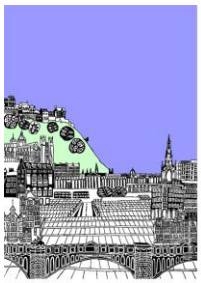

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Evaluation of Social Dimensional Sustainability of Built Environment in the Poor Rural Areas of China

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Abstract: Research and practices on the tremendous rural construction and restructuring in China show that the social dimension of sustainability is crucial for rural development. However, most conventional built environmental sustainability assessment tools (BESATs) are mainly focused on environmental sustainability and building performance. The assessment method of social sustainability in rural built environment is incomplete. This study reviews the concept of social dimension of sustainability and its application in architecture. Maslow's hierarchy of needs is also applied to further understand human needs in social sustainability. Conclusions on the key issues of social dimensional sustainability of built environment are then provided. Several existing BESATs are then analysed and compared to identify their features and gaps in the assessment of social dimensional sustainability. A series of indicators of the social dimensional sustainability of built environment is concluded and discussed in combination with the current situation and challenges in poor rural areas in China. Compared with conventional BESATs, the social dimensional sustainability assessment method proposed in this study highlights the working process and future potential. This conclusion provides a new understanding and method for assessing the sustainability of rural built environment.

Keywords: endogenous development, sustainable development, mountainous rural areas

Introduction

China's top-down rural construction and development policies have been implemented for more than 10 years. Infrastructure in rural areas, especially transportation, improved significantly during this process of rural construction and restructuring. However, several problems, such as the degradation of ecosystem and reginal culture, bring new challenges to the sustainable development of rural areas. In urban areas of China, conventional built environmental sustainability assessment tools (BESATs), such as Assessment Standard for Green Building (ASGB), emphasize environmental dimensional issues, such as water, energy, and resource saving (MOHURD, 2014). By contrast, the indicator commonly used to evaluate rural development is an economic dimension including per capital income. However, social dimensional sustainability is significant for rural development. Researchers lack a comprehensive understanding of the sustainability of the built environment of poor rural area in China, especially social dimensional sustainability. The social dimensional sustainability of rural built environment should be systematically understood. Moreover, evaluation indicators for China's rural construction and development should be developed.

Challenges in the assessment of social dimensional sustainability of BESAT in poor rural areas in China

Key issues in social dimensional sustainability in BESAT

The early stage of development of BESAT dealt with the concept of "green building," which mainly focused on environmental protection and resource preservation. The concept of sustainability emerged in 1987 when the Brundtland Report defined sustainable development as "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (World Commission on Environment and Development, 1987) This definition include a broad range of issues that play an important role in ensuring that future generations can provide for themselves. The three dimensions of sustainability, namely, environmental, social, and economic, are universally recognized. The concept of "green building" then evolved into "sustainable building." (Cole, 2003)

Social dimensional sustainability aims to improve human development and human rights. "Human needs" was highlighted in the definition of sustainable development. This concept can be classified according to Maslow's (1943) five-level hierarchy. Therefore, the social dimensional sustainability should consider and support different levels of human needs.

In a study of BESATs for developing countries, Gibberd (2003) reinterpreted the concept of sustainability and its application in the architectural field. The key points of building sustainability were summarized in this study and established a Sustainable Building Assessment Tool (SBAT) for South Africa. Another representative BESAT is the SBTool developed by the Canadian International Initiative for a Sustainable Built Environment team. SBTool is an indicator framework for building performance assessment that may be used by third parties to develop rating systems relevant to local conditions and building types (Larsson, 2016).

Based on the theory of human needs and the study of the SBAT and SBTool, the key issues of social dimensional built environmental sustainability are summarized as follows.

