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Indicators of Sustainable Housing in Rural Areas: A Review

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Abstract

Housing development on a sustainable basis is gaining global attention, yet the adoptions in rural areas are relatively scarce. Studies had shown that the absence of sustainable housing in rural areas may result in a range of problems, including poor quality of life, rural migration, inadequate physical and mental health, and accelerate social inequality. However, little-to-none studies showed on a possible list of sustainable housing indicators that could be applicable to rural areas. This study aims to review the indicators of sustainable housing in rural areas through literature review. The review results identified six dimensions of sustainability, namely economic, social, environmental, cultural, technical and design, and stakeholder participation that could potentially contribute towards sustainable housing in rural areas, with 54 indicators identified under these six dimensions. These indicators could potentially adopting to the culture and living standards of the residents resided in rural areas. These findings could contribute to the knowledge gap regarding sustainable housing indicators in the rural context.

Keywords: Indicators, Review, Rural Areas, Sustainable Housing

Introduction

Population growth contributes to the demand of housings, leading towards greenhouse gases (GHG) emissions from the construction process and housing operations. United Nations Environment Programme (UNEP) reported that the construction industry alone contributed to around 40% of the energy-related carbon emissions in 2018 (UNEP, 2019). Such high number of emissions alerts the government and housing stakeholders to look into possible ways of reducing GHG emissions and hence alleviating the global warming impact (Miller et al., 2014).

This accentuates the importance of incorporating sustainability features into housing, to reduce GHG emissions. In the United Nations Conference on Human Environment, the principle of sustainable housing laid on the basis of proper planning in inhabited areas and

urbanisation to minimise negative environmental impacts for maximising socio-economic and environmental benefits (Sohn, 1973). Moreover, studies had shown that sustainable housing brings societal benefits including enhanced functionality and durability, reduced maintenance, and improved public health (UN-HABITAT, 2012; Yang & Yang, 2015). Aldossary et al (2016); AlQahtany (2020) supported on the significance of sustainable housing and believed that it is crucial to raise public awareness on the benefits of sustainable housing. Even though several development plans are implemented by the government, its effectiveness and implementation continue to be questioned (Ng et al., 2017).

A number of studies have been conducted for sustainable housing development in urban context and informed on a list of challenges, strategies and/or sustainable housing indicators that could be linking towards the country of study and culture (Abidin et al., 2013; Bredenoord, 2015; Oyebanji et al., 2017; Said et al., 2016; Yang & Yang, 2015). In rural context, Hedayati-moghadam et al (2014) analysed sustainability indicators in Insafahan Province; Oladokun and Komolafe (2017) examined drivers of rural housing in Nigeria; Gorbenkova et al (2018) explored drivers that could contribute to sustainable development. Little-to-none research specifically focusing on the indicators of sustainable housing in rural context.

Therefore, this study reviews and proposes a possible list of indicators of sustainable housing in rural areas. Various indicators that identified from both urban and rural contexts will be reviewed to propose for a possible list of indicators that could be tested in the future research. The study is driven by the unequal progress of sustainable housing development in between urban and rural areas, which would likely deprive the quality of life of the rural residents. The review of the indicators that feature the sustainability characteristics of rural housing would be in harmonious with the culture and lifestyle of the rural residents. Moreover, this study could contribute to the knowledge gap on indicators of sustainable housing in rural areas and add valuable insights into existing literature.

Literature Review

Concept of Sustainable Housing

Sustainability has been defined in Brundtland Report 1987 as the fulfilment of current needs without compromising the capabilities of future generations for meeting their own needs in term of economic, social and environmental aspects (Keeble, 1988). Different parties including government and academics have been concentrating on the concept of sustainable development since the release of the Brundtland Report. In 1992, Rio Earth Summit called attention to the interconnectedness of economic, social and environmental issues, and insisted that success in one sector requires long-term action in others (UNCED, 1992). This further leads to the introduction of Triple Bottom Line (TBL) theory, which takes into account of three aspects, namely economic involvement, social responsibility and environmental performance (Elkington, 1998).

