Sustainable Housing Affordability Construct and the Case of Nigerian Urban Housing Sector

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ABSTRACT

Housing affordability concept and measurement is a recurring subject in architecture and planning literature. Research suggests that in planning for housing, architects and planners typically apply the normative (ratio and residual) measures to all variants of affordability stress. This is because housing affordability is typically assessed and conceptualized in economic terms. Hence, proffering intervention strategies which often fail to address the peculiar situations in their communities. Consequently, optimal measurement of housing affordability has remained a significant concern worldwide. In recent decades, methodological development and researches (conceptual refinements) on housing affordability measurement approaches (HAMA) have accelerated and continue to grow exponentially. Despite this intensive global development, very few attempts have been made to present the theoretical bases and track the developmental trends of these approaches. Furthermore, recent studies suggest that the concept of housing affordability is evolving and that its concerns transcend mere housing cost and its relationship to income; to broader issues of social wellbeing and sustainability. It is an unusual approach to assess housing affordability by incorporating sustainability. Sustainable housing affordability (SHA) construct has been advocated by researchers to address the exponentially growing affordability concerns.

New studies on this subject are increasingly recognizing the need for a broader and more holistic understanding of the criteria system representing SHA. Most key authors have embraced this evolution and view the change as positive, and have analyzed industry professionals, academics, housing providers as well as stakeholders'

perception along these lines. To the best of my knowledge, no study has surveyed the opinions of households on the criteria system representing SHA. Hence, it is not immediately clear if the views of households align with this. Therefore, this thesis aims at filling this literature gap by assessing the views of households on the criteria system representing SHA. In this regard, a holistic list of 81 potential sustainability performance criteria (SPC) were established by an extant systematic literature review. Regarding this, a questionnaire survey was premeditated to assess the opinion of households living in the 26 urban areas of Nigeria on the criticality of these SPC. Through the statistical analysis, 30 critical sustainability performance criteria (CSPC) were established. Based on this, a framework for achieving SHA in the study area was proposed.

A comparative analysis shows that households have distinct and unique views on the criteria system when compared to the industry professionals' and stakeholders' opinions. Findings reveal that household views on these issues differ significantly across the six geopolitical regions of Nigeria, while no significant difference exists based on income group. This study posits that at present, the housing affordability concerns in Nigeria cannot be restrictedly defined by financial attributes. It reiterates the need for reconsideration and offers new insight, but not conclusive information on better ways to conceptualize and measure housing affordability. This thesis provides salient information to policymakers, industry professionals and stakeholders that could aid the sustainable development of housing projects that are deemed affordable.

Keywords: Housing Affordability; Measurements Approaches; Methodological Weaknesses; Sustainability; Household Perception; Quantitative Analysis; Evidence-Informed Planning; Planning for Housing; Nigeria.

ÖZ

Konut satın alınabilirliği konsepti ve ölçümü mimarlık ve planlama literatüründe tekrar eden bir konudur. Araştırma, konut planlamasında genellikle mimarların ve plancıların tüm satın alınabilirlik değişkenlerine kuralcı (oran ve artık) ölçümleri uyguladıklarını öne sürmektedir. Çünkü konut satın alınabilirliği genellikle ekonomik olarak değerlendirilmekte ve kavramsallaştırılmaktadır. Bu nedenle, genellikle toplumlarındaki alışılmamış durumlara hitap etmeyen müdahale stratejileri sunmaktadır. Sonuç olarak, konut satın alınabilirliğinin ideal ölçümü dünya çapında önemli bir endişe kaynağı olmaya devam etmektedir.

Son yıllarda, konut satın alınabilirliği ölçüm yaklaşımları (HAMA) ile ilgili metodolojik gelişim ve araştırmalar (kavramsal düzeltmeler) hızlanmıştır ve katlanarak büyümeye devam etmektedir. Bu yoğun küresel gelişmeye rağmen, teorik temelleri sunmak ve bu yaklaşımların gelişimsel eğilimlerini izlemek için çok az girişimde bulunulmuştur. Ayrıca, son çalışmalar konut satın alınabilirliği kavramının gelişmekte olduğunu ve endişelerinin sadece konut maliyetini ve gelirle olan ilişkisini aşıp sosyal refah ve sürdürülebilirlik konularına yöneldiğini göstermektedir. Sürdürülebilirliği dahil ederek konutların satın alınabilirliğini değerlendirmek alışılmadık bir yaklaşımdır.

Sürdürülebilir konut satın alınabilirliği (SHA) yapısı, araştırmacılar tarafından katlanarak artan satın alınabilirlik endişelerini ele almak için savunulmuştur. Bu konuda yapılan yeni çalışmalar SHA'yı temsil eden kriterler sisteminin daha geniş ve daha bütünsel olarak anlaşılması gereğini giderek daha fazla kabul etmektedir. En

önemli yazarlar bu evrimi benimsemiş ve değişimi olumlu olarak görmüştür ve endüstri profesyonelleri, akademisyenler, konut sağlayıcıları ve paydaşların bu hatlardaki algısını analiz etmişlerdir. Bilindiği kadarıyla, hiçbir çalışma ev halkının SHA'yı temsil eden kriterler sistemi hakkındaki görüşlerini araştırmamıştır. Dolayısıyla, ev halkı görüşlerinin buna uygun olup olmadığı hemen anlaşılamamıştır. Bu nedenle, bu tez, SHA'yı temsil eden kriterler sistemi hakkında ev halkının görüşlerini değerlendirerek bu literatür boşluğunu doldurmayı hedeflemektedir.

Bu bağlamda, mevcut sistematik bir literatür taraması ile 81 potansiyel sürdürülebilirlik performans kriterinin (SPC) bütünsel bir listesi oluşturulmuştur. Bununla ilgili olarak, Nijerya'nın 26 kentsel bölgesinde yaşayan ev halkının bu SPC'nin kritikliği hakkındaki görüşlerini değerlendirmek için bir anket araştırması hazırlanmıştır. İstatistiksel analiz ile 30 kritik sürdürülebilirlik performans kriteri (CSPC) oluşturulmuş ve buna dayanarak, çalışma alanında SHA'ya ulaşmak için bir taslak önerilmiştir.

Karşılaştırmalı analiz, ev halkının, endüstri profesyonellerinin ve paydaşlarının görüşlerine göre ölçütler sistemi üzerinde farklı ve benzersiz görüşlere sahip olduğunu göstermektedir. Bulgular, Nijerya'nın altı jeopolitik bölgesinde bu konulara ilişkin ev halkı görüşlerinin önemli ölçüde farklılık gösterirken, gelir grubuna göre önemli bir fark bulunmadığını ortaya koymaktadır. Bu çalışma, şu anda, Nijerya'daki konut satın alınabilirliği kaygılarının finansal özellikler ile kısıtlanamayacağını ortaya koymaktadır. Çalışma ayrıca yeniden değerlendirme ihtiyacını yinelemekte ve yeni bilgiler sunmakta, ancak konut satın alınabilirliğini kavramsallaştırmanın ve ölçmenin daha iyi yolları hakkında kesin bilgi sunmamaktadır. Bu tez politikacılara, endüstri

profesyonellerine ve paydaşlara, uygun fiyatlı kabul edilen konut projelerinin sürdürülebilir kalkınmasına yardımcı olabilecek dikkat çeken bilgiler sunmaktadır.

Anahtar kelimeler: Konut satın alınabilirliği, ölçüm yaklaşımları, metodolojik zayıflıklar, sürdürülebilirlik, ev halkı algısı, kantitatif analiz, kanıta bağlı planlama, konut planlaması, Nijerya.

DEDICATION

I dedicate this research to my late father, Dr. Steve Ejianya Ezennia, from whom I drew strength, courage, and commitment of purpose, to pursue and never to quit on anything I set my eyes on. Dad, you are fondly remembered.

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LIST OF ABBREVIATIONS

CHTA	Combined Housing and Transportation Affordability.
CM	Composite Method.
CSPC	Critical Sustainability Performance Criteria.
FAH	Federal Housing Authority.
HAMA	Housing Affordability Measurement Approaches.
HMMA	Housing and Mortgage Market Affordability.
HOA	Home-Ownership Affordability.
IHA	Individual Household Affordability.
IRM	Income Ratio Method.
MCDM	Multiple Criteria Decision-Making Method.
PIR	Price to Income Ratio.
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses.
RHA	Rental Housing Affordability.
RIM	Residual Income Method.
SHA	Sustainable Housing Affordability

Chapter 1

INTRODUCTION

There is a growing scholarly concern for the development of better methodologies that could optimally measure housing affordability, as part of efforts towards addressing the ever-escalating housing cost. These concerns are targeted towards achieving a more extensive range of positive policy and economic outcomes, such as; enhanced housing and transportation infrastructure, income adequacy, household wellbeing, reduced inequalities and improved rental housing (Gabriel & Painter, 2018). These discussions among others, are the major issues that continue to steer housing affordability at the core of several international discourses on policies related to housing. However, as discussions over housing affordability issues continue, there is no consensus on the concept based on its meaning and measurement approach. Several arguments hold that this could be the result of the multiple concepts employed in its analysis (Jewkes, & Delgadillo, 2010; Taltavull & Juárez, 2012), which produces a different outcome depending on what constitutes the approach (Ezennia & Hoskara, 2019a).

In planning affordable housing, architects and planners typically base their intervention strategies on empirical evidence predicated upon normative affordability standards. However, these normative standards have shown to superficially measure some variants of housing affordability stress (Seelig & Phibbs, 2006; Anthony, 2018). Researchers of diverse orientations have suggested several approaches for measuring

different variants of housing affordability stress. However, the main methodological challenge that has occupied researchers and planners for decades is the question of how to appropriately measure housing affordability, which is yet unresolved.

It is noteworthy to mention that a growing number of studies have advanced the conventional measures, and the scope transcends poverty measurement and mere economic considerations (Mulliner, et al., 2013; 2016). Therefore, if debates on housing affordability must be sought to address rising costs escalations, then the conventional definitions/concepts and traditional methods of measuring housing affordability must be re-examined. Undoubtedly, housing affordability must be viewed holistically concerning the overall ecosystem and should be responsive to sustainability issues (Arman, et al., 2009; Li et al., 2016). Regarding this, Haffer & Hulse (2019) in their study of 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.

