



BALANCING AFFORDABILITY AND SUSTAINABILITY: UNVEILING HOMEBUYERS' PREFERENCES FOR GREEN AFFORDABLE HOUSING CRITERIA AND FEATURES

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Abstract

Green Affordable Housing (GAH) embodies a balance between affordability and sustainability in housing development. In Malaysia, the Green Building Index (GBI) outlines green housing criteria across six key areas: energy efficiency, indoor environmental quality, sustainable site planning and management, material and resource efficiency, water efficiency, and innovation. Similarly, the National Housing Policy (NHP) emphasizes affordability through income and housing price criteria. This study aims to align these frameworks by integrating GBI and NHP standards with GAH features identified in prior research. Logistic regression analysis of potential homebuyers' data revealed that 75.8% of respondents are willing to pay a premium for GAH features, with an acceptable cost increment of up to 10%. Top preferences include water-efficient fixtures (62.5%), rainwater harvesting systems (61%), and improved indoor environmental quality, such as low-noise designs (61.7%) and reduced volatile organic compounds (58%). The study highlights that incorporating green features into affordable housing is viable if cost increments remain reasonable, offering guidance for policymakers and developers to create sustainable and affordable housing solutions in Malaysia.

Keywords: Green Affordable Housing, homebuyer preferences, sustainability, affordability, Malaysia.

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INTRODUCTION

The integration of green features into affordable housing (GAH) addresses environmental challenges by creating sustainable living spaces for low- and middle-income families (Ye et al., 2024). While GAH offers environmental and economic benefits, such as lower utility bills and improved health outcomes, balancing sustainability with affordability remains a challenge due to higher upfront costs (Galster, 2020; Yeganeh et al., 2019). Understanding homebuyers' needs is critical, as studies show that while buyers value energy-efficient and green features, affordability is their primary concern, with limited willingness to pay significant premiums (Noiseux & Hostetler, 2010). Identifying cost-effective green features is essential for increasing GAH adoption.

Research highlights that affordability and perceived quality strongly influence purchasing decisions, as seen in Malaysia, where weak policies, high costs, and supply-demand mismatches hinder affordable housing provision (Wong et al., 2024; Daud & Nor, 2018). The M40 group, representing 40% of Malaysia's population, faces affordability gaps due to rising property prices and limited mid-range housing options (Daud & Nor, 2018; Baqutayan, 2014). As a crucial segment of homebuyers, the M40 can benefit from GAH's long-term advantages. This study objectives include (i) to identify key GAH features and (ii) to assess the M40 group's preferences and willingness to pay (WTP), contributing to a tailored green affordable housing model that aligns with their needs (Francis et al., 2023; Zaidi, 2024).

LITERATURE REVIEW

Defining Green Affordable Housing

GAH represents an essential link to social justice, prosperity, and homeowner well-being by combining environmental sustainability with social and economic objectives (Anthony, 2023; Favilukis et al., 2023; Global Green USA, 2007). To justify its costs, GAH requires careful evaluation of cost-effective green features while balancing affordability and sustainability, addressing poverty risks for moderate-income groups, and promoting access to public amenities, healthy neighborhoods, and walkable communities (Silva et al., 2024; Kwofie et al., 2025).

This study defines GAH as integrating green building criteria into affordable housing, targeting Malaysian middle-income groups—40% of the population earning between RM5,250 and RM11,819 monthly (DOSM, 2022)—with a willingness to pay (WTP) for 10% higher costs, ranging from RM120,000 to RM180,000. It also considers households earning RM2,000 to RM8,000 monthly (Rahman et al., 2019; Zulkepli et al., 2017; Mousavi et al., 2013; Aziz et al., 2011; Suhaida et al., 2011), particularly in regions like Johor Bahru, Klang

Valley, and Penang, emphasizing the need for clear implementation strategies aligned with affordability and performance goals (Olanrewaju & Tan, 2018).

GAH Criteria and Features

Six green housing criteria and twenty features identified through a literature review (Table 1), linking broad sustainability principles with practical housing applications. These criteria and features serve as essential guidelines in developing affordable yet eco-friendly homes to foster both cost-effectiveness and improved quality of life for residents.

