EXPLORING CULTURAL VALUES AND SUSTAINABILITY PREFERENCES IN HOUSING DEVELOPMENT: A STRUCTURAL EQUATION MODELING APPROACH

Key words: indigenous housing, cultural values, sustainable development, sustainability preferences, Tiv housing

Introduction

Sustainability may be seen as behaviors and procedures directed toward meeting our present needs without jeopardizing the requirements of subsequent generations (United Nations SDGs, 2015). Environment, as one of the primary pillars of sustainability, covers the provision of suitable housing and the creation of human settlements that are inclusive, safe, resilient, and long-lasting (Car-Pušić, Tijanić, Marović & Mladen, 2020). This inclusiveness means that essential services should be provided through changes, improvements, and slum upgrading for the growth of both countries, communities, and regions. According to Neef et al. (2018), this embraces giving communities value-based developments to retain their identities, adapt to climate change, and keep their cultures alive.

Furthermore, to ensure inclusiveness, end-users as beneficiaries should be involved in the planning, designing, and developing implementation schemes in their areas (Wang, Zhao, Wu & Tang, 2017; Ostańska, 2019). The integration of participatory strategy is vital in ensuring the value-based development proponent and preservation of people’s cultural identities in accordance with the UN Sustainable Development Goals.
The hypothesized significant association between cultural values and the people’s preferences for sustainable housing improvements will be tested in this study using the structural equation modelling (SEM) approach. The ordinal-scale survey for this study was carried out between February and March 2022 to systematically validate the values in indigenous built surroundings of the Tiv society of Benue State, central Nigeria, and relate them to the people’s preferences for lasting transformational improvements. The research surveyed and tested the link between people’s values and their choices for sustainable development by utilizing factors previously discovered through some qualitative inquiries. The result is intended to give helpful information for value-based strategies, designs, and implementation among the Tiv society in central Nigeria. Furthermore, the findings will be articulated with the values of other ethnic groups to establish an acceptable and comprehensive vernacular architecture and urban identity acceptable to most Nigerians.

Material and methods

Content design of the survey

This part of the study was a cross-sectional ordinal-scale survey conducted between February and March 2022 using online Google form instruments. The study collected quantitative data to statistically establish the mainstream values and test their relationship with the transformative preferences of the Tiv people of central Nigeria. The survey variables for the inquiry were obtained from themes elicited in previous interviews, as summarized in Figure 1.
The elicited variables earlier coded into attributes, consequences, and values using the QSR® NVivo® software version 12 were also ranked based on the frequency of mentions by interview participants, as presented in Table 1. The elicited and ranked variables provided the basis for the subsequent ordinal scale survey, which is the primary methodology for this study. The variables tested to be significant and valid with 20% frequency in the previous study were further investigated employing a five-point Likert scale, with 1 representing “highly disagree” to 5 for “highly agree”. The survey questions were categorized into attributes, consequences, values, and preferences for transformative improvements.

Questions were based on the shapes, material, and settings of the peoples’ indigenous houses, as earlier elicited and ranked. All questions were formatted multi-choice with a paragraph space provided at the end of the survey for necessary feedback from respondents. The “required” restriction was also activated in the Google form to check cases of missing data. Finally, a survey link was generated and shared with some social media groups and indigent

TABLE 1. Variables elicited from interviews provided the basis for the ordinal scale survey. Adapted as published by the authors (Aule et al., 2022)

| S/No | Concrete attributes | Abstract attributes |
|------|---------------------|---------------------|
| i    | round or circular shape | cultural meaning 17 |
| ii   | separate houses      | material availability 15 |
| iii  | earth-mud            | history, heritage 13 |
| iv   | bamboo framed roof   | natural of earth 11 |
| v    | disperse setting     | strengths of material 07 |
| vi   | thatched roof        | drainage of roof 06 |
| vii  | reeds, canes         | infinite earth 05 |
| viii | rectangle shape      |                     |

| S/No | Functional consequence | Psycho-social consequence |
|------|-------------------------|---------------------------|
| i    | free movements          | feeling natural 17        |
| ii   | climatic control        | feeling relaxed 09        |
| iii  | farming space           | feeling modest 07         |
| iv   | ventilating space       | feeling strong 07         |
| v    | protective purpose      | feeling cool 05           |