In recent years, academic interest in housing affordability measurement approaches (HAMA) has increased extensively, and has seen an incredible amount of use. More so, their role in diverse application areas has grown considerably, mainly as new methods are developed and older ones improved. Several approaches have been developed in this field. Each approach, as suggested is unique, but conceptually very similar, since they are fundamentally formulated on household income and its relationship with housing price levels. However, small differences (such as the

inclusion of specific criteria like transportation cost, location efficiency, among others) make each class more appropriate for different applications.

Despite this intensive development worldwide, prior studies were not able to keep pace and little efforts have been made, to present the theoretical basis and developmental trends of various HAMA. Therefore, it is the conviction of the researcher that there is a need for a new qualitative inquiry about consolidating current studies undertaken in this field. No study has performed a systematic literature survey on the research trend and classification of studies in this area. This assertion is concretized by a recent study, which revealed the lack of rigorous, systematic reviews in the planning field (Xiao & Watson, 2019). Thus, this thesis attempts to fill this literature gap and aims to systematically review the applications of various approaches and concepts used in the measurement of housing affordability; as, put forward by researchers and scholars for planning purposes, with context-specificity of low and medium-income groups.

It is worthy also to note that scholarly interest in HAMA has grown as part of efforts to rectify perceived weaknesses in the widely accepted normative approaches (ratio and residual income methods) commonly used by architects and planners. A systematic literature analysis was performed, the purpose is to show how housing affordability measurement approaches and concepts have been used in the various housing affordability analysis over an 18-year period (2000 – 2018). It is demonstrated that the concept has evolved from its original meaning, which was focused on economic; to more dimensions incorporating social and environmental criteria. Most key authors have embraced this evolution and view the change as positive. More recent literature on housing affordability, particularly since the GFC Crisis, has begun to reframe housing affordability as an urban issue (Haffner & Hulse, 2019).

This thesis, therefore, documents the exponentially growing interest in housing affordability measurement approaches and concept. It provides the state-of-the-art survey of literature relating to housing affordability measurement methodologies and applications. The objectives are to present descriptions of identified measurement methods and the continuing discussion on their relative suitability as affordability measures. This thesis articulates the debate and highlights studies that have advanced the methodologies for measuring housing affordability. For instance, some researchers advocate for complete replacement of the normative measures and have either proposed or developed alternative methods (Cheong & Li, 2018; Mulliner, Smallbone, & Maliene, 2013; Mulliner, Malys &and Maliene, 2016) that account for their weaknesses (O'Dell, Smith & White, 2004; Jewkes & Delgadillo, 2010). Some argue for their continuous usage due to ease of application, global acceptance, and common-sense appeal (Nwuba & Kalu, 2018; Stone 2006a; Stone 2006b; Stone, Burke & Ralston, 2011; Yang et al., 2014). Others have modified these normative measures (Wegmann 2014; Luckey 2018). The research findings suggest that certain housing affordability measurement approaches are better suited for specific situations, while other applications should avoid certain methods entirely. Several methodological issues were observed in most of the articles studied, making it intricate to stipulate the precise pathways. This study arms architects, planners and early-career researchers with the prevalent methodological weaknesses and relative strengths inherent in each method. A reference repository has been established based on the researchers' classification scheme.

In continuation, housing is considered one of the essential social conditions which indicate the living standards of a country's citizens. However, due to rapid rates of

urbanization reported worldwide (Demographia, 2019), housing supply has always failed to satisfy demand (Gan et al., 2017). 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, in an attempt to better the living standards of the low- and medium-income households. However, affordable housing alone is insufficient to achieve family and community wellbeing (Talen & Koschinsky, 2011). In recent times, research findings on housing affordability have highlighted substantial relationships between fiscal, social and environmental factors (Nubi & Afe, 2014; Mulliner et al., 2013; 2016; Gan et al., 2017; Dave et al., 2017), regarding housing appropriateness, accessibility, amenity and adequacy (Cai & Lu, 2015). Consequently, embedding sustainability into the criteria contributing to housing affordability has been the call of recent studies on housing affordability (Ezennia & Hoskara, 2019a). 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.

1.1 Statement of the Problem

Housing affordability is one of the areas in housing studies that have received tremendous research attention in the past and recent decades. Although most households within the high- and medium-income segments of the urban populace enjoy acceptable housing facilities which would be considered luxurious, several other low-income households continue to face huge housing cost burdens rendering them into housing-induced poverty; poverty where households cannot afford any of the

other basic necessities of life after offsetting housing cost. This assertion is consistent with several studies on urban housing in Nigeria, which have demonstrated that there are very high levels of housing affordability problem and housing shortages among the low income segment, with about 3 in every 5 urban households experiencing such difficulties (Ndubueze, 2009; Aribigbola, 2011) and more than 60 % of the Nigerian population said to be homeless.

More so, the typical assessment approaches adopted by studies in Nigeria and government agencies in the estimation of housing affordability problem are fiscally focused. This has led to the continued under-estimation and/or over-estimation, as well as the misclassification of many households as experiencing or not experiencing housing affordability burden. Similarly, the typical definitions and concept of housing affordability in Nigeria have traditionally excluded the reference to the role of institutional agencies and government, to provide decent, adequate and affordable housing as the concept has been so constructed to focus on the perceived financial abilities of the household. This is a notable limitation, as it assumes that agencies such as Federal Housing Authority (FAH) are friction free institutions in the delivery of low-income housing and the un-affording households are the obstacle to the process. In addition, the approaches employed in addressing affordability challenges through the design and provision of affordable housing has also been economically focused. Thereby, neglecting or superficially addressing other dimensions of sustainability such as; the social, ecological and environmental dimensions; that impact on the lives of residents. For instance, the culture of the targeted populations, people's satisfaction of their current houses and residential environments, as well as their aspirations, choice, and preferences in future houses.

Incidentally, the adequate provision of decent housing that supports at least a minimum standard of living and meets affordability concerns of households is the core aim of affordable housing programs in Nigeria (Olotuah, & Taiwo, 2013). However, the housing affordability conditions of low-income earners, who incidentally make up the vast majority of the population in Nigeria, have not shown any substantial improvement over the past decades (Obiadi et al., 2019). Housing demand in Nigeria routinely outweighs supply, and reports show that over 40% of household income is spent on house rent by 85% of the urban population (EFInA/Fin Mark Trust, 2010). Studies have demonstrated that there is a profound inadequacy in the housing circumstances of Nigerians. The truth is that low income Nigerians expect that the few housing programs executed by government and the private sector, should possess certain criteria that recognizes their lifestyle (Muazu & Oktay, 2011).

Unfortunately, housing programs in Nigeria are characterized by lack of consideration of users' perception in determining which housing is affordable. The major indices that show why housing programs perform below household's expectation and need is the inadequate knowledge of changes in household's preference, choice and needs by industry professionals, housing providers and stakeholders. Studies have linked this lack of information to the dearth of studies in this field (Awotona, 1998; Ibem et al. 2013). This position has been worsened by the activities of government and industry professionals who propose and designed the existing housing units without considering the culture (lifestyle) and household perception.

Therefore, there is a need for housing developers and providers to improve the affordable housing programs, by using households' perception of needs and expectations, to assess the degree to which these expectations and needs are met. It is

imperative to determine housing affordability concerns by the consideration of user needs, values and expectations. A clear understanding and assessment of households' perception will offer salient information to issues of user reaction (i.e. how households behave and how they choose their house when confronted by housing affordability stress). This will resultantly lead to more informed decisions by policy makers.

In furtherance, Awotona, (1988), stated that 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 (Mulliner & Maliene, 2015). Where a developing country has been the focus of the study (Gan et al., 2017, Mukhtar et al., 2017; Olanrewaju et al., 2018) or part of the study (Adabre & Chan, 2019; Chan & Adabre, 2019) research has tended to concentrate on academicians, industry/housing professionals, housing providers 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. No study has surveyed the opinion of households (low, medium and/or high-income earners) on the importance of the criteria contributing to sustainable housing affordability; as propounded by housing researchers and scholars. Nevertheless, a criteria system must evolve from people's actual housing affordability experience since they bear the direct brunt of the housing affordability burden. At present, the

views and perceptions of households on the criteria representing sustainable housing affordability are not reflected in housing affordability literature. Presumably, the problems that low-income urban residents go through to meet their shelter needs are therefore not readily known by policymakers.

Thus, this thesis brings to the debate a different viewpoint — Households subjective perception. According to Yates et al. (2007), housing affordability can be assessed by 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. It is the researcher belief 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. It directly asked respondents if they consider their house affordable or not, as the qualitative and subjective measurements are checked against their financial position and other quantitative criteria. The study summarizes the subjective evaluation of households' perception of their housing needs concerning housing quality and condition, affordability dilemma, and overcrowding. It appears that no study on housing research had devoted interest in assessing households' subjective perception of the criteria representing sustainable housing affordability.

Currently, in the urban areas of Nigeria, low- and medium-income groups find it extremely difficult to afford decent and adequate housing. Many reside in both squatter

housing settings and former squatter housing settings, upgraded through urban transformation projects and improvement plans (Obiadi et al., 2019). With the aid of this understanding, the thesis intent is to demonstrate the context of housing affordability for a specific group (urban low- and medium-income earners). This thesis examines the perceptions of urban households residing in different regions of Nigeria, in an attempt to uncover the diversities when conceptualizing housing affordability within the same country. It reveals the similarities and differences in perceptions of urban households.

1.2 Aim, Questions and Objectives of the Study

The aim of this thesis is to explore the subjective perceptions of households on the evolving concept of housing affordability and the criteria system representing sustainable housing affordability, from economic, environmental, and social perspectives, for meeting housing need, choice and sustainable deliverability of housing that is affordable in the study area. To achieve the research aim, the following research questions has to be answered.

Main Research Question:

How have the various concepts and methodologies/techniques of assessing housing affordability as well as their various applications been used in planning affordable housing, over the last few decades? From this, the following six sub-questions emerge:

Sub-questions:

(1) What are the conceptual irregularities arising from the widely accepted definitions of housing affordability and what are the recent methodological discourses on the current worsening affordability trends across the globe and policy responses to quell them?

(2) Which HAM approaches have been used in over an 18-year period based on 6 domains/fields and what type of research has been performed regarding these approaches?

