent the location of bus stops and the number of routes respectively, while some blue circles with the letter ‘M’ inside refer to the location of Metro stations. The results show that the number of stations (routes) for Yulin, Xingyue and Jinyang is 11 (49), 5 (32) and 13 (65) respectively. Clearly, the public transport stations provided near Yulin and Jinyang are denser than those near Xingyue.

People’s perception of ‘Commuting time between home and transport station’ are shown in Table 4. It shows the proportion of respondents who spent less than 20 min walking to transport stations are 75.6% (Yulin), 68.8% (Xingyue) and 88.1% (Jinyang). However, the degree of subjective satisfaction on ‘Acceptable distance to the public transport stations’ in Figs. 5–8 shows that all three neighbourhoods have highly satisfied the respondents in this aspect. 95.0% (Yulin), 89.4% (Xingyue) and 89.5% (Jinyang) of respondents indicated they are satisfied or very satisfied, respectively. This discordance between the distribution of nearby transport stations and user’s actual perception of accessibility is interesting. It demonstrates that the difference in spatial density of nearby station distribution does not linearly contribute to the difference of users’ actual satisfaction on the convenience of and accessibility to the public transport station. A walkable distance and adequate and concentrated bus routes can also satisfy the residents, as shown in the Xingyue case in Fig. 8.

Therefore, user-oriented planning of public transport nodes and adequate routes should be further explored in enhancing residential accessibility to public transport stations. This empirical evidence in China supplements the previous studies using accessibility measures to evaluate social equity in public transport provision (Church et al., 2000; Mannaugh & El-Geneid, 2012).

6.4. Institutional factors (IN)

6.4.1. Benefits of engaging with external parties in neighbourhood development

‘Benefits of engaging with external parties in neighbourhood development’ has the best performance under institutional dimension. Promoting neighbourhood sustainability requires a high level of integration of disciplinary insights and stakeholders’ perspectives (Conte & Monno, 2001) and experts from various disciplines must be able to communicate and share knowledge effectively (Mayer et al., 2005). This factor closely correlates with the ongoing municipal project of ‘Building Sustainable Urban-Rural Neighbourhoods’ in Chengdu. This result indicates that most respondents have a positive attitude towards the efforts and endeavours of engaging external bodies brought by the project. It also reflects that neighbourhood residents’ perceptions of the involvement of external parties, such as charity organization, university, and companies, is favourable and open. This is a very important public channel.
for cultivating multi-stakeholder partnerships and collaborative modes of sustainable neighbourhood development. Additionally, the relatively higher degree of agreement of Yulin (88.1%), Xingyue (90.0%) and Jinyang (90.7%) indicated that engaging external parties in neighbourhood development is very important regardless of the differences in neighbourhood typology and demographic profile.

6.4.2. Opportunities to attend and express myself in the neighbourhood management meeting

‘Opportunities to attend and express myself in the neighbourhood management meeting’ is one of the poorest performances of the three neighbourhoods. Public participation in the neighbourhood decision-making process has been regarded as one of the key institutional sustainability criteria (Spangenberg, 2002). In this case, according to Experts 3 and 6, only representatives can participate in the weekly neighbourhood meeting, thus the other residents were not able to directly express their thoughts during the decision-making procedure. Interestingly, from the neighbourhood manager’ perspective, the senior manager of the Xingyue neighbourhood (Expert 3) clarified that engaging all the residents in the meeting was not effective and constructive in solving problems. He justified this, stating that the duration of meetings is very limited and the neighbourhood managers and the committee members cannot manage to talk to everyone individually. To enhance the information dissemination and collection, they advocated communicators to carry out a connective role between committees and residents to facilitate the discussions. From the residents’ perspective, they regarded the communicators as more reliable and trustworthy people who can share the true thoughts. Thus, the low degree of direct public participation shown in Figs. 5–10 was arguably reasonable. However, it is doubtful that the low presence of the residents in public participation, such as public hearings, necessarily leads to ineffectively incorporation of neighbourhood input into policy making process. Enserink and Koppenjan (2007) argued that participation can either be direct by the public or through legitimate intermediate institutions or representatives. Thus, deeper understanding of contextual situation in local governance is required to enhance institutional sustainability.