Table 1: Green Affordable Housing Criteria and Features

Criteria	Features	References
Energy Efficiency	• Heating, ventilation, and air conditioning with energy-efficient systems • Energy-efficient appliances and light fittings • Techniques to reduce solar heat through walls and roofs • Use of solar panels • Building orientation to maximize natural light (north-south orientation)	Fang, Misnan, and Abdul Halim (2024); Igugu et al., 2024; Zulkepli (2020); Olatunde et al. (2024); Simpeh et al. (2022); Bertoldi (2022); El-Azab (2021); Soheilian et al. (2021); Bottarelli et al., (2020); Aggarwal & Molleti (2024); Ziaacemehr et al., (2023); Akinsulire et al. (2024); Maka & Alabid (2022); Wang et al., (2024); Bashir et al. (2024); Sharma & Dongre (2024); UN-Habitat (2024)
Sustainable Site Planning and Management	• Landscaping, especially on the roofs of high-rise buildings • Extensive landscaping throughout the site • Accessibility to public transportation	Ahzahar, Zakaria, and Ismail (2016); Díaz Caselles and Guevara (2024); Zulkepli (2020); Szolomicki (2019); Misni (2017); Ehab et al. (2025); Hussain, M. R. M. (2014); Akinsulire et al. (2024); Silva et al. (2024); Azmoodeh et al. (2020); Howell et al., (2018); Dragu et al. (2025)
Water Efficiency	• Sustainable water management • Rainwater harvesting systems	Flores and Ghisi (2022); Al-Qawasmi et al. (2019); Zulkepli (2020); Madias & Szymkowiak (2022); ; Akinsulire et al. (2024); Sojka et al. (2016); Freni& Liuzzo (2019); Rodrigues et al. (2023)

Material and Resources	• Use of regional materials to minimize depletion of natural resources • Materials that adopt reduce, reuse, and recycle concepts	Liu (2022); Xiangyu (2024); Zulkepli 2020); Akinsulire et al. (2024); Sánchez Hurtado (2017); Popescu et al. (2024); Shukla et al. (2024); Santos et al. (2024);
Criteria	Features	References
Material and Resources	• Sustainable construction practices • Good waste management principles • Provision of separate bins and chutes for waste separation	Roslee et al. (2022); Akinsulire et al. (2024); Atta et al. (2021); Silva et al. (2024); Azam (2022); Chen & Lee (2020); Safian (2020)
Indoor Environmental Quality	• Design features that ensure low noise levels, low indoor air pollutants, and high indoor air quality • Minimization of volatile organic compounds (VOCs) • Formaldehyde minimization	Shetaw et al., (2024); Niza, Bueno & Broday (2023); Roslee et al. (2022); Lo et al. (2014); Kurmanbekova et al. (2025); Hashemi & Dungrani (2025); Liu et al. (2024); Alkarimiah et al. (2023); Chaturvedi et al. (2023). Kurmanbekova et al. (2025); Silva et al. (2024).
Innovation	• Environmental ideas to enhance sustainability • Design ideas that promote eco-friendliness	Ahmad (2023); Meena et al. (2022); Gunaselan (2025); Silva et al. (2024); Akinsulire et al. (2024) Gunaselan (2025); Mohamad et al. (2022)

Source: Author (2024)

Homebuyers' Preferences for Green Affordable Housing Criteria and Features

Understanding homebuyers' willingness to pay (WTP) is essential for pricing strategies and developing housing features, as it reflects the maximum buyers are willing to spend (Wang et al., 2024; Mishi & Mwanypedza, 2023; Breidert et al., 2006). Factors like location, property traits, and disclosure influence WTP, while financial feasibility is key to balancing economic benefits (Mwanypedza & Mishi, 2024; Azizul & Chuweni, 2024). Research shows buyers are inclined to pay more for green features such as LED lighting and water-saving devices, though affordability and cost-effectiveness remain limiting factors (Yau, 2012; Estep et al., 2013; Ling & Gunawansa, 2011). Affordable housing prioritizes price and income considerations to keep expenses under 30% of income (Crowe & Rowley, 2024; Azmi & Bujang, 2021; Aziz et al., 2011; Hashim, 2010; Global Green USA, 2007). Demand, tied to financial capacity and interest rates, also affects WTP and sustainable housing goals, highlighting the importance of cost-effective solutions (Cervelló-Royo et al., 2021; Węgrzyn & Kania, 2024; Goedertier et al., 2024). While homebuyers value the economic benefits of green

features, their modest WTP underscores the need for affordable and sustainable housing options that align with their financial capabilities.

