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Assessing the subjective perception of urban households on the criteria representing sustainable housing affordability

Ikenna Stephen Ezennia[a,*], Sebnem Onal Hoskara[b]

[a] Department of Architecture, Faculty of Environmental Sciences, Nnamdi Azikiwe University, Awka, Anambra State PMB 5025, Nigeria
[b] Department of Architecture, Faculty of Architecture, Eastern Mediterranean University, North Cyprus, , Mersin 10, Famagusta 99450, Turkey

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ABSTRACT

Housing affordability is typically assessed in economic terms, but housing affordability concerns transcend mere housing cost and its relationship to income, to wider issues of social wellbeing and sustainability. New studies on this subject are increasingly recognizing the need for a wider and more holistic understanding of the criteria representing sustainable housing affordability (SHA). Most key authors have embraced this evolution and view the change as positive, and have analyzed industry professionals, academics as well as stakeholders perception along these lines. However, it is not clear whether the views of households align with this since no study has surveyed household opinions. Regarding this, a comprehensive list of 81 potential sustainability performance criteria (SPC) were determined through the review of existing literature. Based on which a questionnaire survey was designed to assess the opinion of households residing in the 26 urban areas of Nigeria on the criticality of these SPC. Through statistical analysis, 30 critical sustainability performance criteria (CSPC) were established. This study posits that at present the housing affordability concerns in urban areas of Nigeria cannot be restrictedly defined by financial attributes. Our findings provide salient information to policymakers and stakeholders that could aid the sustainable delivery of affordable housing programs.

Introduction

Housing is one of the essential social conditions which indicate the living standards of a country's citizens. However, due to rapid rates of urbanization reported world-wide [26], housing supply has always failed to satisfy demand [34]. Therefore, it has become a common experience globally that a house which is already expensive will become even more expensive. This phenomenon amongst other issues has pushed the provision of affordable housing into the center of many governments' agenda around the globe, to better the living standards of the low- and medium-income households. However, affordable housing alone is insufficient to achieve family and community wellbeing [77]. In recent times, research findings on housing affordability have highlighted substantial relationships between fiscal, social and environmental factors [25,34,59,60,63],

* Corresponding author.
E-mail address: is.ezennia@unizik.edu.ng (I.S. Ezennia).

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regarding housing appropriateness, accessibility, amenity and adequacy [19]. Consequently, embedding sustainability into the criteria contributing to housing affordability has been the call of recent studies on housing affordability [6,30]. Thus, to create more affordable and sustainable communities implies that closer connections must be established between social, environmental, and economic concerns. Yet very few studies on housing affordability, consider the three pillars of sustainability as suggested by housing researchers.

According to Awotona, [13], standards and criteria designed specifically to sustain housing provision and its related services for the urban low-income households are yet to be devised in Nigeria. To date, much of the perceptive analysis of the criteria importance and performance indicators leading to sustainable housing affordability has focused on developed countries [58]. Where developing country has been the focus of the study [6,34,56] or part of the study [5,20] research has tended to concentrate on academicians, professionals, and stakeholder's perception. Thus, neglecting the views of households and thereby potentially hiding their unique housing experiences and perspectives. Though it is clear from housing affordability literature that academicians, scholars, housing professionals and stakeholders are beginning to broaden their views and consider wide-ranging criteria that breed housing affordability. However, it is unclear if the views of households align with this. Nevertheless, a criteria system must evolve from people's actual housing affordability experience since they bear the direct brunt of the housing affordability burden.

Thus, we bring to the debate a different viewpoint — Households subjective perception. According to Yates et al. [88] housing affordability can be assessed in accordance with people's subjective experience in managing their housing costs. Therefore, this study enabled household respondents to weigh wide ranging criteria and circumstances that affect their housing affordability, with the conviction that households are better positioned to offer the best assessment of the criteria influencing their housing situation. The authors believe that analyzing the subjective views of household on the criteria apposite to sustainable housing affordability can offer other information left out under other subjective assessments (e.g., Housing professionals and stakeholders' opinion), and can support cost-benefit analysis, policy evaluation as well as aid the identification of potential policy problems.

Therefore, the purpose of this study is to identify a comprehensive list of criteria system through which housing affordability can be holistically and sustainably assessed. Objectives are, (1) To determine the criteria importance using household's subjective opinion. (2) To establish if the opinions on criteria importance vary based on the respondent's income group, e.g., Low, or medium income. (3) To determine if household respondents residing in different regions in the study area have differing opinions on criteria importance and, (4) Develop a framework for achieving sustainable housing affordability within the study area.

This research is guided by the hypothesis that, Null Hypothesis (H_{01}): Household opinions on criteria representing sustainable housing affordability do not significantly differ based on (a) household income group, and (b) region of residence. The attainment of the research objectives and analysis of the hypothetical statement will present sound evidence on how to improve the performance of affordable housing programs through the deployment of a comprehensive framework for understanding the role and significance of sustainability for enhanced affordable housing delivery in Nigeria.

Housing affordability concept: meaning and definition

The phrase "housing affordability" is polysemous and nebulous in meaning because it is used to describe several components of housing needs such as housing condition, housing costs, housing quality, household income and overcrowding. Studies have revealed that it has become a multi-faceted phrase [58]. Consequently, due to its heuristic nature, it has been perceived differently by several researchers who have used various definitions and methodological approaches in measuring it (Mattingly & Morrissey, 2014). However, housing affordability is generally described as households' ability to access and obtain decent housing without experiencing unwarranted financial hardship ([51]; 2017). Such a broad description refers to two aspects: (1) Attainability - access to a house at a certain period and (2) Sustainability - the possibility of the household to continue maintaining the house. This implies the ability (or inability) to sustain economic commitments with regard to the housing already obtained, which generally emerge through constraint (e.g., illness or serious injury, unemployment), or through choice (e.g., more desirable location, larger house).

Recent research evidence reveals that it is an uncommon approach to address housing affordability challenges by means of incorporating features of sustainability, as well as the dearth of suitable framework that integrates sustainability into affordable housing programs [5,34]. Therefore, this paper explores the role of social and physical environmental factors in minimizing housing affordability problems. It explores the extent to which researchers have postulated the positive impacts of incorporating sustainability criteria into housing affordability assessment. Thus, the real challenge is to inspire stakeholders and industry professionals through the interpretations of genuinely more sustainable solutions for affordable housing delivery (that is, sustainable housing affordability strategies), from the economic, social–psychological and ecological perspectives; as well as to harness emerging sustainable technological innovations and global experiences, and apply them in a more creative way in order to achieve higher standards of economic and social wellbeing amongst households.

Understanding the 'sustainable housing affordability' construct

Although housing affordability has always been at the core of national policy in several nations, scholars agree that the housing affordability concept is poorly defined both in policy and guidance documents as well as scientific literature. Con-

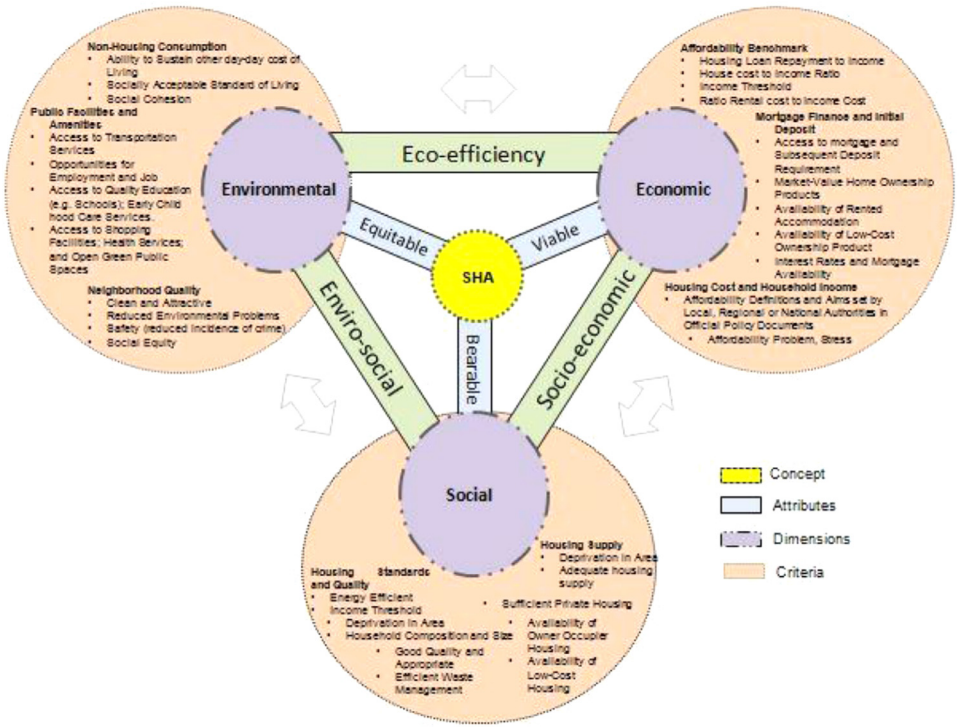

Fig. 1. A conceptual model for understanding the sustainable housing affordability (SHA) concept.

ceptualizing housing affordability dates back more than 40 years, since 1970's. However, this period has been characterized with the housing affordability concept solely focused on economic dimension, although many aspects of housing exist with no direct market price (see [31]). Haffner & Hulse [38] in their study on urban housing affordability, argued that the concept of housing affordability has evolved such that the focus is more on the urban policy challenges of growing inequities in access to urban resources and less on understanding housing expenditures in contributing to poverty and disadvantage within the domain of social policy.

An understanding of affordability in the light of sustainability extends its scope to incorporate an environmental and social perspective as well as the generally accepted economic dimension. Economic viability alone cannot improve housing affordability. Rather, other sustainability concerns must be considered like location, transportation routes, neighborhood settings, housing design and job opportunities amongst other multitudinal issues.

Sustainability sets out to correct the domineering influence of economic sophistication on all aspects of living which has negative climatic effects. It pursues reasonable opportunity distribution between future and present generation through resource conservation, but economic development encourages uncontrolled resource consumption principally aimed at increasing material wealth. The unsustainable construction practices underlying affordable housing production presently raise concerns that merit the attention on sustainability [4]. Many housing initiatives focus on affordable housing provision, yet environmental and sustainability issues are severely neglected. Mainly because of the lack of a comprehensive approach towards the understanding of sustainable housing affordability construct.

