

A Preliminary Sustainable Housing Development Framework for Rural Areas in Sarawak, Malaysia

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ABSTRACT

The Malaysian National Housing Policy 2018-2025 proposed different housing development strategies, specifically focusing on the urban areas, with relatively little investigation on housing development in rural areas. This research investigates the challenges of incorporating sustainability features into housing and strategies to moving forward which leads to the development of a preliminary sustainable housing framework in rural areas. Semi-structured interview was conducted with 13 rural area residents' representatives and suppliers of housing materials who have more than ten years of experience in Sarawak. Content analysis was employed to analyse the collected data to further develop a framework related to sustainable housing development in rural areas. The proposed framework was validated with six experts who have 10-20 years of experience in rural areas through questionnaire. The findings revealed that accessibility issues, such as lack of proper transportation, and residents' financial capacity, hindered sustainable housing development, as the houses in Sarawak rural areas are mostly built by the residents. A preliminary framework that includes collaboration between government, suppliers of housing materials, contractors and residents, was proposed for improving housing conditions in rural areas to ensure the durability of the traditional timber house as well as the newly constructed houses with bricks and cement. This research could assist the government in identifying residents' housing needs, improving housing conditions and hence, enhancing residents' quality of life.

1.0 INTRODUCTION

The United Nations Sustainable Development Goals (UN SDGs) require the participation of both poor and rich nations in achieving economic, social and environmental sustainability (Bergman et al., 2018). The availability of good quality and secure housing, along with sustainable transportation, undoubtedly assists in meeting SDG 11 on sustainable cities and communities, especially in low-income countries with housing scarcity (Leal Filho et al., 2019; United Nations, 2022). Although the primary focus of SDG 11 is on urban areas, planning in rural areas also contributes to sustainable and resilient communities. Studies reported difficulties in securing houses for poor and vulnerable groups of residents (Leal Filho et al., 2019). Housing concerns not just the edifice of sustainable societies, but also the refurbishment and creation of an arena for people to stay with continuous operation for residents throughout its lifespan (Oyebanji et al., 2017).

The accessibility issues and absence of clean water and electricity imposed a detrimental impact on the well-being of those living in rural areas, leading towards urban-rural inequality (Padda & Hameed, 2018; Tey et al., 2019). Residents who reside in rural areas are often characterized as having minimal income (Padda & Hameed, 2018). Consequently, sustainable housing is not a priority, as residents focus solely on the elemental necessity of shelter. Studies have shown that houses in rural areas encounter a series of issues, including inadequate roofing insulation, soil-related flooding, and inadequate waste-disposal practices (Li et al., 2020; Mihai et al., 2022). The housing durability and habitability issues together with the financial incapability of the residents in rural areas, raise concerns about whether current housing is able to meet residents' needs and the possibility of improving current housing conditions by introducing sustainable housing (Seneviratne et al., 2015).

Research on housing in rural areas is relatively limited although housing development is getting attention in different research fields to meet the needs of residents. Studies have been conducted on the drivers of housing development in rural areas of Nigeria (Oladokun & Komolafe, 2017), priority areas of housing development in rural areas of Spain (Jeong et al., 2017), and strategies to ensure effective housing land use in rural areas of China (Cheng et al., 2019). However, research on housing in rural areas of developing countries, specifically Malaysia, is relatively scarce. Idris et al. (2016) adopted rural areas in Peninsular Malaysia as case studies to investigate the overall quality of life index. Wan Mohamad and Ahmad (2016) emphasized the ease of building a sustainable house by using self-assembly components, and Rashid et al. (2021) proposed a modern rural development framework for physical, economic, social, and technological change in rural areas. However, little-to-none of the studies focused on the perspectives of residents residing in rural areas and suppliers of housing materials for achieving sustainable housing in Sarawak. Although studies have shown that urban households in Iskandar Malaysia produce a higher carbon footprint compared to rural households (Zen et al., 2021), the sustainability aspect of rural areas should not be overlooked. This research refers to sustainable housing from economic, technical and social aspects, as houses in rural areas of Sarawak are mostly built by the residents through cooperation. Therefore, the sustainable materials and techniques of housing construction shall be immersed in the residents' knowledge and skills, for developing sustainable housing.

This research investigates the challenges faced in having sustainable housing and strategies to move forward. This research seeks to provide a preliminary framework for assisting sustainable housing development in rural areas. In the current market with no mandatory requirement on the incorporation of sustainability features into housing, this framework could potentially provide a strategy to improve housing conditions in rural areas and reduce rural-urban housing inequality issue. This research assists the government in strategizing their housing planning and offers practical steps to assist residents in improving housing conditions in rural areas.