The concept of sustainable housing was known by introducing the concept of sustainability into houses by fulfilling the fundamental needs of residents and improving their quality of life (Maliene & Malys, 2009). Sustainable housing could be referred as housing that is economically viable, socially acceptable, environmentally benign, technically feasible, and structurally durable to meet the needs of the present generations while taking economic, safety, ecological and cultural concerns into account (Choguill, 2007). Sustainable housing could minimise the negative impact of houses and its operations on human well-being and circumstances as well as environment through improved design, location, construction, operating, upkeep, and the full life cycle of the structure (Roshanfekr et al., 2016). Ng et al

(2017) stressed that the concept of sustainable housing could be referred as a comfortable living environment capable of meeting humans' needs, such as reducing living costs.
In the rural context, Rezvani et al (2011) added that sustainable housing provides long-term success despite its environmental friendliness. Researchers had shown that the absence of sustainable housing in rural areas may result in a range of problems, including poor quality of life (Wilkinson & Pickett, 2009), lack of health and welfare services (Wet et al., 2011), rural migration, higher crime rates, education dropouts, inadequate physical and mental health (Herrmann & Svarin, 2009), and accelerate social inequality (WHO, 2010). In addition, psychological disorders may occur which positioned the residents at a level of higher risk for diseases and malnutrition (Howell et al., 2005; Ruel et al., 2010).

Overview of Prior Studies

Various research had been conducted in relation to sustainable housing in urban context. Internationally, literatures had merged the concepts of affordability with sustainability, to discuss on the sustainable affordable housing (Adabre & Chan, 2019; Adabre et al., 2020). Bredenoord (2015) supported that sustainable housing is achieveable in low-cost housing to improve the houses of Netherland's lower-income households. Gan et al (2017) further investigated on the key sustainable housing indicators that could be incorporated into the affordable housing in China and discovered 24 indicators under social, economic and environment categories. Travakoli et al (2017) reported on the factors that affecting design of sustainable housing in Iran. Oyebanji et al (2017) suggested that financial viability is the vital indicators for the success of sustainable housing in England. Heffernan and de Wilde (2020) stressed that energy efficiency and financial affordability were the key indicators for sustainable housing in England. Nainggolan et al (2020) conducted literature review on sustainable housing indicators. Framework had also been proposed for sustainable housing development (Ibem & Aduwo, 2015).
In Malaysia, Bakar et al (2011) discussed on the practices that could contribute towards sustainability index establishment. Lop et al (2016) investigated the green building indicators for successful implementation of environment related indicators into the buildings. Roshanfekr et al (2016) proposed that indoor environment quality as the key sustainable housing indicator. Ng et al (2017) reviewed earlier research on the formation of sustainable housing in order to discover the features, trends, measures, or parameters that those researchers had applied to gauge sustainable housing development. Framework in relation to sustainable housing implementation had been discussed by Bakar et al (2010); Ng et al (2017) while Rizal and Tarmidi (2022) proposed to measure affordable housing sustainability by using spatial framework. Yusof and Ariffin (2020) examined the implementation of sustainable development through literature reviews and content analysis.
In the rural context, incorporating sustainability features into rural housing could be challenging due to the lower income, accessibility, and a lack of government efforts (Gorbenkova et al., 2018). In terms of literature, sustainable housing in rural context is comparatively little to the urban context. Shayan et al (2014) investigated the sustainable housing indicators in Zarrindasht. Hedayati-moghadam et al (2014) utilised an Insafahan Province to analyse rural sustainability indicators. Gorbenkova et al (2018) identified 13 drivers that could contribute to sustainable development in rural context, such as human capital, budget allocation and living standards. However, both Hedayati-moghadam et al (2014); Gorbenkova et al (2018) did not specified on the housing aspect. These seem to point

on the research gap of the sustainable housing indicators in rural context, specifically in Malaysia.

Overview of Sustainable Housing Dimensions

Sustainable housing requires possible dimensions to indicate its features and performances. Various sustainable housing indicators had been proposed by different stakeholders and/or researchers. Studies had shown that the sustainable housing dimensions first revolved based on the TBL theory, which are economic, social, and environment (Heffernan & de Wilde, 2020; Safronova et al., 2017). The economic dimension for achieving sustainable housing could ensure the financial viability for the housing suppliers, workers welfare, and increase adaptable and flexible of housing to meet future demands (Turcotte & Geiser, 2010). This economic dimension could possibly be referred as the duration of housing production processes that can be perpetuated in order to fulfil current and future housing demands (Chiu, 2012). The main focus of the social aspects of sustainable housing relates to how housing affects people's quality of life, both now and in the future (Ibem & Aduwo, 2015). Chiu (2012) emphasised that this could probably related to social justice and equality, social cohesiveness and integrity. In terms of environmental dimension, previous studies reported that houses need to be designed to conserve energy, water, and reduce greenhouse gases while in construction and throughout its lifetime (Al Surf, 2014; Aldossary et al., 2016; Safronova et al., 2017).