6.5. Policy implications

Apart from following the municipal-level guideline, contextual variations should be considered in policy making for developing sustainable neighbourhoods. Generally, implementing the principles of ‘Retaining most old neighbours’ and ‘Nearby resettlement’ may help in mitigating the negative impact and improving the social sustainability of the resettlement neighbourhood. The field study and interview reveal that sustaining the pre-resettlement social network works well in promoting current social interactions. Old social network, kinship and its derived domestic interaction, to some extent, can be retained, rather than largely destroyed. ‘Nearby resettlement’ was highlighted as another characteristic conducive to keeping existing social networks. Considering the statements of Experts 2 and 3, it is important to enable most original inhabitants to be resettled back into new and nearby neighbourhoods. During the transitional period (2007–2011), each affected resident was allocated a monthly stipend of 300 RMB (45 USD) as a transitional housing allowance. This turned out to be an effective method for retaining the existing social network during the urban renewal procedure.

Proposing differentiated social sustainability consideration and keeping good environmental sustainability performance is imperative in enhancing overall neighbourhood sustainability of the commodity housing neighbourhood. The higher degree of neighbourhood attachment is perhaps attributable to the residents’ higher satisfaction with the provision of amenities and other physical environments rather than daily face-to-face interaction. A similar circumstance was identified in a study conducted in Guangzhou (Zhu et al., 2012). Since residents enjoyed more privacy in new commodity housing, to what extent face-to-face social interaction should still be an essential condition of cultivating sense of belonging in China is questioned. This is similar to findings in other foreign neighbourhoods (Rosenblatt et al., 2009). Thus, reviewing the environmental and psychological consideration in the physical design of commodity neighbourhoods is necessary.

Policy should address declining social capital, increased heterogeneity and changes of residents’ perception, including preference and demand of those who live in the traditional Danwei neighbourhood. The largest proportion of long-term living respondents and a growing number of non-locals and tenants suggest the urgency of addressing heterogeneity challenges, such as old-new and owner-tenant relationships, in policy making. Institutionally, Jinyang is still at the transition stage of neighbourhood management between CRC system and Real Property Management Enterprise (RPME) autonomy. To facilitate the establishment of RPME is essential for promoting neighbourhood institutional sustainability. Generally, to cope with the decay of both physical (living conditions) and non-physical (social capital) aspects (expert 4), effectively engaging tenants and immigrants in policy making process should be a priority.

7. Conclusion

To efficiently advance sustainable neighbourhood development in China, identifying the contextual characteristics of different types of neighbourhoods is becoming crucial. This study provides useful insights for planners by addressing how perceived sustainability differs by neighbourhood typology and what contextual factors should be considered in promoting neighbourhood sustainability. In fact, this study does not aim to identify a list of universal sustainability factors for enhancing sustainable neighbourhood performance for different neighbourhoods in Chengdu. The findings suggest that different neighbourhoods faced different contextual sustainability problems thus unique context-specific characteristics should not be neglected when universal sustainability principles are implemented. It advocates that sustainable neighbourhood development should be an adaptive and pluralistic action process rather than an extensive top-down citywide and general practice, regardless of each neighbourhood’s context. This neighbourhood planning model could be adopted in other cities facing similar transitions and rapid urbanization in China.

The investigated similar patterns of sustainability performance showed neighbourhood infrastructure and public engagement with Chinese characteristics should be emphasized in cultivating sustainable neighbourhoods. Specific contextual issues that were identified reflect that different types of neighbourhoods should pluralistically pursue sustainability. For traditional Danwei neighbourhoods, ‘rebuilding the neighbourhood identity’ and ‘enhancing public participation’ should be a priority. For the resettlement neighbourhood, ‘retaining most old neighbours’ and ‘nearby resettlement’ are important principles. Regarding the commodity housing neighbourhood, ‘promoting effective autonomy’ conducive to social interaction and inclusion should be its priority.

The findings support the advocacy of considering local contextual variation in improving the development of neighbourhood sustainability principles (Bond & Morrison-Saunders, 2013). It also supplements the development of neighbourhood sustainability assessment tools in China. Several findings also provide different perspectives for future research. For instance, exploring how the neighbourhood attachment and sense of belonging in modern commodity housing neighbourhoods can be fostered is the topic in point. This is associated with the capacity of collective action or emergent mobilization, which turned out to be critical in fighting the ongoing COVID-19 pandemic. With the dismantling of the Danwei, Danwei compounds or neighbourhoods are experiencing massive transitions. How can we achieve the balance among securing private rights, meeting market demand and maximizing public interests by delivering a sustainable transition? Practically, it suggests
that local authorities and urban planners should break the upper-level plan or policy down into adaptive strategies for sustainable neighbourhood development. The contextual variations discovered in this study provide specific references for the corresponding government departments to addressing the importance of local level sustainability and the need for integrating bottom-up participatory neighbourhood planning in policy makings and implementations by incorporating local residents’ perceived sustainability.