Table 1 Key issues of social dimensional built environmental sustainability

Human needs	**Social dimensional sustainability issues of built environment**
Level 1. Physiological needs	**1. Health and comfort**: Ensures that built environment can meet the basic physiological needs of occupants and be good for occupants' health.
Level 2. Safety needs	**2. Safety and security**: Ensures that the built environment supports safety of occupants.
Level 3. Love and belonging needs	**3. Culture and heritage**: Ensures that the heritage value of existing cultural relics and intangible cultural heritage is maintained. **4. Accessibility**: Provides increased access to social capital, such as information, technology, and communications.
Level 4. Esteem needs	**5. Inclusiveness**: Ensures that the process and outcome of the built environment consider the benefits of different groups of people.
Level 5. Self-actualization needs	**6. Participation**: Ensures that the process and outcome of the built environment support partnerships, social interaction, and involvement, and are influenced by the people it affects. **7. Education**: Ensures that the process and outcome of the built environment improve the levels of education and awareness.

Scholars argued that the systems used in different countries should not be generalized because of the diversity of environmental, social, and economic conditions and the availability of local materials. Assessment criteria based on local conditions and development needs

should be added to compromise this gap (Ismail et al, 2015). The sustainable development of a place can only be achieved if the specific context of that place is considered (Crawley et al, 1999). Therefore, existing studies and assessment tools can provide a systematic and comprehensive understanding of social dimensional sustainability of built environment, which can be used to guide the establishment of BESATs in poor rural areas of China.

Transformation of rural development in China

China has a vast territory and a large population of 1.3 billion. In 2015, 43.9% of the population in China lived in rural areas (National Bureau of Statistics of China, 2016). A widening gap between urban and rural areas emerged with the rapid development and urbanization of China in recent years. Under the New Countryside Construction policy launched in 2005, the government increased its funding for rural infrastructure construction. This modernization development model significantly improved rural life and urban–rural integration in several flat rural areas near cities. However, this model is not suitable for most of the poor rural areas that exhibit the following characteristics:

- Mountainous areas where the distribution of population is increasingly dispersed
- Ecological fragile regions, which feature harsh natural conditions, shortage of water resources, and frequent natural disasters
- Low infrastructure development and living environmental quality
- Minority group occupation with a relatively low educational level
- Presence of elderly and children because of migration to urban areas to find work (Qiu, 2009; Chen et al, 2007; Li et al, 2009)

These situations helped preserve several unique regional cultures by limiting outside access to their living environment, but they also contributed to geographical and psychological marginalization. Therefore, the poor rural areas of China faced several challenges in terms of social sustainability:

- Low level of built environmental quality (uncomfortable and unsafe)
- Local construction materials, technology, and culture cannot be inherited and innovated because of the rural settlement hollowization and the impact of industrialization
- Limited access to public service facilities, information, and education
- Low level of villagers subjectivity and engagement during the village construction because of the top-down management and rural settlement hollowization

A critique of rural modernization that focuses on the problems of over-production, environmental degradation, and spatial inequality developed in Europe and other developed regions as early as the 1970s (Woods, 2011). In the early 1990s, the term “eco-village” was first defined by Gilman (1991) as a “human-scale full-featured settlement in which human activities are harmlessly integrated into the natural world in a way that is supportive of healthy human development and can be successfully continued into the indefinite future.” The eco-village movement began to coalesce after the Global Ecovillage Network (GEN) was formed in 1995. The network created the Community Sustainability Assessment (CSA) tool to provide measuring rods for individuals and to enable existing villages and communities to compare their current status with ideal goals for ecological, social, cultural, and economic sustainability. In the CSA tool, 19 of the 35 assessment issues consider social dimension, such as participatory design, social practice, and cultural practice (GEN, 2014).

The Chinese government proposed the construction of The Beautiful Countryside in 2013. This project was based on the summary and criticism of New Countryside Construction

and the influenced by the new theory of rural development. This rural policy especially stressed the value of natural environment and regional culture to achieve sustainable rural development (Chen et al, 2014). Professor He (2015), who studied rural policy and management, argued that large-scale and mechanized cultivation is not suitable for poor rural areas that have small pieces of lands located in mountainous areas. Most rural residents who work in urban area will return to rural areas when they age because urban areas cannot provide them with decent life given the current level of urban development. Therefore, Chinese rural development should provide adequate economic and social support to small-scale peasant economy and aged farmers to empower them rather than introduce agriculture business entities from urban areas.

