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Tom OKOT✉

Universidad Latinoamericana de Ciencia y Tecnología, Costa Rica

Bridging sustainability awareness and housing preferences: insights from Generation Z in Costa Rica

Keywords: Generation Z, sustainable housing, green building certification, environmental attitude, Costa Rica, green mortgage

Introduction

Urban population growth, climate change, and the increasing scarcity of natural resources have placed substantial pressure on housing systems worldwide, especially in the Global South (Van Noorloos et al., 2020). In response, sustainable construction practices have gained prominence, seeking to reduce environmental impacts while improving building efficiency and long-term livability. Costa Rica, known for its strong environmental policies and progressive green agendas, presents a unique opportunity to study how younger generations perceive and engage with these sustainable housing options (Conejo et al., 2023). The sustainable construction movement arose from life-cycle thinking and resource efficiency principles (reduce, reuse, recycle), and early scholarship emphasized environmental assessment tools and whole-building sustainability evaluation (Ding, 2008; Bragança et al., 2010). Modern certification systems grew from these early frameworks.

✉tokot199@ulacit.ed.cr

In this paper, "Generation Z (Gen Z)" refers to individuals born between 1996 and 2010 (age cohort 22–28 in the present study). This cohort is characterized by high digital connectivity, early labor-market entry, and heightened exposure to environmental discourse via social media and formal education attributes that shape distinct consumption preferences and expectations for product transparency and sustainability (Dragolea et al., 2023).

In recent years, the construction sector has been recognized as one of the primary contributors to environmental degradation, accounting for 39% of global energy--related carbon dioxide emissions (Min et al., 2022). Latin American countries have begun implementing sustainability strategies in urban planning and housing development, including energy efficiency, water conservation, bioclimatic architecture, and the use of environmentally responsible materials (Nassary et al., 2022). Certification systems such as Leadership in Energy and Environmental Design (LEED) and Excellence in Design for Greater Efficiencies (EDGE) have played a pivotal role in operationalizing these goals, offering structured guidelines to assess the sustainability of real estate projects (Isimbi & Park, 2022).

This study focuses on LEED and EDGE, two internationally recognized certification systems with growing relevance in Costa Rica. LEED is a credit-based framework widely used worldwide, while EDGE is tailored for housing markets in emerging economies and emphasizes cost-effective efficiency measures. Both involve registration and review fees that increase initial project costs, but these are often offset by operational savings and higher market appeal. In Costa Rica, EDGE has recently been promoted through the Green Building Council (GBCCR) and financial institutions as part of green mortgage programs.

However, despite these advancements, the adoption of green construction practices remains limited, especially in residential real estate. One of the factors influencing this gap is consumer demand, or lack thereof, for sustainable features. While green technologies may offer long-term financial and ecological benefits, their uptake largely depends on whether potential buyers understand and value these attributes. This is particularly relevant for emerging buyer segments such as Gen Z, whose members are entering the housing market with distinct values and preferences shaped by digital exposure, climate change discourse, and educational access (Okot et al., 2022).

This study is grounded in two complementary theoretical frameworks: the theory of planned behavior (TPB) and the norm activation model (NAM). TPB posits that behavioral intentions are driven by attitudes toward the behavior, subjective norms, and perceived behavioral control (Ajzen, 2020). In the context of sustainable housing, this suggests that Gen Z consumers are more likely to consider eco-friendly

features if they perceive them as beneficial, socially endorsed, and within their purchasing power. NAM, on the other hand, emphasizes the role of personal norms activated by problem awareness and a sense of responsibility (Park & Ha, 2014). Applied to this context, it suggests that Gen Z individuals may feel morally compelled to support sustainable housing if they understand its environmental impact and feel personally accountable.