2.0 LITERATURE REVIEW

Sustainable housing could be referred to as housing that is economically suitable, environmentally friendly, structurally durable, socially acceptable, comfortable and adequately accessible to infrastructure (Jamaludin et al., 2018; Yang & Yang, 2015), and this notion could possibly be ideal for sustainable housing development in rural areas. Sustainable housing development in rural areas could potentially provide residents with a better quality of life. Improving accessibility to rural areas could allow residents to have better access to urban areas,

which in turn enhances development (Abdullah, 2017). Liu et al. (2021) purported that residents could understand better on environmental related features, including shading, collection of rainwater, and housing's heating and cooling features. However, such awareness and understanding may not be sufficient without government support (Shooshtarian et al., 2021).

Studies had been conducted with regards to housing development in rural areas. A study conducted in rural areas of Nigeria on the drivers of housing development identified cultural, infrastructural and neighborhood as the factors influencing housing development (Oladokun & Komolafe, 2017). However, challenges exist for housing development in rural areas, from the aspects of accessibility and cultural values in Ghana (Ampofo, 2020). Moreover, ageing seems to be an issue for housing development. Abramsson and Hagberg (2020) purported that semi-rural areas in Sweden are dominated by the elderly who stay in more than 20 years in their current houses. Government policy together with residents' interests are essential for housing development in rural areas of Spain (Jeong et al., 2017). This notion is supported by studies in China which investigates the system that could ensure the sufficient and/or effective use of land for housing (Cheng et al., 2019; Zhao et al., 2019). Astuti and Handayani (2020) indicated that the residents of a rural-urban neighborhood in Indonesia have limited capacity in dealing with their unstable income. Aini et al. (2016) compared the housing aspirations of the elderly in both urban and rural areas in two areas of Malaysia without looking into the overall populations and strategies for providing better housing.

Adamowicz and Zwolińska-Ligaj (2020) examined sustainable development in rural areas of Poland by introducing the smart village concept. They found that smart villages incorporate technological, social innovations and network connections in assisting competitive sustainable development in rural areas of Poland. However, the smart village concept focuses on the whole development including networking and agricultural projects, with little detailing on the sustainable housing aspect. Studies suggested that the successful implementation of sustainable housing in England relied on energy efficiency and financial viability (Heffernan & Wilde, 2020; Oyebanji et al., 2017). Oyebanji et al. (2017) seconded that the achievement of sustainable housing in the United Kingdom prioritized adequate funding provisions. Li et al. (2019a) reported that sustainable housing practices in New Zealand are fostered by the central government. However, such financial provision and government planning in developed countries may not be applicable to developing countries due to disparities in income and skill level (Karji et al., 2019). Tafazzoli (2018) indicated several obstacles hindering further enhancements in sustainable construction, including inadequate funding to address initial expenses, decreased construction efficiency due to additional sustainability prerequisites, and the higher market value of sustainable buildings needed to justify the extra upfront costs. Different stages of urbanization and development among each country make it difficult to generalize the findings to all rural areas without investigation (Li et al., 2019b).

In Sarawak rural areas, traditional houses are usually built with local materials such as timber and palm trees, but such materials are at risk of being threatened by modernization (Stia & Mahayuddin, 2017). Previous studies revealed the unique housing constructions in rural areas of Sarawak, which are constructed by obtaining timber from the nearby forest for affordability concerns (Sanggin et al., 2016; Stia & Mahayuddin, 2017), without reviewing the sustainability aspects. Moreover, most of the housing in rural areas of Sarawak is made of wood with low carbon footprint (Stefanska et al., 2021), which is mostly built by the carpenter and/or the residents. This signifies the unique nature of housing construction in rural areas which differs from normal construction in urban areas which is dominated by developers and contractors. The unique value of houses in rural areas raises concerns about the feasibility of developing sustainable housing to better meet rural residents' needs. To the best of the authors' knowledge, sustainable housing in Sarawak rural areas is an unexplored area. Therefore, this research aims to fill in this knowledge gap by investigating the perspectives of residents and suppliers of housing materials in Sarawak, and proposing a preliminary sustainable housing development framework.

3.0 RESEARCH METHODOLOGY

This research involved two stages of data collection for developing and validating the framework of sustainable housing development in rural areas of Sarawak. A mixed method approach: semi-structured interview and questionnaire was adopted, in 2021 and 2022 respectively. Semi-structured interviews were conducted with residents and suppliers of housing materials in rural areas. This qualitative method was chosen to collect the perspectives and experiences of interviewees, to gain an in-depth understanding of a particular issue. It involved open-ended questions to allow flexibility for two-way communication between the interviewer and interviewee (Creswell & Creswell, 2017). A similar research method was employed by Abdullah (2017). This research adopted purposive and snowball sampling methods. The purposive sampling method was selected to ensure the richness of the gathered data as the interviewees possessed certain years of experience with rural housing. The interviewees were required to meet the following requirements: (a) rural residents shall be the head of village and/or residents who are above 18 years old and have at least five years experience in building houses, as houses in rural areas are mostly constructed by residents and (b) suppliers of housing materials shall be the owners (i.e., decision makers) of the shops to decide the orderings of housing materials (e.g., hardware and cements) from manufacturers with at least ten years experience in supplying materials to rural areas. Snowballing method was used to approach the interviewees, which begins with personal contacts. This is because the recruitment of residents and suppliers is inherently difficult due to accessibility issues, and such recruitment through acquaintances would facilitate trust building prior to the interview and ensure the right interviewees were approached. Similar methods were employed by Ebekozen et al. (2021).