These new rural policies and studies in China echo the eco-village concept mentioned above. The eco-village concept that highlights social dimensional sustainability is suitable for maintaining the vigor and the cohesive force of the poor rural areas and increasing the life control of the rural residents. This concept respects the unique features, resources, and limitations of poor rural areas and aims to solve the problem through local actions and social capitals rather than copying the industrialization model.

Challenges in applying the social dimensional indicators of BESATs to poor rural areas of China

Most of the widespread BESATs are based on the urban context. By contrast, the research and application of BESATs in rural areas are limited. Newman (2013), a Leadership in Energy and Environmental Design accredited professional (LEED-AP), found that LEED did not work in rural Africa. He suggested that social factors should be considered in the sustainability assessment of buildings in Africa. Similarly, a study that assessed the sustainability of the built environment in mountainous rural China also found that social dimensional sustainability is not sufficiently considered in existing BESATs (Wan et al, 2016). The disadvantages of the lack of systematic social dimensional sustainability assessment in rural BESATs are gradually revealing themselves, particularly in developing countries such as China.

Several analyses of different BESATs were conducted to further investigate the gap in the social dimensional sustainability assessment in poor rural areas of China. ASGB 2014 version was selected because it is the major building environmental assessment method in China. SBAT Residential 1.04 from South Africa was included because it is the first assessment method established for developing countries and employs three dimensions of sustainability (GAUGE Performance Architecture, 2016). CSA was also investigated to provide a different perspective on the development of rural community.

The first analysis aims to investigate the importance of social dimensional sustainability in each BESAT. The indicators of each BESAT are classified into different dimensions of sustainability. The percentage of scores of social dimension is calculated and displayed. The result of the first analysis (Figure 1) confirms that BESATs for urban areas, such as SBAT and ASGB, put less consideration in social dimensional issues than BESATs for rural communities, such as CSA. ASGB emphasizes the environmental dimension. SBAT puts a relatively equal attention to issues related to the three dimensions. In CSA, social dimension is deemed the most important dimension. Results show that the consideration of social dimensional issues in conventional BESATs is insufficient for rural areas.

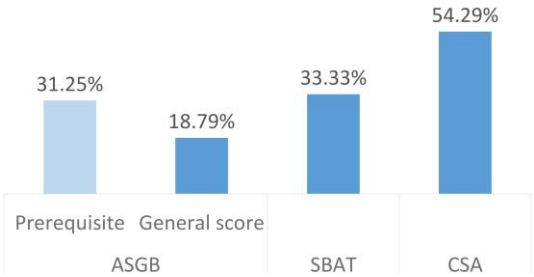

Figure 1. The significance of social dimensional issues in different BESATs

The second analysis aims to investigate whether the social dimensional indicators of the existing BESATs can address social dimensional sustainability issues comprehensively and reveal the applicability of social dimensional indicators of each BESAT. The social dimensional indicators of ASGB, SBAT, and CSA are classified into different issues of social dimensional sustainability according to Table 1. The percentage of scores of each issue are calculated and displayed in a bar chart. The indicators of each bar are analyzed to determine whether they are applicable to a typical rural village in poor rural areas of China. The outcome is displayed in terms of the percentages of applicability and inapplicability of indicators. The weighting for operation evaluation of residential building is selected in ASGB with a weighting system. Prerequisite indicators are calculated separately in ASGB with prerequisites.

The result of the second analysis (Figure 2) shows that ASGB significantly focuses on health and comfort issues, but not on other social dimensional issues. Furthermore, a huge proportion of social dimensional indicators of ASGB are not applicable to poor rural areas of China. Moreover, SBAT put less consideration on safety, cultural and heritage, and participation issues. More than half of the indicators are not applicable to poor rural areas of China.