(3) To what extent does the wider dimensions of housing affordability indicators, as advocated by researchers and housing professionals, are being incorporated in the design and construction of affordable housing in the study area?

(4) To what extent is each criterion important based on household views?

(5) Do the opinions on criteria importance vary based on the respondent's income group (e.g., low or medium income)?

(6) Do household respondents residing in different regions in the study area have differing opinions on criteria importance?

The following objectives would be applied in order to achieve the aim of the study, and to answer the main and sub-research questions;

1) To track, through an extensive literature review, the extent to which housing researchers have advanced the concept and measurement approaches of housing affordability.
2) To present the descriptions of the identified methods and concepts, as well as the continuing discussions on their relative suitability as affordability measures; and to explore the extent wider dimensions of housing affordability indicators, as advocated by researchers, are being incorporated in the design and construction of affordable housing in the study area.
3) To identify a comprehensive list of criteria system through which housing affordability can be holistically conceptualized and sustainably assessed; and determine the criteria importance using households' subjective opinion.

4) To determine whether the opinions on criteria importance vary based on the participant's income group (e.g., low or medium income) and/or region of residence.
5) Lastly, to develop a framework for achieving sustainable housing affordability within the study area.

1.3 Research Hypotheses

The hypothesis is what the researchers predict the relationship between two or more variables are or represent, but it involves more than a guess. Many at times, the hypothesis begins with a question which is then explored through background research. It is only at this point that researchers begin to develop a testable hypothesis. Hypothesis explains what the researcher expects to happen during the course of the research. This research is guided by the postulation that:

Null Hypothesis (H_{01}): Is there any significant difference in the households' opinion on the evolving concept of housing affordability and criteria representing sustainable housing affordability based on geopolitical zones in Nigeria?

Null Hypothesis (H_{02}): Is there any significant difference in the households' opinion on the evolving concept of housing affordability and criteria representing sustainable housing affordability based on the respondents' income group in Nigeria?

Null Hypothesis (H_{03}): The wider dimensions of housing affordability indicators, as advocated by researchers, are presently being incorporated in the design and construction of affordable housing in the study area?

The answers to the analysis of the hypothetical statements and sub-questions will offer salient insight 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. In addition, it could aid suggest sustainable solutions which would help, stakeholders, government, and housing authorities in designing affordable housing programs.

1.4 Research Design and Methodology

A design is a general strategy for conducting a research. Research design is an outline of what the researcher intends to do, beginning from writing of objectives, hypotheses and its operational implications to collection and analysis of data. Therefore, the nature of the research hypothesis variables involved, and the constraints of the real world all contribute to the selection of the required research design. Considering the nature of the research questions and hypotheses of this study. The set of data needed for this study is both qualitative and quantitative in nature. Therefore, the most appropriate design for this study is a mixed research design approach. A mixed design approach, according to Bian (2011), focuses on collecting, analysing, and mixing both quantitative and qualitative data in a single study or series of studies. In this approach, Creswell (2003) opined that researchers may first survey a large number of individuals, then follow up with a few of them to obtain the specific information about the topic. Consequently, Bian (2011) and Creswell (2003), stressed that the key premises of using quantitative and qualitative approach, in combination, is to provide a better understanding of research problems than either approach alone.

Two different methods have been adopted within the scope of the study. On one hand, the theoretical part of the study has been developed through extensive systematic quantitative review of housing affordability related literature, as clearly illustrated in Chapter 3, Section 3.1 – 3.2.3. As a subject area, housing affordability measurement has a relatively long history, from 1970s through the 1990s, when the foundations of

modern measures were laid (see Hancock 1993; Stone 1993; Hulchanski 1995). Research and development on this subject have accelerated and continue to grow exponentially. A quick search for articles published after the year 2000 and with the keywords of "housing affordability measurement method, concept" and "application" yields more than 17,000 results on six major online databases including ScienceDirect, Wiley Online Library, Sage Journals, EmeraldInsight, Taylor & Francis Online, and Springer (see Appendix A). The large volume of literature demands a systematic review and classification to summarize the accumulated knowledge and develop future research agendas. The PRISMA methodology was proposed based on Moher et al. (2009).

Therefore, a review of 160 scholarly articles published in 47 academic journals indexed in Web of Science Core Collection between 2000 and 2018 was collected to achieve an extensive review on HAMA and their applications. Relying on experts' knowledge-based opinion, articles were classified based on the type of study (HAMA utilizing study, HAMA developing study and HAMA proposing study). Also, to evaluate the research trend of various HAMA, relevant articles was broadly classified into three categories according to frequency of usage and developmental trend. Under such classification framework, twelve (12) methods were identified from three approaches namely: (1) Conventional approaches (income ratio, residual income, composite method and econometric/regression modeling); (2) Scarcely used approaches (behavioral method, subjective method and location affordability index) and; (3) Emerging novel approaches (Scenario technique, Multicriteria decision making [MCDM] method, Data envelopment analysis [DEA]; Gini Coefficient method, and Mobility probability plot [MPP]).

Furthermore, six (6) application fields/domains, namely; rental housing affordability (RHA), home-ownership affordability (HOA), combined housing and transportation affordability (CHTA), housing and mortgage market affordability (HMMA) and individual household affordability (IHA) were identified with expert knowledge-based categorization; based on which, a database of common applications of various HAM approaches for different and specific situations were established.

On the other hand, an empirical analysis (as clearly presented in Chapter 5, Section 5.1 -5.3) has been developed to obtain solid data for case study, which is mainly based on questionnaire survey. Case studies are used when the researcher intends to support his/her argument by an in-depth analysis of a person, a group of persons, an organization or a particular project (Naoum, 2007). As the nature of the case study focuses on one aspect of a problem, the conclusion drawn will not be generalized but, rather, related to one particular event. This is not to say that the case study approach is of limited value. On the contrary, it provides an in-depth analysis of a specific problem. This exploratory study was designed as a case study in the 26 urban areas in the 6 geopolitical regions of Nigeria; which is the most populous nation in Africa. Thus, this thesis employed a combination of questionnaire survey (quantitative research) and qualitative research methods in a case study methodology, as presented in Figure 1 below;

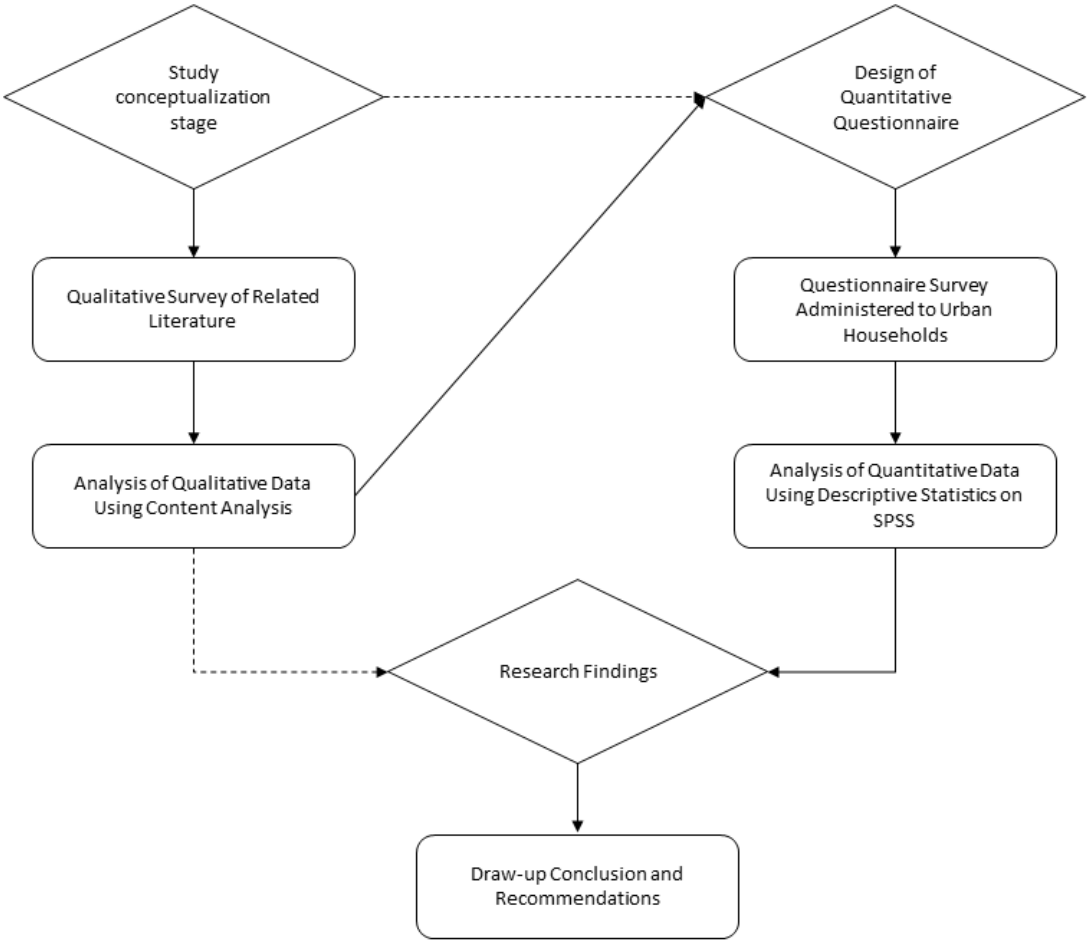

Figure 1: Protocol for the Mixed Methods Design

1.5 Research Scope and Delimitation

This thesis reviewed the various housing affordability research exploring the concept, debates, nebulous nature, weaknesses, trends and challenges in undertaking housing affordability measurement. This study neither aims to construct a new approach, nor to rectify the weaknesses in various approaches, but to track, through an extensive literature review, the extent to which housing researchers have advanced methodologically in innovating better alternative of HAMA. It also tracks the evolution of various measurement methods.

Although academic discussion on HAMA has been on for some decades now, this thesis focuses on the identification of common and recent approaches as well as concepts. A wide publication era was considered to reflect significant sources and historical materials that are relevant in forming the objective of this study. The time frame of this study was formerly within 2000 and 2017, but as a result of further reviews and feedbacks it was extended to 1981 and June of 2018. This timeline is synonymous with the development of measures for assessing housing needs, problems and the calculation of affordable housing areas; which are the hallmark of Millennium Development Goals (MDGs) Target 11 of Goal 7; which sets for measuring progress in housing conditions within, among other things, the structural, locational and neighborhood aspects of housing, security of tenure and sanitary conditions.