Virtual interviews with 13 rural area residents and suppliers of housing materials were conducted over a four-month period, from September to December 2021, as the outbreak of the pandemic limited access to rural areas. The number of interviewees recruited in this study is considered acceptable and it is consistent with Aziz and Zainon (2023). Semi-structured questions were asked surrounding the current housing conditions, challenges faced while using sustainable housing materials for construction and strategies to overcome the challenges (refer to Appendix A). The interview process ceased when two to three interviewees repeated similar content as other interviewees. Eight residents were recruited, with two interviewees from the northern region (R6-R7), five interviewees from the central region (R2-R5, R8), and one interviewee from the southern region of Sarawak (R1). Four suppliers of housing materials are from the central region of Sarawak (S2-5), while one is from the northern region (S1). The backgrounds of the eight residents and five suppliers are shown in Tables 1 and 2 respectively. The interviewees were informed that their participation was voluntary and that no reference to specific locations or individuals would be made available in the findings. For privacy and confidentiality reasons, this research would not reveal the names of the villages, but only identify the interviewees based on the major regions (i.e., northern, central and southern) of Sarawak. The authors acknowledged that certain information may not be able to be delivered clearly if compared to meeting in person. However, the interviews had been recorded and transcribed to ensure their reliability.

Table 1. Demographic details of interviewees (Residents).

Code	Age (years old)	Ethnic	Position	Region	Years of experience in building house
R1	65	Iban	Head of village	Southern	14 years
R2	54	Iban	Resident	Central	10 years
R3	50	Iban	Resident		30 years
R4	76	Iban	Head of village		35 years
R5	52	Iban	Resident		10 years
R6	75	Kenyah	Head of village	Northern	40 years
R7	32	Lun Bawang	Resident		20 years
R8	24	Iban	Resident	Central	11 years

Table 2. Demographic details of interviewees (Suppliers of housing materials).

Code	Ethnic	Region	Years of working experiences
S1	Iban	Northern	11 years
S2	Chinese	Central	25 years
S3	Chinese		12 years
S4	Chinese		20 years
S5	Chinese		15 years

Throughout the interview process, all interviews were recorded with the interviewees' consents, and notes were taken. The recordings were transcribed and analysed using content analysis method with the assistance of Nvivo version 12. Overall, 30 codes were created based on frequency and occurrences (refer to Appendix B). Nine sub-themes were generated from the 30 codes and grouped under the two main themes.

A framework for sustainable housing development in rural areas was then developed based on the results of semi-structured interview. In 2022, validation of the proposed framework was completed through a questionnaire. Ebekoziem et al. (2021) suggested that a mixed-methods approach could triangulate the data to enhance the findings. Six experts (i.e., three academicians, one developer, one contractor cum rural area resident, and one contractor cum supplier of housing materials) with 10-20 years of housing experience in Sarawak rural areas participated in the questionnaire. These experts were selected as the proposed framework shall incorporate knowledge of academicians from theoretical perspectives, as well as practitioners and residents involved in the housing construction. The diverse experiences of the experts could ensure that the framework is able to meet both theoretical and practical aspects of sustainable rural housing development. The questionnaire consisted of two sections: (1) background information of respondents (e.g., occupation, age, year of working experience) and (2) respondents' agreeability with the validation criteria of the proposed framework with space for them to comment on the criteria. The proposed framework was presented and explained to the respondents via face-to-face approach to ensure that the respondents had a thorough understanding of the framework. The respondents were then asked to rank their agreeability on 11 validation criteria in relation to the proposed framework based on a five-point Likert scale (i.e., from 1 being strongly disagree to 5 being strongly agree). Descriptive statistics were used to analyse the collected data.

4.0 FINDINGS AND DISCUSSION

This section presents the findings and discussion. Sections 4.1 and 4.2 present the two themes that emerged from the interviews. Section 4.3 summarizes the main findings as indicated in Sections 4.1 and 4.2. Section 4.4 shows the proposed framework derived from the interview findings and Section 4.5 refers to the validation results of the framework.

