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Evaluation of the social dimension of sustainability in the built environment in poor rural areas of China

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ABSTRACT

Research on the experiences of the recent tremendous rural construction and restructuring in China show that the social dimension of sustainability is crucial for the success of rural development. However, most conventional built environmental sustainability assessment tools (BESATs) are mainly focussed on environmental sustainability and building performance. There are to date no useful or complete assessment methods of social sustainability in the rural built environment. This study reviews the concept of the social dimension of sustainability and its application in architecture. Several existing BESATs are analysed and compared to identify their features and gaps in the assessment of social sustainability. From this, a series of indicators of social sustainability in the built environment are developed and discussed in the context of the current situation and challenges in poor rural areas in China. Compared with conventional BESATs, the social dimension of sustainability assessment method (SDM) not only considered indoor environmental quality but also covered a variety of issues from human physiological needs to psychological needs. More importantly, it can be used to guide the practice of rural construction from the initial stage by providing a systematic understanding and point-by-point instructions.

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Endogenous development; sustainable development; mountainous rural areas

1. 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 ecosystems and regional cultures, have brought new challenges to the sustainable development of China's rural areas. In urban areas of China, conventional Built Environmental Sustainability Assessment Tools (BESATs), such as Assessment Standard for Green Building (ASGB), emphasize environmental issues, such as water, energy, and resource saving (MOHURD 2014). By contrast, the indicator commonly used to evaluate rural development is an economic one, primarily per capital income. However, issues surrounding the social dimensions of sustainability that are relevant to human development and human rights are significant for closely knit rural communities and their development.

There are several interpretations of sustainability, however the most widely accepted of these is the three dimensional model, encompassing environmental, economic and social sustainability. Social sustainability is

> a process for creating sustainable, successful places that promote wellbeing, by understanding what people need from the places they live and work. Social sustainability combines design of the physical realm with design of the social world – infrastructure to support social and cultural life, social amenities, systems for citizen engagement and space for people and places to evolve (Bacon and Caistor 2014).

Researchers often lack any, let alone a comprehensive understanding of, these social issues, not least because there are no robust tools available for measuring the social impacts of China's rural construction. The aim of this study was to develop such measures to provide a new understanding and method for assessing the social sustainability of a rural built environment, and more importantly, guide the practice of rural construction from the initial design stage by providing a systematic understanding and point-by-point instructions.

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

2.1. Key issues in social dimensional sustainability in BESAT

BESATs originated from the critique of environmental issues and energy crises that emerged during the urbanization of several developed countries in the late twentieth century. In their early stages, BESATs dealt with the concept of 'green building', which mainly focussed on environmental protection, focussing on concepts of energy efficiency, pollution and waste prevention, resource optimization and water conservation.

A major criticism of BESATs in their current form is of their focus on environmental issues (Haapio and Viitaniemi 2008; Mao, Lu, and Li 2009). The concept of sustainability became prominent 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). With the extension and improvement of its definition, the concept of sustainable development now

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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 the 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.

includes a broad range of issues, such as economic growth, social equity, and public participation. All of these components play an important role in ensuring that future generations can provide for themselves (Cooper 1999; Haapio and Viitaniemi 2008; Mao, Lu, and Li 2009). The three dimensions of sustainability (environmental, social, and economic) are internationally recognized not least as the concept of 'green building' evolved into that of 'sustainable building' (Cole 2003).

The social dimension of sustainability deals with issues of the improvement of human development and human rights. The idea of 'human needs' was highlighted in the influential definition of sustainable development given by Brundtland Report and can be classified according to Maslow's (1943) five-level hierarchy (see Table 1). The idea of social sustainability was developed to consider and support these different levels of human needs.