Costa Rica offers an ideal empirical setting to investigate these dynamics. The country has demonstrated a commitment to sustainability through national strategies such as the Decarbonization Plan 2018–2050, urban planning initiatives supporting green infrastructure, and its early adoption of renewable energy, which already powers over 98% of its electricity grid (Godínez-Zamora et al., 2020). However, residential projects still face challenges in balancing sustainability, affordability, and market appeal. Given that Costa Rican cities are experiencing densification, particularly in the greater metropolitan area (GAM), real estate developers are increasingly targeting younger buyers with vertical housing solutions, including apartments and mixed-use buildings.

Building on this context, the study seeks to answer the following questions:

1. Research questions:

– To what extent does Gen Z in Costa Rica value sustainable housing attributes in their residential purchase or rental decisions?
– What is the level of awareness and perceived importance of environmental certifications among Gen Z in the Costa Rican housing context?
– How do attitudes, perceived behavioral control, and personal norms influence Gen Z's preference for sustainable housing?

2. Research hypotheses:

– H1: Gen Z's positive attitudes toward sustainability significantly influence their preference for green-certified housing.
– H2: Higher levels of perceived behavioral control increase the likelihood of preferring sustainable housing options.
– H3: Personal environmental norms positively influence the perceived attractiveness of sustainable residential features.
– H4: Awareness of environmental certifications (e.g., EDGE, LEED) moderates the relationship between attitudes and housing preference.

To test these hypotheses, a quantitative survey was administered to members of Gen Z in Costa Rica, whose responses form the empirical basis of this research. The findings aim to inform both public policy and the real estate sector on how

to design and market residential projects that align with the values and expectations of the emerging Gen Z demographic, potentially accelerating the mainstreaming of sustainable construction in Latin America. Figure 1 summarizes the research design, instrument, and sampling, and the sequence of data cleaning and statistical analyses.

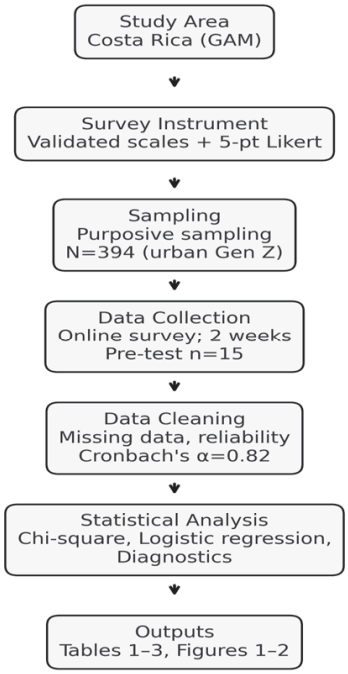

FIGURE 1. Methodological flow diagram
Source: own work.

Material and methods

Study area

The study was carried out in Costa Rica's GAM, which includes San José, Heredia, Alajuela, and Cartago. The GAM concentrates over 70% of the country's urban population and is the primary housing market targeted by new vertical developments (Instituto Nacional de Estadística y Censos [INEC], 2023).

Survey instrument and data collection

We used a structured online questionnaire, built from validated scales in TPB and NAM literature. Guided by TPB (Ajzen, 2020) and NAM (Le & Nguyen, 2022; Kim, 2023), the research aimed to test behavioral and normative predictors of interest in sustainable housing. The survey was designed based on validated instruments from existing literature on sustainable housing preferences (Aule et al., 2022; Isimbi & Park, 2022) and aligned with TPB and NAM constructs. The instrument consisted of: (a) sociodemographic items, (b) familiarity with certification systems (LEED, EDGE, and national initiatives), (c) importance ratings for 10 sustainable housing attributes (five-point Likert), and (d) items measuring attitudes, subjective norms, perceived behavioral control, and personal norms (five-point Likert). The questionnaire was pre-tested with 15 participants, and minor wording and flow edits were applied. The final survey was administered online for two weeks, distributed via university mailing lists, alumni networks, and social media. Participation was voluntary and anonymous, and informed consent was obtained. Ethical clearance was granted by Universidad Latinoamericana de Ciencia y Tecnología (ULACIT).