This exploratory research performed in this study was designed as a case study in the 26 urban areas in the 6 geopolitical regions of 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 the 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.

Currently, in these urban areas, low- and medium-income groups find it extremely difficult to afford decent and adequate housing. Many reside in both squatter housing settings and former squatter housing settings, upgraded through urban transformation projects and improvement plans (Obiadi et al., 2019). 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.

With the aid of this understanding, the scope of this thesis is to demonstrate the context of housing affordability for a specific group (urban low- and medium-income earners). This thesis examines the perceptions of urban households residing in different regions of Nigeria, in an attempt to uncover the diversities when assessing and conceptualizing housing affordability in a regional and national context. This thesis reveals the similarities and differences in urban households' perceptions and conceptions of their housing affordability situation.

1.6 Limitations of the Study

This thesis suffers some limitations which could be suggested as future themes for research.

1) This research focused on various applications of different HAMA. Article publications of late 2018, if any, were excluded in the literature review due to the limited reporting time. Future surveys should expand the scope even further.

2) This study equally focused on 6 domains/fields. Thus, future research can utilize this study as a basis for further classification of other sub-fields and sub-areas; such as residual housing affordability (Borrowman, Kazakevitch & Frost, 2017; 2015), price affordability, mass housing affordability, amongst others.
3) Another limitation was that information was obtained from high impact journals, excluding non-peer reviewed articles, textbooks, conference articles, master and doctoral dissertations, and unpublished studies relating to HAMA issues. Therefore, future studies are encouraged to collect data from these scholarly grey literatures and the results obtained can be compared with ours.
4) Another limitation was that selected studies were found in English language journals only, journal article publications in the other languages were excluded from this study. It could suggest that this survey is not complete; however, it is the researchers believe that most of the articles published in 47 high ranking journals were comprehensively reviewed and included. In this view, this survey provides a deeper understanding of HAMA and their applications for early-career researchers and planners. It is also hoped that this study be used by scholars as a basis for studies in further and by planners for making more precise decisions employing these approaches, and as a guide for researchers in enhancing HAMA.
5) In addition, due to manpower and time limitations, the researcher surveyed, only journal article publications of six (6) major databases. Though, some important outlets may be found beyond this study's scope. Hence, as a more comprehensive literature research, future reviews should cover other relevant databases. Finally, this study makes no pretense of covering all published

scholarly research on housing affordability measurement and application, which met the authors' inclusion criteria. It is possible that a few studies may have slipped or erroneously excluded. However, it is the belief of the research that this study extensively covers significant studies in this field of inquiry.

6) It is acknowledged that the study sample size is relatively small. This could limit the survey results representativeness. Therefore, future researches can improve the generalization and interpretation by employing 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.
7) Only the opinions of urban households were assessed. Future studies should consider the opinions of rural households to ascertain the urban-rural differences in conceptualizing housing affordability, since housing experience in the rural and urban settings are dissimilar.
8) The views of stakeholders, academics and industry professionals were not included in this report. It could be of international interest if further studies analyze households' opinions on CSPC representing sustainable housing affordability together with the views of academics, stakeholders and industry professionals. Furthermore, future research can study household preferences and compare them with our study results.

9) Another limitation was the application of online survey. Online distribution of surveys neglects audiences without computers; in addition, participants somehow are more educated (Dillman, Smyth, & Christian, 2009). Hence, this study barely captured the opinions of residents without computer or a smart phone; it marginally considered respondents with no form of education. This could be the reason for the negligible difference in respondents' opinions based on income group. Since, most low-income segment of Nigerian population cannot afford electronic gadgets like computer or phones with internet facility. Future studies are encouraged to consider this group of residents and compare their findings with ours.

1.7 Significance of Study and Research Contributions

By harmonizing a wide collection of research on this subject area over a relatively long period (18 years), this thesis makes a valuable contribution to architecture and planning research. The research output is valuable and offers guidance to architects, planners and early career researchers, for effective adoption of appropriate HAMA according to the nature of the problem, policy guidelines, planning objectives, and available data. This thesis offers key techniques used in HAMA-related literature to aid stakeholders in better assessing the nature of the housing problem in each market condition and the intervention strategies they propose. This survey provides recommendations for future research, and facilitates knowledge accumulation and creation. The study argues that informed application of an appropriate affordability metric in a specific context of housing affordability problem leads to better planning outcome. The best method thus, can be obtained by analyzing the various weaknesses and strength inherent in each method. However, the methodological framework and choices for evaluating decisions are still ongoing.

In furtherance, this research also 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 industry professionals and stakeholders because 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. The study also has the potential to contribute to the housing affordability literature practically, since it heeds to the call of two recent scholarly studies (Mulliner & Maliene, 2015 and Chan & Adabre, 2019) 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, housing providers and city planners in the design as well as the construction of better livable, sustainable and affordable housing settings in accordance with the expectations, preferences, choice and needs of urban households.

Furthermore, 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.

1.8 The Structure of the Thesis

Chapter 1: This chapter provides an introduction of the issues surrounding affordable housing delivery and the particular pressures faced by the Nigerian Government. In addition, this chapter presents research problem, the main research question, propositions, and several assumptions, methodology and methods; and as well outline the purpose of the research, its scope and the outcomes desired.

Chapter 2: This chapter discusses the Nigerian urban housing condition; it shows that over the years many urban areas are experiencing rapid and continuous growth, as people tend to migrate from rural areas to urban areas in order to better their living conditions. The chapter then identifies the Federal Governments' past and current efforts in mitigating housing problems and the challenges limiting those efforts.

Chapter 3: This chapter explores the concepts of affordable housing, housing affordability, and as well introduce a general conceptual framework to evaluate the general housing provision from the perspective of affordability. This framework is expected to help in the understanding of the problem from the angle of the households specifically in terms of their basic needs, choice and demand. It suggests possible solutions that can promote the development of affordable housing.

Chapter 4: This chapter introduces the research design used in collecting qualitative data for the literature review. It then presents the holistic evaluation of the measurement approaches of housing affordability. The evaluation of these approaches will be undertaken in two stages. Firstly, two stages of analysis will be presented in

this chapter. That is, to identify the approaches based on literature review and present the mathematical representations of the identified approaches. The second stage presents the applications of the identified measurement approaches used in accessing the actual affordability situation in the field. Due to wider applications of HAMA in the real affordability problems, there is a need to classify these applications across several domains/field. This is important because wrong application of HAMA has been linked as one of the problems fueling the unabated problems of housing affordability experienced worldwide.

Chapter 5: This chapter discusses the criteria system for sustainable housing affordability based on the research findings of Chapter 3, obtained through an extensive systematic quantitative review of housing affordability related literature.

Chapter 6: This chapter presents the research context, which deals with the research design, the methodology or theoretical perspectives and the methods or tools used in the process of data collection. It explains the stages of data collection beginning with the pilot study phase to the actual study phase. The chapter discusses the case study research methods, data collection strategy where qualitative and quantitative data are collected in sequence, analyzed, interpreted and presented as findings. The said data is analyzed separately, however, would be mixed at the interpretation stage where the qualitative data will anchor with the numerical data. This chapter also deals with the data analysis and presentation of the study results. As well as the discussions and findings of the data collected.

Chapter 7: It presents the findings and discussions, from which the study drew general conclusions and recommendations, as well as provide an insight into the scope for

further studies. Recommendations and framework for the practical implementation of the policies that would advance sustainable affordable housing development in Nigeria is also presented in this chapter.

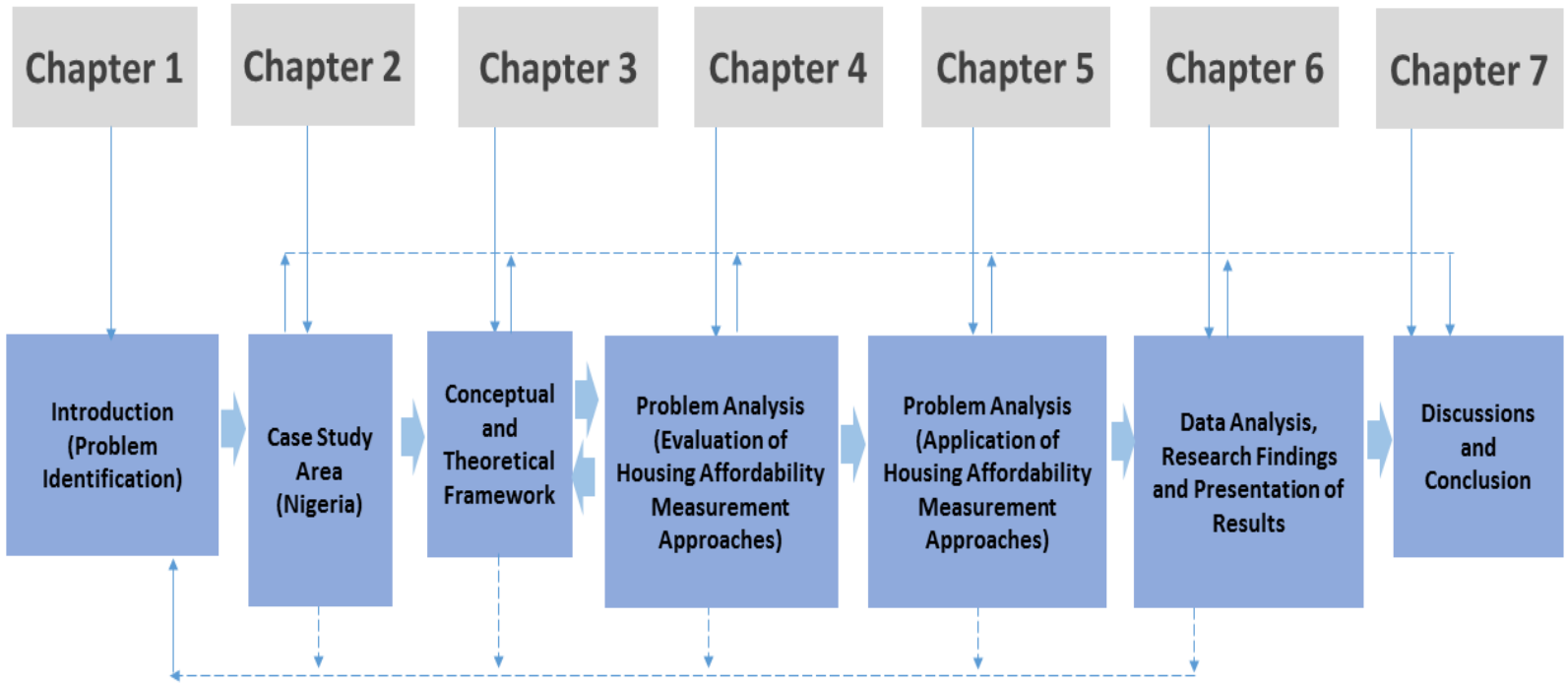

Figure 2: Thesis Structure

Chapter 2

STUDY AREA

This thesis 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, like other developing countries, is faced with increased rate of urbanization, with different urban areas emerging as a result. There are both positive and negative impacts of urbanization on the nation. Apparently, the negative ones outweigh those that are positive, and the former affect the urban populace than the positive variables. Nonetheless, most of them are hinged on the housing deficit which keeps increasing because it is not affordable to majority of the population. Hence, it has been identified that is pertinent to ensure the availability of affordable housing by giving a better commitment and attention to the delivery of housing facilities that are affordable and accessible to Nigerians, especially those within the no-income, low-income and lower medium-income groups. This chapter articulates the affordable housing situation in Nigeria.