Other than the TBL, cultural, technical and design dimensions could possibly contribute towards sustainable housing (Narvydas, 2014; Soini & Dessein, 2016). Tavakoli et al. (2017) suggested that considerations should be given to indicators related to cultural dimension of housing in Iran, and design of sustainable housing in addition to concerns of sustainability such as economic, social and environmental. Cultural dimension could be referred as the continuance of certain forms of arts, religion, and way of life that were impacted by the local natural environment where the human settlement was created (Chiu, 2012). A technical trend in sustainable housing could be referred to the use of advanced technology to attain highest levels of energy efficiency (Narvydas, 2014), such as the cutting-edge technology, knowledge, and systems to achieve sustainability goals (Syed Jamaludin et al., 2020). The design dimension could be referred as the ideal housing location, pertaining to the concerns for climate and weather. Such housing design significantly contributes to the growth of architecture toward sustainability (Khiabanian & Abbasi, 2012; Khorami, 2004).

As housing is a complex context that involved multiple stakeholders, Eden (2000) emphasised on the collaboration between local governments and stakeholders as well as public engagement, by introducing stakeholder participation as one of the dimensions for sustainable housing. Susilawati and Al-surf (2011) supported that implementing of sustainable housing may be aided through cooperation among different stakeholders, including government agencies, private sectors, housing agencies and households. Ng et al. (2017) supported that government needs to take the initiative in developing and implementing the overall strategy for sustainable housing development, with the supports from stakeholders with specialised knowledge on sustainable housings.

Research Methodology

This study utilised descriptive review approach in collecting the possible indicators for sustainable housing in rural areas through literature review. Descriptive research focuses on outlining the characteristics of demographic segment or phenomenon under study

(Manjunatha, 2019). Literature review was conducted on the reliable sources, such as journals, reports, conference articles and theses, published from 2010 to 2021, for generating the indicators. The topics covered through literature review were related to sustainable housing, affordable sustainable housing, urban, rural, indicators, critical success factors, and housing industry. The possible indicators related to the sustainable housing in rural areas were identified through reviewing the relevant studies.

Findings and Discussions

The review of existing literatures showed on a total of six dimensions and 54 indicators that could be important in achieving the sustainable housing development in rural areas. These six dimensions were identified based on the literatures, such as TBL (Heffernan & de Wilde, 2020; Safronova et al., 2017), culture (Nainggolan et al., 2020; Soini & Dessein, 2016), technical and design (Golubchikov & Badyina, 2012; Narvydas, 2014), and stakeholder participation (Van Bueren & De Jong, 2007; Yang & Yang, 2015). These dimensions and indicators were presented in Table 1.

Table 1
Indicators of Sustainable Housing Identified from Literature Review

Dimension	Indicator	Reference
Economic	Lower operational cost	[1], [3], [4], [5]
	Reduced life cycle cost	[1], [3]
	Reduced transportation cost	[1], [3]
	Balanced housing market provision	[1], [3], [4], [6], [7], [8], [9]
	Cost recovery throughout the life cycle process	[1], [3]
	Desirability	[9], [11]
	Availability of competitive interest rates on mortgage	[3], [10], [12], [13], [14], [15]
	Efficient use of resources	[3], [5], [8], [15], [16], [17], [18]
	Labour productivity in housing construction	[4], [19]
	Time efficiency in housing construction	[4], [19]
Social	Accessibility to infrastructure facilities	[1], [2], [3], [4], [6], [8], [9], [12], [13], [14], [15], [16], [17], [18], [20], [21], [22], [23], [24]
	Equability of housing distribution	[1], [3], [8], [16], [18], [23], [24], [25]
	Effective management of property	[1], [3], [22]
	Safety	[1], [2], [3], [8], [9], [13], [14], [15], [16], [17], [20], [22], [23], [24]
	Harmonious social relationship	[1], [2], [3], [8], [16], [17], [18], [22]
	Privacy in dwelling units	[2], [3]
	Social networks capable of generating social capital	[2], [3], [23], [26]