The concept of sustainable housing affordability as detailed in Fig. 1 was first introduced by Mulliner & Maliene [57]. It integrates other criteria which are derived from the concepts of housing affordability, sustainable housing, and sustainable communities. It then draws a closer link between environmental sustainability and social justice and connects the peoples' wellbeing with environmental wellbeing. In other words, it can be referred to as the combination of the ability to own a house at a minimal price, in a safe environment that enables healthy living, and covers other sustainable aspects which relate to more fundamental concepts in, among other areas, of micro-economics and social policy. However, there is a dearth of research that identifies a holistic set of criteria for sustainability and performance assessment of housing affordability. In this regard, housing affordability is typically assessed in terms of price or rental cost in relation to income, which creates disconnect between sustainability and affordability of housing. Reconnecting this link requires establishing a comprehensive list of critical sustainability performance criteria (CSPC) contributing to sustainable housing affordability.

Generally, the best-known criteria are for sustainable housing which were developed by the UK Green Building Council – BREAM (Building Research Establishment Environmental Assessment Methodology) and US Green Building Council – LEED (Leadership in Energy and Environmental Design) certificate'. Both BREEAM and LEED certificates generally consist of sustainability criteria for buildings concerning: transportation, location, energy and atmosphere, water efficiency, materials and

resources, neighborhood pattern and design, indoor environmental quality, renewable energy systems, infrastructure, waste management, pollution, health and well-being. These criteria are largely physical requirements and environmental issues which are subsumed within a discourse that conflated 'economic growth' and 'development' hence neglecting the human dimension. Recent studies have posited that the conventional assessment and planning processes of affordable housing programs are not often well structured to address social and ecological effects within complex systems [59,60]. However, the sustainable housing affordability concept promotes the consideration of social concerns as well.

It has been argued that sustainability should be the spine of affordable housing by promoting cost efficiency of energy, transportation, and health care [48]. Therefore, it has become evident that not housing cost alone that needs to be considered to keep cost criteria in affordable housing in check; energy efficiency of housing, access to amenities [60] as well as citizen participation may also need to be promoted to create sustainable and successful living environments. Only a few studies have proposed some criteria that must be addressed in achieving sustainable housing affordability (see [57]; 2015; [34]).

Much recently, the housing affordability situation has become even more diverse, and more complex as a result of the ever-changing approaches which exist in this domain. The understanding that there is not one solution for further reduction of cost criteria and achieving enhanced energy-savings in affordable housing programs, but a series of steps to address these challenges is necessary in ensuring that the housing programs are targeted towards main issues; and may be a tool for achieving sustainable communities. In their attempt to address this dynamic paradigm Gan et al., [34] identified twenty-four (24) key sustainability performance indicators (KSPIs); Chan & Adabre, [20] and Adabre &Chan, (2019) presented 21 critical success criteria (CSC) and 30 success factors (SFs) respectively through questionnaire survey of major industry stakeholders and key housing professionals; As a guide for the sustainable development of affordable housing programs. Similarly, Mulliner & Maliene, [58] established 20 sustainable housing affordability criteria (C1-C20).

However, in order to stimulate a constructive and concrete academic discourse in this domain, as illustrated in Table 1. These guides were factored together and expanded through extensive systematic literature review, for a more sustainable housing affordability strategy, and were narrowed down to; Social sustainability performance criteria (safe and secure, universally designed amongst others); environmental sustainability performance criteria (resource efficiency in water, waste, and energy amongst others) and economic sustainability performance criteria (cost efficient over time amongst others). These performance criteria are centered on the basic sustainability requirements (i.e., ability to sustain) and affordability (ability to afford); as well as how to incorporate these criteria into specific circumstances, particular cases, and context; and more general; how to design a practical sustainability assessment model that acknowledges the important role technology plays, especially in both delivery and implementation. All of which are centered on maximizing social acceptability criteria, minimizing cost and environmental impact criteria.

Social (cultural) sustainability performance criteria (SSPC)

Poor housing condition is an indicator of poor social conditions [74]. Therefore, a well-articulated affordable housing program can guarantee positive social conditions required to support and sustain stronger community cohesion outcomes. Social cohesion defines a society which offers opportunities to every of their member within a framework of accepted institutions and values. A community cultural need is therefore addressed also by a socially acceptable housing regarding size, function, affordability, safety, sense of accomplishment, aesthetics [55]. Consistent with this, Wiedmann, et al. [84] opined that the integration of various social groups, lifestyle choices and social services, as well as healthy urban densities, optimized spatial layout for safety and comfort; and a role as a new landmark and cultural center, are the key social parameters for resolving affordability concerns within the ambit of sustainability. Ultimately, the social objective of housing affordability addresses social exclusion by ensuring decent housing quality, combating spatial segregation by preventing social polarization and reduces inequalities in wealth and income. Maina [49] reported that in Nigeria socio-cultural related criteria such as safety, are not adequately considered in choosing locations and housing unit designs, resulting in their abandonment.

Environmental (ecological) sustainability performance criteria (ESPC)

Bordigon (1998) illustrated that decreasing the strain placed on the environment by a home can significantly contribute towards attaining a global sustainable society. Environmental considerations are closely associated with materials used and their suitability; construction technique and housing system operations, resource-efficiency (waste and water) energy saving and reducing footprint to lessen biodiversity loss. Therefore, there is both an equity and efficiency imperative to ensure that affordable housing is socially equitable and environmentally sustainable [57]. Material selection for affordable housing construction is generally dependent on the cost, durability of the building materials, their availability as well as acceptability by the users [37].

Building materials can be a major source of indoor air pollution**.** For instance, nearly 70% of formaldehyde a known asthma trigger and carcinogen is used in building materials, as a binder for carpets, engineered wood products and insulation, among others [44]. This is not often known to architects who make specifications or developers who build, nor households whose indoor environments are most affected by the materials they are constructed with. Yet, with the appeal for inexpensive cost, problematic chemicals like formaldehyde are expected to maintain widespread use, especially for housing programs aimed at cost reduction per square foot. Studies have severally extolled the values of adopting energy saving materials, which are harmless to humans and low level of technology inputs, as the most veritable for sustainable and affordable housing development [7].

Table 1
Comprehensive set of CSPC contributing to sustainable housing affordability with selected references.

Category	Type	Code	Performance Criteria	Reference
Social (cultural) sustainability	Public Facilities and Amenities	SS101	Access to recreational facilities e.g., Parks, green open spaces	[71, 85]
		SS102	Access to health centers e.g., Hospitals, GPs	[84]
		SS103	Access to religious places e.g., Temple, mosque, church etc.	[55]
		SS104	Access to educational centre e.g., School, tuition centre etc.	[3]
		SS105	Access to child day care centre	[Talen & Koschinsky, 2011]
		SS106	Location of shopping mall or market	[58]
		SS107	Accessibility to working place.	[58]
		SS108	Proximity to government establishment	[Pollard, 2010; Talen & Koschinsky, 2011]
		SS109	Proximity to private establishment	[Pilot survey]
		SS110	Availability of public transportation	[3]
		SS111	Major access road	[3]
		SS112	Minor access road	[3]
	Non-Housing Consumption	SS201	Ability to sustain other day to day cost of living	[[30, 76], b]
		SS202	Social cohesion	[22, 60]
		SS203	Safety/Security (reduced incidence of crime)	[84]
		SS204	Fire safety	[Pilot Survey]
		SS205	Effective management and maintenance of properties	[14, 21]
		SS206	Cultural and heritage conservation	[22, 55]
		SS207	Religious affiliation	[55]
		SS208	Sense of community	[22, 27]
		SS207	Community participation	[30, 71, b]
		SS210	Minimize social segregation	[22, 71]
		SS211	Tenure security	[14, 85]
		SS212	Equitability and fairness of housing distribution	[22]
		SS213	Social acceptability	[22, 69]
		SS214	Increased consciousness of environmental protection	[61]
	Architecture and Innovative Design	SS301	Aesthetic views	[52]
		SS302	Suitability/Appropriateness	[Ibem & Aduwo, 2013]
		SS303	Clean and Attractive	[52]
		SS304	Cozy and Comfort (from the social–psychological point of view)	[52]
		SS305	Type of building e.g., Apartments, condominiums, semi-detached etc.	[Tibesigwa et al., 2017; [15]]
		SS306	Unit size	[Pilot Survey]
		SS307	Number of bathrooms	[Tibesigwa et al., 2017]
		SS308	Interior decoration e.g., Painting, layout etc.	[Pilot Survey]
		SS309	Floor tiles marble	[Pilot Survey]
		SS310	Number of garage spaces	[Pilot Survey]
		SS311	Presence of lift or elevator	[Pilot Survey]
		SS312	Presence of parking area	[Pilot Survey]
		SS313	Housing location	[27, 42]
		SS314	Presence of heating system	[Pilot Survey]
		SS315	Number of bedrooms	[Pilot Survey; [10]]
		SS316	Floor spaces	[Pilot Survey]
		SS317	Accessibility	[Pilot Survey]
		SS318	Number of fireplaces	[Pilot Survey]
		SS319	Housing quality e.g., meeting decent home standards	[15, 34]
		SS320	Lighting quality	[69, 85]
	Household Characteristics	SS401	Age groups	[15, 58]
		SS402	Household size	[15, 58]

(*continued on next page*)

Table 1 (*continued*)

Category	Type	Code	Performance Criteria	Reference
Environmental (Ecological) Sustainability	Presence of Environmental Problems	EN101	Noise pollution	[[60]; 2016, [30], b]
		EN102	Water pollution	[Mulliner & Maliene, 2012]
		EN103	Air quality (Indoor and outdoor)	[22, 85]
	Efficiency	EN201	Waste management e.g. level of recycling, reuse, composting	[23, 71]
		EN202	Use of appropriate materials	[12, 37]
		EN203	Energy efficiency	[71, 72]
		EN204	Land-use efficiency	[21]
		EN205	Reduced footprint	[62, 71]
		EN206	Thermal comfort	[Gan et. al., 2017, [30], b]
		EN207	Minimized biodiversity loss	[69]
		EN208	Disaster resilience	[14, 21]
		EN209	Mixed land using	[27, 85]
		EN210	High housing density	[21, 27]
		EN211	Water efficiency	[71, 72]
Economic (affordability) sustainability	Affordability benchmark	ES201	Availability of rented housing (social and private)	[20, 58]
		ES202	Availability of low-cost shared ownership products (shared housing)	[20, 58]
		ES203	Availability of market value home ownership product	[5, 58]
	Mortgage Finance and Initial Deposit Affordability Criteria	ES301	Financial viability	[22, 79]
		ES302	Tenure security	[58]
		ES303	Interest rates	[57]
		ES304	Economic trends/Cost effectiveness	[29, 42]
		ES305	Desirability	[Pullen et al., 2010]
		ES306	Taxation influences	[[30, 34], b]
		ES307	Family income level	[Mulliner & Maliene, 2012]
		ES308	Provide human resource for economic development	[55]
		ES309	Employment opportunities	[35]
		ES310	Ensure balanced housing market	[32]
		ES311	Reduced energy bill	[[30, 42], b]
		ES312	Reduced transportation cost	[72]
		ES313	Reduced life cycle cost	[58]