4.1. Theme 1: Challenges to achieving sustainable housing in rural areas

The interviewees were introduced to the sustainability features (e.g., durable housing materials, higher insulation levels, solar panels, etc.), and asked about their perceptions of the challenges of introducing such sustainability features. The responses revealed that lack of financing, government support, technical skill, and awareness are the key challenges of having such features.

Financial challenges.

Seventy-five percent of the residents pointed out that financing is a challenge for having sustainability features in housing. The residents claimed that such sustainability features require money, and the pandemic outbreak has worsened the situation with limited job opportunities. The residents seem to be acquainted with the current housing condition (e.g., improper insulation, wear and tear) due to their limited financial capacity. A total of 60% of the suppliers supported that financing as a major concern to the residents in having more

durable housing construction materials. S3 said, “*The better-quality product is more expensive... If such pricing meets their financial capacity, then we will order materials from the manufacturers.*” Yang and Yang (2015) were concerned high upfront cost of sustainable technologies and materials. Chan et al. (2018) supported that the high cost of technologies is the key challenge for sustainability uptake in developing countries. Even though implementing sustainable housing features, such as solar panels, initially costs more than conventional housing, the long-term benefits include lower energy expenses and minimal overall costs throughout its lifespan with less dependence on the national electricity grid (Khan et al., 2020). However, residents in rural areas are mostly classified as lower income earners, which hinders them from high capital investment while waiting for the return on investment. Studies have shown that residents are apt to use an excessive amount of energy to enhance their comfort, rather than selecting a sustainable housing option and patiently awaiting the benefits until the repayment period ends (Zhang et al., 2018).

Lack of government support.

Seventy-five percent of the residents stated that the government provided little-to-none housing incentives for new housing construction, as the government mostly provided incentives for repairing works. The residents explained that most of the housing repair and/or renovation work is self-funded. R5 stated, “*The current housing repair or renovation is funded by ourselves. Government did not provide [financial support].*” The residents also pointed out that the government provided a lump sum contract to the contractor for the repair work of houses. A total of 40% of the suppliers supported the residents’ perspective on the limited support provided by the government, as the residents have to cover the remaining housing material costs if the incentives provided by the government is insufficient. The government may have financial difficulties supporting sustainable housing development in rural areas in the near future. A recorded inflation rate of 3.3% in Malaysia in 2021 (Department of Statistics Malaysia, 2021) seems to indicate an extra challenge for the residents in their spending allocations, such as food, education, lifestyle and housing. Moreover, sustainability may be an additional burden to the government and/or the residents of the housing development. This is aligned with the finding by De Zoysa et al. (2021), who suggested that altering the existing low-cost housing in Sri Lanka to incorporate sustainability features is inherently difficult.

Lack of technical skill.

The houses in rural areas were mostly built by the residents with less machinery. 50% of the residents were concerned with the technical skills required for building houses with sustainability features, as they did not attend a specific training course for housing construction and did not master any advanced techniques. The residents mentioned that they mostly used manpower with little machinery support for constructing houses. A supplier suggested that the residents have sufficient housing construction skills prior to the assistance of skilled carpenters. S4 mentioned, “*The residents are building their own house. If they are facing difficulties, they could hire workers to perform the construction. There is carpenter in the village.*” Despite the surge in technology in construction, time-tested traditional methods still hold valuable knowledge. Houses in rural areas could incorporate simple techniques that tailor buildings and surroundings to fit the culture of the residents (Nguyen et al., 2019). In this circumstance, technical skills could be associated with the social aspect of sustainability. A lack of technical skill could add environmental and social burdens to houses and residents (Davies & Davies, 2017).

Lack of accessibility.

Twenty-five percent of the residents pointed out the delivery of required materials and machinery to rural areas is a challenge for building houses with sustainability features. R1, a head of village, said, “*There are difficulties in transportation, as sending things here is difficult... have to go through small boat, and carry the materials for quite a distance. There is no bridge [connected] to the village.*” All suppliers identified accessibility issues in delivering housing materials to rural areas. The suppliers emphasized flooding issue and difficulties in reaching certain areas due to non-accessibility of cars. The government’s budget allocation for infrastructure development seems to not solve the entire rural area’s accessibility issue. The existing road is flood prone during rainy days, and some areas could only be accessible by boat. Abdullah (2017) stated that

the Sarawak rural areas have limited access to basic services, partially due to the lack of proper infrastructure development, which leads to the need for access through roads and/or rivers. Limited accessibility and improper infrastructure hinder residents from experiencing a better quality of life, such as transporting sustainable materials and techniques for housing improvement. Zhao and Yu (2020) reported that rural areas that were far from the city centre decreased the mobility of rural areas' residents.

Lack of residents' awareness.