In developed countries such as UK, social sustainability has been studied in the development of sustainable communities. Four key dimensions of social sustainability are summarized below (Woodcraft, Hackett, and Caistor-Arendar 2011):

- Voice & Influence – residents' ability & willingness to take action to shape the local environment; governance structures to represent residents & engage them in shaping local decisions
- Social & Cultural Life – sense of belonging, wellbeing, community cohesion, safety, relationships with neighbours & local networks
- Amenities & social Infrastructure – amenities & support services in place; emphasis on schools, social spaces, transport & community workers
- Adaptability & Resilience – flexible planning; housing, services & infrastructure that can adapt over time; adaptable use of buildings & public space

The issues and indicators become more specific and straightforward when social sustainability is implemented within a building environment construction process. In a study of BESATs for developing countries Gibberd (2003) reinterpreted the concept of sustainability and its application in the architectural field. He established a Sustainable Building Assessment Tool (SBAT) for South Africa, which summarized the objectives of social dimension of building sustainability as below:

- Access – ensure that development supports increased access to land, adequate shelter, finance, information, public services, technology and communications, where this is needed
- Education – ensure that development improves levels of education and awareness, including awareness of sustainable development
- Inclusive – ensure that development processes and benefits are inclusive
- Health, safety and security – ensure that development considers human rights and supports improved health, safety and security
- Participation – ensure that development supports partnerships, social interaction and involves and is influenced by the people that it affects

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. There are three aspects of this system relevant to social sustainability (Larsson 2016):

- Indoor environmental quality – indoor air quality and ventilation; air temperature and relative humidity; daylighting and illumination; noise and acoustics; and control of electromagnetic emissions
- Service quality – safety and security; functionality and efficiency; controllability; flexibility and adaptability; and optimization and maintenance of environmental operating performance
- Social, cultural and perceptual aspects – social aspects; culture & heritage; and perceptual

Based on the theory of human needs and the studies of BESATs for developing countries, the table below summarizes the key issues of social sustainability in the built environment.

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, Elela, and Ahmed 2015). The sustainable development of a place can only be achieved if the specific context of that place is considered (Crawley and Aho 1999). Therefore, existing studies and assessment tools can provide a systematic and comprehensive understanding of social dimensional sustainability of the built environment, which can be used to guide the establishment of BESATs for poor rural areas of China.

2.2. 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 and construction (Qu, Li, and Wang 2006). This modernization development model significantly improved rural life and urban–rural integration in several flat rural areas near cities. However, whilst this model may have achieved short-term improvement of rural infrastructure and housing with government grants and outside investments (Chen et al. 2007; Li, Zuo, and Ye 2009; Qiu 2009), this may not be sustainable in 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 levels of infrastructural development and poor quality of living environments
- Minority inhabited regions
- Low educational level
- Presence of high levels of elderly people and children because of migration to urban areas to find work

These conditions have helped preserve several unique regional cultures by limiting outside access to their living environments, but they have 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, technologies, and cultures cannot be passed on and upgraded because of the depopulation of rural settlements and the impacts of industrialization, resulting in settlements stuck in a past age
- Limited access to public service facilities, information, and education
- Low level of participation and engagement of villagers during the village construction because of the top-down management and rural depopulation, where solutions are imposed from the top

A critique of rural modernization that focuses on the problems of over-production, environmental degradation, and spatial inequality began 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 comparative indicators for individuals and to enable existing villages and communities to compare their own current status with ideal goals for ecological, social, cultural, and economic sustainability. In the CSA tool, 19 of the 35 assessment issues consider the 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 (Liu and Zhou 2015). This project was based on the summary and criticism of New Countryside Construction and was influenced by the new theory of rural development. This rural policy especially stressed the value of natural environments and regional cultures to achieve sustainable rural development (Chen and Yu 2014). 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 land located in mountainous areas. He posited that most rural residents who work in urban areas will return to rural areas when they age because urban areas cannot provide them with a decent life, given the current level and pace of urban development. Therefore, Chinese rural development should provide adequate economic and social support to a small-scale peasant economy and aged farmers to empower them to follow sustainable farming practices into old age, rather than introduce agriculture business entities from urban areas that may well stop them from doing so.

These new rural policies and studies in China echo the eco-village concept mentioned above. The eco-village concept that highlights social sustainability is suitable for maintaining the vigour and the important cohesive forces of the poor rural areas and increasing the ability of rural residents to control their own lives. The eco-village 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 and promoting a model of industrialized agriculture and development.