2.1 Case Study: Nigeria

Nigeria sits on an area of 356,669sq mile (923,768sq km) with an estimated population of 190.9 million people (World Development Indicators, 2019), 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 Ofem, 2012). 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, (2012) 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 (Weeks, 2010). 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. The 26 urban areas in the 6 geopolitical regions of Nigeria as shown in Figure 1 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.

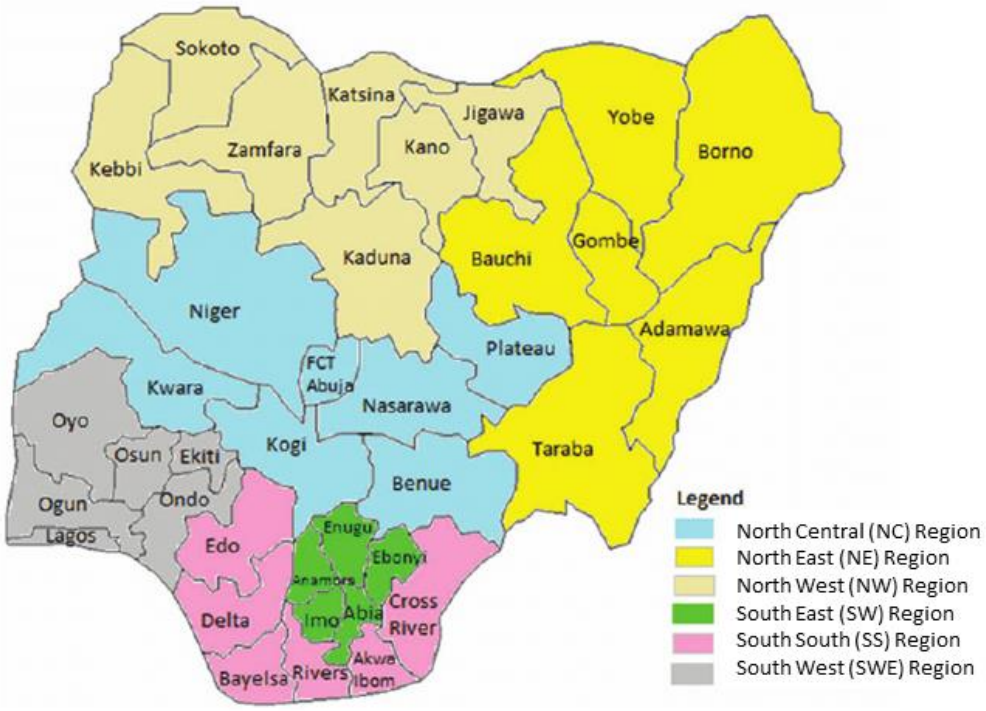

Figure 3: Map of Nigeria showing the 6 Geopolitical Regions and the 36 States and Federal Capital Territory (FCT).

Furthermore, Figure 2 shows the regions in Nigeria, where the respondents were drawn from. To provide some background to Figure 2; North East region comprises of 5 states (Bauchi, Adamawa, Gombe, Borno, Yobe and Taraba) and covers about one-third of Nigeria's total area. The major tribes are Fulani and Hausa whom are predominately Muslims. The North West region showcases a variety of Islamic beauty and culture. It covers six states (Jigawa, Katsina, Kaduna, Kebbi, Zamfara and Sokoto), and largely consists of Hausa's and Fulani's. North Central region consists of seven states (Kogi, Benue, Nasarawa, Kwara, Plateau, Niger and Federal Capital Territory) situated geographically spreading from the west, around the confluence of the River Niger and the River Benue. This region is characterized by its lack of clear majority ethnic group, the eminence of manifold minority groups, to some degree, constitutes an ethno-linguistic barrier and draws a separation between the principally Islamic North and the mainly Christian South.

Before the colonial British government, the South East region housed several ethnic groups like the Igbo, Ibibo, Ijaw and Efik which are known for their democratic systems of government and many kingdoms. Presently the region consists of Abia, Anambra, Ebonyi, Enugu and Imo. The local language is Igbo and the people are predominately Christians. The South West region has six states (Lagos, Ekiti, Ondo, Ogun, Oyo and Osun) and Yoruba is the dominant language in the area. The South-South region consists of six states Bayelsa, Akwa-Ibom, Delta, Cross River, Rivers and Edo. The region is rich in oil and provides the economic mainstream of the country.

2.2 Urban Development in Nigeria

Prior to the colonial era, Nigeria had several cities of different sizes and importance. Examples of such cities are Lagos, Ibadan and Ilorin, in the south western region (see Figure 4), Kano and Zaria, in the northern part, and Onitsha and Aba, in the eastern area (see Figure 5), as well as Port Harcourt and Calabar in the south. The aforementioned are all with their distinctive socio-cultural identities even as they are locations occupied by the three major ethnic groups in Nigeria, plus the southern sub-ethnic group, respectively. The rate of movements of the people from rural areas to the cities during this era was low, as majority concentrated on agricultural occupation. In the post-independence era, starting from 1960, people in Nigeria kept migrating at an increasing rate from the rural areas to the urban areas in pursuit of better living conditions. Like every other nation of the world, the migration has been causing rapid and extensive growth in the urban areas. The urban population in Nigeria has grown from 6.9 million, 15.4% of the total population of 45 million in 1960 to 99.9 million, which is 48.9% of the total population of 195.8 million today.

Figure 4: The City of Lagos in the South-western Nigeria

Consequently, many more towns such as Akure, Osogbo, Bauchi and Sokoto have emerged, and they are fast turning into urban areas due to explosion induced by migration, both in numbers and sizes. Lagos, the former capital city, still remains the most urbanized city despite the movement of the country's capital to Abuja. This may not be unconnected to the fact that Lagos still remains the commercial capital for Nigeria.

Figure 5: The City of Awka in the South-eastern Nigeria

2.2.1 Urban Housing Situation in Nigeria

Recent studies have estimated that 200 million urban households in Asia, Latin America, and Africa are ill-housed and Nigeria experience the biggest numbers of households living in substandard housing (Woetzel, et at., 2014). Several studies demonstrated that, there is a profound inadequacy in the housing circumstances of Nigerians. Housing demand in Nigeria outweighs supply, and research evidence shows that 85% of the urban residents spends more than 40% of their income on house rent (Olotuah & Aiyetan, 2006; EFinA, 2010). The housing conditions of the low - income segment, who by the way make up the vast majority of the population in Nigeria, have

not shown any substantial improvement over the past decades (Olotuah & Taiwo, 2013; Obiadi et al., 2019).

Nigeria's urban housing problems manifest in overcrowding, slum housing and the development of shanties in virtually every major Nigerian city (see Figure 5a below). The housing problems vary from inadequate quantity and quality of housing to the attendant impact on the psychological, social, environmental and cultural aspects of housing. Housing is capital-intensive and for this reason, the cost of adequate housing is beyond reach for the majority of Nigerians.

Figure 5a: Typical Slum Dwellings in Nigerian Cities

The rate of expansion in public services and infrastructure of cities in Nigeria is low when compared with the rapidly growing population, which results in great strain on urban facilities (e.g. Public housing estates) and immediate collapse in many occasions (Daramola et al., 2005). Studies have demonstrated that poor housing as well as housing dissatisfaction of urban residents has serious adverse effects on the health and

the built-environment (Lanrewaju, 2012; Ihuah et al., 2014), resulting in delinquency, poor health, stress, maladjustment and pathological conditions amongst urban residents (Ukoha et al., 1997), and sometimes social and even political unrest (Omole, 2000).

2.3 Federal Government Intervention on Urban Housing Problems

A total of 618,498 housing units was intended for construction in the different public housing programs nationwide between 1960 and 2015. However, 85,812 of such housing units were constructed, which is 14% of the total planned housing units; as illustrated in (Table 1). This lowly implementation level demonstrates governments' lack of commitment in addressing urban housing problems; as well as the number of housing units proposed in the various public housing programs it initiated between 1960 and 2010 fail far below the targeted number. The resulting implication of this failure is that an estimated 70% of Nigeria's 60 million urban dwellers reside in shanty towns (Adewale, 2011). However, to address this awful housing situation nationwide an estimated 700,000 housing units are required annually (Olotuah, 2010).

According to UN-Habitat 2006 report on Nigeria, while focusing on affordable housing provision and supply, stated that previous public housing policies and schemes were designed to enable medium and low-income earners increased access to decent housing at affordable rates. The 2002 New National Housing and Urban Development Policy (NNHUDP) advocated that on no account shall any household be expected to pay above 20 percent of their monthly income on housing (Aribigbola, 2008). However, many studies have demonstrated clearly that previous public housing schemes in Nigeria failed to assist the targeted population (Ibem, 2010); largely because of the high cost of housing units provided (Iwuagwu & Iwuagwu, 2015).

Resultantly, many studies have argued that the challenges in accessing housing inputs such as land, finance and building materials; in addition to the burden of providing infrastructure, were also responsible for the cost escalation of public housing units beyond the grabs of an average household in the country (UN—Habitat, 2006; Aribigbola, 2008).