Sampling and sample characteristics

Inclusion criteria: age 22–28, current residence in the urban GAM, and basic internet access. Purposive sampling targeted digitally-accessible Gen Z respondents across multiple cantons in the GAM. Using Cochran's formula and a 95% confidence level, the required minimum sample was 385; after data cleaning, $N = 394$ valid responses remained (no missing key outcome data) (Mardia et al., 2024). The sample skews towards tertiary-educated respondents (67% university students or graduates), which we note as a limitation regarding representativeness.

Data analysis

Data processing and statistical analyses were conducted using IBM SPSS v27. Descriptive statistics summarized respondent profiles and attribute importance. Chi-square tests examined categorical associations (e.g., certification familiarity × × preference). Binary logistic regression tested predictors of preference for green--certified housing (dependent variable: preference for certified housing equals 1,

otherwise 0). Model checks included multicollinearity [variance inflation factor (*VIF*) below 2.0], linearity of continuous predictors with logit (Box–Tidwell test), influential observation checks (Cook's distance), and goodness-of-fit tests (Hosmer–Lemeshow). Results are reported with beta coefficients (β), standard errors (*SE*), Wald statistics, odds ratios [exp(β)], 95% confidence intervals, and model fit indices (Nagelkerke R^2). Statistical significance was set at $p < 0.05$.

Results and discussion

Descriptive statistics and participant profile

A total of 394 valid responses were collected from individuals aged 22 to 28 residing in urban areas of Costa Rica. Of these, 53% identified as female, 46% as male, and 1% as non-binary. The majority of respondents (67%) reported having a university degree or being currently enrolled in a tertiary program. Income distribution was relatively even, with 49% reporting a middle-income status and 31% identifying as lower-middle income.

Regarding environmental attitudes, 100% of respondents stated that environmental sustainability is "important" or "very important" to them, confirming a strong baseline environmental awareness in this generational cohort.

Awareness and perceived relevance of certifications

Despite the high degree of environmental concern, only 31% of participants reported familiarity with green housing certifications such as LEED or EDGE. Among those familiar, 72% associated these certifications with energy efficiency, and 54% with environmental health and air quality. However, nearly 70% of respondents could not explain the specific criteria or benefits associated with these certifications.

This finding suggests some knowledge–intention gap, where pro-environmental attitudes are not supported by functional knowledge, echoing similar patterns observed in sustainable consumption literature (Dimitrova et al., 2022). It aligns with NAM's premise that unless awareness is sufficiently activated, personal norms may not translate into action (Park & Ha, 2014; Table 1).

TABLE 1. Awareness and perceived value of green certifications among participants

Certification awareness	Familiar	Consider it important
	%	
LEED	29	66
EDGE	18	71
Not familiar with any	69	–

Source: own work based on survey responses.

Preference for sustainable housing attributes

Participants were asked to rank the importance of ten sustainable features using a five-point Likert scale (1 = not important, 5 = very important). The top three features were:

– energy efficiency ($\bar{x}$ = 4.61, *SD* = 0.48),
– quality of indoor environment ($\bar{x}$ = 4.44, *SD* = 0.53),
– bioclimatic design ($\bar{x}$ = 4.26, *SD* = 0.57).

Lower-rated attributes included the use of locally sourced materials ($\bar{x}$ = 3.41) and connection to graywater treatment systems ($\bar{x}$ = 3.52). While these latter features have strong environmental implications, they may lack perceptual immediacy or be poorly understood, reinforcing the role of perceived behavioral control and awareness, per TPB (Ajzen, 2020; Fig. 2).