CRediT authorship contribution statement

Qi Zhang: Conceptualization, Methodology, Software, Visualization, Data curation, Writing - original draft. Esther Hiu Kwan Yung: Writing - review & editing, Methodology, Supervision. Edwin Hon Wan Chan: Investigation, Supervision.

Declaration of competing interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.habitatint.2020.102204.

Appendix A. Finalized theoretical framework

| Main Themes                        | Factors                          | Sub-factors                                      | Description of the factor | References                      |
|------------------------------------|----------------------------------|--------------------------------------------------|----------------------------|---------------------------------|
| Social                             | Social culture and capital       | Cultural Events and Festivals                     | Events and festivals were randomly organized to sustain the cultural root. | CASBEE-UD (2014). |
|                                    |                                   | Conservation of Cultural Assets: Preservation and Restoration of Historical Legacies and Buildings | Respecting local landmarks and conserving material as well as cultural resources by encouraging the conservation of historical legacies. | Beam Plus Neighbourhood (2016); TAHER (2011); CASBEE-UD (2014). |
| Quality of life                    | Social Interaction and Functional Mixed | Social Interaction and Functional Mixed | Mixed-use neighbourhoods are conductive to social interaction and mingling of the community within walking distance. | Beam Plus Neighbourhood (2016); DGNB-NUD (2012). |
| Affordable and Diverse Housing Provision | How well is the building condition and what is the rate of repair. | Housing Condition and State of Repair | Good quality of open space in terms of materials, equipment, and accessibility. | Beam Plus Neighbourhood (2016); BREEAM Communities (2012); LEED-ND (2016). |
| Quality of Open Space              | Good quality of open space in terms of materials, equipment, and accessibility. | Quality of Open Space | Essential facilities (school, clinic, etc.) are provided within accessible and safe walking distance. | Beam Plus Neighbourhood (2016); BREEAM Communities (2012); DGNB-NUD (2012). |
| Delivery of Services, Provision of Facilities and Amenities and Their Convenience | Provision of housing, services, facilities and amenities, which are based upon the local demographic trends and priorities. | Social Inclusion and Equity | Enhancing connectivity and accessibility both for current and possible future residents. | BREEAM Communities (2012); Beam Plus Neighbourhood (2016); DGNB-NUD (2012). |
| Sense of place and Community Identity Security | Public art or other cultural programs were provided to enhance the sense of place. | Disaster Prevention and Response Ability | Security measure including night lighting, monitorable characteristics from the periphery, security cameras, and security patrol system in the block is arranged. | Beam Plus Neighbourhood (2016). |
| Building Security                  | Installing security equipment which consists of security system and | Traffic Safety | Establishing sidewalks and separating the pedestrian and vehicles for securing pedestrian safety and existence of plans of movement lines. | Beam Plus Neighbourhood (2016); TAHER (2011); CASBEE-UD (2014); DGNB-NUD (2012). |