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

Most of the commonly used BESATs are based on the urban context and few exist for rural areas. In addition to the study of SBAT, Newman (2013), a Leadership in Energy and Environmental Design accredited professional (LEED-AP), also argued that LEED did not work in rural Africa because as many as 45 of the 100 points in LEED were 'simply irrelevant or financially irresponsible in rural Africa.' He suggested that social factors should be considered in the sustainability assessment of buildings in Africa, as was found in subsequent work in China (Wan and Ng 2016). Some issues relevant to social sustainability such as indoor environmental quality (IEQ) has a considerable weighting in existing commonly used BESATs because in urban areas people typically spend a significant amount of time in indoor environments. In rural areas however, people usually work and stay outside more, and as such, have more adaptation and tolerance of surrounding environmental conditions. It is argued therefore that IEQ may not be a such a crucial issue in rural areas and can be difficult to

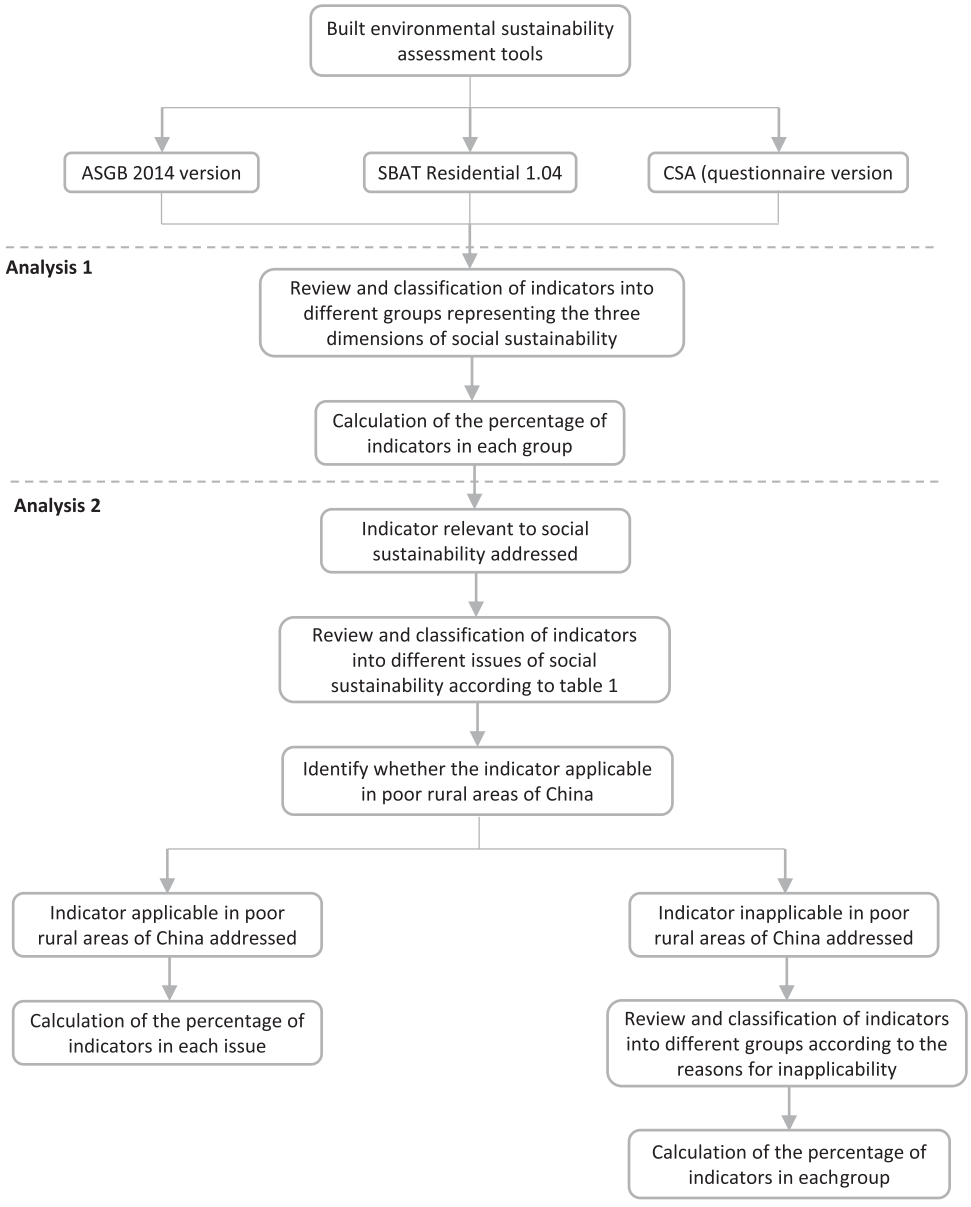

Figure 1. The research methodology.