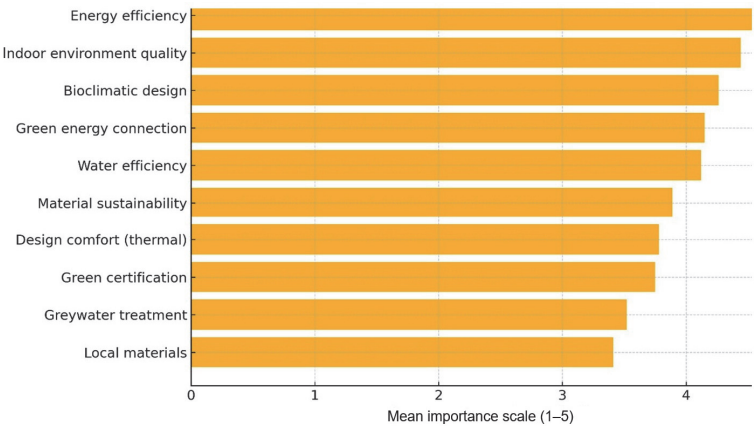

FIGURE 2. Sustainable housing attributes ranked by mean importance

Source: own work.

Model diagnostics and fit

The logistic regression model met assumptions and showed an acceptable fit. Multicollinearity diagnostics indicated *VIF* < 2.0 for all predictors, ruling out problematic collinearity. Linearity of the logit for continuous predictors was verified using the Box–Tidwell test (all $p > 0.05$), and no influential observations were detected (maximum Cook's distance < 1.0). Goodness-of-fit was satisfactory (Hosmer–Lemeshow $\chi^2 = 7.82$, $df = 8$, $p = 0.45$). The model explained approximately 26% of the variance in preference for certified housing (Nagelkerke $R^2 = 0.26$). Odds ratios and 95% confidence intervals are reported in Table 2, indicating that environmental attitudes (*OR* = 1.79, 95% *CI* [1.36, 2.37]), perceived behavioral control (*OR* = 1.55, 95% *CI* [1.09, 2.20]), personal norms (*OR* = 2.03, 95% *CI* [1.48, 2.80]), and certification awareness (*OR* = 1.43, 95% *CI* [1.03, 1.99]) significantly increased the likelihood of preferring green-certified housing.

TABLE 2. Logistic regression results predicting preference for green-certified housing ($n = 394$)

Predictor variable	β (*SE*)	Wald χ^2	p	*OR* [exp(β)]	95% *CI* for *OR*
Environmental attitude (H1)	0.58 (0.14)	17.14	0.000**	1.79	[1.36, 2.37]
Perceived behavioral control (H2)	0.44 (0.18)	6.00	0.014*	1.55	[1.09, 2.20]
Personal norms (H3)	0.71 (0.16)	19.72	0.000**	2.03	[1.48, 2.80]
Certification awareness × attitude (H4)	0.36 (0.17)	4.48	0.034*	1.43	[1.03, 1.99]

*$p < 0.05$; **$p < 0.01$.

Source: own work.

Regression analysis confirmed that environmental attitudes, perceived behavioral control, and personal norms significantly predict preference for certified green housing. Awareness of certification systems positively moderated this relationship. Table 3 presents a synthesis of the four tested hypotheses, including their theoretical basis, effect sizes (β), and significance levels. All hypotheses were statistically supported within the logistic regression model.

TABLE 3. Summary of hypotheses and regression results

Hypothesis	Statement	Supported?	β	p
H1	Environmental attitudes positively influence preference	supported	0.58	< 0.01
H2	Perceived behavioral control positively influences preference	supported	0.44	< 0.05
H3	Personal environmental norms increase preference likelihood	strongly supported	0.71	< 0.001
H4	Certification awareness moderates the attitude–preference relationship	supported	0.36	< 0.05

Source: own work.

Interpretation and theoretical contributions

These results confirm that attitudinal and normative drivers, as described in TPB and NAM, are central to Gen Z's housing preferences in Costa Rica. While prior studies have discussed environmental concerns abstractly (Dragolea et al., 2023), this paper provides empirical validation in the residential housing context, specifically among first-time market entrants in Latin America.