In summary, the conceptual framework for GAH (Figure 1) integrates affordability considerations namely price, income, and cost—with green building principles, reflected in both criteria (e.g., energy efficiency, water efficiency, sustainable site planning, indoor environmental quality, materials and resources, and innovation) and specific features (e.g., use of solar panels, rainwater harvesting systems, sustainable construction practices, and eco-friendly design ideas). This framework serves to identify comprehensive housing features while analyzing prospective homebuyers' preferences and their willingness to pay for sustainable yet affordable housing solutions.

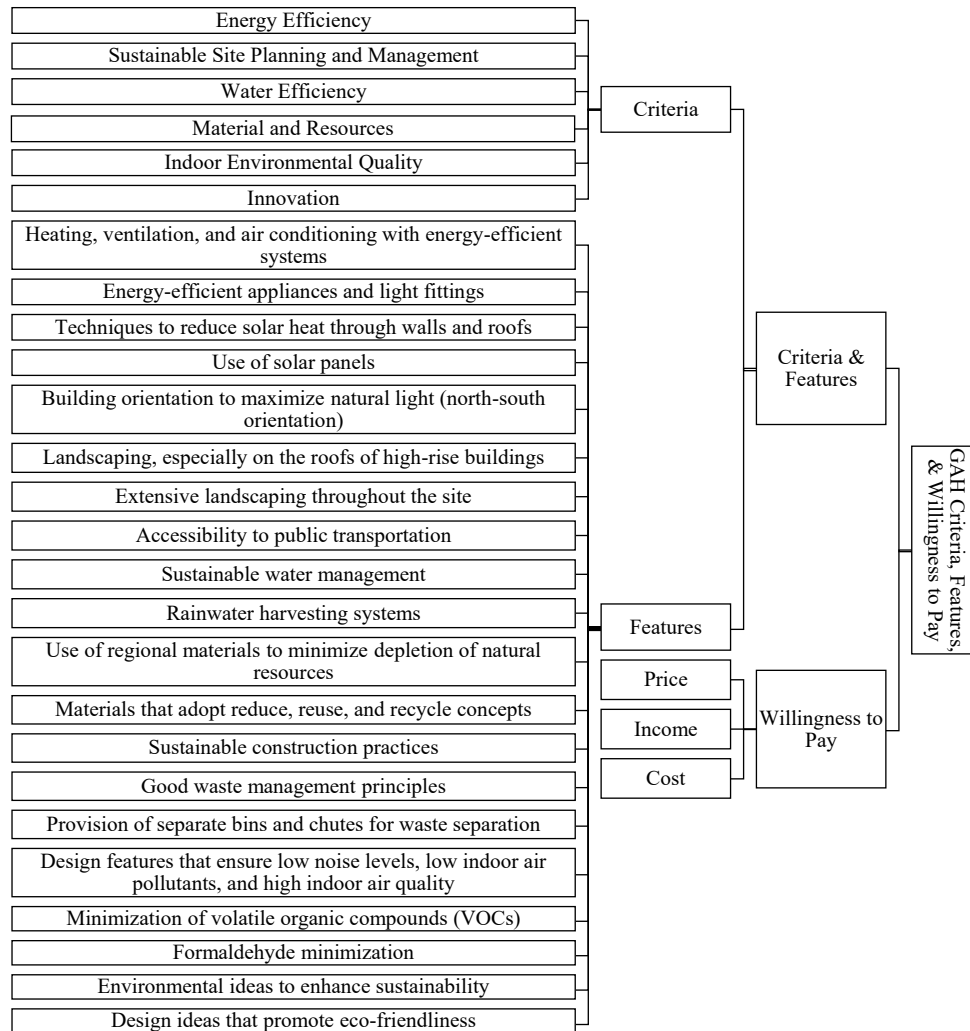


Figure 1: Green Affordable Housing Conceptual Framework

Source: Author (2024)

RESEARCH METHODOLOGY

This study identified GAH criteria and features based on existing literature, considering homebuyers' preferences and willingness to pay. Using a cross-sectional survey design, structured questionnaires were distributed in Johor Bahru, Klang Valley, and Penang, covering respondent profiles and GAH preferences (Cooper, Schindler, & Sharma, 2018, Zikmund et al., 2013).