evaluate. Besides, other social issues relevant to psychological needs such as culture and heritage, accessibility, inclusiveness, participation, and education are more significant in rural areas since the existing development level of these issues are much lower compared to urban areas.

Several analyses of different BESATs were conducted to further investigate the nature of the gap in the social sustainability assessment of the rural poor in areas of China. The MOHURD 2014 version was selected because it is the major building environmental assessment method currently used in China. The SBAT Residential 1.04 assessment method 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). The CSA method (questionnaire version) (GEN 2014) was also investigated to provide a different perspective on the development of the rural community. The research methodology is illustrated in Figure 1.

The first analysis of these tools was aimed at investigating the importance of the social dimension of sustainability in each BESAT. The indicators of each assessment method were classified into different dimensions of sustainability, in accordance with Gibberd's understanding of three dimensions (environmental, social, and economic) of building sustainability (Gibberd 2003). The percentage of scores of the social indicators was calculated and displayed. The weighting for operation evaluation of residential building is selected in ASGB with a weighting system. Prerequisite indicators are calculated separately, where present.

The result of this first analysis (Figure 2) confirms that BESATs for urban areas, such as SBAT and ASGB, concentrate less on social issues when compared to BESATs for rural communities, such as the CSA. The ASGB emphasizes the environmental dimension. SBAT pays almost equal attention to issues related to the three dimensions. In the CSA, the social dimension is deemed the most important dimension. The results showed that

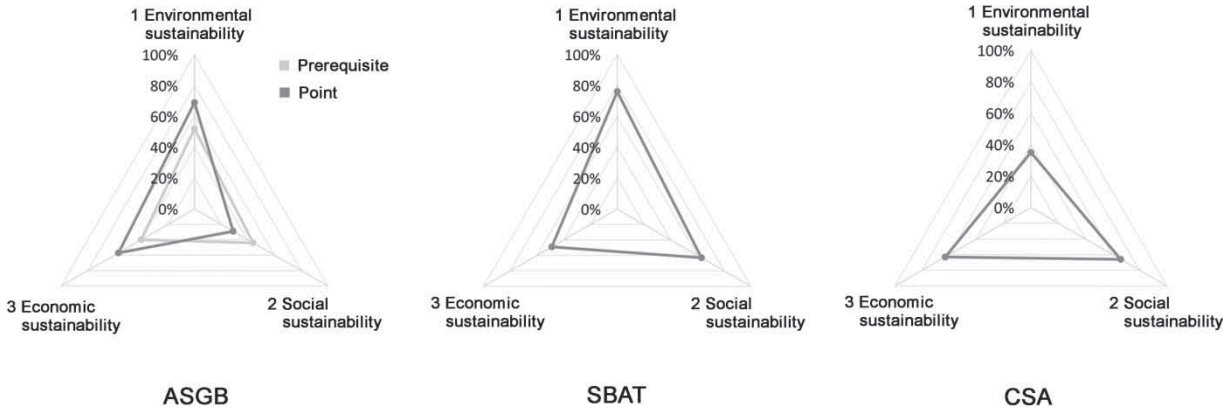

Figure 2. The significance of social dimensional issues in different BESATs.