Table 1: Federal Government Housing Programs and Implementation Level in Nigeria (1960- 2019).

PERIOD	PROGRAM	IMPLEMENTATION/PERCENTAGE
1971 – 1974	To construct 61,000 housing units.	500 Housing units were constructed, representing less than 1% of the planned units.
1975 – 1980	To construct 59,000 'low-cost' housing units nationwide.	7,080 housing units were constructed, representing 12% of the planned units.
1981 – 1985	To construct 202,000 'low-cost' housing units nationwide.	30,000 housing units were constructed, representing less than 15% of the planned units.
1986 – 1999	Phase 1: To construct 160,000 housing units, for the low - income segment. Phase 2: To construct 20,000 housing units, nationwide.	Phase 1: 47,234 housing units were constructed representing about 23.6% of the planned units. Phase 2: Interrupted by the military coup in 1983
1999 – 2010	To construct 121,000 housing units on Site- and-Services housing program	5,500 housing units were constructed representing less than 5% of planned units.
2011-2015	To construct 10,271 housing units via the Public- Private Partnership (PPP) arrangements in different PPP housing programs, nationwide. To construct additional 500 housing units in the Presidential Mandate Housing Program, nationwide.	2,000 serviced plots through the PPP site and service in Ikorodu, Lagos. 4,440 housing units completed in Abuja, Port Harcourt, Akure and Abeokuta, through PPP. The Presidential Mandate Housing Scheme was not implemented in many states. 100 housing units were constructed in Ogun State, representing 20% of the planned units.

2015-2019	Phase 1: To provide 40 blocks of housing units, nationwide; leading to the potential delivery of 12 flats per block and 480 flats per state, subsequently providing 17,760 flats nationwide.	Yet to kick start

Source: Adopted from (Ali, 1996; Kayode, 2001; Ajanlekoko, 2002; UN-HABITAT, 2006; Olotuah, 2010; Makinde, 2015; Ezennia & Hoskara, 2019b).

The Federal Government of Nigeria's housing policy stipulates that interested citizens should have access to safe, decent and healthy accommodation at affordable cost. However, as part of government's effort to provide adequate and suitable shelter for the citizenry, she went into subsidized housing provision initiative (Obeng-Odoom, 2009). These types of housing are government owned and operated, although some are managed by subcontracted private agencies. They are financed, constructed and allocated by the state, usually for the low-income populace. Affordable housing provision has remained top on the agenda of the Nigerian government. However, there is a deficit of 17 million housing units in Nigerian urban centers (Geissler, et al., 2018). To date, millions of urban poor reside in inadequate housing despite a host of government interventions, because of shortages and poor distribution. A clear understanding of the household' choice will offer new insight into these problems. According to Olanrewaju & woon, (2017), the most likely problem triggering the imbalance between the demand and supply of affordable housing, is the inability to reconcile households' choice and supply.

2.4 Challenges in National Housing Policies

The country's national housing policy challenges are enormous; many of which include inadequate empirical research, implementation, and limited studies on the execution and formulation of the policy, poor funding, building industry skilled

manpower shortage, insufficient infrastructural amenities, as well as lack of effective housing finance (; Aribigbola, 2006; Fadiye, 2005; Akeju, 2007). Other issues include high rate of urbanization and rural-urban migration, ineffective planning, availability of dilapidated houses, development of shanty towns, as well as high cost of building materials. In spite of the housing policy, the problems of housing are witnessed both in urban and rural places. Housing problems in urban areas are caused majorly by rural-urban migration. The problem is also compounded by natural increment in population. Worse still, the effects of the housing policy are not felt in the rural areas. Rural houses are of generally poor condition, and they are characterized by lack of potable water, toilet and decent environmental condition. Land is the most essential of all the ingredients of housing scheme. It is a major input into housing and housing policy. In spite of this, the cost of land is very expensive in all Nigerian cities. The problem is also escalated by bottlenecks in the processing of certificate of occupancy (C of O) as well as approval of building plan. Other lapse of the housing policy lies in the area of environmental management, social integration, as well as urban security and governance. Above all, the policy is faced with the challenge of ever-changing socio-economic and political circumstance in the country. Another challenge that is facing the national housing policy is its inability to address the quantitative and qualitative housing problems. A major factor that is responsible for housing shortage in terms of quality and quantity is the ever-increasing demand that cannot be met by supply (Ezennia & Hoskara, 2019a). The inability of the supply of housing to meet the ever-increasing demand is caused by its immobility. All of these impede the performance objective of the various National Housing Policies.

Chapter 3

THEORETICAL AND CONCEPTUAL UNDERPINNING OF THE STUDY

Understanding housing based on what it does for the people rather than what it is, is intrinsic to successful prevention of affordability problems. This chapter discusses the major concepts in housing philosophies which have been implemented into practice. It began with a brief account of the evolution of thoughts underpinning public housing provision. From housing as a leverage, empowerment, for the people to housing as a form of welfare for the vulnerable. This understanding helped in the development of a conceptual model of how to make logical sense of the relationship among variables or factors that have been identified in literature as essential to the problem under investigation.

3.1 Theoretical Basis of Public Housing Provision

In any society, two theoretical constructs underpin the provision of housing. These are housing as a leverage, empowerment, for the people and welfare for the vulnerable (Makinde, 2014; Harvey, 2005; Rapoport, 2001). In the first instance a radical idea towards housing is upheld in which the provision of housing is perceived as an approach for achieving social responsibility. In this view, shelter becomes a natural right of which people have entitlement to and that is bestowed on individuals for being a citizen of an independent state (Harvey, 2005). This approach is basically a Marxist laden technique which is associated with the housing provision as a state duty and the retention of labor pool at a minimum cost. This approach tilts in the direction of the

economic equality realization and welfarism. Housing as an instrument of welfare possess the capacity of improving social status and health well-being of individuals (Bloze & Skak, 2012). The motive of the welfarists could possibly be the basis for the interest of government, during the pre-independence Nigeria, in housing provision for its workforce and the promises of politicians to provide housing for the poor in the post-independence era (Aliu et al., 2018). The issue of housing, by the second republic, had become political such that a governments success or failure is linked to the extent it delivered affordable housing to the populace. Perhaps, the welfare approach is the supposed reason public housing provision has remained central in the manifestoes of politicians in Nigeria for decades.

The liberal approach is the second theoretical construct of housing provision, which sees housing as an economic product that has powerful connection with the market, community, and the state. Thus, imperative in the advancement of economic development of a society (Makinde, 2014; Rapoport, 2001). Therefore, provision of housing is perceived as an act undertaken with the sole intent of accumulating capital (Adams, 1986). The government's role in this context is to ensure an enabling environment that guarantees great deal of housing market accessibility. Therefore, the liberal system stresses the essential socio-cultural issues of identity, opportunity, security, ability to pay, and participation (Rapoport, 2001). This understanding of housing as a cost dependent product leads to the idea that housing development must be undertaken by both the government and the people. Thus, it could be seen from a theoretical lens that housing provision involves both the private and public, and is a fund requiring product. Generally, housing is a booming complex market whose production, demand, management, and maintenance, comprise market-based activities (Makinde, 2014; Wakely, 2014).

Globally, provision of housing is usually undertaken by a tripartite framework involving the government, the private organized sector often referred to as developers, and the individuals (Sule, 1981; Mabogunje, Hardoy, & Misra, 1978). According to Aliu et al., (2018) developers and individuals constitute the informal housing sources, while the government or public housing form the formal housing sources. Studies in urban research have always documented the role of housing in urban sustainability and has been engulfed with the frameworks and policy debates that promote mass housing provision to most urban residents. Nevertheless, as a result of low performance of housing policy in developing countries, urban public housing continues to remain an illusion. For instance, in Nigeria public housing has steadily suffered inadequacy both in quality and quantity (Ezennia & Hoskara, 2019b).

However, for many reasons housing adequacy is very crucial to humans. Not only does it provide covering against the weathers buffeting elements, it is also an indicator of social status in a community (Aribigbola, 2008; Mabogunje, Hardoy, & Misra, 1978; Rapoport, 2001). According to Adams, (1986) housing is also crucial in economic development and capital accumulation by individuals and communities. Regarding this criticality of housing in human life, it is therefore essential to see to all inputs into the housing provision dynamics and maintenance. In advanced countries, the housing dilemma have relatively been addressed in comparison to developing countries where reports have shown little progress.

3.1.1 Meaning and Definitions of Housing Affordability

The phrase “housing affordability” (HA) is polysemous 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. Housing affordability has become a multi-faceted phrase (Mulliner & Maliene, 2014) 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 (Aribigbola, 2011, Makinde, 2014). 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 (Taltavull & Juárez, 2012).

Table 2: Selected Key Definitions of Housing Affordability based on Literature

References	Focus	Definition
Howenstine, (1983)	Economic	Households ability to acquire decent accommodation by the payment of a reasonable amount of its income on shelter
Maclennan & William, (1990)	Economic	Affordability is about securing some prescribed housing standard (or different standards) at a cost (rent or price) which exerts no unreasonable burden on household incomes, according to any third party (mostly the government).
Bramley, (1990)	Economic	The ability households to occupy housing that meets socially acceptable standards of adequacy, considering household composition (size and type) at a net cost which allows them sufficient income for survival without plunging them below some poverty standard.
Whitehead, (1991)	Economic	Focuses on the housing expenditure-household income relationship, and thus seek to design, a measure that can establish what amount of rent spent on the housing that is considered affordable.
Hancock, (1993)	Economic	Affordability is about the concept of opportunity cost of housing, what is forgone in order to secure housing and if that which is

		forgone is unreasonable or moderate in some sense.
Thalmann, (2003)	Economic	Households are experiencing affordability burden, if the cost of housing displaces excessively other expenses.
Burke & Ralston, (2004)	Socio-economic	Affordability describes the ability of households to meet the costs of housing, while there is the possibility of maintaining other basic expenses.
Stone (2006a)	Socio-economic	Housing affordability is the articulation of the challenges that confront households in balancing the actual or potential housing cost, as well as the non-housing expenses, within the limits of their income.
Leishman & Rowley, (2012)	Socio-economic	Affordability is a broad concept that is concerned with housing appropriateness and standards, as well as social and neighborhood issues, in addition to economic participation.
Mulliner, et al., (2013; 2016)	Social, Economic & Environmental	Affordability is comprised of some broader and more sustainable perceptions of wide-ranging criteria such as economic, environmental and social aspects that affect households.
Minchenko & Nozdrina, (2017)	Social, Economic & Environmental	The housing affordability concept should receive both social and economic content, in addition to the ecological content.