Following Israel's (1992, 2019) sample size formula, a target of 400 respondents was set, adjusted for population differences across states. To ensure sufficient responses, 300 questionnaires were distributed per state, yielding 600 valid responses with a 100% response rate in Johor Bahru and Penang, and 82% in Klang Valley.

ANALYSIS AND DISCUSSION

Data Analysis

The survey data was analyzed using descriptive and Logistic Regression Analysis to explore respondents' socio-demographic characteristics, knowledge of GAH, and willingness to pay for GAH features. Reliability and validity of the research instrument were ensured through Exploratory Factor Analysis (EFA), identifying patterns among variables and enabling data reduction. Respondents selected GAH features from their perspectives, and cross-tabulation analysis was conducted to assess the incremental cost of GAH criteria and features.

Socio-demographic Profile

The respondent profile illustrated in Table 2 provides a detailed summary of the demographic and socioeconomic profiles of the sample population.

Table 2: Socio-demographic profile of respondents.

Category	Item	Percentage
Gender	Female	55.5
	Male	44.5
Race	Non Bumiputera	12.8
	Bumiputera	87.2
Age	18 – 40 years	76.5
	41 years and above	23.5
Dependent	No dependent	22.8
	Have dependent	77.2
Qualification	School level	37.0
	Graduate level	58.3
	Post graduate level	4.7
Income	RM 5001 and above	29.7
	RM 1001 – RM 5000	70.3
Expenditure	More than RM 1500	65.8
	RM 500 – RM 1500	34.2
Category	Item	Percentage
Housing Loan	RM 501 and above	69.0
	RM 500 and below	31.0
Occupation	Self employed	8.2
	Government Sector	78.7
	Private Sector	13.2
Knowledge of GAH	No	34.7
	Yes	65.3

Source: Author (2024)

Reliability Test

A reliability analysis was executed to assess the consistency of the responses obtained. A Cronbach's Alpha value exceeding 0.7 signifies that the data is reliable for further analysis and reporting (Taber, 2018 and Hair et al., 2017). The Cronbach's Alpha value in this research was in the range of 0.930 to 0.970, demonstrating a high level of internal consistency and confirming the reliability of the respondent data.

Exploratory Factor Analysis (EFA)

EFA was used to refine 26 questionnaire items into constructs for independent variables, utilizing SPSS version 27 with varimax rotation (Creswell & Creswell, 2018). The analysis categorized 20 GAH features into six key criteria: energy efficiency, sustainable site and management, water efficiency, material and resources, indoor environmental quality, and innovation.

The EFA results indicate that the six GAH criteria explain 66.67% of the variance and show strong reliability (Cronbach's alpha > 0.966). The 20 items retained were grouped as follows:

(i) Energy Efficiency – 5 items (ii) Sustainable Site and Management – 3 items
(iii) Water Efficiency – 2 items (iv) Material and Resources – 5 items (v) Indoor Environmental Quality – 3 items (vi) Innovation – 2 items

These findings align with other GAH rating tools, such as:

- i. BREEAM Eco Homes (UK): 8 criteria, 33 features
- ii. Green Communities Initiative Criteria (US): 8 criteria, 60 features
- iii. Ecocents Living (Australia): 11 criteria, 24 features (Pullen et al., 2009)
- iv. Green Building Index Malaysia (GBI): 6 criteria, 39 features

Though not representing GAH Malaysia, GBI served as a basis for its development.

Logistic Regression Analysis

Table 3 presents the logistic regression results, showing that GAH criteria and features significantly influence willingness to pay ($p < .05$). The model meets all key assumptions, with the Omnibus test indicating strong significance ($p < .001$) and explaining 26% to 38.9% of the variation in the dependent variable, based on Cox & Snell and Nagelkerke values.