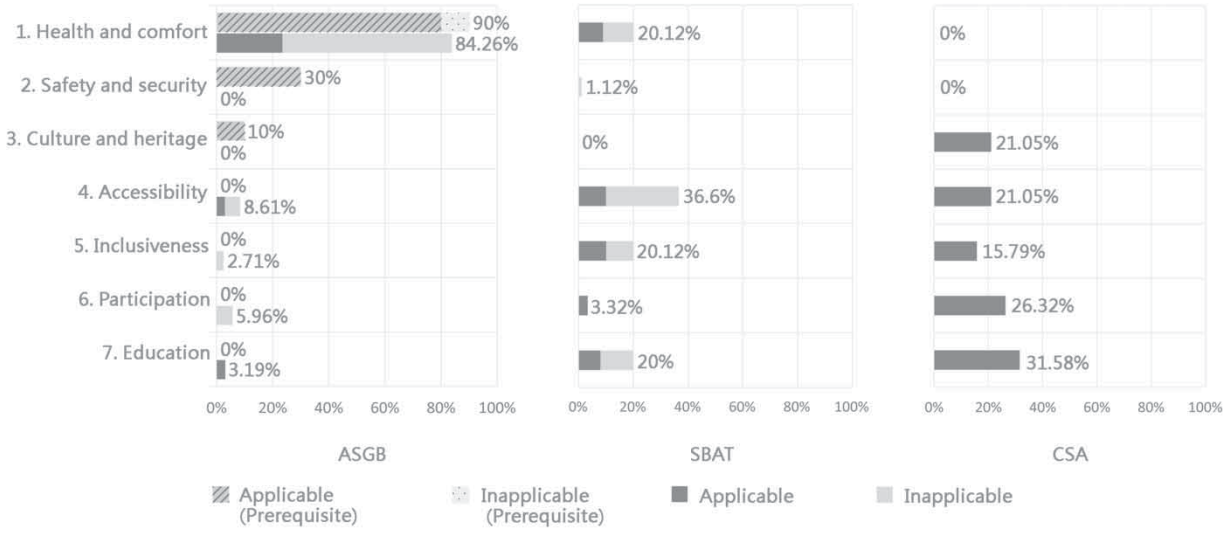

Figure 3. BESATs' emphasis on different key issues of social dimensional sustainability and their applicability.

the consideration of social issues in conventional BESATs was insufficient for rural areas.

The second analysis was designed to investigate the extent to which the social indicators of the existing BESATs address social sustainability issues, and also to reveal the usefulness for such regions of the individual social indicators of each BESAT. The social indicators of ASGB, SBAT, and CSA were classified into different social issues as in Table 1. The percentage of the scores of each issue were calculated and displayed in the bar chart. The indicators in each bar were analysed to determine whether they were applicable to a the lives of the rural poor in typical rural villages in China. There are several reasons for inapplicability:

- The indicator is based on urban structure that is different from poor rural areas (in terms of scale, density, infrastructure, and building function)
- Lack of assessment method for the materials and technologies of vernacular buildings
- Lack of indoor environmental quality standard for vernacular buildings in rural China
- The quoted standards, regulations, or guidelines are established for other countries
- The hardware or software required for calculation is unavailable in rural China

The results are shown in terms of the percentages of applicability (usefulness) and inapplicability of indicators. The weighting for the evaluation of the residential building was selected in ASGB with a weighting system. Prerequisite indicators for ASGB were calculated separately.

The results of the second analysis (Figure 3 & Table 2) show that the ASGB significantly focuses on health and comfort issues, but not on other social dimensional issues. Furthermore, a huge proportion (10% of the prerequisite scores and 73.6% of the normal scores) of social dimensional indicators of the MOHURD (2014) were found to be not applicable to poor rural areas of China. Moreover, the SBAT residential (1.04) method placed low levels of consideration on issues of safety, cultural and heritage, and participation issues. 60% of the social indicators they include were not applicable to poor rural areas of China.

One of the main reasons for this inapplicability, the lack of relevance of these assessment methods, is due to the very different scales of the settlements and structures in the poor rural communities in China. Rural communities are usually located in

Table 2. Applicability of ASGB and SBAT in poor rural areas of China.