| S/No | Instrumental values | Terminal values |
|------|---------------------|-----------------|
| i    | determination & ambition | independent living 17 |
| ii   | simple living        | basic comfort 11 |
| iii  | cleanliness          | safety & security 07 |
| iv   | creative craft       | cultural identity 06 |
| v    | nature conservation  |                 |
Since the survey is concerned with one state in Nigeria, Benue state was taken as an area cluster where the sample was taken. As an area with limited internet and other electronic amenities, the convenient sampling approach was used where units in the Benue cluster volunteered to engage in the survey. The results were first scrutinized using the IBM® Statistical Package for Social Science (SPSS®) software version 22. Main tests were conducted using the IBM® SPSS® Analysis of Moment Structures (Amos™) software version 24 for the first-order confirmatory factor analysis (CFA) and the subsequent second-order SEM.

**An overview of structural equation modeling**

While it could be more accessible to measure tangible elements such as the number of people, weight, height, cars, and temperature, among others, with some physical devices; it is often difficult to measure intangible perceptions, values, achievement, esteem, preferences, satisfaction, among others, using instruments (Pahlevan Sharif & Sharif Nia, 2018). The Likert scale is one of the practical ordinal survey tools to measure non-concrete perceptions of people (Kline, 2016). Therefore, the CFA and SEM are instruments to analyze and test correlations in ordinal scale data, especially in social science studies.

The SEM estimates a sequence of dependent connections among a collection of ideas or constructs represented by several measurable variables, incorporating the results into an integrated model (Malhotra, 2020). Though referred to by other family names such as covariance structure analysis, co-variance structure modeling, or covariance structure analysis (Kline, 2016), it is usually carried out in two parts called orders. The two parts are the first-order CFA and the second-order SEM. Typically, CFA involves drawing path diagrams and covariances and loading the observed or measured variables called factors. The loaded CFA model is then run and assessed, eliminating insignificant factors with less than 0.5 standardized regression weights (Pahlevan Sharif & Sharif Nia, 2018). The model is then fitted based on recommended standards, with reliability and validity also assessed. The first-order CFA is completed once the model goodness-of-fit is attained and conditions for reliability and validity are met.

The second-other SEM involved reorganizing the model into independent and dependent constructs, fitting it before establishing the strength of their relationships.

Since this study is modeled on constructs of attributes, consequences, and values, the SEM model will be used to test the three hypotheses:

- **H₁**: There is a significant correlation between housing attributes and transformative preferences.
- **H₂**: There is a significant correlation between utility consequences and transformative preferences.
- **H₃**: There is a significant correlation between people’s values and transformative preferences.

**Demography of survey respondents**

This section contains the demography of survey respondents. Regarding age, about 82% of respondents were adults above 30 years with the requisite knowledge
and experience to elicit meaning and values in their indigenous built environments. Concerning the state of origin, close to 98% of respondents were indigenous to Benue state, the study area; however, the remaining 2% of outsiders were retained for negative case analysis and generalizations. In the sphere of home ownership, more than 80% of respondents either live in their houses or rented apartments, while the remaining were drawn from local builders and female leaders. Interestingly, all the respondents reported having completed their secondary education, with about 81% graduates. The demography of the survey respondents looks good as most seem mature and responsible enough to provide needed responses. Even the 18% of female respondents seem reasonable to identify gender-based values in the African context, where participation of the female gender in many spheres is still gathering momentum.

Preliminary data checks and screening

Two supervisory experts, among other experienced research-group members, validated the survey contents. Their valuable feedback and inputs were utilized to refine and finalize the inquiry. Furthermore, preliminary results for the first week were utilized as a pilot study where inconsistencies were checked and minor errors were corrected. While the sample size for CFA varies based on complexities and area of study, many scholars agreed to a minimum of 200 valid responses (Kline, 2016; Sharif, Mostafiz & Guptan, 2018; Malhotra, 2020; Achoba, Majid & Obiefuna, 2021).