(continued on next page)
| Main Themes | Factors | Sub-factors | Description of the factor | References |
|-------------|---------|-------------|---------------------------|------------|
| Economic    | Jobs and Opportunities | Local Training and Skills | Surveillance camera in common area, elevator with 24-h employment. | Turcu (2013); Young and Church (2014); BREEAM Communities (2012); LEED-ND (2016); DGNB-NUD (2012); CASBEE-UD (2014). |
|             | Housing and Job Proximity | Proximate housing and employment opportunities. | Zhao et al. (2011); Turcu (2013); LEED-ND (2016); DGNB-NUD (2012). |
| Growing Potential | Population Growth and Staying Population | Cooperative Activities | The cooperative activities with the area include an approach based on collaboration between government, industry and academia, a cooperative business with company in and around the block, and a cooperative approach with residents in and around the block. | Williams and Dair (2007). BREEAM Communities (2012). |
|             | Economic Inactivity Rates | The percent population of the people who are not in employment or unemployed. | Sharifi, A., & Murayama, A. (2013); Manzi et al. (2010). |
| Land Use    | Compact Development | Encouraging daily walking, biking, and transit use, and support car-free living by providing access to diverse land uses. | Yigitcanlar et al. (2015); Burton (2000); LEED-ND (2016); DGNB-NUD (2012); TAHER (2011). |
| Commercial Information Establishment Types | Performance | The different types of commercial organization have been established. | Yigitcanlar et al. (2015); Sutton (2010); Beam Plus Neighbourhood (2016); CASBEE-UD (2014); DGNB-NUD (2012). |
| Environmental | Site and Outdoor Environment | Outdoor Thermal Environment and Urban Heat Island Effect | Shaded and covered routes and sitting area is provided. | Zhu and Lin (2004); Beam Plus Neighbourhood (2016); LEED-ND (2016); BREEAM Communities (2012). |
|             | Outdoor Air Quality | This mainly refers to the air quality of outdoor open space. A buffer distance between any open space within the site and the nearest road or highway. | Engel-Yan et al. (2005); Beam Plus Neighbourhood (2016); BREEAM Communities (2012); TAHER (2011). |
|             | Noise | The location of buildings will help minimize the noise. Some approaches have been adopted to mitigate noise as well. | Siew (2014); Bijoux et al. (2007); Williams and Dair (2007); Beam Plus Neighbourhood (2016); BREEAM Communities (2012); DGNB-NUD (2012); TAHER (2011). |
|             | Universal Access | Preferably on flat land or land carefully designed for visual and spatial connections with gradient or slope with due consideration given to universal access. | Barton (2000); Burton (2000); Beam Plus Neighbourhood (2016); LEED-ND (2016). |
|             | Accessibility to Open Space, Green Space and Blue Assets. | The open space, green space and blue assets, which refers to water features, are accessible to residents. | Burton (2000); Beam Plus Neighbourhood (2016); LEED-ND (2016). |
|             | Ecological and Biodiversity | Ground and Roof Greenery | A specific area of green is arranged. Greening is performed mainly with native species that originally lived in this area. Shared or public open space such as planted or wild areas that are sufficiently large to be ecologically viable. | Moldan et al. (2012); Bernstein (2014); CASBEE-UD (2014); BREEAM Communities (2012); Beam Plus Neighbourhood (2016); TAHER (2011); |
| Street and Transport | Safe and Appealing Streets | Motivating mutual interaction and cultivating a positive sense of place by enhancing the safety and vitality degree of the street. | Li et al. (2005); Cubukcu (2013); BREEAM Communities (2012); DGNB-NUD (2012). |
|             | Cycling Network and Facilities | Promoting cycling as a leisure activity and as alternative to vehicle driving by providing a safe and efficient cycle network. | Williams and Dair (2007); BREEAM Communities (2012); CASBEE-UD (2014); Environmental; DGNB-NUD (2012); Beam Plus Neighbourhood (2016); BREEAM Communities (2012). |
|             | Low Carbon Transport | To reduce pollution generated by car use and provide viable alternatives to car ownership. | Stubbis (2002); Williams and Dair (2007). |
|             | Walkable Street and Pedestrian-Oriented | To promote walkability, livability and reduce vehicle distance traveled. | Williams and Dair (2007); LEED-ND (2016); DGNB-NUD (2012). |

(continued on next page)
| Main Themes | Factors | Sub-factors | Description of the factor | References |
|-------------|---------|-------------|---------------------------|------------|
| Access to Public Transport | Rain Water Management | Taking measures to reduce the risk of flooding caused by either rain to the neighbourhood and the surrounding areas. | Ellis (2013); Morales-Pinzon et al. (2015). |
| Public Transport Facilities | Resource Cycling and Water Circulation System and Reused Infrastructure Building Reuse | Encouraging the reuse of old buildings to extend their life cycle, reduce waste and environmental harm from materials manufacturing as well as transport for building new buildings. | Turcu (2013); Messari Becker et al. (2014). |
| Multiple Transit Types | Resource and Materials | The Adaptive Reuse of Historic Resource | Balaras et al. (2004); Bromley et al. (2005). |
| Energy Efficiency | Energy Strategy, Energy Efficiency Infrastructure and Renewal Energy | An energy strategy has been issued to incorporate renewable energy type, such as solar, wind or biomass in production capacity. | LEED-ND (2016); TAHER (2011). |
| Solar Orientation | Building Reuse | Arranging and designing passive and active solar strategies. | Neuff (2005). |
| District Heating or Cooling | Waste and Pollution | Light and Dust Pollution | Dales (2002). |
| Integrated Waste Management (Water, Solid Waste) | Institutional | Policy Making | Consistency with The Upper-Level Planning | The development is consistent with and utilization of urban infrastructure which was included in the upper level plan. | Shen et al. (2011); Lafferty (2006). |
| The Integrated Decision Making | | | | Spangenberg, Pfahl and Deller (2002); Kears and Forrest (2000); Spangenberg et al. (2002). |
| Local Authority Services | Community Engagement and Partnership | Community Engagement in Planning and Management | Whether the community was engaged within the neighbourhood planning and management process. | Carmichael et al. (2005); Meek (2008); Barton (2000); Backstram (2006); Kears and Forrest (2000); Turcu (2013). |
| Collaborative System for Area Management | | | | Backstram (2006); Kears and Forrest (2000); Turcu (2013). |

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