		ASGB		
		prerequisites	points	SBAT
	Applicable	90%	26.4%	40%
Inapplicable	1. The indicator is based on urban structure that is different from poor rural areas	0	32.7%	53.6%
	2.Lack of assessment method for the materials and technologies of vernacular buildings.	0	0	2.2%
	3.Lack of indoor environmental quality standard for vernacular buildings in rural China.	10%	28.6%	1.1%
	4.The quoted standards, regulations, or guidelines are established for other countries.	0	0	2.8%
	5.The hardware or software required for calculation is unavailable in rural China.	0	12.4%	0

mountainous areas where the distribution of poor populations 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 met in most of the poor rural areas of China where the care of small children is often undertaken by grandparents and kindergartens are rarely available. Another reason for inapplicability of their indicators 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 and Humphreys 2002), not least because they wear what westerners might call extreme levels of clothing to combat hot and cold conditions indoors. 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, the CSA highlights issues that are neglected in the ASGB. In addition, the CSA provides several qualitative and procedural evaluation indicators and methods that do not exist in SBAT and ASGB. The CSA has the best applicability to Chinese conditions because it was designed specifically for rural communities. The limitation of the 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 identified several barriers to the effective application of existing BESATs to rural areas in China in terms of social dimensional indicators.

First, the consideration and weighting of social issues, especially those indicators considering human psychological needs in rural communities should be increased.

Second, the evaluation method of IEQ for rural areas should differ from that for urban areas, or should at least be considerate of contextual differences, such as the availability of resources and comfort requirements associated with time spent indoors. People in urban areas spend most of their time inside buildings with artificial comfort control equipment. Therefore, a dedicated IEQ assessment standard based on an urban building environment and modern heating, ventilation, air conditioning, and lighting systems has been established for these contexts. However, rural residents spend more time in outdoor environments. 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 methods for them are significant issues to be resolved in the research of rural built environmental sustainability assessment. Therefore, new evaluation methods should be developed to ensure sufficient flexibility to cater responsibly for different 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 should not only aim to provide solid results, but more importantly, should provide a reasonable measurement system that can benchmark how well or badly an area is doing in terms of the sustainability of its rural constructions and lifestyle for the stakeholders participating in the evaluation, be they policy makers, investment decision makers, rural planners or the communities themselves. These BESATs also aim to establish a series of practice and management frameworks that can ensure that the right decisions are taken to improve the long-term positive environmental and social outcomes on the ground. Rural sustainable development has been shown to thrive best through endogenous development models built on bottom-up strategies (Woods 2011). Therefore, indicators of the social dimensions of sustainability should focus on the function of the process of measuring the indicators locally rather than on the abstract quantitative results of idealized and inappropriate measurement systems or computer simulation.

3. Proposed social sustainability indicators for poor rural areas in China

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

Based on the analysis and criticism of the study outlined above, indicators are proposed below to evaluate social dimensions of sustainability in the built environments in poor rural areas of China. The main objective in doing this was to:

- Improve the IEQ evaluations of traditional vernacular houses
- Limit the impacts of natural disasters and accidents on them
- Increase the communication and support from expertize and professionals
- Involve and empower local residents, including children, women, and the elderly

The indicators in Table 3 are established according to existing situations and challenges in poor rural areas of China and the implications from the SBAT and CSA.

Table 3. Suggested evaluation indicators of social dimensional built environmental sustainability for poor rural areas of China.

Issues	Evaluation indicators (eg. Good to Bad)
1. Health and comfort	1.1 Levels of indoor natural ventilation
	1.2 Levels of indoor daylighting
	1.3 Levels of indoor thermal environment
	1.4 Sanitory conditions in toilets and livestock sheds
	1.5 Cleanliness and stability of the water supply
2. Safety and security	2.1 Safety of the location
	2.2 Safety of the signage and disaster prevention facilities
	2.3 Level of disaster preparedness planning and education
3. Culture and heritage	3.1 Level of cultural relics and intangible cultural heritage protection
	3.2 Amount of local traditional technologies and craft innovation and application
4. Accessibility	4.1 Access to public service facilities
	4.2 Access to sports and entertainment facilities
	4.3 Access to information facilities
	4.4 Level of cooperation with experts and professionals
	4.3 Access to information facilities
	4.4 Level of cooperation with experts and professionals
5. Inclusiveness	5.1 Level to which the needs of women, the elderly, and children in development and construction are met
	5.2 Clear identification and instruction system for outsiders
6. Participation	6.1 Level of public participation in planning to encourage local residents to join the design process
	6.2 Involvement of local residents in the construction
	6.3 Involvement of local residents in the operation and maintenance
7. Education	7.1 Provision of education spaces, such as reading rooms, meeting rooms, and classrooms, or multifunctional space that could allow these education and learning activities.
	7.2 Organization of artisan training during construction
	7.3 Extent to which materials and outcomes of the innovative local technology as a part of public education facilities are displayed