	Provision of recreational and leisure facilities	[2], [3], [4], [8], [9], [12], [13], [14], [15], [16], [17], [21], [23]
	Public awareness	[3], [6], [8], [10], [24], [25]
	Quality of life	[2], [3], [4], [8], [16], [26]
Environmental	Land use efficiency	[1], [2], [3], [4], [6], [8], [17], [18], [23][26]
	Energy efficiency	[1], [2], [3], [4], [5], [6], [9], [11], [13], [17], [18], [20], [21], [22], [23]
	Water Efficiency	[1], [3], [11], [16], [18], [20], [21], [22]
	Available green public spaces	[1], [2], [3], [9], [13], [18], [21], [24]
	Effectively utilizing resources	[1], [3], [4], [18], [22], [25]
	Landscaping elements	[2], [3], [4], [16], [20]
	Reduction on car dependency	[2], [3], [8], [9], [12], [15], [17], [24]
	Storm water discharge system	[2], [3], [4], [25]
	Waste management system	[2], [3], [4], [13], [14], [15], [20]
	Sources of water and power supply	[2], [3], [24]
	Environmental protection	[3], [8], [9], [20], [22], [23], [26], [27]
Cultural	Architectural design in relation to cultural values of residents	[2], [3], [27]
	Housing suitability to occupants' natural way of life	[1], [2], [3], [4], [5], [16], [18]
	Reflection of the unique historical and cultural characteristics	[2], [3], [23]
	Local theme	[14], [15]
	Local construction materials	[2], [3], [4], [5], [6], [7], [8], [9], [11], [18], [19], [21], [22], [25], [27]
	Cultural and heritage conservation	[1]
	Social acceptability	[1], [3], [11], [16]
Technical and Design	Appropriate construction techniques	[2], [3], [4], [5], [7], [8], [10], [11], [17], [19], [22], [23], [26], [27]
	Adequate living spaces within small size unit	[1], [3], [9], [19], [23]
	Acoustic comfort	[2], [3], [9]
	Thermal comfort	[23]
	Disaster resistant	[1], [3], [16], [20], [22], [25]
	Renewable energy	[23], [27]
	Integrated design	[10], [14]
	Safety of construction process	[27]

	Adaptability of housing design for future needs	[2], [3], [11], [23]
	Durability of housing	[1], [2], [3], [4], [5], [6], [8], [9], [12], [13], [14], [15], [16], [22], [26]
Stakeholder Participation	Government participation	[7], [8], [10], [15], [21], [23], [26], [28], [29], [30], [31], [32], [35]
	Non-government organisation (NGO) participation	[7], [21], [28], [29]
	Suppliers of housing materials participation	[28], [29], [31], [33], [34]
	Households' participation	[10], [21], [23], [28], [30], [32], [34], [35]
	Owner builders' participation	[10], [21], [29], [31], [32], [33], [34]
	Local authorities' participation	[7], [10], [29], [32], [33]

Source: [1]: Gan et al., 2017; [2]: Ibem & Azuh, 2011; [3]: Nainggolan et al., 2020; [4]: Shayan et al., 2014; [5]: Heffernan & Wilde, 2020; [6]: Abdul Hamid et al., 2018; [7]: Abidin et al., 2013; [8]: Oyebanji et al., 2017; [9]: Shama & Motlak, 2019; [10]: Yang & Yang, 2015; [11]: Pullen et al., 2015; [12]: Adabre et al., 2020; [13]: Mulliner & Maliene, 2011; [14]: Said et al., 2017; [15] Said et al., 2016; [16]: Hedayati-moghadam et al., 2014; [17]: Roshanfekr et al., 2016; [18]: Ross et al., 2010; [19]: Wan Mohamad & Ahmad, 2016; [20]: Bakar et al., 2011; [21]: Bredenoord, 2015; [22]: Golubchikov & Badyina, 2012; [23]: Turcotte & Geiser, 2010; [24]: Visvaldis et al., 2013; [25]: Yadav et al., 2017; [26]: Gorbenkova et al., 2018; [27]: Ayman, 2010; [28]: Feige et al., 2011; [29]: Hamdan et al., 2021; [30]: Komolafe et al., 2019; [31]: Ng et al., 2014; [32]: Shari & Soebarto, 2012; [33]: Bal et al., 2013; [34]: Zedan & Miller, 2018; [35]: Adabre & Chan, 2019

Table 1 showed that 54 indicators of sustainable housing are categorised into six dimensions in terms of economic, social, environmental, culture, technical and design, and stakeholder participation. Sustainable development continuously being recognised as a goal, despite of the challenges and complexity surrounding emerging environmental issues in both developed and developing nations. The process of sustainable development is dynamic, driven by time, and built on a variety of measures. Without a good set of indicators, there is no concomitant impression of sustainability.