Green improvements to affordable housing could promote positive health outcomes of low-income households, for instance access to green public space [71] which is routinely ignored in affordable housing programs [27]. In recent times, heightened interest in eco-friendly living has led to the emergence of environmentally sustainable construction processes [24] such as green affordable housing concept [32]. These “green” housing integrated design practices consist; measures to increase energy efficiency, utilization of non-toxic materials, decrease water usage, and maintains the quality of the indoor air environment [75]; and also ensure proximity to community resources, such as parks and transit; as well as delighting as an essential component of the building design strategy [17]. Hence, are generally termed as environmentally friendly buildings [24,28]. Therefore, if designers and developers are concerned about the impact of their projects on the health disparities of low-income families or want to ensure that their projects do not isolate residents and concentrate poverty, then they are concerned about the core elements of green building. In the end, the goals of green building are very much aligned with the goals of affordable housing and community development [45,46]. Indeed, affordable housing professionals and designers will increasingly need to understand green building techniques to achieve safe, decent, and affordable housing for low-income households. Hence, advocacy efforts should be encouraged to support the expansion of green housing and emphasize healthy community development.

Furthermore, disaster resilience should receive special attention [21] as well as mixed land using, as it promotes accessibility, minimizes cost of transportation, and encourages efficient land use [42,79] in addition ensure flexibility and adaptability [79] which meets the changing needs of households and prevent issues like more resource consumption and environmental disruption [69].

Economic sustainability performance criteria (ESPC)

The economic sustainability mostly focuses on countries characterized by poor and dysfunctional economies as well as unstable political institutions. Economic aspect entails job opportunities, economic buoyancy and equitable development which encourage local policies that create more affordable housing, living wage jobs, mass transit systems, health care, and quality education; as well as the consideration of both initial acquisition cost and energy bill [32,42]. Minimizing cost of transportation and energy bill, allows low-income households to spend a larger portion of their income on non-housing necessities [35,40].

Studies found that factors such as house size, monthly installment, and physical characteristics like number of bedrooms and bathrooms [9], desirability by would be occupants [69] as well as construction cost; are closely associated with economic sustainability criteria. Contractors can utilize cost reduction strategies that reduce cost on the environment, e.g. Use of regionally available techniques and materials [12,43] like earthen materials [7].

Also, providing stable financial incentives and subsidy is necessary to secure financial viability for developers [69] and for individuals who are unable to rent or pay for a house [1]. Earlier studies raised concerns over governments' disinvestment in public housing and re-placement of public housing mechanisms with market-driven systems [83]. This is consistent recent studies which suggest that several countries have reduced or eliminated housing supply subsidies for low incomes [18]; the question is whether direct income subsidy is more efficient? Subsidizing housing as a means of poverty alleviation is very questionable, because no research has illustrated the positive outcomes of subsidizing households over housing units for households with limited income [53]. The effectiveness of housing subsidies depends on risk management and the price elasticity of housing demand [36]. Tax relief is as well known to be an efficient means of reducing the affordability burden of low-income households, particularly those residing in the rental housing [86].

Furthermore, access to housing (i.e., The capacity to secure enough mortgage finance to acquire a decent housing unit) is thus imperative in the acquisition of housing, requiring long-term financing [81]. However, this has always eluded low-income earners. Rolnik [70] observed a global U-turn some decades ago in the prevailing urban and housing policy agendas, influenced world-wide via forces driven by neoliberalism and globalization. The commodification of housing, as well as continued usage of housing as investment assets in a globalized financial market, has significantly distorted the enjoyment rights to decent housing. Achieving sustainable housing finance for lower-income groups is an almost unattainable goal of a growing number of countries worldwide and therefore presents a major challenge.

Methodology and research protocol

Identifying potential SPC for sustainable housing affordability (SHA)

It is pertinent to identify possible SPC for SHA, because there is a dearth of studies on this subject and some studies on SPC for affordable housing programs fail to provide a comprehensive list. For instance, Ahadzie et al. [8] study neglected household income in relation to rental cost and housing price, which are considered significant housing affordability criteria. In addition, the cost of transportation and its relationship to household income was ignored in the criteria system identified by their research. Therefore, to identify relevant SPC contributing to sustainable housing affordability, an extensive review of peer reviewed articles in highly ranked journals (Section 2) was undertaken. As a result, a holistic set of SPC apposite to sustainable housing affordability was identified (Table 1). Followed by questionnaire design, which was pilot surveyed and administered to urban low- and medium-income residents and affordable housing applicants in the 26 urban areas of the 6 geopolitical regions in Nigeria. Before the questionnaire design, a pilot survey was performed on the potential list of SPC for sustainable housing affordability. The reason for process was to test the comprehensiveness and the significance of the possible SPC. One affordable housing district was used in the pilot study comprising low- and medium-income earners, who had experienced or experiencing housing affordability stress. The respondents were asked to evaluate if the criteria list contained a suitable number of performance criteria and if other potential critical performance criteria may be included or expunged from the list. One criterion was added under the attribute "Public Facilities and Amenities" and the rest under "Architecture and Innovative Design" in the social sustainability performance criteria. Consequently, a total of 13 criteria was added to the comprehensive set of SPC through the pilot survey as shown in Table 1. The completeness and relevance of the criteria were finalized and confirmed after the pilot study.

Study area and research scope

This paper is a household level study focused on determining critical sustainability performance criteria (CSPC) that influence sustainable housing affordability using Nigeria as a case study. Nigeria sits on an area of 356,669 sq mile (923,768 sq km) with an estimated population of 190.9 million people [87], nearly 48% of this population resides in urban areas. Politically, Nigeria is partitioned into 6 geopolitical regions and administratively into 36 states plus the Federal Capital Territory. The states are divided further into 774 local government areas and legally the headquarters of these local government areas are established as urban centers (National Urban Development Policy, 2006 cited in [65]). Urban areas in Nigeria are established based on population and legal or administrative criteria, adopting a threshold population of 20,000 persons as a criterion for defining an urban area. This could mean according to Ofem, [65] that Nigeria has a total of 774 urban areas.

However, an urban area is a continuous urban development of built up land mass with high population density and infrastructure of built environment, within a labor market, and with no regards for administrative, political or city boundaries [82]. This implies that there are only 26 urban areas in Nigeria, according to Demographia's "World Urban Areas" study (2019). The case study approach was applied to the 26 urban areas in Nigeria. These urban areas were preferred on the basis that they could represent Nigeria's housing affordability dilemmas' better. The study centers on the urban housing sector and thus, it is concerned with the housing affordability assessment of the urban poor households. The purpose of restricting the study scope to urban housing sector is that, problems of urban housing in Nigeria are normally more profound and severe than that of rural housing both in complexity and intensity.

Table 2
List of urban areas in Nigeria with at least a population of 500,000 (Adapted from Demographia's "World Urban Areas" study 2019).

Rank	Urban Area	State	Population	Area (km^2)	Density ($/km^2$)	Geopolitical region
1	Lagos	Lagos	14,630,000	1,425	9,000	South West
2	Onitsha	Anambra	8,075,000	1,965	3,800	South East
3	Kano	Kano	3,980,000	251	14,600	North West
4	Ibadan	Oyo	3,155,000	466	6,200	South West
5	Uyo	Akwaibom	2,360,000	729	2,700	South South
6	Port Harcourt	Rivers	2,130,000	158	11,800	South South
7	Nsukka	Enugu	1,895,000	645	2,700	South East
8	Abuja	FCT	1,580,000	225	7,000	North Central
9	Benin	Edo	1,485,000	228	5,900	South South
10	Aba	Abia	1,215,000	91	13,400	South East
11	Kaduna	Kaduna	1,170,000	153	7,200	North West
12	Ilorin	Kwara	960,000	83	10,700	South West
13	Jos	Plateau	850,000	70	11,300	North Central
14	Owerri	Imo	840,000	130	5,800	South East
15	Maiduguri	Borno	815,000	155	4,900	North East
16	Ikorodu	Lagos	740,000	130	5,700	South West
17	Zaria	Kaduna	770,000	88	8,300	North West
18	Enugu	Enugu	775,000	78	9,200	South East
19	Warri	Delta	795,000	142	4,900	South South
20	Osogbo	Osun	735,000	104	6,600	South West
21	Akure	Ondo	645,000	117	5,000	South West
22	Sokoto	Sokoto	635,000	88	6,600	North West
23	Lokoja	Kogi	590,000	70	8,346	North Central
24	Bauchi	Bauchi	585,000	88	5,900	North East
25	Abeokute	Ogun	555,000	62	8,400	South West
26	Ogbomosho	Oyo	520,000	28	1,800	South West

Fig. 2. Map of Nigeria showing the 6 geopolitical regions and the 36 states and Federal Capital Territory (FCT).

The 26 urban areas (listed in Table 2) in the 6 geopolitical regions of Nigeria as shown in Fig. 2 experiences higher population growth rates, higher rates of population density, higher property value and land cost, high degree of in-migration, and higher employment and income inequalities. Resultantly, slums and squatter settlements, high rents, overcrowding, are common Nigerian urbanscape features. Therefore, this research concentrates on the urban sector due to the severity of its housing problems. Another justification of the scope is that the major housing problems in rural areas center on qualitative

improvement concerns regarding infrastructure and sanitation for existing units. Thus, housing affordability concerns are nearly insignificant in rural areas in comparison with urban areas. Issue of study relevance to current policy reforms on housing in the country was another consideration. Given that consecutive policies and housing programs are mainly targeted at urban areas and most of the contentious housing policy dilemma and issue the study sets to debate are mostly applicable to the urban housing sector.