3.2. Developing a new evaluation method for poor rural areas

The evaluation method of such indicators should be simple and representative. A good to bad scale for each indicator is possible for this assessment system. Actually the first version of CSA is a checklist with a good to bad scale, which is easy to understand and follow (GEN 2008). The indoor and outdoor environmental quality standards of different climate zones in rural areas need to be further investigated systematically. New measurement or evaluation methods need to be developed to ensure sufficient flexibility for various local situations. 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. It is more reasonable to measure by time, i.e. how many types of facilities can be reached and used within one day or half a day. Some services, such as medical services or a 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 communities and empower rural residents, which is significant for meeting the high level of human needs of rural residents (Xu 2017). Therefore, several indicators are relevant to this issue.

Besides, public participation should be implemented not only through consultation but also through employment and training of local craftsman. Village construction should not only be a consumption process for the community but also be a creation, innovation, and empowerment process for the community. Social resources from non-profit organization, academia, and other social networks should be fully employed. Qualitative assessment methods need to be used for certain indicators that are difficult to be quantified.

Simple and representative indicators should be identified to estimate the social sustainability of rural built environment. The use of indicators that need to be measured after construction should be limited to those that can be easily used in such communities, whereas indicators that guide the rural construction and development in the beginning should be optimized. The aim of rural built environmental sustainability assessment is not only to evaluate or certify the 'sustainability level' exactly after rural construction but, more significantly, to underpin a process of making sure that the actions taken work to push developments into the direction of being more sustainable from the day of their inception. Thus the indicators should be developed alongside the key aims of the project, to inform the strategies of how the project should be approached and the hardware of how those strategies will be implemented in practice; that is, what form they will take. The same measures can then be usefully applied over time to evaluate the extent to which the project or place gets worse or better against those measures and then finally the extent to which the SDM measurement system has worked at each stage of its application, to provide a reasonable value system to encourage and demonstrate a sustainable example of rural construction from the beginning.

4. Conclusions

Social sustainability is an overridingly significant factor in the transformation of rural communities in the poor rural areas of China. The study presented here investigated the key issues of the social dimensions of sustainability through the exploration and development of a series of developmental indicators for poor rural areas of China. The indicators were designed to cover all the five levels of human needs, reflecting the new rural sustainable development policies that are based on bottom-up and endogenous strategies relating to the perceived real problems and challenges in poor rural areas of China.

In the recent decades of urbanization in China a significant effort has been made in researching urban development including the development of urban-oriented BESATs. On rural sustainable development there has been little work done. In the course of urbanization, the exchanges of capital and human resources between urban and rural areas will rapidly increase.

The simultaneous consideration of urban and rural issues is necessary to achieve sustainable development, especially in developing countries. Rather than directly utilizing urban models, development strategies for rural areas should be independently investigated scientifically and systematically.

This study, however, has several limitations. The number of BESATs that were analysed 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 more real-world testing and data collection in certain rural regions. Further research on strategies for rural sustainable development in China will be conducted in the future.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Bacon, N., and L. Caistor. 2014. "Measuring Social Sustainability in Sutton." http://www.social-life.co/media/files/Sutton_Social_Sustainability_Nov14.pdf.

Chen, G., Y. Fang, Y. Chen, M. Shen, D. Yang, Q. Wang, and Y. Gao. 2007. *Research Report of Development of Chinese Mountainous Areas—Research of Chinese Mountainous Settlement*. Beijing: The Commercial Press.

Chen, Q., and F. Yu. 2014. "A Review of the Research and Practice of the Beautiful Countryside Construction." *Study and Practice* 6: 107–116.

Cole, R. J. 2003. "Building Environmental Assessment Methods: A Measure of Success." *International Electronic Journal of Construction*, Special Issue article (ISBN 1-886431-09-4).

Cooper, I. 1999. "Which Focus for Building Assessment Methods – Environmental Performance or Sustainability?" *Building Research & Information* 27 (4/5): 321–331.