The residents were unaware of the benefits of incorporating sustainability features into housing. A resident explained that sustainable housing is not the key focus as it could not improve their quality of life. A house may just be a place of shelter. The residents have no further intention to improve housing conditions, such as housing durability. Such findings tally with AlQahtany (2020), Aldossary *et al.* (2016), and Durdyev *et al.* (2018), which find that a lack of knowledge and awareness about sustainability hinders sustainable housing development and investment. Stakeholders might not have sufficient understanding of environmental concerns like the utilization of sustainable energy sources and appliances that conserve water.

4.2. Theme 2: Strategies to achieving sustainable housing in rural areas

Interviewees' responses revealed that government policy, the provision of durable housing materials, financial capacity and quality workmanship could be possible measures for achieving sustainable housing in rural areas.

Government policy.

87.5% of the residents and all suppliers recognized that government policy is essential for sustainable housing development. Such initiatives include providing accessible infrastructure to rural areas, providing sustainability features, and providing technical and financial incentives/supports. The accessible infrastructure could ease the transport of construction materials and labor for housing construction. The residents stressed the importance of solar panel in rural areas due to the frequent breakdown of electricity supply. The government's financial incentives could ensure the provision of durable housing materials from suppliers and contractors. The interviewees revealed that the government's focus on infrastructure could help with transporting housing materials to rural areas. This is supported by the year 2022's Sarawak government rural areas development budget allocation of USD 1.04 billion (MYR4.8 billion) (64% of total development budget) on roads, bridges and riverine construction (Cheng, 2021). The government may engage with construction experts to propose strategies for introducing sustainable housing in rural areas. Successful implementation of sustainability features in housing involves contractors, builders and residents, as facilitated by government policy (Yang & Yang, 2015). However, the Malaysian government did not mandate incorporating sustainability features into housing. The rating tool, Green Building Index, is only a voluntary approach for residents and supply chain agents. This differs from Australia which mandates a minimum six-star rating requirement for residential energy efficiency (Commonwealth of Australia, 2021), and such a mandatory requirement has somewhat fostered the incorporation of energy efficiency features into housing. It seems that regulations incorporating sustainability features into housing could help with housing development in rural areas.

Provision of durable housing materials.

37.5% of residents and all suppliers agreed that the use of durable housing materials to improve the lifespan of the housing is essential for sustainable housing. A resident and all suppliers pointed out that this would go hand-in-hand with the improved financial capacity as higher costs are associated with durable materials. R7, a resident cum contractor, said, "*Durable materials...comes with quality. Higher quality materials for sure is more expensive than the normal material.*" Suppliers of housing materials reacted positively towards the supply of sustainable housing materials, which was subject to the residents' financial capacity and accessibility to rural areas. Quality and financial capacity are interrelated as better-quality housing materials could enhance housing durability, but may require a higher financial investment.

Financial capacity.

To improve the financial capacity, a resident reckoned that the sole reliance on government support for a better housing is not feasible. Self-development for skill enhancement and income generation would be a long-term plan for having an ideal living environment. A resident suggested that the government provide agriculture projects to warrant the sale of agricultural products, for income generation. Such stable income could ensure the survival of residents, improve residents’ financial capacity and hence further create a possibility for residents to improve their housing conditions. R4 mentioned, “*Government has to start housing together with agriculture project for the community. We need to look into the food [production], secured income, to allow people for focusing on houses.*” The residents have to equip themselves with proper skills to ensure stable income, and support their lives without relying solely on government incentives. To meet the SDGs by targeting sustainability and poverty, income generation is suggested as the main focus. With sufficient financial capacity, the residents could self-support their lives, and have a better quality of life in the future. However, the current source of income seems to limit residents’ capacity to improve their housing conditions. Levin and Feniger (2018) emphasized that strengthening technology engagement, local business, health and welfare are essential to achieving sustainable development in rural areas. Rural entrepreneurship could assist in income generation and rural area development (Zivdar & Sanaeepour, 2022).

Quality workmanship.

A resident stressed the importance of quality workmanship by contractors if the government assigned contractors for housing construction. The resident emphasized that proper workmanship could ensure the functionality of the house and the safety of the residents. Shan et al. (2020) stressed the importance of skilled and early contractors’ involvement in the successful implementation of sustainable housing. Such findings tallied with those of Raouf and Al-Ghamdi (2023), who emphasized the importance of quality workmanship as housing performance during the operational phase reflects the efficacy of the design solution and construction workmanship to meet sustainability demands. Maintenance and overhaul procedures prolong housing longevity. Inadequate construction practices and a lack of comprehension about operations and maintenance practices resulted in the underperformance of sustainable housing.

4.3. Relationship between Theme 1 and Theme 2 with stakeholders’ participation

The interviewees identified challenges in Section 4.1 and suggested potential measures to overcome the suggested challenges as indicated in Section 4.2. The relationship between the main findings is shown in Figure 1.