Data collection

This research consists of a comprehensive literature review to enable the assemblage of a holistic set of SPC for sustainable housing affordability. All together 81 SPC was identified from literature review (Table 1), with the first objectives to determine the criticalities of the SPC from urban households' view point, then, finding out the disparities (if any) between respondents based on income group and region of residence on the ranking of the established CSPC and lastly, classifying the established CSPC into underlying categories. The A Section of the questionnaire demanded the respondents' background data. It requested background questions in order to form filters, which enable comparisons of different group's opinions on criteria importance, like gender, age, income, respondent's current housing situation, e.g. Squatter houses, and apartment buildings, as well as the geopolitical region the household resides. It is important to determine the reliability of the responses before further analysis is conducted on subsequent data. On Section B respondents were requested to assess the criticality of the 81 SPC via a 5-point Likert Scale of 1–5 as follows: 5 = Very important; 4 = important; 3 = slightly important; 2 = less important and 1 = least important; which represent the importance of sustainable housing affordability from the urban households' perspective. The adoption of this scale was due to its relative brevity. Thoughtfully, at the end of the 81st SPC spaces were provided for respondents to rate and list the criticality of other SPC for sustainable housing affordability as may be identified by them. This allowed the inclusion of additional 13 SPC to the comprehensive list.

To set a general background for participants to respond appropriately on the SPC, prior to the question on CSPC an immediate question directed at the goals or on a set of performance outcomes for sustainable housing affordability. The set of performance outcomes is intended to solicit the opinion of potential respondents on the rating of these outcomes and to pre-inform them on the aim for sustainable housing affordability. Then, based on the rating on the performance outcomes, respondents can then adequately rate the criticality of the criteria for achieving sustainable housing affordability.

Sampling

The convenience sampling technique was used for the collection of primary data. In convenience sampling, the survey administration is targeted at willing, available and accessible respondents [73]. This technique is suitable where adequate information on population size is lacking e.g. Nigeria. Therefore, findings drawn may not be generalizable, however, using bigger respondents, the findings can be representative [73]. The case study utilizes data gathered from two questionnaire surveys carried out between January and June 2019, focusing on urban residents and applicants of affordable housing. Housing experiences of affordable housing applicants can provide clues on how low-income groups choose their housing or behave when confronted with high housing costs. Therefore, obtaining the views of eligible applicants and occupants of affordable housing scheme portend salient information on the criteria importance of indicators for sustainable housing affordability. By comparison, the residents of affordable housing, is perceived as direct beneficiaries of affordable housing schemes, hence their housing experiences can shed light on how housing policies sharp housing outcomes. Specific techniques to approach these two target groups are detailed below.

For applicants of affordable housing, information was collected through self-completed questionnaires. There were 1315 participants in the survey, collected by three approaches:

Questionnaires obtained from the federal ministry of housing state offices

After careful consideration, state offices within the twenty-six (26) urban areas of the 6 geopolitical regions were surveyed. Questionnaires were administered to applicants by director(s) of 1 to 2 states offices within every region. Like snowballing, potential respondents were beseeched to send the questionnaire to any other potential applicant of affordable housing they considered can answer the questionnaire appropriately. Therefore, it is difficult to pin-point the actual number of questionnaires distributed through this means. However, nearly 1864 questionnaires were distributed. Each applicant was sent an email which consists of a letter of introduction with a concise research information statement as well as a web link option to answer the questionnaire via "Survey monkey" app. These flexible options ensured convenience in responding to the questionnaire and it enhanced the response rate. 653 responses were received out of 820 questionnaires were administered, making a very high response rate of 78%.

Email distribution

This technique was used in the region with the highest application rate (about 3,456,000 applications) during the three months survey work. Applicants' names and email address in the application information, was obtained from the Federal Housing Authority's (FHA) website. This data is available to public on the website for 7 days after the release of the information. However, only 400 responses sent in this way were received out of 3036 questionnaires administered, making a low response rate of 13%.

Questionnaires obtained from affordable housing districts

To complement previous techniques and increase response rate, questionnaires were as well administered in affordable housing districts. Thoughtfully, the authors made small modifications to the applicant questionnaire to explore housing experiences of residents prior to their stay in the current housing. These respondents have resided in their present housing for years, hence were sometime in the past, applicants of affordable housing. In that light, responses obtained by this approach were considered comparable with those collected through the other techniques. Out of 1800 questionnaires distributed in this way only 262 responses were received, a response rate of 15%.

For residents of affordable housing, information was also collected through self-completed questionnaires. One affordable housing project with the highest number of residents was chosen in each of the geopolitical regions. These projects are popular affordable housing programs in Nigeria. 1211 responses were obtained out of 4009 questionnaires administered in this manner, making a 30% response rate. The authors recognized that the survey utilizes a small sample size with a relatively low response rate, which could constrict the representativeness of the survey results. Thus, the findings of this study are indicative and insightful rather than conclusive. Future studies are therefore encouraged to use a larger sample size to generalize the understanding of the issues discussed in this research.

Respondents profile: socio-economic characteristics

The socio-demographic characteristic of the respondents in Table 3 indicates that 54.3% and 45.7% of the household respondents were males and females, respectively. However, on aggregate, there are more males than females in the study and this gender difference is statistically significant ($W = 11.533$; $p = 0.045$). The distribution of age range of the respondents shows that the mean age of the respondents is 38.8 years with a standard deviation of 5.8 years. Table 3 also shows that a total of 543 representing 21.5% of the respondents is homeowners; 1,243 (49.2%) reside in a rented apartment while 740 (29.3%) live in shared houses.

Analysis of educational qualification revealed that about 93.6% of the total respondents have better education; while on the distribution of employment status there is a close match between those who are fully employed and those who are unemployed, 37.3% and 32.2%, respectively; 19.1% are temporary employed while 11.4 are retired. The income status shows that most of the respondents are low- and middle-income earners (40.6 and 38.5%), respectively, about 63.9% earn below ₦100,000 (277 USD) monthly. Statistics of the household number show that most of the respondents, despite not earning a good salary are faced with large family size of 3 members and above. Most of their house types are apartments/flats and terraced houses which are about 10 years or below. About 49.1% of them own vehicles while 50.9% do not. Result of proximity to various facilities was normal as most of them are located not farther than 5 km away from the respondent's residence.

Analytical tools and techniques

Descriptive statistics

The weighted means and standard deviations were employed in the data description and evaluation of the critical sustainability performance criteria (CSPC). The weighted mean and standard deviations were computed as:

$$\bar{x} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i} \tag{1}$$

Where, w_i is the weight of the ith cell; $\sum w_i = n$ = sample size of the study.

Similarly, the weighted standard is obtained as

$$S = \sqrt{\frac{\sum_{i=1}^{n} w_i (x_i - \bar{x})^2}{n-1}} \tag{2}$$

Where, $\bar{x}$ is the weighted mean; and every other variable in the equation retained its original identity.

Normality test– one sample kolmogorov-smirnov (K-S) test

One sample Kolmogorov-Smirnov (K-S) test was used to ascertain whether the data series follows normal distribution and provided evidence of disagreement. Therefore, in this study nonparametric test was adopted, in addition to the Kruskal-Wallis H. test which was used to compare the respondents' opinion across the geopolitical zones.

Kruskal-Wallis H test

Kruskal-Wallis test is a non-parametric test of comparison for k-independent samples or populations. The Kruskal-Wallis H test for K $\geq$ 3 independent populations is estimated as:

$$H = \left[\frac{12}{n_t(n_t+1)} \sum_{i=1}^{k} \frac{R_j^2}{n_j} \right] - 3(n_t+1) \tag{3}$$

Where, k = number of populations; n_j = number of questions in factor j; $n_t = \sum n_j$ = total number of questions in all factors; R_j = sum of the ranks for factor j. The null hypothesis was that there is insignificant difference between the mean ratings of different groups.

Table 3
Socio-economic characteristics of the respondents.

Variable		Frequency (N=2526)	Percentage (%)
Gender	Male	1372	54.3
	Female	1154	45.7
Age in groups	18-25 years	200	7.9
	26-35 years	468	18.5
	36-45 years	904	35.8
	46-55 years	822	32.5
	More than 55 years	132	5.2
	Mean ±(SD)	38.8±5.8	
Ownership status	Own the house	543	21.5
	Rented apartment	1243	49.2
	Share the house	740	29.3
Educational Qualification	Diploma	162	6.4
	B.Sc./HND	611	24.2
	M.Sc./MBA	457	18.1
	Ph.D.	318	12.6
	Others (specify)	978	38.7
Employment status	Fully employed (permanent)	941	37.3
	Partially employed (temporal)	482	19.1
	Not employed	814	32.2
	Retired	289	11.4
Region Based	North East	265	10.5
	North West	184	7.3
	North Central	399	15.8
	South East	740	29.3
	South West	397	15.7
	South South	541	21.4
Income Group	Low income	1026	40.6
	Medium income	973	38.5
	High income	527	20.9
Monthly Household income	Below N100,000	1614	63.9
	N100,000-N200,000	584	23.1
	N210,000-N300,000	170	6.7
	N310,000-N400,000	92	3.6
	N410,000-N500,000	55	2.2
	Above N500,000	11	0.4
Household number	1-2 members	101	4.0
	3-6 members	1732	68.6
	More than 6 members	693	27.4
House type	Terraced house	513	20.3
	Apartments/Flats	1201	47.5
	Condominium	400	15.8
	Others	412	16.3
Age of House	Less than 5 years	589	23.3
	5-10 years	1386	54.9
	11-20 years	411	16.3
	More than 20 years	140	5.5
Vehicle Ownership	Yes	1241	49.1
	No	1285	50.9
Distance from house to recreation facilities	Less than 2 Km	1024	40.5
	2Km – 5Km	989	39.2
	More than 5 Km	513	20.3
Distance from house to Health Centres	Less than 2 Km	1102	43.6
	2 Km – 5 Km	1009	39.9
	More than 5 Km	415	16.4
Distance from house to religious places	Less than 2 Km	1867	73.9
	2Km – 5Km	578	22.9
	More than 5 Km	81	3.2
Distance from house to Educational centre	Less than 2 Km	1255	49.7
	2Km – 5Km	836	33.1
	More than 5 Km	435	17.2
Distance from house to child day care centre	Less than 2 Km	1433	56.7
	2Km – 5Km	822	32.5
	More than 5 Km	271	10.7
Distance from house to shopping mall or market	Less than 2 Km	1903	75.3
	2Km – 5Km	311	12.3
	More than 5 Km	312	12.4

(*continued on next page*)

Table 3 (*continued*)

Variable		Frequency (N=2526)	Percentage (%)
Distance from house to working place	Less than 2 Km	1593	63.1
	2Km – 5Km	665	26.3
	More than 5 Km	268	10.6
Distance from house to public transport station	Less than 2 Km	2013	79.7
	2Km – 5Km	433	17.1
	More than 5 Km	80	3.2

Source: Authors field study 2019.