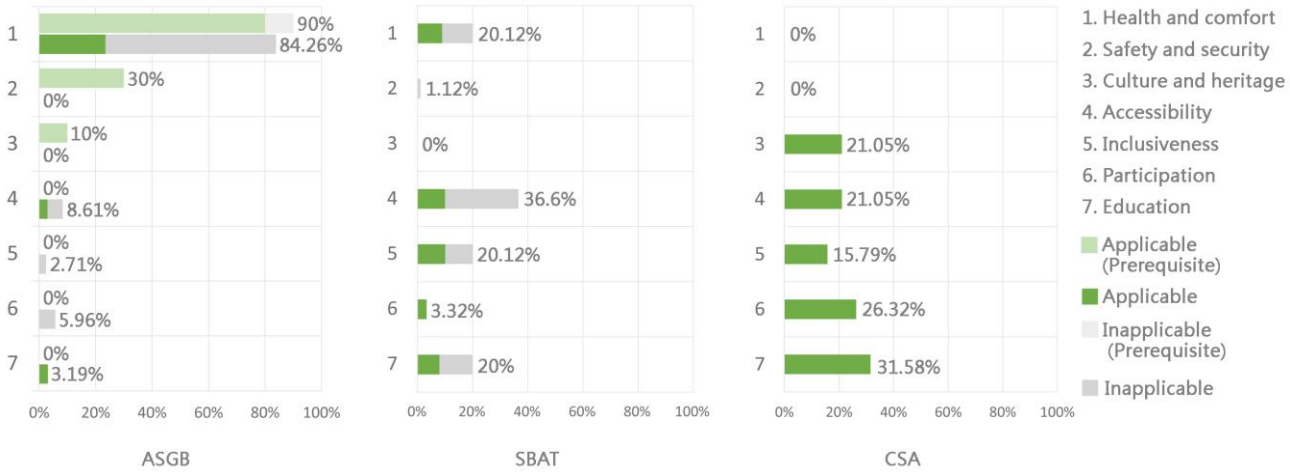

Figure 2. BESATs' emphasis on different key issues of social dimensional sustainability and their applicability

One of the main reasons for this inapplicability is the different scales and structures of the rural community in poor rural areas. Rural communities are usually located in mountainous areas where the distribution of poor population is increasingly dispersed. The indicators that evaluate the distance from the site to public service facilities, for example, "the distance from the site to the nearest kindergarten should be less than 2000 meters,"

cannot be satisfied in most of the poor rural areas of China. Another reason for inapplicability is the lack of indoor environmental quality (IEQ) standards for vernacular buildings in rural China. Studies showed that the environmental tolerance of occupants cannot be standardized because they are adapted to different climate zones and lifestyles (Nicol et al, 2002). Therefore, the simple requirement of a certain range of indoor air temperature in conventional BESATs cannot be directly applied in rural areas in China.

By contrast, CSA highlights the issues that are neglected in ASGB. In addition, CSA provided several qualitative and procedural evaluation indicators and methods that do not exist in SBAT and ASGB. CSA has the best applicability because it is designed specifically for rural communities. The limitation of CSA is that most of the indicators are not quantifiable. Several indicators, such as "natural and traditional healing methods," are not directly relevant to the built environment.

These analyses and comparisons identify several problems in the application of existing BESATs to rural areas in China in terms of social dimensional indicators.

First, the consideration and weighting of social dimensional issue in rural community should be higher than that in urban community. The evaluation should not only focus on health and safety issue, but should also consider other key issues of social dimensional sustainability.

Second, the evaluation method of the IEQ for rural areas should differ from that for urban areas. People in urban areas people spend most of their time in building environment with artificial control equipment. Therefore, a delicate IEQ assessment standard based on urban building environment and modern heating, ventilation, and air conditioning systems has been established for urban buildings. However, rural residents spend more time in outdoor environment. The IEQ of their houses mainly rely on passive strategies, such as natural ventilation, solar heating/shading, and natural daylighting. Moreover, some IEQ indicators require specific computer software or monitoring equipment to complete the assessment process. These methodologies cannot be easily implemented in rural areas, particularly in poor rural areas. The identification of simple but representative indicators and the simplification of the calculation method are significant issues in the research of rural built environmental sustainability assessment. Therefore, new evaluation methods should be developed to ensure sufficient flexibility for various local situations.