The observed moderating effect of certification awareness provides an actionable insight: promoting education on certification systems may significantly boost sustainable housing uptake. This is particularly relevant in a region where technical information is often fragmented, and green building literacy is low (Isimbi & Park, 2022).

Interestingly, while personal norms exhibited the strongest effect size, less tangible attributes like locally sourced materials or graywater treatment were less appreciated, likely due to limited visibility or knowledge. These findings support the notion that moral responsibility alone is insufficient without targeted awareness – a key implication for policymakers and developers (Levy, 2014).

Comparative insights and regional applicability

While this research focuses on Costa Rica, its insights are highly relevant across Latin America, where youth-led environmentalism is rising, yet housing markets remain slow to adapt. In countries like Colombia, Chile, and Mexico, similar generational demand patterns for eco-efficient housing are emerging, but adoption is limited by cost concerns, lack of awareness, and institutional inertia (Bungau et al., 2022).

A key differentiator between Millennials and Gen Z lies in digital fluency and immediacy of environmental urgency. While Millennials laid the foundation for sustainable consumption, Gen Z exhibits a sharper demand for transparency and long-term ecological value in purchasing decisions (Jasrotia et al., 2023). These preferences must be matched with responsive design and financing models, especially in urban peripheries where sustainable options are rare or unaffordable.

For housing developers across the region, market readiness remains uneven. While large firms are beginning to adopt green design principles, SMEs and cooperatives still face barriers in accessing certification systems or financing retrofits (Iwuanyanwu et al., 2024). Regional coordination through platforms like the Inter-American Development Bank's green housing initiatives or national climate financing programs could catalyze systemic change (Almeida et al., 2022).

Beyond Costa Rica, similar challenges and opportunities shape sustainable housing adoption across Latin America. In Mexico, progress has been constrained by limited access to green mortgage instruments, which restricts younger consumers' ability to finance certified housing. In Colombia, the uptake of certification has been hindered by cost barriers for small and medium-sized developers, limiting the diffusion of sustainable practices beyond high-end projects. In Chile, uneven regulatory incentives across municipalities have created disparities in sustainable housing implementation, despite national-level commitments to climate goals. Regional initiatives provide a counterbalance: the Inter-American Development Bank has piloted green housing financing programs that lower upfront cost barriers, and their regional case studies demonstrate how certification uptake can follow different pathways depending on local institutional support. These comparative insights highlight that Costa Rican Gen Z consumers display a strong preference for certified housing, yet regional constraints in financing, certification cost structures, and uneven policy incentives remain critical barriers to widespread adoption (Almeida et al., 2022).

Overall, scaling green housing adoption in Latin America will require not only policy harmonization but also active partnerships between developers, youth-oriented civil society groups, and multilateral funding sources. The Costa Rican case can serve as a blueprint for designing policy bundles and outreach strategies aligned with the values of environmentally engaged youth.

Conclusions

While the findings of this study contribute meaningful insights into Gen Z's housing preferences and sustainability attitudes in Costa Rica, several limitations should be acknowledged.

First, the use of non-probabilistic, purposive sampling, while effective for reaching a digitally connected urban Gen Z cohort, limits the generalizability of results. Participants were largely drawn from university networks and online platforms, potentially overrepresenting individuals with higher levels of education and sustainability exposure. As a result, the findings may not fully capture the perspectives of less connected or rural young adults, or those without a tertiary education.

Second, the study's cross-sectional design restricts the ability to draw causal conclusions or assess changes over time. Environmental awareness and housing market dynamics are evolving rapidly, particularly in response to climate-related

policies and economic volatility. Future studies employing longitudinal methods could help track the stability of green housing preferences as Gen Z transitions into different life stages or as housing affordability shifts in response to policy incentives.