Table 4
Opinion poll of respondents housing affordability stress experience.

Question items	SA (%)	A (%)	I (%)	D (%)	SD (%)	$\bar{X}$	Std. dev.
Have you experienced housing affordability stress in the last 5 years	1291 (51.11%)	739 (29.26%)	94 (3.72%)	350 (13.86%)	52 (2.06%)	4.13	1.127
The affordability stress was as a result of:							
I) Constraint (e.g. illness or serious injury, unemployment).	925 (36.62%)	1010 (39.98%)	470 (18.61%)	113 (4.47%)	8 (0.32%)	2.91	1.676
II) Choice (e.g. more desirable location, larger house).	898 (35.55%)	1298 (51.39%)	301 (11.92%)	28 (1.11%)	1 (0.04%)	4.21	0.691
III) Others factors	290 (11.48%)	236 (9.34%)	70 (2.77%)	925 (36.62%)	1005 (39.79%)	2.16	1.344
Have you suffered more than one affordability stress in the past 5 years	347 (13.74%)	158 (6.21%)	750 (29.69%)	761 (30.13%)	510 (20.19%)	2.63	1.259
Have you lived in any place you did not want to live in the last 5 years	91 (3.60%)	270 (10.69%)	430 (17.02%)	720 (28.50%)	1015 (40.18%)	2.09	1.147
Cluster mean						3.22	1.073

Source: Authors Field Survey (2019).
Source: Authors Field Survey (2019).

Factor analysis

The principal component method of factor analysis was used to extract the critical sustainability performance criteria for sustainable housing affordability in the study area. The operational equation of the factor analysis is given by:

$$\left.\begin{array}{l} P_1 = a_{11}X_1 + a_{12}X_2 + \ldots + a_{1k}X_k \\ P_1 = a_{11}X_1 + a_{12}X_2 + \ldots + a_{1k}X_k \\ \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \\ P_k = a_{k1}X_1 + a_{k2}X_2 + \ldots + a_{kk}X_k \end{array}\right\} \tag{4}$$

The tests confidence level for all inferential statistics was 95%, which implies 0.05 level of significance.

Results

Respondents housing affordability stress experience

The 2002 New National Housing and Urban Development Policy (NNHUDP) advocated that on no account shall any household spend above 20 percent of their monthly income on the housing units provided by FHA (Aribigbola, 2008). However, the descriptive statistics result represented in Table 4, with a cluster mean value of $3.22 > 3.00$ and associated standard deviation estimate of $1.073 < 1.581$ indicates that the household respondents are experiencing housing need and suffering affordability stress; hence the necessity for this research. This result is in-line with studies which have clearly demonstrated that previous affordable housing schemes in Nigeria failed to assist the targeted population [41,64] largely because of the high cost of housing units offered [43]. Turok, [80] argued that housing program and policy should serve a more expansive purpose beyond the sheer increase in number of houses. The author noted that carefully-designed human settlement policy can assist in lifting households out of poverty by providing avenues for people to become more productive, support urban areas to function more effectively and expand economic activities (jobs and investment).

Ranking of sustainable housing affordability criteria based on household's opinion

A total of eighty-one (81) list of criteria apposite to sustainable housing affordability were extracted from the literature. These 81 set of potential criteria comprise of nineteen (19) economic sustainability criteria, forty-eight (48) social sustain-

ability criteria and fourteen (14) environmental sustainability criteria. Descriptive statistics (mean and standard deviation) were used to extract the key criteria through opinion ranking of the households. The result is as presented in Table 5 below:

Criticality of SPC for sustainable housing affordability

From the comprehensive ranking of the household respondents, the first thirty (30) ranked criteria were extracted and presented in their order of importance, as shown in Table 6 below. These criteria which are considered most critical by the household respondents form the target for further analysis in this study.

Table 6 shows the most critical SPC for sustainable housing affordability from urban households view point is House price in relation to income (ES101). One interesting finding is that the criterion "clean and attractive" (SS303) is rated as the least CSPC, indicating that the attractiveness of housing perceived as affordable by households in the urban areas of Nigeria is not considered as a priority.

Comparison of household views with industry professionals and stakeholders

The comparison of the criticality of the views of stakeholders and industry professionals from previous studies, with that of households established in this study; indicates that households have distinct and unique views of the criteria relevant for sustainable housing affordability. For instance, in the study of Mulliner & Maliene [58] all four economic-related (housing cost) criteria were ranked among the top four considering that affordability is commonly assessed and defined based on economic terms by academics and professionals. Though households rated three economic-related criteria as part of the top four, they also considered a non-housing criterion as equally critical. Reduced transportation cost was ranked third by household respondents. This position had been affirmed by studies which argued that housing affordability must address not only the monetary dimension of housing, but likewise other wide range of costs that confront households, such as transportation cost (Acolin & Green, 2017).

It is worthy to note that while safety (reduced incidence of crime) was lowly rated by industry professionals according to Mulliner & Maliene, [58] at 15*th* position. Stakeholders did not consider safety at all amongst the top 20 criteria in Gan et al. [34] study. However, in this study households perceive safety (reduced incidence of crime) amongst the key criteria relevant to sustainable housing affordability and was ranked 12th. This aligns with the concerns of Maina [49] who opined that insecure housing locations in Nigeria prevent households from occupying housing units.

Therefore, it is safe to say that households have distinct and unique views on the criteria importance when compared with the industry professionals and stakeholder's opinion. This study recommends periodic assessment of household views on the CSPC as such a subjective perception is characterized by instability over time. Table 7 presents other comparison results of the top 20 critical criteria as adjudged by industry professional, stakeholders and households.

Household perceptions based on the geopolitical region and income group

To compare group differences to answer the research questions and hypothesis shown in Table 8; the Kruskal-Wallis test was adopted.

Households geopolitical region of residence in Nigeria

From the ranking statistics across the six (6) geopolitical regions in Nigeria, as presented in Table 9, the significant criteria were: House price in relation to income (ES101), reduced energy bill (ES311), Reduced transportation cost (ES312), Rental cost in relation to income (ES102), Ensure balanced housing market (ES310), Financial viability (ES301), Accessibility to working place (SS107), Type of building (SS305), Air quality (ENS103), and Reduced footprint (ENS206). Particularly, in the North East region, effective maintenance and management of properties (SS205) was ranked highest. This is followed by house price in relation to income (ES101), reduced energy bill (ES311), and Tenure (SS211). The least factor of importance was air quality (ES103). In the North West region, the major identified factors were number of fire place (SS313), energy efficiency (ENS203), accessibility to workplace (SS107), house price in relation to income (ES101), and ensure balanced housing market (ES310). The least critical factor was thermal comfort (ENS207).

The five most ranked criteria in the North central region were ENS206, ES101, ES301, ES102, SS305, SS203, ENS207 and SS208. In the South East Zone, the top five ranked criteria are ES312, ES311, ENS208, ES310, ES101, and ES301; in the South West region, we have ES311, ES312, ENS103, ENS203, ES101 and ENS206; while in the South-South region, the most ranked factors are ES101, ES102, ES310, ES311, and ES312. Table 9 presents other comparison results by geopolitical regions of Nigeria.

Therefore, to measure the variations in the rankings of the respondents across the geopolitical regions, the Kruskal-Wallis test for k-independent variables were employed. The result indicates a significant difference in the rankings of the respondents across the 6 geopolitical regions (Kruskal-Wallis H (5) = 21.433; p-value = 0.001) at $p < 0.05$. This implies that the respondent's region of residence has significant impact on the ranking of criteria importance for sustainable housing affordability in Nigeria.

However, a multiple comparison test was performed to ascertain the regions with varying opinion and those with similar opinions. The number of comparisons necessary for the post hoc Mann-Whitney test was determined as $6(6-1)/2 = 15$. Using the formula $k(k-1)/2$, where k is the number of groups. The Bonferoni multiple comparison test result indicates

Table 5
Ranking of the comprehensive list of potential SPC representing sustainable housing affordability.

Potential Sustainability Performance criteria	Code	$\bar{X}$	Rank
Economic Sustainability Performance Criteria			
House price in relation to income	ES101	4.80	1
Rental cost in relation to income	ES102	4.64	3
Availability mortgage and Interest rates	ES201	4.02	50
Availability of rented housing (social and private)	ES202	3.76	72
Availability of low-cost shared ownership products (e.g. shared housing)	ES203	3.62	79
Availability of market value home ownership product	ES204	3.63	78
Financial viability	ES301	4.56	6
Tenure security	ES302	3.78	70
Interest rates	ES303	3.50	80
Economic trends/Cost effectiveness	ES304	4.00	53
Desirability	ES305	3.66	76
Taxation influences	ES306	3.48	81
Family income level	ES307	3.89	62
Provide human resource for economic development	ES308	3.70	75
Employment opportunities	ES309	4.04	46
Ensure balanced housing market	ES310	4.57	5
Reduced energy bill	ES311	4.74	2
Reduced transportation cost	ES312	4.64	3
Reduced life cycle cost	ES313	3.76	72
Social Sustainability Performance Criteria			
Access to recreational facilities e.g. Parks, green open spaces	SS101	4.21	18
Access to health centres e.g. Hospitals, GPs	SS102	3.99	56
Access to religious places e.g. Temple, mosque, church etc.	SS103	3.65	77
Access to educational centre e.g. School, tuition centre etc.	SS104	3.76	72
Access to child day care centre	SS105	4.05	44
Location of shopping mall or market	SS106	4.05	44
Accessibility to working place	SS107	4.37	7
Proximity to government establishment	SS108	3.98	58
Proximity to private establishment	SS109	4.08	36
Availability of public transportation	SS110	4.00	53
Major access road	SS111	4.00	53
Minor access road	SS112	4.07	38
Ability to sustain other day to day cost of living	SS201	4.08	36
Social cohesion	SS202	4.05	44
Safety/Security (reduced incidence of crime)	SS203	4.28	13
Fire safety	SS204	4.10	32
Effective maintenance and management of properties	SS205	4.21	18
Cultural and heritage conservation	SS206	3.83	66
Religious affiliation	SS207	4.06	41
Sense of community	SS208	4.11	30
Community participation	SS209	4.02	50
Minimize social segregation	SS210	4.28	13
Tenure	SS211	4.15	25
Equitability and fairness of housing distribution	SS212	3.80	68
Social acceptability	SS213	3.96	60
Increased consciousness of environmental protection	SS214	3.83	66
Aesthetic views	SS301	4.03	48
Suitability/Appropriateness	SS302	4.23	17
Clean and Attractive	SS303	4.11	30
Cosy and Comfort (from the social–psychological point of view)	SS304	4.07	38
Type of building e.g. Apartments, condominiums, semi-detached etc.	SS305	4.35	8
Unit size	SS306	3.90	61
Number of bathrooms	SS307	4.04	46
Interior decoration e.g. Painting, layout etc.	SS308	3.76	72
Floor tiles marble	SS309	3.97	59
Number of garage spaces	SS310	3.99	56
Presence of lift or elevator	SS311	4.24	16
Presence of parking area	SS312	4.14	27
Housing location e.g. City, countryside etc.	SS313	4.14	27
Presence of heating system	SS314	4.18	21
Number of bedrooms	SS315	4.25	15
Floor spaces	SS316	3.86	64
Access and security	SS317	4.06	41
Number of fireplace	SS318	3.86	64
Housing quality e.g. meeting decent home standards	SS319	4.29	11
Lighting quality	SS320	3.86	64
Age groups	SS401	4.17	23
Household size	SS402	4.14	27