Table 3: Result for Logistic Regression

	B	S.E	Wald	df	Sig.	Exp (B)
GAH Criteria and Features	1.146	0.096	143.521	1	.000	3.146

Best Model Summary: Omnibus Test ($p < .000$)

-2 Log Likelihood (479.917); Cox and Snell R² (.260); Nagelkerke R² (.389)

Source: Author (2024)

Table 4 exhibits the results of the classification of the best model. It shows how well the model predicts group membership. The overall classification accuracy is 75.8%, exceeding the 50% cut off threshold.

Table 4: Predicted vs. Observed Frequencies for GAH Preferences and Willingness to Pay Using Logistic Regression (Cutoff = 0.50)

Observed	Predicted		% Correct
	Not Willing to Pay More (No)	Willing to Pay More (Yes)	
Not Willing to Pay More (No)	0	145	.0
Willing to Pay More (Yes)	0	455	100.0
Overall % correct			75.8

Source: Author (2024)

This classification plot shows the frequency of the willingness to pay for different probabilities and whether there were ‘yes’ or ‘no’ categorisation. Figure 2 reveals the graphic guide on how precise the model is and displays how many time the model would predict ‘yes’ or ‘no’ outcome based. The outcome from the following graph shows many cases in the right-side area. So, this model identifies that GAH criteria and features significantly influence willingness to pay.

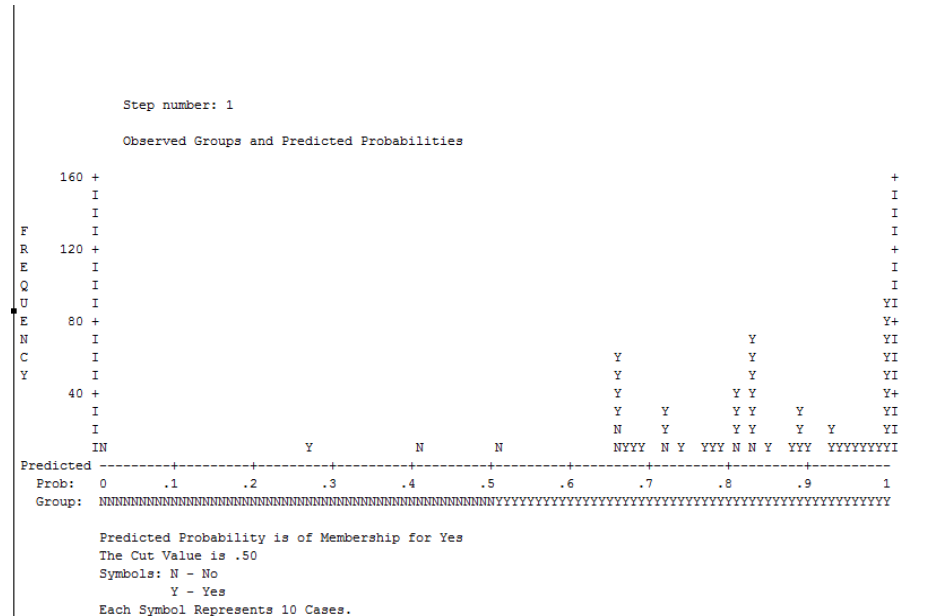


Figure 2: Observed Groups and Predicted Probabilities
 Source: Author (2024)

GAH features from Potential Home Buyers' Perspectives

Table 5 highlights potential homebuyers' preferences for GAH features, with high selections for water efficiency criteria like Water Saving Appliances and Fittings (62.5%) and Rainwater Harvesting (61%), as well as indoor environmental quality features such as Low Noise Levels, High Indoor Air Quality (61.7%), Volatile Organic Compounds (58%), and Formaldehyde Minimization (56.7%). These preferences emphasize long-term benefits like lower utility bills, better ventilation, and health-focused living, reflecting buyers' awareness of sustainability and willingness to invest in eco-friendly housing (Liow, 2024; Azizul & Chuweni, 2024). However, findings align with prior studies indicating that buyers prioritize criteria offering direct economic benefits (Zalejska-Jonsson et al., 2020; Estep et al., 2013; Yau, 2012), with affordability constraints showing that Malaysian buyers can only pay less than RM 55 monthly for such features over ten years (Mousavi et al., 2013).