3.1.2 Conceptual Irregularities in Housing Affordability Definitions

Earlier attempts by researchers to define housing affordability were characterized by diverse interpretations which focused primarily on the economic dimension; as illustrated in Table 2 above. For instance, Howenstine's (1983) interpretation of housing affordability as an 'unreasonable amount' was faulted by Maclennan & William, (1990) whose definition, though clarified the question of 'unreasonable amount' but their concept of a 'given standard of housing' and 'unreasonable burden' was also not comprehensive. Hancock's (1993) introduced the concept of opportunity cost. This implies trade-offs made by households in order to afford housing cost and

whether such trade-offs are reasonable or excessive. The weakness in the concept of opportunity cost is that it created an understanding of housing affordability that does not imply any form of measurement approach.

Only a few studies attempted to distinguish the housing affordability concept from its measurement approach. A very clear example is the views of Chapman (2006), who opined that housing affordability is the measure of the financial outcome of outright purchase or renting a house. Recently, researchers began to see the need to consider other non-monetary dimensions into the definitions and measurement approaches of housing affordability. For instance, Leishman & Rowley (2012) posited that housing affordability is comprised of housing standards and appropriateness, as well as social, neighborhood issues and economic participation. However, Rowley & Ong (2012) questioned the extent to which neighborhood quality is addressed when evaluating the appropriateness of affordable housing with regards to cost.

3.2 Distinction between Housing Affordability and Affordable Housing

One definition of 'affordable housing' is; that housing, which does not subject the owner or occupier into mortgage stress (Aurand, 2010). Practical definitions of what is deemed as affordable housing are often specific to the program context and/or policy in which they are applied (Abelson, 2009). However, they share some fundamental characteristics, such as; a belief of what comprises affordability and a reference to the targeted group(s) for whom it is intended (Marquis & Ghosh, 2008). Provision of affordable housing is aimed at poverty reduction, hence connecting affordable housing provision to the concept of housing affordability (Cheong & Li, 2018). The main difference in comparing housing affordability and affordable housing lies in the fact

that housing affordability approaches the problem from the demand point of view, while affordable housing addresses it from the supply side (Napoli, 2017). Therefore, affordable housing in most cases emphasize the activities and perceptions of stakeholders such as industry professionals, developers and government agencies in improving capability and capacity of affordable housing production, which usually lead to the relative neglect of the demand viewpoint. However, housing affordability is mostly associated with households and examines the ways vulnerable members of the society are disenfranchised from the enjoyment rights of housing. Consequently, the assumptions, perceptions, concepts and criteria system for housing affordability may slightly differ from that of affordable housing.

3.3 Housing Affordability Concept – Weaknesses and New Understanding

Indeed, the debates, concerns and opinions about the housing affordability concept reflect the different assumptions and priorities of researchers with different orientation. For instance, economists mostly prioritize clarity of concept, utility, and objectivity (Quigley & Raphael, 2004), while sociologists usually focus on social inequality concerns and the research capacity of housing affordability to cover actual experiences of household housing stress (Stone, 1993). Architects are focused largely on providing savings and cost reductions in both upfront costs and the ongoing cost of occupation (Ken Maher, 2017). Such diverse academic orientation led to the revelation of the weaknesses in the conventional measurement approaches, and arguments in support of methodologies that better reflect the concept of HA.

However, there are no generally agreed standards by which it is conceived or measured. Thus, international housing policy documents of most countries adopt the

'rule of thumb', advocating that 30 percent or more of household income should be spent on housing for it to be considered affordable (Napoli, 2017). This notion is usually propagated without any recourse to household composition, size, housing quality or neighborhood characteristics, income levels, age groups and location. Therefore, the 30% affordability standard as a qualifying ratio is flawed. But it has remained the reference point for housing policy's purposes; for instance, in allocating housing vouchers, low-income tax credits, stamp duty concessions and grants.

The most common weakness in the housing affordability concept is its insensitivity to the effect of housing supply; and neglect for people's heterogeneous behaviors within the same income group. This is consistent with Stone et al., (2011) assertion that the HA concept must be founded on the interaction flanked by households and their houses. The authors maintained that affordability is not an innate attribute of the house and its measurement must not depend upon house price and income alone; owning that an affordable house could be different for each individual. Therefore, it suggests that in measuring affordability the approach applied must significantly capture each human variable that describes such relational concept.

3.4 Adopting Sustainability Principles into Measurement Criteria of Housing Affordability

Recent studies are starting to consider wider dimensions of the criteria that induce housing affordability problems and have advocated that housing affordability assessments should address more sustainable and wide-ranging criteria such as economic, environmental and social aspects that affect households (Mulliner, et al., 2013; Minchenko & Nozdrina, 2017). This implies that a broader range of quantitative and qualitative criteria must be accounted for, towards achieving actual housing

affordability. These include, but not limited to, social wellbeing, neighborhood and location issues. In addition to sustainability and health concerns, housing standards and appropriateness, housing market, transportation cost, households and their quality of life as well as political criteria (Fisher et al., 2009; Rowley & Ong 2012; Isalou, et al., 2014) instead of exclusively focusing on income and housing price as the prime determinants. Congruently, it is essential that both sustainability and affordability issues are tackled simultaneously in the measurement approaches used in housing affordability analysis (Mulliner, et al., 2016). These are illustrated in Figure 6, a model for understanding the evolving concept of housing affordability.

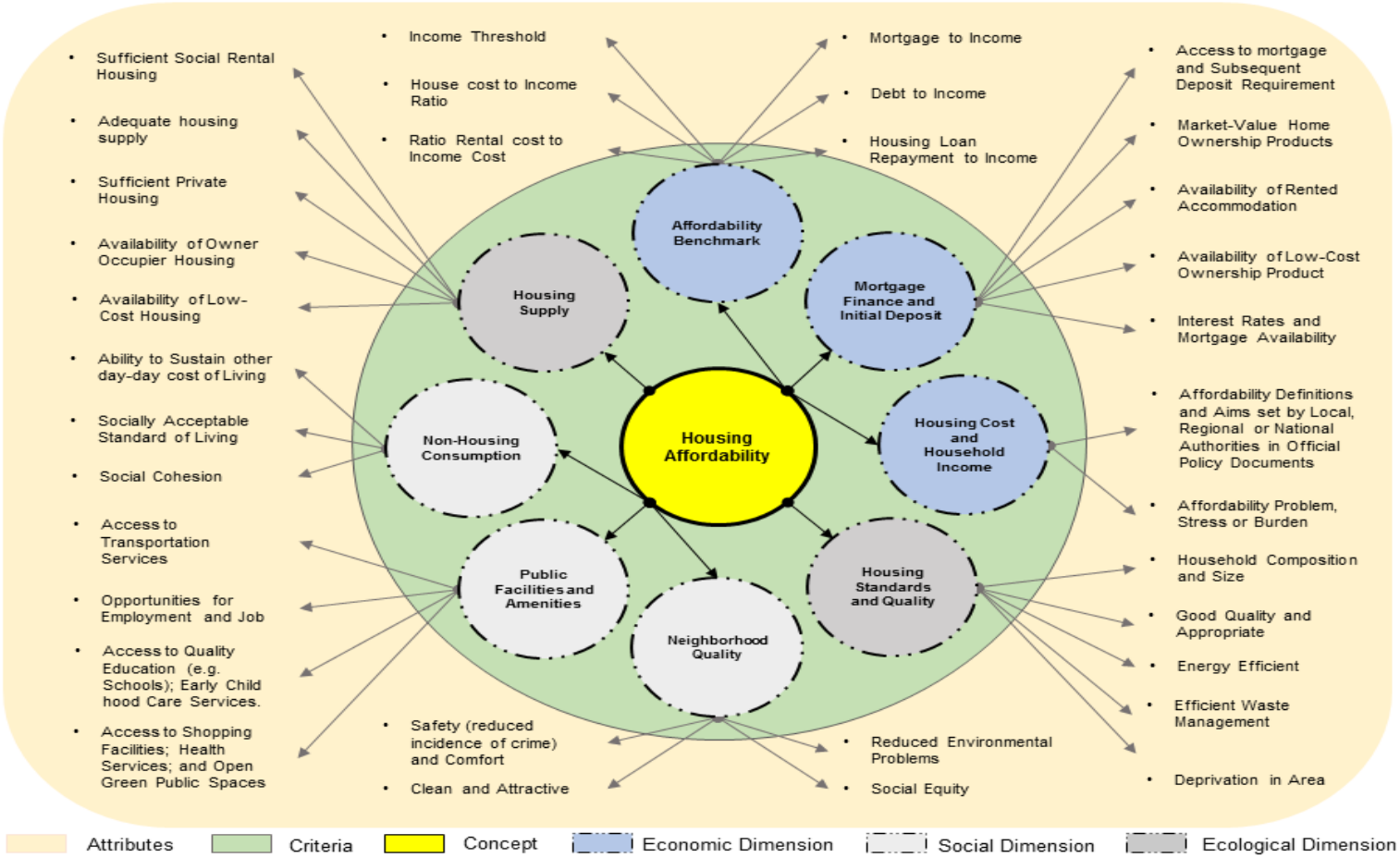

Figure 6: A conceptual Model for Understanding the Housing Affordability Concept.

3.5 Current Affordability Trends and Weaknesses in Policy Responses

Recent discourse on housing affordability are focused on whether meager income and/or issues of housing inadequacy trigger housing affordability problems. For instance, as shown in Table 3, Americans (US) public policy is guided on the perception that housing affordability issues are problems of poverty (Desmond, 2018), and inadequate housing triggering a 3 % worse-case needs (HUD, 2011). Hence, solutions have been addressed on the side of demand policies, such as eliminating regulatory barriers. However, merely removing regulatory barriers might be of limited benefit to low-income households, supposing that housing developers continually focus on luxury houses (Dong, 2018).