(*continued on next page*)

Table 5 (*continued*)

Potential Sustainability Performance criteria	Code	$\bar{X}$	Rank
Environmental Sustainability Performance Criteria			
Noise pollution	ENS101	3.99	56
Water pollution	ENS102	4.10	32
Air quality	ENS103	4.33	9
Waste management e.g. level of recycling, reuse, composting	ENS201	4.18	21
Use of appropriate materials	ENS202	4.18	21
Energy efficiency	ENS203	4.13	29
Land-use efficiency	ENS204	4.08	36
Water efficiency	ENS205	4.06	41
Reduced footprint	ENS206	4.33	9
Thermal comfort	ENS207	4.17	23
Minimized biodiversity loss	ENS208	4.28	13
Disaster resilience	ENS209	3.79	69
Mixed land using	ENS210	4.09	34
High housing density	ENS211	4.03	48

Table 6
Criticality of SPC representing sustainable housing affordability in Nigeria.

Rank	Code	Criteria Importance
1	ES101	House price in relation to income
2	ES311	Reduced energy bill
3	ES312	Reduced transportation cost
3	ES102	Rental cost in relation to income
5	ES310	Ensure balanced housing market
6	ES301	Financial viability
7	SS107	Accessibility to working place
8	SS305	Type of building e.g. Apartments, condominiums, semi-detached etc.
9	ENS103	Air quality
9	ENS206	Reduced footprint
11	SS319	Housing quality e.g. meeting decent home standards
13	SS203	Safety/Security (reduced incidence of crime)
13	SS210	Minimize social segregation
13	ENS208	Minimized biodiversity loss
15	SS315	Number of bedrooms
16	SS311	Presence of lift or elevator
17	SS302	Suitability/Appropriateness
18	SS101	Access to recreational facilities e.g. Parks, green open spaces
18	SS205	Effective maintenance and management of properties
21	SS314	Presence of heating/cooling system
21	ENS201	Waste management
21	ENS202	Use of appropriate materials
23	SS401	Household size
23	ENS207	Thermal comfort
25	SS211	Tenure
27	SS312	Presence of parking area
27	SS313	Housing location
27	SS402	Household size
29	ENS203	Energy efficiency
30	SS208	Sense of community
30	SS303	Clean and Attractive

significant differences in opinion rankings of South-South to North West, South-South to North Central, South South to South East, and between North East to North Central region.

Household income group

The variation in the average rankings of criteria importance based on the participant's income group is as shown in Table 10. The general average order of criteria ranking is as represented in the "overall ranking column". This was compared with the average rank gotten by income group. Descriptive statistics (mean and standard deviation) were employed to achieve this aim.

Also, to measure the variations in the rankings of the respondents' opinion by income group, the Kruskal-Wallis test for k-independent variables were again employed. The result indicates no significant difference in the rankings of the respondents on criteria importance based on income group (Kruskal-Wallis $H(2) = 1.620$; p-value $= 0.445$) at $p > 0.05$. This implies that the respondent's opinions on criteria importance do not differ based on income group in Nigeria.

Table 7
Comparison of household views with industry professionals and stakeholder's opinion on the first 20 criteria apposite to sustainable housing affordability.

Criteria Ranking	Industry Professionals Opinion [58]	Stakeholders Opinion [34]	Household Views (Table 1)
1	House prices in relation to income	Financial viability	House price in relation to income
2	Rental costs in relation to income	Disaster resistance	Reduced energy bill
3	Interest rates and mortgage availability	Effective maintenance and management of properties	Reduced transportation cost
4	Availability of rented accommodation (private and social)"	Energy efficiency	Rental cost in relation to income
5	Quality of housing	Cost recovery	Ensure balanced housing market
6	Access to employment	Provide human resource for economic development	Financial viability
7	Energy efficiency of housing	Equability and fairness of housing distribution	Accessibility to working place
8	Availability of low-cost home ownership products	Social acceptability	Type of building
9	Access to good quality schools	Reliability and durability	Air quality
10	Access to public transport	Cost effectiveness	Reduced footprint
11	Access to health services	Other non-housing related costs	Housing quality e.g., meeting decent home standards
12	Availability of market value home ownership products	Accessibility	Safety/Security (reduced incidence of crime)
13	Access to early years child care	Energy efficiency	Minimize social segregation
14	Access to shopping facilities	Effectively utilizing resources	Minimized biodiversity loss
15	Safety (crime)	Suitability	Number of bedrooms
16	Low presence of environmental problems	Ensure balanced housing market	Presence of lift or elevator
17	Deprivation in area	Effective maintenance and management of properties	Suitability/Appropriateness
18	Access to open green space	Integrate related industries of sustainable housing	Access to recreational facilities e.g., Parks, green open spaces
19	Waste management	Affordable price/renting	Effective maintenance and management of properties
20	Access to leisure facilities	Harmonious social relationships	Presence of heating system

Table 8
Research hypothesis.

Research Hypothesis	Groups Compared
Is there any significant difference in the households' opinion on the criteria representing sustainable housing affordability based on geopolitical zones in Nigeria?	Region of residence
Is there any significant difference in the households' opinion on the criteria representing sustainable housing affordability based on the respondents' income group in Nigeria?	Income group

Table 9
Comparison of criteria importance by geopolitical region.

Code	NE (n=265)		NW (n=184)		NC (n=399)		SE (n=740)		SW (n=397)		SS (n=541)		All (N = 2526)	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
ES101	4.78	2	4.72	4	4.84	2	4.80	5	4.82	5	4.83	1	4.80	1
ES311	4.68	3	4.64	7	4.67	10	4.94	2	4.90	1	4.62	4	4.74	2
ES312	4.44	10	4.24	24	4.67	10	4.98	1	4.90	1	4.62	4	4.64	3
ES102	4.45	8	4.48	17	4.78	4	4.68	8	4.64	9	4.81	2	4.64	3
ES310	4.60	5	4.68	5	4.44	18	4.84	4	4.24	19	4.63	3	4.57	5
ES301	4.54	6	4.04	29	4.81	3	4.80	5	4.70	7	4.46	6	4.56	6
SS107	3.99	21	4.73	3	4.56	13	4.44	14	4.23	20	4.24	13	4.37	7
SS305	4.45	8	4.49	16	4.76	6	4.36	16	4.05	23	4.00	17	4.35	8
ENS103	3.35	30	4.55	10	4.39	20	4.70	7	4.87	3	4.13	15	4.33	9
ENS206	3.17	31	4.54	13	4.88	1	4.58	9	4.72	6	4.06	16	4.33	9
SS319	4.43	11	4.55	10	4.67	10	3.76	29	3.99	26	4.36	10	4.29	11
SS203	4.34	13	4.32	21	4.76	6	4.42	15	3.87	27	3.96	18	4.28	13
SS210	4.43	11	4.54	13	4.32	22	4.49	11	4.04	24	3.84	22	4.28	13
ENS208	3.93	23	4.28	23	4.65	12	4.91	3	3.45	31	4.43	7	4.28	13
SS315	4.50	7	4.56	8	4.55	15	3.65	31	4.44	12	3.79	23	4.25	15
SS311	3.85	25	4.33	18	3.99	29	4.32	19	4.54	11	4.38	8	4.24	16
SS302	4.00	19	4.32	21	4.22	26	4.33	18	4.32	16	4.16	14	4.23	17
SS101	3.99	21	4.55	10	4.55	15	4.49	11	3.76	29	3.89	20	4.21	18
SS205	4.79	1	4.65	6	4.55	15	4.48	13	3.76	29	3.03	31	4.21	18
SS314	4.02	18	4.55	10	4.06	28	4.32	19	4.25	18	3.86	21	4.18	21
ENS201	4.03	17	3.65	31	4.23	25	4.12	24	4.65	8	4.37	9	4.18	21
ENS202	3.68	28	4.53	15	4.36	21	4.55	10	4.37	13	3.60	29	4.18	21
SS401	4.32	14	4.14	27	4.44	18	4.14	23	4.00	25	3.95	19	4.17	23
ENS207	3.80	26	4.01	30	4.76	6	4.36	16	3.76	29	4.33	11	4.17	23
SS211	4.68	3	4.14	27	3.87	30	4.12	24	4.32	16	3.74	24	4.15	25
SS312	4.06	16	4.22	25	4.26	24	3.96	27	4.57	10	3.74	24	4.14	27
SS313	4.12	15	4.76	1	4.19	27	3.76	29	4.33	15	3.65	28	4.14	27
SS402	3.76	27	4.20	26	4.32	22	4.02	26	4.21	21	4.32	12	4.14	27
ENS203	3.58	29	4.76	1	3.65	31	4.23	22	4.87	3	3.66	26	4.13	29
SS208	3.88	24	4.32	21	4.76	6	4.24	21	4.36	14	3.12	30	4.11	30
SS303	3.99	21	4.33	18	4.55	15	3.96	27	4.14	22	3.66	26	4.11	30

A Joint assessment of the criteria performance by income group and geopolitical zone indicates that out of the thirty (30) sustainable housing affordability criteria, twenty-one criteria were considered relevant from the opinion responses of the respondents using descriptive statistics (mean and standard deviation). These 21 criteria were thus subjected to factor analysis for final extraction and development of a general framework. Table 11 presents the 21 criteria importance and their respective comparison result using the Kruskal-Wallis H test technique.