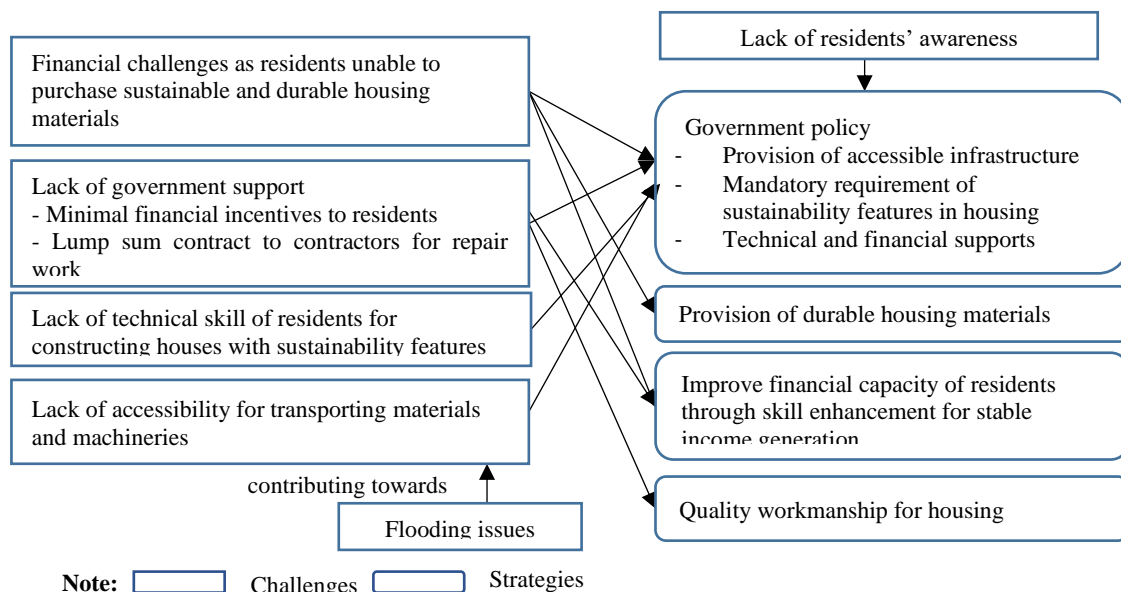


Figure 1. Summary of the main findings which led to the development of a preliminary framework.

4.4. Proposed framework for sustainable housing in rural areas

The interviewees discussed challenges such as financial challenges, lack of government support, lack of accessibility and lack of residents’ awareness, and proposed possible strategies to overcome the existing challenges. The challenges and strategies were consolidated and incorporated to propose a framework for sustainable housing development in Sarawak (see Figure 2). The proposed framework showed possible stakeholders’ collaboration between the government, suppliers of housing materials, contractors and rural area residents. The provision of financial support from the government to residents and suppliers of housing materials could assist in the uptake of sustainable housing. Other than financial support, the government could provide agricultural projects to the residents in rural areas to secure their income. Moreover, as houses in rural areas are mostly constructed by the residents, the government shall focus on the provision of education to enhance residents’ knowledge about sustainable housing. The government could mandate the sustainability features requirement as part of the rural housing development plan as well as provide a lump-sum contract to the contractor for developing sustainable rural housing.

Other than the efforts from the government, Figure 2 depicts contractors, suppliers, and/or residents using durable housing materials for sustainable rural housing development. The use of local building materials in this endeavour will not only assist in the development of the local building material industry, but also contribute to its overall strength and growth (Leal Filho et al., 2019). This could undoubtedly assist in achieving SDG 11, as rural areas contribute to creating sustainable and resilient communities as well. Ebekozien et al. (2023) emphasized leakages in achieving SDG 11 for Malaysian low-cost housing and urged the government, owner builder and building contractor to focus on the documentation with policy guidance. Such suggestions could be similar to the proposed framework with the collaboration between contractors, residents, suppliers and the government in achieving sustainable rural housing through proper workmanship from the contractors, financial capacity and sustainable-related knowledge of residents, durable housing materials from suppliers, as well as the mandatory sustainability features requirement from the government. Hence, such a framework could possibly be generalized to other developing countries that face accessibility and financial issues in rural areas, to achieve the SDGs.