Table 5: GAH features from Potential Home Buyers' Perspectives

GAH Features		Potential Home Buyers' Willingness to Pay (%)
EE1	Good natural ventilation	53.7
EE2	Energy saving appliances and light fittings	55.5
EE3	Walls and roof fitted with materials that reduce solar heat gain	56.0
EE4	Solar panels	56.8
EE5	North-south orientation	54.3
SM1	Plants and greenery planted on the facade and roof of high-rise buildings	54.5
SM2	Extensive landscaping	56.7
SM3	Public transport accessibility	57.8
WE1	Water saving appliances and fittings, and low water usage	62.5
WE2	Rain water harvesting	61.0
MR1	Building installed with regional materials that minimize depletion of natural resources	60.2
MR2	Building installed with materials adopt reduce, reuse and recycle concepts	52.7
MR3	Sustainable construction practices	51.5
MR4	Good waste management principles	53.7
MR5	Provision of separate bins/chutes	55.8
EQ1	Design with low noise level, low indoor air pollutants and high indoor air quality	61.7
EQ2	Volatile Organic Compounds	58.0
EQ3	Formaldehyde Minimisation	56.7
IN1	Environmental idea	59.8
IN2	Green design idea	31.8

Source: Author (2024)

The Incremental Cost for GAH Criteria and Features

Table 6 presents the cross-tabulation results for GAH criteria, including energy efficiency, sustainable site planning, water efficiency, materials, indoor environmental quality, and innovation, showing that over 50% of homebuyers are willing to pay for all six criteria and 20 features within a 10% incremental cost. Developers are ready to adopt these features, but affordability remains crucial, as buyers can only bear up to a 10% increase beyond affordable housing prices (Ibrahim et al., 2013). Studies by Simpeh et al. (2024), Cheam et al. (2023), Mazli and Fauzi (2022), and Swett et al. (2007) reveal limited awareness of green housing, so this study focused on incremental costs buyers are willing to pay. Most respondents (54-56%) prefer up to a 5% cost increase, reflecting interest in sustainability but high cost sensitivity, while 22-25% are willing to pay a 6-10% premium for features like energy efficiency and site management, demonstrating flexibility for added value.

Table 6: Percentage of Incremental Cost Potential Homebuyers Willing to Pay

Criteria	0-5 %	6-10%	11-15%	16-20%	21-25%	26-30%
Energy Efficiency	54.3	25.0	10.3	5.8	2.5	2.0
Sustainable Site and Management	55.0	25.3	10.2	5.3	2.8	1.3
Water Efficiency	53.7	24.5	11.5	5.3	2.7	2.2
Material and Resources	54.2	24.7	10.7	6.2	2.3	1.8
Indoor Environmental Quality	54.7	22.8	10.3	6.8	3.3	2.0
Innovation	55.7	22.5	11.2	5.3	2.5	2.8

Source: Author (2024)

CONCLUSION

This study examines potential homebuyers' preferences for green affordable housing (GAH), highlighting that most respondents, aged 18–40 years, married, and employed in the government sector, earn RM1,001–RM5,000 and allocate significant portions of their expenses to housing loans. Respondents demonstrated knowledge of GAH and expressed strong preferences for water efficiency features like water-saving appliances and rainwater harvesting, as well as indoor environmental quality criteria such as low noise levels and high air quality, with more than half willing to pay up to a 10% incremental cost for these features (Piao & Managi, 2023; Kucher et al., 2019). Recommendations include introducing cost-effective green features, targeted marketing campaigns, affordable designs, innovative elements, and policies like tax rebates and subsidies to promote broader GAH adoption while ensuring alignment between sustainability and affordability goals. Future research should address GAH design and construction challenges, include broader geographic samples, and explore qualitative methods or cross-cultural comparisons to better understand the trade-offs between affordability and sustainability in diverse contexts.

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