The result in Table 11 indicates significant variations in household rankings of the factors at 5% level of significance. Table 12 shows the key criteria importance as extracted using principal component method of factor analysis.

From the principal component result, there are five (5) key criteria for sustainable housing affordability in Nigeria. These criteria are Waste management (ENS201) which explains about 29.9% of the total variations in the system, Safety/Security (reduced incidence of crime) [SS203] which accounts for about 27.6% of the total variations, Energy efficiency (ENS203) which accounts for about 21.2% of the variations, financial viability (ES301) accounting for about 12.9% of the total variations, and Ensure balanced housing market (ES310) which explains about 8.3% of the total variations in the system in Nigeria. The general framework is therefore developed based on these criteria as extracted through factor analysis and shown in Fig. 3.

From the framework, the major criteria for attaining sustainable housing affordability in Nigeria are as follows; in the economic sustainability criteria are financial viability (ES301) and ensure balanced housing market (ES310); while in the environmental sustainability criteria are Waste management (ENS201) and Energy efficiency (ENS203). Also, Safety/Security (reduced incidence of crime) [SS203] is the only criterion in social sustainability criteria.

Table 10
Comparison of criteria importance by income group.

Code	Overall Ranking	Low Income$N = 1026$		Medium Income$N = 973$		High Income$N = 527$	
		Mean	Rank	Mean	Rank	Mean	Rank
ES101	1	4.58	13	4.66	7	4.76	2
ES311	2	4.66	11	4.71	4	4.73	4
ES312	3	4.73	4	4.75	2	4.59	10
ES102	3	4.77	1	4.73	3	4.59	10
ES310	5	4.74	3	3.69	20	4.62	7
ES301	6	3.42	29	3.99	16	3.81	17
SS107	7	3.87	19	3.38	29	3.62	24
SS305	8	4.72	5	4.79	1	4.64	6
ENS103	9	4.59	12	4.71	4	4.60	9
ENS206	9	4.71	7	4.58	11	3.80	18
SS319	11	3.91	17	3.60	25	3.57	26
SS203	13	4.75	2	4.39	13	4.62	7
SS210	13	3.60	28	3.29	30	4.23	13
ENS208	13	4.68	9	4.62	10	3.87	16
SS315	15	3.72	25	3.58	27	3.73	19
SS311	16	3.89	18	3.23	31	3.28	30
SS302	17	4.72	5	4.63	9	4.75	3
SS101	18	4.58	13	4.69	6	4.72	5
SS205	18	4.69	8	4.29	14	3.69	20
SS314	21	3.75	23	3.75	19	3.50	28
ENS201	21	4.68	9	4.64	8	4.77	1
ENS202	21	4.53	15	4.49	12	4.56	12
SS401	23	3.79	22	4.29	14	3.64	22
ENS207	23	3.86	20	3.60	25	3.26	31
SS211	25	3.38	30	3.68	21	3.92	14
SS312	27	3.29	31	3.42	28	3.47	29
SS313	27	3.68	27	3.67	22	3.64	22
SS402	27	3.99	16	3.84	18	3.67	21
ENS203	29	3.84	21	3.64	23	3.58	25
SS208	30	3.75	23	3.63	24	3.88	15
SS303	30	3.69	26	3.91	17	3.57	26

Table 11
Comparison of ratings of the criteria importance.

Criterion	Kruskal-Wallis Test Result
ES101: House price in relation to income	$H(5) = 17.510$, $p = 0.0003$ ($p < 0.01$)
ES311: Reduced energy bill	$H(5) = 21.041$, $p = 0.0001$ ($p < 0.01$)
ES312: Reduced transportation cost	$H(5) = 16.292$, $p = 0.0010$ ($p < 0.01$)
ES102: Rental cost in relation to income	$H(5) = 13.879$, $p = 0.0201$ ($p < 0.05$)
ES310: Ensure balanced housing market	$H(5) = 21.446$, $p = 0.0001$ ($p < 0.01$)
ES301: Financial viability	$H(5) = 18.107$, $p = 0.0002$ ($p < 0.01$)
SS107: Accessibility to working place	$H(5) = 20.481$, $p = 0.0001$ ($p < 0.01$)
SS305: Type of building e.g. Apartments	$H(5) = 17.215$, $p = 0.0040$ ($p < 0.01$)
ENS103: Air quality	$H(5) = 19.105$, $p = 0.0006$ ($p < 0.01$)
ENS206: Reduced footprint	$H(5) = 15.463$, $p = 0.0031$ ($p < 0.01$)
SS203: Safety/Security (reduced incidence of crime)	$H(5) = 20.202$, $p = 0.0015$ ($p < 0.01$)
ENS208: Minimized biodiversity loss	$H(5) = 21.025$, $p = 0.0003$ ($p < 0.01$)
SS302: Suitability/Appropriateness	$H(5) = 18.503$, $p = 0.0014$ ($p < 0.01$)
SS101: Access to recreational facilities e.g. Parks, green open spaces	$H(5) = 21.042$, $p = 0.0022$ ($p < 0.01$)
SS205: Effective maintenance and management of properties	$H(5) = 18.982$, $p = 0.0034$ ($p < 0.01$)
ENS201: Waste management	$H(5) = 18.554$, $p = 0.0011$ ($p < 0.01$)
ENS207: Thermal comfort	$H(5) = 16.984$, $p = 0.0031$ ($p < 0.01$)
SS211: Tenure	$H(5) = 17.540$, $p = 0.0022$ ($p < 0.01$)
SS313: Number of fireplace	$H(5) = 16.434$, $p = 0.0013$ ($p < 0.01$)
ENS203: Energy efficiency	$H(5) = 18.016$, $p = 0.0011$ ($p < 0.01$)
SS208: Sense of community	$H(5) = 15.104$, $p = 0.0014$ ($p < 0.01$)

Discussion

The quantitative study performed in Section 4 shows the analysis of 2526 questionnaires, carried out with households residing in 26 urban areas in 6 geopolitical regions of Nigeria. This survey enabled the authors to establish the criticality of 81 potential SPC relevant to sustainable housing affordability. 30 CSPC was established using household's opinion. Research results showed that presently households in Nigeria perceive the economic criteria, such as "house prices in relation to

Table 12
The factor analysis result.

Criterion	Component				
	1	2	3	4	5
ES101: House price in relation to income	-.707	.497	-.348	.258	-.255
ES311: Reduced energy bill	-.289	.384	.495	.450	.568
ES312: Reduced transportation cost	-.584	.624	.125	.366	.348
ES102: Rental cost in relation to income	-.480	.750	-.358	-.211	-.186
ES310: Ensure balanced housing market	.415	-.023	-.430	-.318	.736
ES301: Financial viability	-.456	.521	-.219	.681	.089
SS107: Accessibility to working place	.706	.571	.205	-.350	-.110
SS305: Type of building	.802	.160	-.308	.428	-.233
ENS103: Air quality	.004	.740	.646	-.171	.076
SS203: Safety/Security (reduced incidence of crime)	.149	.870	.422	-.095	-.186
ENS206: Reduced footprint	.702	.321	-.474	.415	-.088
ENS208: Minimized biodiversity loss	.386	.566	-.611	-.186	.351
SS302: Suitability/Appropriateness	.178	.680	.650	-.224	.179
SS101: Access to recreational facilities	.862	.460	-.175	.011	.120
SS205: Effective maintenance and management of properties	.796	-.145	.000	.574	.126
ENS201: Waste management	-.898	.294	.133	.216	-.205
ENS207: Thermal comfort	.182	.756	-.604	-.077	-.156
SS211: Tenure	.075	-.703	.299	.601	.222
SS313: Housing location	.619	-.229	.626	.027	-.414
ENS203: Energy efficiency	.139	.112	.963	-.154	.130
SS208: Sense of community	.532	.433	.381	.579	-.222
Eigenvalue	**6.279**	**5.798**	**4.461**	**2.716**	**1.745**
%age of Variance	**29.90**	**27.61**	**21.24**	**12.94**	**8.31**
Cumulative %age	**29.90**	**57.51**	**78.75**	**91.69**	**100%**

Extraction Method: Principal Component Analysis.
a. 5 components extracted.

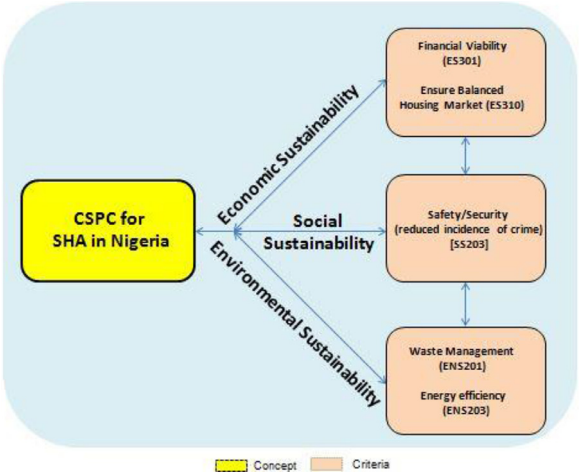

Fig. 3. Framework for achieving sustainable housing affordability in Nigeria.

income" and "rental costs in relation to income" amongst the key significant criteria for sustainable housing affordability, ranking them 1st and 3rd respectively. This result is not surprising, owning to the fact that housing cost and its relation to income (ratio income method) has been typically used to measure and define housing affordability situations; due to their ease of computation and appeal to peoples' common-sense experience, since they generally require information on housing cost and income.