Crawley, D., and I. Aho. 1999. "Building Environmental Assessment Methods: Applications and Revelopment Trends." *Building Research & Information* 27 (4/5): 300–308.

GAUGE Performance Architecture. 2016. "Sustainable Building Assessment Tool Residential 1.04." http://gauge.co.za/downloads/sustainable-building-assessment-tool-residential/.

Gibberd, J. 2003. "Integrating Sustainable Development into Briefing and Design Processes of Buildings in Developing Countries: An Assessment Tool." PhD, University of Pretoria.

Gilman, R. 1991. "The Eco-village Challenge." In *Context* 29: 10–11. (Living Together).

Global Ecovillage Network. 2008. "Community Sustainability Assessment (CSA)." https://sites.ecovillage.org/wp-content/uploads/drupal_files/files/csa-previous.pdf.

Global Ecovillage Network. 2014. "Ecovillage Questionnaire." http://gen.ecovillage.org/sites/default/files/files/ecovillage_questionnaire.pdf.

Haapio, A., and P. Viitaniemi. 2008. "A Critical Review of Building Environmental Assessment Tools." *Environmental Impact Assessment Review* 28 (7): 469–482.

He, X. 2015. "Agricultural Modernization for Whom?" *Open Times* 5: 36–48.

Ismail, A. M., M. M. A. Elela, and E. B. Ahmed. 2015. "Localized Green Building Standards: The Anti-globalization Thesis." *International Journal of Innovative Research in Science, Engineering and Technology* 4 (9): 8024–8032.

Larsson, N. 2016. "Overview of the SBTool Assessment Framework." http://www.iisbe.org/system/files/private/SBTool%202016%20description%2021Jul16.pdf.

Li, X., T. Zuo, and J. Ye. 2009. *Status of Rural China (2008)*. Beijing: Social Sciences Academic Press.

Liu, Y., and Y. Zhou. 2015. "Challenges and Countermeasures for Beautiful Countryside Construction in China." *Journal of Agricultural Resources and Environment* 32 (2): 97–105.

Mao, X., H. Lu, and Q. Li. 2009. "A Comparison Study of Mainstream Sustainable/Green Building Rating Tools in the World." Paper presented at the MASS '09 International Conference, Wuhan.

Maslow, A. 1943. "A Theory of Human Motivation." *Psychological Review* 50: 370–396.

MOHURD (Ministry of Housing and Urban-Rural Development of People's Republic of China). 2014. *Assessment Standard for Green Building (Vol. GB/T 50378-2014)*. Beijing: China Architecture & Building Press.

National Bureau of Statistics of China. 2016. *China Statistical Yearbook 2016*. Beijing: China Statistics Press.

Newman, C. 2013. "Why LEED doesn't Work in Rural Africa and what will." http://intercongreen.com/2013/04/12/why-leed-doesnt-work-in-rural-africa-and-what will/#more-2539.

Nicol, J. F., and M. A. Humphreys. 2002. "Adaptive Thermal Comfort and Sustainable Thermal Standards for Buildings." *Energy and Buildings* 34 (6): 563–572.

Qiu, B. 2009. "Rural Planning and Construction in Ecological Civilization." http://www.mohurd.gov.cn/jsbfld/200903/t20090316_187287.html.

Qu, Z., X. Li, and X. Wang, eds. 2006. *New Rural Construction in Socialist China*. Beijing, People's Republic of China: Social Sciences Academic Press.

Wan, L., and E. Ng. 2016. "Assessing the Sustainability of the Built Environment in Mountainous Rural Villages in Southwest China." *Mountain Research and Development* 36 (1): 4–14.

Woodcraft, S., T. Hackett, and L. Caistor-Arendar. 2011. "Design for Social Sustainability: A Framework for Creating Thriving New Communities." http://www.futurecommunities.net/files/images/Design_for_Social_Sustainability_0.pdf.

Woods, M. 2011. *Rural*. New York: Routledge.

World Commission on Environment and Development. 1987. *Our Common Future*. Oxford: Oxford University Press.

Xu, L. 2017. "Exchange of Life Experiences a Monologue of Rural Construction." *Urban China* 79: 54–63.