Though 255 completed responses were received, 12 were initially excluded as redundant and outliers. With the “required” restriction in the online survey, there was no incidence of missing values from the data collected. A general reliability test was conducted where data exhibited high consistency with a Cronbach’s alpha of 0.934. A principal component analysis (PCA) test was also conducted, with most variables having communalities greater than 0.5 weights. Furthermore, the Kaiser–Meyer–Olkin (KMO) and Bartlett’s test of sphericity were generated to check the correlation matrix and data’s suitability for a productive confirmatory factor analysis (CFA). As shown in Table 2, the PCA results produced a 0.000 significance level and 0.872 KMO, confirming the relevance of the data set for CFA.

| Test                                      | Value     |
|-------------------------------------------|-----------|
| Kaiser–Meyer–Olkin measure of sampling adequacy | 0.872     |
| Bartlett’s test of sphericity              |           |
| chi-square approximation                   | 6 438.240 |
| degrees of freedom                         | 1 225     |
| significance                               | 0.000     |

Following recommendations by scholars (Sharif et al., 2018), an exploratory factor analysis (EFA) was also conducted on the data to check variables with high cross-loadings, where two were finally removed, bringing the absolute sample to 241 valid respondents. With suggestions from the resulted eigenvalues, the constructs were grouped into the four parent clusters of attributes, consequences, values, and preferences.
Results and discussions

The first-order confirmatory factor analysis factor loadings

The IBM® SPSS® Amos™ software version 22 was utilized for the first-order CFA and the subsequent second-order SEM. The CFA commenced with a path diagram drawn with four latent constructs of attributes, consequences, values, and preferences, each with their respective number of observed variables and error terms, as presented in Figure 2.

The observed variables were loaded into the four latent constructs of attributes, consequences, values, and preferences, where 27 of the variables were returned significant, with standardized regression weights of 0.5 and above.

CFA model fit

Variables with weaker loadings were systematically eliminated during the CFA model assessment, while the recommended model fit indices were checked in the output mode. A model fit was eventually realized...
with acceptable indices, as shown in Table 3. Though a perfect CFA model fit should have a significant chi-square value greater than 0.05, the larger-sample hallmark of SEM most times affects its significance (Pahlevan Sharif & Sharif Nia, 2018; Achoba et al., 2021). In line with Kline (2016) and Malhotra (2020), other indices that fit a model’s goodness-of-fit index (GFI) include comparative fit index (CFI), Tucker–Lewis index (TLI), normal chi-square per degree of freedom ($C_{\text{min}}/df$), root-mean-square error approximation (RMSEA), and standardized root mean square residual (SRMR). Table 3 presents the fitted first-order CFA model according to recommendations (Kline, 2016; Pahlevan Sharif & Sharif Nia, 2018; Malhotra, 2020).

**Reliability and validity of the CFA model**

Reliability refers to how a scale produces consistent results if repeated measurements are made (Malhotra, 2020). In SEM, a construct can be measured with composite reliability (CR), maximum reliability ($\text{max } R(h)$), Cronbach’s alpha ($\alpha$), or omega ($\omega$), where all are expected to have a value greater than 0.70 (Pahlevan Sharif & Sharif Nia, 2018). This model is reliable as all values for constructs’ composite, and maximum reliability is above 0.70 acceptable minimum, as shown Table 4.

On the other hand, validity may be seen as the extent to which observed disparities in scale scores represent actual variances between matters on the feature being assessed rather than a systematic or random error (Malhotra, 2020). Two types of validity are measured in SEM: convergent and discriminant. While the convergent validity in SEM can be assessed through average variance extracted (AVE), which is expected to be greater than 0.50 for all constructs, the discriminant validity, on the other hand, may be measured as maximum shared variance (MSV) expected to be less than the AVE. It can also be assessed using heterotrait-monotrait (HTMT) measurement, expected to be less than 0.9 for all constructs (Pahlevan Sharif & Sharif Nia, 2018). As presented in Table 4, the reliability and validity of this study’s model were generated using Amos™ plugin called Master Validity Tool developed by James Gaskin and John Lim (Gaskin, James & Lim, 2019).