One interesting thing about the results of this study is that non-housing cost criteria such as "reduced transportation cost" and "reduced energy bill" had an equal rank with "rental costs in relation to income" at 3rd position each. This implies that households are beginning to place very high importance to non-housing cost. This is in line with the debates of some researchers who demonstrated that the relationship between housing cost, housing location and cost of transportation ensures an actual measure of housing affordability [47]. It is worthy of note that a very high rank of importance (5th) of criterion "Ensure balanced housing market" reflects Baranoff [16] assertion that housing affordability is a growing crisis in urban areas with constrained housing markets. As urban population grows exponentially, many urban areas experience continuous and rapid growth, as in-migration continue from rural to urban areas in quest for better living conditions, leading

to an increase in housing demand. However, as the Nigeria's economic woes continue unabated; there also exists an even more increasing demand for affordable housing. Thus, demands for housing always outstrip housing supply by a very wide margin in the study area. This inevitably brings about the survival of the "fittest syndrome". This housing inequality concept in addition to other scales and types of disparity in housing services availability as investigated by Awotona [13] are still very much present. One striking feature of Nigerian urban areas is a sharp disparity in housing standards. This results in the acquisition of ostentatious luxury housing quarters by rich individuals, while according to Obiadi Bons et al. [64] the urban poor are left with little or no choice but to make do with shanty houses in less desirable areas such as marshy sites, neighborhood adjacent to refuse dumps, among others.

Furthermore, social and more qualitative criteria like "Accessibility to working place" and "Type of building", were ranked as 7th and 8th; and environmental criteria "Air quality" and "Reduced footprint", were equally ranked 9th, are considered highly important by households and could significantly inform decision making. It therefore does seem that households recognize, to some extent at least, the importance of quality and ecosystem related criteria in line with several scholars [2,50].

Given that different interpretations have been employed in the housing affordability analysis by researchers of diverse orientation [51], questionnaire data analyses were performed using non-parametric statistics. The purpose was to establish if any significant differences exist in perceptions among respondents; first, based on the households' location in the 6 geopolitical regions of Nigeria and second, according to the income group which the household belongs. Findings from the first analysis show that opinion on criteria importance differs considerably across the geopolitical regions of Nigeria. This is an indication that households' perceptions and views on criteria importance were inconsistent within the country. Criteria were ranked based on the current economic (affordability) situation and safety concerns reported in several regions of Nigeria (e.g., unaffordable housing prices in the South West region (like Lagos) than in other regions of Nigeria [10] and increasing rates of hostilities reported in the North East and North West regions than in other parts of the country [11]. Such reports detail the irregularities in households' assessment and interpretation of sustainable housing affordability criteria across the entire regions of Nigeria. This conceptual irregularity is in line with the views of Gabriel et al. [33] that diverse groups (which in this study is perceived as the different regions of Nigeria) struggle to impose their own concept and definition of housing affordability. However, the criteria importance established in this study could be considered equally relevant for every geopolitical region of Nigeria if such criteria system is employed in future studies.

The second analysis showed that the households' opinion does not depend on the household income group, but instead with part of the region in which the household resides. The research, therefore, rejects the alternative hypothesis and accepts the null hypothesis for H_{O1} since there p-value is more than 0.05. The null hypothesis H_{O1} states that household opinions on criteria representing sustainable housing affordability do not significantly differ based on household income group. However, it accepts the alternative hypothesis H_{A1} and rejects the null hypothesis for H_{O2} which states that household opinions on criteria representing sustainable housing affordability do not significantly differ based on geopolitical region of residence, since it has a *p*-value of 0.001 which is less than 0.05.

Furthermore, from the descriptive statistical result, the households unanimously agreed that broader dimensions and wide-ranging criteria relevant to sustainable housing affordability as propagated by researchers, are presently not incorporated in housing delivery practices in the study area. This assertion aligns with studies which have reported lack of consideration to socio-cultural related criteria like kingship and security [49]; poor solid waste management system [68], problems with open/recreational space delivery and management [66], spatial variations in housing quality [54], and improper utilization of natural resources available in the housing environment [67] as well as low user participation in housing delivery processes in Nigeria [39] amongst many others.

Limitations and future research agenda

This survey suffers some weaknesses which can be suggested as themes for future studies. The study sample size is acknowledged to be relatively small. This may limit the representativeness of the survey results. Consequently, the generalization and interpretation can be improved by future research which employ larger sample size of respondents. Hence, the available data are inadequate to provide a thorough cross-country view; further studies can increase the data coverage and substantiate the quality of this study finding. Future studies employing bigger responses can adopt statistical analysis like ANOVA to determine and compare statistical differences between the opinion of low- and medium-income families.

More so, future studies can corroborate the CSPC established by this study using evidence-based case studies. Another limitation of this study is that only the opinions of urban households were assessed. Future studies should consider the opinions of rural households to ascertain the urban-rural differences in the criteria importance, since housing experience in the rural and urban settings are dissimilar. In addition, the views of stakeholders, academics and industry professionals were excluded in this report. It would be interesting if further studies analyze households' views on CSPC representing sustainable housing affordability alongside the opinions of academics, stakeholders, and industry professionals. Furthermore, future research can study household preferences and compare them with our study results.

Research contribution to existing literature

Although this research suffers some weaknesses, it however makes some salient contributions that are worthy of note. First, it deepens housing affordability literature theoretically, by bringing a different type of perception to the conversation. The study argues that urban households have different, distinct, and unique views on the criteria representing sustainable housing affordability than professionals and stakeholders since households bear the direct brunt of the housing affordability problem. Thus, it broadens the housing affordability concept and meaning by revealing the housing affordability perceptions of urban low- and medium-income families. Secondly, the study has the potential to contribute to the housing affordability literature practically, since it heeds to the call of two recent scholarly studies ([20,58]) for an investigation into how low- and moderate-income families perceive the criteria system for sustainable housing affordability. Uncovering diverse and wide-ranging criteria influencing housing affordability of urban households takes a critical role in improving the quality of life, quality of housing layout and environment. Therefore, the study results can help architects, housing authorities and city planners in the design as well as the construction of better livable, sustainable, and affordable housing settings in accordance with the expectations and needs of urban households. Additionally, the established criteria system can offer policy makers, local authorities, and governments, with wide ranging criteria to consider in making more informed and sustainable decisions about the affordability of housing. The presented system of criteria representing sustainable housing affordability will assist in formulating techniques that can be used in assessing affordable housing locations in a sustainable manner. The criteria rankings can be employed in placing degrees of importance in affordable housing policies and programs. It is hoped that this research will inspire future studies into establishing a broader housing affordability concept that is better aligned with sustainability.

Conclusion, implications and recommendation

Many criteria influence housing affordability and recent studies emphasized the need for reconsideration in the way housing affordability is assessed and conceptualized. From this study, it could be said that housing affordability is also a product of subjective judgment which arises from the overall perception which households hold towards what they view as important features of an acceptable housing setting at a given time. This is a value judgment to some extent. Therefore, housing affordability concerns also arise from the overall peoples' experience and account of the difficulties suffered in their quest to secure decent and affordable housing. Thus, this study provides an alternative lens to view housing affordability from the perspective of urban low- and medium-income households. It discusses the concept and broader criteria apposite to sustainable housing affordability, which transcends mere economic terms widely adopted in assessing housing affordability. Through a systematic literature review and pilot survey the study identified a comprehensive list of criteria through which housing affordability could be assessed more holistically within the ambit of sustainability. Then a case study in the 26 urban areas of Nigeria is applied to exemplify how households conceptualize and assess their housing affordability situation in a specific region and national context.

From the results, the criterion "House price in relation to income" is the most important which is consistent with similar studies in this domain, but it was also found that households placed high priorities to other non-monetary criteria such as security (safety), location and building type; as well as other non-housing related cost like transportation cost and energy bill. However, ranking the criteria contributing to sustainable housing affordability is a daunting task, as household views are distinct and unique particularly in a multi-ethnic country like Nigeria. Thus, this study recommends that household perceptions be considered on every affordable housing program, because neglecting household views will derail affordable housing goals. For instance, studies have demonstrated that the neglect of housing quality perception [50,78] and socio-cultural concerns of households often result in housing facility abandonment. Therefore, this study recommends that a pilot study should be carried out to assess the views, expectations and needs of the intended households, prior to the construction of affordable housing projects. Periodic assessment of these needs is essential for the needs of the household are ephemeral. Regular assessment would guarantee that the expected affordability concerns of households are met. This research will guide stakeholders and industry professionals, particularly the contractors and architects about the criteria that are exceptionally relevant to sustainable housing affordability. The theoretical purpose of this study is to guarantee that households are contented with the houses and that "reasonable" profit margin is made by developers. The study's policy implications are that the views and perceptions of households should be routinely assessed and drive the delivery of affordable housing.

Furthermore, implicit in the study findings is that respondents approached these criteria from the angle to lighten their affordability burden. Thus, industry professionals must guarantee that households will not spend excessively to commute to workplaces, health facilities, markets and parks on account of them residing in the house. In addition, the house must discourage and not contribute to crime and vandalism. To provide broader findings, further research on this subject might include other household compositions such as nonfamily households. It is appealing to consider performing a continental survey on this subject, e.g., Africa, however, this may be superfluous. Thus, it may be more realistic to compare the study findings with other populous nations in Africa like Ethiopia and Egypt. Moreover, housing prices in Luanda, Angola is higher compared to other nation's urban areas in Africa; hence, the applications of the study findings to other developing countries should be interpreted carefully.

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Declaration of Competing Interest

The authors affirm that there is no conflict of interest.

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Ikenna Stephen Ezennia received his master's degrees in the field of Architecture in 2011 and a second master's degree in the field of Construction Management from Nnamdi Azikiwe University, Awka, Nigeria in 2014. He is a Senior lecturer in the Department of Architecture at Nnamdi Azikiwe University, Awka, Nigeria. Recently, he successfully completed his Ph.D. in Architecture at Eastern Mediterranean University, North Cyprus. His research interest is on affordable housing planning, housing affordability amongst others.

Şebnem Onal Hoşkara is a full professor at the Department of Architecture, Eastern Mediterranean University (EMU). She is the Director of Urban Research and Development Center (URDC) of EMU. She worked as a Visiting Professor at University of Texas at San Antonio (UTSA) as the Interim Director of Urban and Regional Planning (URP) Graduate Programs between 1 September 2018-31 May 2019. Şebnem does research in Architectural and Urban Design Education, Urban Morphology, Sustainable Urban Design and Planning in Cypriot Settlements, Cultural Heritage Conservation and Conservation of Industrial Heritage in Cyprus. Her recent project is 'EMU Campus Master Plan' and 'Urban Design and Conservation Guidelines in Alsancak Village, Kyrenia'.