From economic dimension, achieving sustainable housing requires cognisance of the fact that need to design housings that are cost effective throughout both construction and during the lifetime. Additionally, it emphasises the necessity of meticulous planning to prevent the need for large scale renovation projects in the future and lowers maintenance and water consumption expenses (Aldossary et al., 2016; Safronova et al., 2017; Said et al., 2017). This can enable the continuing delivery of sustainable housing while allowing both the providers and the beneficiaries to maintain their financial viability over the long run. It will help in reducing the waste of natural resources by ensuring the appropriate type of adequate land is accessible in the right places and at the right time as well as promote evolution and innovation by identifying and addressing development requirements, including the supply of infrastructure (DCLG, 2012).

The concept of social dimension in achieving sustainable housing emphasises the importance of housing design so that residents, particularly children and those with restricted mobility, may live comfortably and adaptably as their needs may change over time. It also emphasises the usage of security measures that increase resident sense of security and lower crime as well as built-in safety equipment to prevent injuries (Al Surf, 2014; Safronova et al., 2017). The review of literature found that most authors confounded social and cultural dimension of sustainable living (Nainggolan et al., 2020; Yang & Yang, 2015). However, this study separated cultural dimension from social as the authors classified that housing could represent traditional, native and regional knowledge, in order to foster sustainable beliefs, regulations, and conventions, as well as to stimulate effective electricity usage and the formation of harmonious inhabited regions. Chiu (2012) supported that the conservation of cultural identity is essential for cultural sustainability.

In terms of environment dimension, 11 indicators had been identified, including storm water discharge system, environmental protection etc. UN-HABITAT (2012) supported that the environmental dimension of housing includes determining the use of different environmental resources during design, construction, operations of housing, such as materials, energy, water and land. Moreover, the residential activities in human settlements result in direct ecological impacts on local areas by polluting air and water, generating waste, and damaging natural ecosystems. Therefore, a minimum reduction in energy consumption and environmental effect of housing throughout their lifetimes are essential indicators to attain environmentally sustainable housing. The degree to which the environmental impact of housing activities is diminished, conforming to levels that are within the natural environment's capacity to carry and improving the environmental quality of the surrounds to support healthy living, is referred to as environmental sustainability of housing (Chiu, 2012).

The technical and design dimensions included 10 indicators. The technical aspect in this study referring as the technology that shall be incorporated into the sustainable housing design, for comfort assurance. Moreover, there is a connection between design and nature, and hence this study included the integrated design, renewable energy as part of the sustainable housing indicators. The literature review supported that gaining a solid grasp of environmental repercussions and applying the technological and design dimension could lessen the negative effects of houses (Khiabanian & Abbasi, 2012; Khorami, 2004).

In terms of stakeholder participation, collaborative integration through constant leadership and cooperation among project stakeholders are essential indicators for successful sustainable housing (Van Bueren & De Jong, 2007; Yang & Yang, 2015). Government, builders and households need to be aware of sustainable living, and stakeholders must be prepared to take steps towards its implementation (Bakar et al., 2010). Engagement from the community and end users is also crucial for better understanding societal values and goals as well as discovering local knowledge on climate issues. By distributing ownership among the neighbourhood and end users, the viability of sustainable housing in rural areas could potentially be assured.

It is undeniable that living in a sustainable housing improves one's quality of life by allowing for the provision of various forms of comfort and integrating as part of the natural beauty and harmony while reducing the energy cost. Adopting the phases of time toward sustainable housing demands solid planning, effective administration, and the presence of a specialised centre after the application of the sustainability terms during the development of housing projects. Construction costs of sustainable housing could potentially be lowered when local housing materials are used, including recycled materials (Shama & Motlak, 2019). This creates

local work opportunities while lowering energy and transportation costs as well as air pollution.

Conclusion

This study reviewed the existing literatures in collecting the list of indicators that are influencing the sustainable housing development in rural areas. A total of six dimensions and 54 indicators that could be important in achieving the sustainable housing in rural areas have been identified. These indicators mostly achieve economic, social, environmental and fulfil future generations' needs. The government, NGOs, housing material suppliers, owner builders, and local authorities are the stakeholders that need to build strong cooperation to achieve economic, social and environmental goals. However, these dimensions and indicators have to be further validated through further studies to provide a more comprehensive and solid framework in achieving the sustainable housing in rural areas. Future research could be conducted by collecting the viewpoints from the stakeholders to further explore the indicators and ease for decision making by each stakeholder, either through qualitative or quantitative approach. Sustainable housing development is not only a pipe dream; it is a reality that can be attained for both present and future generations, by combining a structured and systematic approach with continuous efforts. In order to improve and develop the management of industry toward the optimisation of sustainability for the benefit of stakeholders, there is a need to conduct more research on the principles of sustainable housing development in rural areas.

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