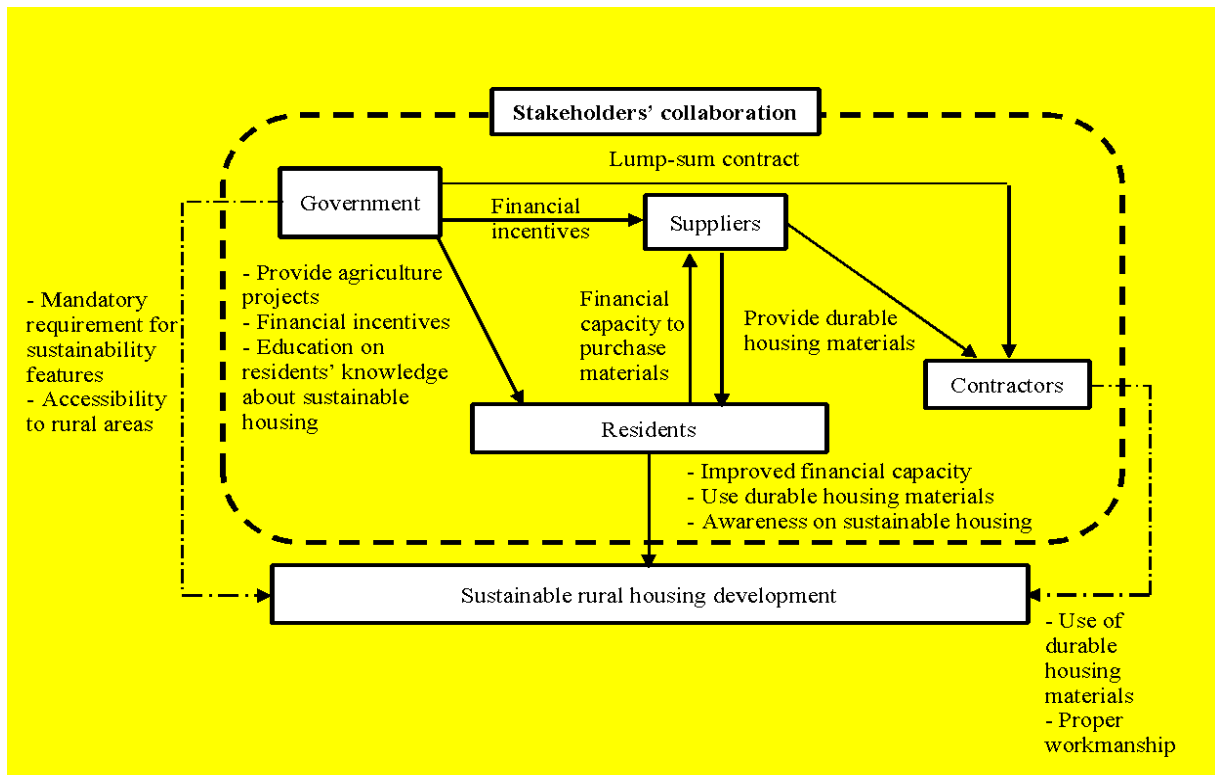


Figure 2. Proposed preliminary framework for sustainable housing development in rural areas.

4.5. The Validation of proposed framework

The questionnaire survey was conducted in August 2022 with academicians, rural area residents, contractors, suppliers of housing materials and developers to validate the proposed framework. The respondents were asked about their level of agreeability based on five-point Likert Scale on the proposed framework with a few statements. The results validated the framework with all mean values greater than 3.5, demonstrating satisfactory suggestions have been proposed (see Table 3). The results showed that proper workmanship by the contractor (mean value of 5) was the most important criterion perceived by all experts. The criterion of the government mandating the incorporation of sustainability features into housing seems to receive contradictory views from one of the experts. Warren-Myers and McRae (2017) showed that housing stakeholders tend to meet the minimum mandatory sustainability requirement with little-to-no intention to exceed it. However, Doyon and Moore (2020) argued on the initiatives taken to introduce voluntary approaches for incorporating sustainability into housing on top of the mandatory requirements in Melbourne and Vancouver. For this study, if a criterion was mostly agreed upon by the majority of the experts, the framework would retain this criterion. The respondents were asked to propose other criteria that would be included in the framework and the respondents confirmed the comprehensiveness of the framework with no additional criteria. Hence, the results of the validation questionnaire supported the validity of the proposed framework.

Table 3. Results of the validation questionnaire on sustainable housing development framework.

Validation criteria	Respondent						Mean
	1	2	3	4	5	6	
Government has to offer financial incentives to suppliers and/or contractors for them to provide durable housing materials to rural areas.	5	4	3	4	5	5	4.33
Government has to assist the residents of rural areas so that they can afford to purchase durable housing materials.	5	5	4	5	5	4	4.67
Government has to educate residents on the existence and benefits of sustainable housing	5	4	4	5	3	4	4.17
Government needs to mandate the incorporation of sustainability features into housing development in rural areas.	5	2	4	4	5	3	3.83
Government needs to improve the accessibility to rural areas to facilitate the transport of materials.	5	5	4	5	5	5	4.83
Government needs to provide agriculture projects to residents for them to improve their financial capacity on sustainable housing development.	5	5	4	5	4	3	4.50
Suppliers have to provide durable housing materials to the residents and/or contractors.	5	4	4	4	5	5	4.50
Residents need to have sufficient financial capacity to purchase materials from the suppliers.	5	5	4	5	5	4	4.67
Contractors need to provide good workmanship to ensure the quality of the sustainable housing development in rural areas.	5	5	5	5	5	5	5.00
Residents' financial capacity will determine the extent of their usage and/or purchase of durable housing materials.	5	4	4	4	5	3	4.17
Residents need to be aware on the existence and benefits of sustainable housing.	4	4	4	5	4	4	4.17