Third, unlike conventional market-based BESATs that have a comprehensive registration, consultation, evaluation, and certification system, BESATs for poor rural areas of China do not only aim to provide solid results, but more importantly, to provide a reasonable value system that can show a sustainable manner of rural construction to the stakeholders from the beginning. These BESATs also aim to establish a series of practice and management framework that can ensure long-term positive environmental and social outcomes because rural sustainable development needs endogenous development through a bottom-up strategy (Woods, 2011). Therefore, indicators of social dimensional sustainability should focus on the process rather than on the quantitative result through measurement or computer simulation.

Develop social dimensional sustainability indicators for poor rural areas of China

Based on the analysis and criticism, indicators can be established to evaluate social dimensional sustainability of built environment in poor rural areas of China. The main objective is to improve the IEQ of traditional vernacular houses, limit the impact of natural disasters and accidents, increase the communication and support from expertise and

professionals, and involve and empower local residents, including children, women, and the elderly. The indicators in Table 2 are established according to existing situations and challenges in poor rural areas of China and the implications from SBAT and CSA.

The evaluation method of these indicators should be simple and representative. For example, the IEQ can be evaluated according to certain passive design strategies, material choice, and simple calculation of openings rather than computer simulation or field measurement. The accessibility of public facilities cannot be evaluated through distance because people in mountainous areas may walk several hours uphill and downhill to reach a nearby place. Some services, such as medical service or market, may be provided periodically. Therefore, the assessment method should be custom-made based on the real situation in certain rural areas. In addition, long-term cooperation with experts and professionals outside will provide new visions and knowledge to rural community and empower rural residents, which is significant for meeting the high level of human needs of rural residents. Therefore, several indicators are relevant to this issue.

Table 2. Suggested evaluation indicators of social dimensional built environmental sustainability for poor rural areas of China

Issues	**Evaluation indicators**
1. Health and comfort	1.1 Improves indoor natural ventilation 1.2 Improves indoor daylighting 1.3 Improves indoor thermal environment 1.4 Improves sanitation in toilets and livestock sheds 1.5 Provides clean and stable water supply
2. Safety and security	2.1 Provides safe locations 2.2 Provides safety signage and facilities 2.3 Provides a disaster preparedness plan and education
3. Culture and heritage	3.1 Involves cultural relics and intangible cultural heritage protection 3.2 Involves local traditional technologies and craft innovation and application
4. Accessibility	4.1 Provides access to public service facilities 4.2 Provides access to sports and entertainment facilities 4.3 Provides access to information facilities 4.4 Encourages cooperation with experts and professionals
5. Inclusiveness	5.1 Considers the needs of women, the elderly, and children in development and construction 5.2 Provides a clear signage system for outsiders
6. Participation	6.1 Provides a public participation plan to encourage local residents to join the design process 6.2 Involves local residents in the construction 6.3 Involves local residents in the operation and maintenance
7. Education	7.1 Provides education spaces, such as reading rooms, meeting rooms, and classrooms. 7.2 Provides artisan training during construction 7.3 Displays the materials and outcomes of the innovative local technology as a part of public education facilities

Conclusions

Social dimensional sustainability is significant in the transformation of rural development in poor rural areas of China. This study investigated the key issues of social dimensional built environmental sustainability and developed a series of indicators for poor rural areas of China. The indicators cover all the five levels of human needs, follow the new rural sustainable

development manner that is bottom-up and endogenous, and relate with the real problems and challenges in poor rural areas of China.

This study, however, has several limitations. The number of BESATs that were analyzed is limited because of time and space limitations. The detail of the evaluation and rating method of indicators needs further studies through in-depth investigation and data collection in certain rural regions. Environmental and economic dimensional indicators should be investigated to establish a comprehensive BESAT for poor rural areas of China.

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