While the convergent AVE is generally expected to be viable with values above 0.50 for all constructs, it is viewed by Malhotra (2020) as being too strict a measure for the models validity. Pahlevan Sharif and Sharif Nia (2018) further explain the challenge of attaining all recommended values in new research areas, where knowledge of phenomenon is minimal, with scanty

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### TABLE 3. First-order CFA model goodness-of-fit based on recommended indices (own studies)

| Goodness-of-fit | Chi-square group | Absolute fit | Incremental fit | Incremental fit | Absolute fit | Standard RMR |
|----------------|-----------------|-------------|----------------|----------------|-------------|--------------|
| Fitness indexes | $C_{\text{min}}$ | df | $C_{\text{min}}/df$ | CFI | IFI | TLI | RMSEA | RMR |
| Recommended value | > 0.05 sig. | < 3.0 | > 0.90 | > 0.90 | > 0.90 | < 0.08 | < 0.08 |
| This model | 140.426 | 59 | 2.380 | 0.933 | 0.934 | 0.912 | 0.057 | 0.689 |

The CFA model is accepted for meeting acceptance levels.
Aule, T. T., Majid, R. B. A., Jusan, M. B. M. (2022). Exploring cultural values and sustainability preferences in housing development: A structural equation modeling approach. Sci. Rev. Eng. Env. Sci., 2971. DOI 10.22630/srees.2971

| Attribute | CR  | AVE | MSV | max(R(H)) | Attribute | Consequence | Value | Preference |
|-----------|-----|-----|-----|-----------|-----------|-------------|-------|------------|
| Attribute | 0.842 | 0.519 | 0.261 | 0.858 | 0.720 | × | × | × |
| Consequence | 0.832 | 0.624 | 0.566 | 0.846 | 0.228** | 0.790 | × | × |
| Value | 0.722 | 0.466 | 0.566 | 0.737 | 0.408*** | 0.753*** | 0.683 | × |
| Preference | 0.748 | 0.599 | 0.261 | 0.777 | 0.510*** | -0.063 | 0.275** | 0.774 |

** Values statistically significant at p level < 0.010.
*** Values statistically significant at p level < 0.001.

**TABLE 5.** The essential attributes, consequences, and values predicting preferences for sustainable housing transformation (own studies)

| Construct | Code | Variable | SRW ($\lambda$) | Cronbach’s alpha ($\alpha$) > 0.7 | Composite reliability (CR) > 0.6 | Average variance (AVE) > 0.5 |
|-----------|------|----------|-----------------|-------------------------------|--------------------------------|-------------------------------|
| Attribute | AC2  | earth-mud materials | 0.697 | 0.832 | 0.842 | 0.519 |
|           | AC3  | use of sun-dried adobe bricks | 0.678 | | | |
|           | AC5  | use of thatch roofs | 0.594 | | | |
|           | AC6  | dispersed compound setting | 0.802 | | | |
|           | AA1  | expression of culture | 0.747 | | | |
|           | AA4  | compound expresses communal living | 0.667 | | | |
| Consequence | CF1 | insulation from heat and rainfall | 0.743 | 0.875 | 0.832 | 0.624 |
|           | CF3  | simple to construct | 0.721 | | | |
|           | CF4  | cheap and economical materials | 0.800 | | | |
|           | CP2  | feel cool within the buildings | 0.693 | | | |
| Value | V15  | simplicity and hospitality | 0.618 | 0.737 | 0.722 | 0.466 |
|           | V16  | cleanliness & vigilance | 0.741 | | | |
|           | VT3  | cultural identity | 0.659 | | | |
|           | VT5  | promote communal unity | 0.522 | | | |
| Transformative preference | Pref2 | independence & privacy | 0.595 | 0.747 | 0.748 | 0.599 |
|                     | Pref4 | modernize Tiv houses | 0.535 | | | |
|                     | Pref6 | integrate traditional forms in modern | 0.684 | | | |
|                     | Pref8 | context-specific buildings | 0.604 | | | |
published materials. The study proposes that an AVE measure of more than 0.40 and other acceptable measures is deemed sufficient to establish a model’s acceptability validity. Accordingly, the 18 constructs that were finally seen to be reliable and valid represent the most important attributes, consequences and values in Tiv indigenous housing, presented in Table 5.

**Structural equation model**

Structural equation model is the second-order analysis. Most of the variables fitted in the CFA, tested to be reliable with acceptable validity, were utilized for the final structural model and for testing the study hypothesis. The measures for goodness-of-fit such as comparative fit index (CFI), Tucker–Lewis index (TLI), normal chi-square per degree of freedom ($C_{min}^2/df$), root-mean-square error approximation (RMSEA), and standardized root mean square residual (SRMR), were also attained. Therefore, as presented in Figure 3, the second-order structural model was fit based on recommended indices (Kline, 2016; Pahlevan Sharif & Sharif Nia, 2018; Malhotra, 2020). With the second-order model fulfilling indices for goodness-of-fit, it was used to predict the relationship between the constructs.