5.0 CONCLUSIONS

This research is one of the first investigations that investigates the residents' and housing material suppliers' perceptions of the challenges and possible strategies for sustainable housing development in rural areas of Sarawak, Malaysia. The lack of financial support adds to the wear and tear conditions of the houses in rural areas. The findings revealed that the key challenges for sustainable housing development are financial and accessibility issues. The interviewees revealed that government policy, quality workmanship, financial capacity and provision and durable housing materials could be possible ways to foster sustainable housing development.

The consolidation of both identified challenges and strategies proposes a framework for sustainable housing development in rural areas. The proposed framework suggested that the aspiration of residents and housing material suppliers towards sustainable housing in rural areas could become a reality with the collaboration of all parties, including the government, housing material suppliers, contractors and residents. Residents' awareness of sustainability features and financial provision is essential to improving housing conditions. Despite the use of durable housing materials, good workmanship is essential to enhancing the quality of houses. These could, in turn, achieve the economic, social and technical aspects of sustainable housing in rural areas. Implementation of the proposed framework could assist the government in managing the housing needs of rural residents and strategic planning for the development of sustainable housing, to improve the quality of life in rural communities.

The generalization of these research findings could be extended by comparing the sustainable housing development in rural areas of other states and/or regions, such as between Asian and Oceania regions. A comparison could also be conducted between developed and developing countries. Future research could consider the Analytic Hierarchy Process (AHP), a systematic approach to assessing and ranking intricate choice criteria with pairwise comparisons, as well as a focus group for a small group of experts, to validate the conceptual framework.

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Appendix A

Semi-structured interview questions

Residents

1. What type of housing materials are your current house using?
2. If you have changed at least one house in the past, how many years did your previous house(s) last for? What was the reason for the change of house?
3. What are the current initiatives (i.e. financial, technical) provided by the government in terms of housing supply?
4. Why (or why not) are you and/or your family involved in sustainable housing development?
5. What are the challenges you faced or anticipated to face, if introducing sustainability features into the housing?
6. What are the shortcomings which you could recognise if introducing sustainable housing?
7. What is your suggestion to promote sustainable housing and/or overcome the existing problems in developing sustainable rural housing in Sarawak?

Suppliers

1. What type of housing materials are you supplying to the rural areas residents in Sarawak?
2. What could be the possible motivation for you to supply durable housing materials that could help in sustainable housing development in rural areas?
3. What are the challenges you faced or anticipated to face, if introducing sustainability housing materials?
4. What are the shortcomings for suppliers which you could recognise if introducing sustainable housing?
5. What is your suggestion to promote sustainable housing and/or overcome the existing problems in providing sustainable housing materials (e.g. transportation of materials to remote area, cost)?
6. What can be your role in increasing contributions by your profession in the area of sustainable housing development in rural areas?

Appendix B**Codes and associated frequency**

Sub-themes	Codes	Frequency of Code
Theme 1: Challenges to achieve sustainable housing in rural areas		
Financial challenges	Residents are lacking of specific knowledge/skill for income generation	7
	Limited job opportunities	5
	Farming as the only source of finance	17
	Unable to upgrade houses due to limited financial capacity	7
	Self-financed for own-built houses	12
	Unable to secure loan	4
Lack of government support	No financial support from the government	10
	Support for housing repair only	10
Lack of technical skill	No specific technique / use of simple method for construction	13
	No training course provided for specific construction technique	1
	Less machinery	5
Lack of accessibility	Transportation issue	14
	Flooding issue	9
Lack of residents' awareness	Unaware on the benefits of sustainable housing	7
	Sceptical on the possibility that sustainable housing could improve quality of life	4
	House is not the priority of residents	6
Theme 2: Strategies to achieving sustainable housing		
Government policy	Initiatives from government to introduce sustainable housing	11
	Provision of accessible infrastructure	3
	Provision of electricity / solar panel in rural areas	12
Provision of durable housing materials	Improve lifespan of houses	4
	Higher cost for durable materials	9
	Financial capacity of residents	6
	Accessibility to rural areas	4
Financial capacity	Financial incentives from government	12
	Residents' self-development for skill enhancement	3
	Income generation of residents	3
	Provision of agricultural project	2
Quality workmanship	Functionality of houses	5
	Skillful contractors	7
	Government provided lump sum contract to contractors	4