Third, while the study applied validated theoretical models (TPB and NAM), it relied on self-reported intentions rather than actual housing decisions. Although intentions are meaningful predictors of behavior, future research would benefit from incorporating behavioral data, such as home purchase patterns or rental choices among green-certified versus conventional units.

Additionally, the study was geographically limited to Costa Rica, which, while a leader in sustainability policy, may differ significantly from other Latin American nations in terms of housing finance systems, urban infrastructure, and environmental regulation. Comparative studies across countries like Colombia, Mexico, or Brazil could offer valuable cross-cultural insights and test the robustness of the TPB–NAM framework in diverse institutional environments.

Finally, future research could explore intergenerational comparisons, such as differences between Millennials, Gen X, and Gen Z in how they perceive and act upon green housing opportunities. These insights could support segmentation strategies for developers and inform policy design that reflects the diverse environmental motivations across age groups.

By addressing these limitations, future research can expand the external validity and practical utility of green housing studies in Latin America and beyond.

This study explored the preferences of Costa Rica's Gen Z regarding sustainable residential housing, with a focus on the perceived value of green building attributes and environmental certifications. The findings confirm that members of this demographic cohort exhibit strong pro-environmental attitudes, prioritizing features such as energy efficiency, indoor environmental quality, and bioclimatic design when considering housing options. These results are consistent with the increasing global awareness among younger generations about climate change and resource depletion and reflect Costa Rica's longstanding commitment to sustainability.

Despite this interest, the study identified a significant knowledge gap concerning green housing certifications, as only 31% of respondents were familiar with systems like LEED or EDGE. This disconnect between environmental concern and technical awareness represents a barrier to informed housing decisions and highlights the need for targeted communication strategies. Developers and policymakers must work to translate sustainability into accessible, visible, and trusted information, particularly through certification education and labeling.

The application of TPB and NAM provided strong theoretical grounding for understanding the behavioral mechanisms driving these preferences. Statistical

analysis showed that environmental attitudes, perceived behavioral control, and personal environmental norms were all significant predictors of preference for certified green housing. Furthermore, awareness of certification systems moderates the relationship between attitudes and housing preference, suggesting that education and exposure can significantly enhance sustainable decision-making.

These results have important implications for housing developers, urban planners, and public institutions. Promoting green certifications, offering financing incentives such as green mortgages, and embedding sustainability into housing policy frameworks are key steps toward aligning market offerings with the values of a new generation of buyers. Additionally, this research underscores the importance of investing in sustainability literacy campaigns that go beyond general awareness to provide clear, actionable knowledge.

By bridging the gap between environmental values and technical understanding, Costa Rica can lead by example in the Latin American region. Empowering Gen Z with tools to act on their sustainable preferences may not only transform housing markets but also contribute to broader environmental and social resilience.

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Summary

Bridging sustainability awareness and housing preferences: insights from Generation Z in Costa Rica. This study investigates how Generation Z perceives and values sustainable residential housing, with a focus on environmental attitudes, personal norms, and awareness of green building certifications. This study is situated in Costa Rica, one of Latin America's sustainability leaders. It applies the theory of planned behavior (TPB) and the norm activation model (NAM) to explore the behavioral and normative drivers of housing preferences. A structured survey of 394 urban residents aged 22–28 was conducted, and responses were analyzed using descriptive statistics and binary logistic regression with diagnostic tests. Findings show that energy efficiency, indoor environmental quality, and bioclimatic design are the most valued features. Although environmental concern is nearly universal among respondents, only 31% are familiar with certifications such as LEED or EDGE, revealing a critical awareness gap. Regression analysis confirms that pro-environmental attitudes, perceived behavioral control, and personal norms significantly influence preference for green-certified housing, and certification awareness strengthens this relationship. These insights highlight the need for targeted sustainability education and clearer communication of certification systems. The study offers practical guidance for developers, urban planners, and policymakers aiming to align residential products with the values of environmentally conscious young adults in Costa Rica and comparable markets.