**Cultural values and sustainability preferences**

The squared multiple correlations were seen to have good values for the two endogenous constructs of values

| Goodness-of-fit | Chi-square | Absolute fit | Incremental fit | Incremental fit | Absolute fit | Standard RMR |
|-----------------|------------|--------------|-----------------|----------------|-------------|--------------|
| Fitness indexes | $C_{min}^2$ | $df$ | $C_{min}^2/df$ | CFI | IFI | TLI | RMSEA | RMR |
| Recommended value | > 0.05 sig. | < 3.0 | > 0.90 | > 0.90 | > 0.90 | < 0.08 | < 0.08 |
| This model | 265.491 | 125 | 2.124 | 0.920 | 0.916 | 0.901 | 0.068 | 0.693 |

SEM model is accepted for meeting acceptance level

FIGURE 3. Model and fitted indices for the second-order SEM (own studies)
and preferences in the second-order SEM. Generally, the SEM model in this study has good squared multiple correlations ($R^2$) of 0.75 for values and 0.77 for preferences. This correlation means the model explained 75% variance for the values and 77% variances for preferences. The final unstandardized regression weights ($p$-values), showing relationships of the constructs, were all tested significantly, with values less than 0.05. Apart from the consequences construct with a significant but negative correlation with preferences, the two other constructs of attributes, and values, have significant and positive relationships with sustainable preferences.

Therefore, as presented in Table 6, the three research hypotheses, $H_1$, $H_2$ and $H_3$, significantly correlate with preferences for sustainable housing improvements.

**Conclusion**

Exploring the inherent values in Nigerian indigenous housing is becoming increasingly important to articulate value-based development for identity and cultural sustainability. In this study, the mainstream indigenous housing values for the Tiv society of central Nigeria were elicited through their attributes and consequential utility. This study’s subsequent ordinal scale quantitative approach was built on earlier perceptions elicited through laddering interviews. The five-point Likert scale survey data were tested and validated to have reliable results, ranking the most critical attributes, consequences, and values in Tiv indigenous housing. The correlational outcomes show that attributes, consequences, and values significantly affect people’s preferences for sustainable, transformative improvements.

Future developments in the area ought to reflect society’s mainstream values. Additionally, with the global solidarity to attend to poorer and vulnerable people, efforts should be made by governments, organizations, and highly placed individuals to transform and improve the Nigerian indigenous people and their built environments. While the study provides an empirical base for data-based policy, planning, and implementation of needed developments in the area in context, there is a need to explore individual constructs further to confirm the reliability of the

**TABLE 6. Significant regression weights showing valid relationships (own studies)**

| Label | Estimate | SE | CR  | $p$   |
|-------|----------|----|-----|------|
| Values <--- Attributes | 0.209 | 0.085 | 2.458 | 0.014 | × |
| Values <--- Consequences | 0.626 | 0.086 | 7.276 | *** | × |
| Preferences <--- Attributes | 0.600 | 0.144 | 4.153 | *** | $H_1$ |
| Preferences <--- Consequences | −0.891 | 0.244 | −3.651 | *** | $H_2$ |
| Preferences <--- Values | 1.054 | 0.329 | 3.208 | 0.001 | $H_3$ |

$H_1$: Attributes have a significant relationship with sustainability preferences.

$H_2$: Consequences have a significant relationship with sustainability preferences.

$H_3$: Values have a significant relationship with sustainability preferences.
results. Practically applied studies on each attribute, consequence, and value should be further conducted to develop concrete scientific and technological strategies for transformative improvements.

References

Achoba, M. I., Majid, R. B. A. & Obiefuna, C. O. (2021). Relationship between window and view factors in the workplace: a SEM approach. International Journal of Built Environment and Sustainability, 8 (2), 103–113. https://doi.org/10.11113/ijbes.v8.n2.667

Aule, T. T., Jusan, M. B. M. & Ayoosu, M. I. (2019). Outcomes of community participation in housing development: an update review. International Journal of Scientific Research in Science, Engineering and Technology, 6 (6), 208–218. https://doi.org/10.32628/ijrset196642

Aule, T. T., Majid, R. B. A., Jusan, M. B. M. & Ayoosu, M. I. (2022). Exploring motivational factors of indigenous house form for value-based development: the Tiv people of central Nigeria in context. International Journal of Sustainable Development and Planning, 17 (2), 683–691. https://doi.org/10.18280/ijsdp.170234

Car-Pušić, D., Tijanić, K., Marović, I. & Mladen, M. (2020). Predicting buildings construction cost overruns on the basis of cost overruns structure. Scientific Review Engineering and Environmental Sciences, 29 (3), 366–376. https://doi.org/10.22630/PNIKS.2020.29.3.31

Ezennia, I. S. & Hoskara, S. O. (2021). Assessing the subjective perception of urban households on the criteria representing sustainable housing affordability. Scientific African, 13, e00847. https://doi.org/10.1016/j.sciaf.2021.e00847

Gaskin, J., James, M. & Lim, J. (2019). Master validity too: AMOS Plugin. Retrieved from: http://statwiki.gaskination.com

Isah, A. D. & Khan, T. H. (2016). Re-emergence of indigeneity in transformed layouts in urban public housing in Nigeria. International Journal of Built Environment and Sustainability, 3 (1), 1–9. https://doi.org/10.11113/ijbes.v3.n1.104

Kline, R. B. (2016). Principles and practices of structural equation modelling. New York: The Guilford Press.

Maina, J. J. (2013). Uncomfortable prototypes: Rethinking socio-cultural factors for the design of public housing in Billiri, north east Nigeria. Frontiers of Architectural Research, 2 (3), 310–321. https://doi.org/10.1016/j.far.2013.04.004

Malhotra, N. K. (2020). Marketing research: an applied orientation. Harlow: Pearson Education.

Neef, A., Benge, L., Boruff, B., Pauli, N., Weber, E. & Varea, R. (2018). Climate adaptation strategies in Fiji: The role of social norms and cultural values. World Development, 107, 125–137. https://doi.org/10.1016/j.worlddev.2018.02.029

Ostańska, A. (2019). Monitoring the resident’s needs: Input for the pre-construction stage of rehabilitation projects in housing estates. Scientific Review Engineering and Environmental Sciences, 28 (3), 383–393. https://doi.org/10.22630/PNiKS.2019.28.3.36

Pahlevan Sharif, S. & Sharif Nia, H. (2018). Structural equation modeling with AMOS. Tehran: Artin Teb.

Sharif, S. P., Mostafiz, I. & Guptan, V. (2018). A systematic review of structural equation modelling in nursing research. Nurse Researcher, 26 (2), 28–31. https://doi.org/10.7748/nr.2018.e1577

Umar, G. K., Yusuf, D. A., Ahmed, A. & Usman, A. M. (2019). The practice of Hausa traditional architecture: Towards conservation and restoration of spatial morphology and techniques. Scientific African, 5, e00142. https://doi.org/10.1016/j.sciaf.2019.e00142

UN General Assembly (2016). Preparatory committee for the united nations conference on housing and sustainable urban development (Habitat III). Policy Paper 10: Housing Policies. New York: United Nations.

United Nations SDGs (2015). Transforming our world: The 2030 Agenda for Sustainable Development. Retrieved from: http://www.un.org/en/development/desa/news/sustainable/un-adopts-new-global-goals.html#more-15178
Wang, J., Zhao, J. L., Wu, T. Y. & Tang, L. K. (2017). New-type intensive rural settlements in China based on the unified and self-construction mechanisms of spatial organization. International Journal of Sustainable Development and Planning, 12 (6), 1073–1084. https://doi.org/10.2495/SDP-V12-N6-1073-1084

Summary

Exploring cultural values and sustainability preferences in housing development: A structural equation modeling approach. The study aimed to establish the relationship between values and people’s preferences for sustainable improvement in Nigeria’s indigenous housing context. The relationship was tested in SEM using ordinal survey data obtained between February and March 2022 with 241 valid samples. The mainstream values were statistically validated using CFA while the relationships were generated in the SEM. Results established a significant relationship between values and the people’s preferences for transformative improvements. The findings provide a foundation for long-term policy formation, practical transformative experimentation, and an empirical foundation for future methodological research.