In nearly all countries of Europe and the United Kingdom, policy framings are based on concerns that housing affordability problems are caused by insufficiency of affordable housing supply; and that the lower income households suffer affordability stress the most, even though they pay for cheaper houses (Cox, 2018b). Therefore, have sought solutions on the supply side with increased housing provision, and development of urban planning to ensure that housing supply respond better to changing demands (Dewilde, 2018). However, the over dependence on the private sector to supply more housing units weakened the potency of the policy changes; coupled with the adoption of America's (US) "demand-side" policy which did not exert meaningful impact to reverse the UK's worsening volatile housing prices, nor improve overall affordability (Poon & Garratt, 2012), that is occasioned by demand pressure through in-migration (Dewilde, 2018).

In China, the major causes of high housing prices may not necessarily be the problem of demand and supply, rather fiscal and financial problems. Hence, policy framings are geared towards the restriction of housing purchase (Li, et al., 2016). However, uncertainty still blights the appropriateness of such policy on the Chinese housing market since its implementation, with some researchers arguing against it, noting that it was not founded on the main reasons for high housing prices, and shrinks trade volume in housing market (Yang, 2017); while others argue in its favor, noting also that it decreased the growing levels of housing prices (Li, et al., 2016).

Similarly, in Turkey and almost all developing countries, policy responses are predicated upon the fact that housing affordability dilemmas are issues of inadequate funding and access to finance. Solutions have been sought on reforming policy frameworks to encourage access to homeownership, taking into account that running cost affordability may be problematic for many low-income homeowners (Sarı & Khurami, 2018, Nwuba, et al., 2015).

In the Nigerian context, fiscal policies border on increasing governmental spending only (Nwosa, 2017). This implies that more money is available to households and therefore, households have a leveraged purchasing power. More income for households would mean that, affordability would also rise proportionately. However, the weakness in this policy response is that it does not guarantee affordability as various stakeholders in the financial sector could hit back through trade and exchange rate fluctuations, thus resulting in the continued weakening of the Nigerian currency's purchasing power, as with the Turkish currency.

The worsening housing affordability problems experienced across the globe seem to defile solutions. Many of the policy responses discussed above failed to address the issues for which they were enacted. This could be attributed partially to hastily affordability analysis founded on the conventional measurement approaches. An ill-defined and poorly measured affordability dilemma will always lead to inappropriate policy response that may have little or no effect in ameliorating affordability stress suffered by residents. Therefore, considering several dimensions (rather than just economic) in the measurement approaches of the criteria that influence affordability burden could perhaps be a major step in tackling this ever-growing monster.

3.6 Chapter Summary

This chapter discussed the major concepts in housing philosophies which have been implemented into practice. It presented a brief account of the evolution of thoughts underpinning public housing provision. From housing as a form of welfare for the downtrodden to housing as an empowerment, leverage for the individuals. This understanding helped in the development of a conceptual model of how to make logical sense of the relationship among variables or factors that have been identified in literature as essential to the problem under investigation. Hence, this Chapter argues that understanding housing based on what it does for the people rather than what it is, is intrinsic to successful prevention of affordability problems.

Table 3: Summary of Key Policy Responses of Selected Countries and their Attempts in Addressing Worsening Housing Affordability Problem

Perceived key triggers of housing affordability problem	Orientation of affordability Policy (Solutions sought)	Key Housing policy initiative	Enactment Date	Country	Major weaknesses in the policy strategies
• Poverty. • Limited housing supply. • Lack of decent quality affordable housing. • Lack of sufficient rental housing for low-income populace. • Housing market volatility and changes in income distribution. • Changing regulatory regime that impedes large-scale development in expensive locations. • Not as a result of declining availability of land.	• Solutions sought through the side of demand policies. • Removing regulatory barriers. • Encouraging infrastructure investment. • Self-Help approaches. • Encouraging access to affordable housing, for both owners and renters. • Restructuring assistance for the homeless. • Changes in the regulations of housing supply.	Low Income Housing Tax Credit (LIHTC) HOPE VI Program Housing Choice Voucher (HCV) program Hardest Hit Program	1987 1993 1998 2010	USA	• Removing regulatory barriers alone might be of limited benefit, if the focus of housing developers is fixated on developing luxury houses. • Current federal expenditure on housing is weakly targeted, because of huge amounts it spends on the mortgage interest deduction, which essentially profits the wealthy homeowners. • Current political will in allocating significant new resources to check this dilemma is extremely weak. • Rents in housing financed with tax credits are fixated to a given sum, so the percentage of income paid on housing by tenants may increase if their incomes decline and could spend over 30 percent of their income on rent. • The normative policy agenda ought to focus on better understanding of the benefits of limits and costs of new construction.
• Insufficiency in affordable housing supply. • Demand pressure caused by in-migration. • Affordability brunt is borne more by the low-income households. • Failures of housing market occasioned by pro-market reforms.	• Solutions sought through the side of supply policies. • Increasing new housing supply. • Urban planning development • Making supply of housing more sensitive to market conditions.	Housing Green Paper Sustainable Communities: Building for the Future Starter Home Initiative	2000 2003 2015	UK	• Marred by the over dependence on the private sector for the provision of additional housing units. • Wrong adoption of America's "demand-side" policy. • Higher income tenants occupy some of the cheaper housing targeted by tax credits, and this weakens the policy rationale for such supply-side measures. • New build cannot totally address housing affordability, also managing and modernizing existing housing stock must be considered. • Starter home is a short-term initiative that fails to address the main issues behind affordability problem. • Merely increasing housing supply alone creates its own demand.
• Not necessarily a problem of demand and supply. • Rather fiscal and financial problems. • Housing system Imperfections • Growing inequality in income and wealth	• Geared towards restrictions of housing purchase. • Suppression of housing markets speculation. • Adopting strict administrative measures. • Creating market-oriented housing system. • Stimulating affordable housing investment. • Promoting housing subsidies.	Capped-Price Housing (CPH) also known as dual-restriction commodity. Public Rental Housing (PRH)	2007 2007 state level and in 2010 nation-wide 2010-2015	China	• Focused essentially on sale volume. • Restrictions on housing purchases can only suppress housing prices in the short period. • Perceived as an ineffective approach in controlling rising housing prices. • Only postpones certain categories of demand for the future instead of total elimination. • Beclouded with uncertainty in terms of its suitability. • Not founded on the reasons behind high housing prices. • Not concerned on the impact it exerts on housing markets. • Raises entry cost into housing market.

		Home Purchase Restriction (HPR) Policy.	Re-enacted back in 2016		• Price of housing is not determined by the effective households' demands.
• Lack of funds. • Poor access to finance. • Rising poverty due to migration occasioned by political instability in the Middle East. • Housing system Imperfections • Growing inequality in income and wealth	• Solutions sought through policy reforms to encourage access to homeownership. • Liberalization and deregulation of institutional and legal framework as it concerns the control of urban development. • Tax exemption and reduced vat rate. • Discouraging luxury housing through additional tax. • Financial subsidy and incentive.	Mass Housing Fund Planned Urbanization and Housing Production Program Tenth National Development Plan KENTGES Integrated Urban Development Strategy and Action Plan	1980-1998 2002-2014 2014-2018 2010-2023	Turkey	• Budget deficit and inefficiency in the mortgage markets weakened the potency this policy. • Encouraged the growth of shanty and luxury homes rather than the much needed social and mass housing. • Unable to develop institutional form that could deliver housing to the targeted populace. • Policies are formulated non-theoretically.
• Lack of funds. • Poor access to finance and insufficient financial mechanism. • Slow administrative procedures and cumbersome regulatory approval process. • Increase in speculation and inflation. • Dearth of housing integrated planning and programs. • Very small amount of mortgage lending institutions.	• Fiscal policies border on increasing governmental spending. • Solutions sought through policy reforms to encourage access to homeownership. • Provision of tax holiday for housing developers • To reduce the number of individuals excluded from financial services. • Addressing legislative bottlenecks shredding housing. • Delivering at least one million decent affordable housing units annually. • Establishing a new mortgage regime and developing secondary mortgage market. • Negotiating more favorable mortgage terms.	National Policy on Housing (NHP). National Transformation Agenda. Final Draft Nigeria Land, Housing and Urban Development Roadmap.	2006 2011– 2015 2014-2043	Nigeria	• Increased governmental spending alone cannot guarantee affordability as various players in the financial sector could hit back through trade and exchange rate fluctuations, leading to continuous weakening of the currency's purchasing power. • The federal and state government is expected to carter for about 50% of the housing supply deficit; while the private sector covers the rest. • Current trend of leaving the provision of housing to the dictates of market forces cannot support affordable housing. • Housing prices could be increased by easy credit policy.

Chapter 4

METHODOLOGICAL APPROACH USED IN THE QUALITATIVE STUDY

This chapter first presents the research methodology employed in the qualitative study, contained in Section 3.3-3.7 and Chapter 4. It describes and justifies the methods and processes of data collection, and sampling. It presents the various stages and phases that were undertaken during the course of the literature review. Secondly, the chapter describes the various housing affordability measurement approaches (HAMA) used in affordability analysis in housing studies. The Chapter neither aims to construct a new approach, nor rectify the weaknesses in various approaches, but to track, through an extensive literature review, the extent to which housing researchers have advanced methodologically in innovating better alternative methods for improved measurement outcome. The objectives are to present descriptions of identified methods and the continuing discussions on their relative suitability as affordability measures. For instance, some researchers advocate for complete replacement of the normative measures and have either proposed or developed alternative methods (Cheong & Li, 2018; Mulliner, et al., 2013; 2016) that account for their weaknesses (Jewkes & Delgadillo, 2010). Others have modified these normative measures (Wegmann 2014; Luckey 2018). While, some argue for their continuous usage due to ease of application, global acceptance and common-sense appeal (Stone, 2006a; Nwuba & Kalu, 2018). This Chapter articulates these debates and narrates the situation with review on HAMA and their weaknesses based on the main research question: What are the

methodological weaknesses in the various HAMA as identified by researchers over the last few decades? From this, the following four sub-questions emerge: (1) What are the conceptual irregularities arising from the widely accepted definitions of HA? (2) What are the recent methodological discourses on the current worsening affordability trends across the globe and policy responses to quell them? (3) Which methods could serve as an alternative to the conventional approaches? And (4) What are the various procedures for improving HAMA as proposed by housing researchers? The answers to these sub-questions will present sound evidence on the developmental trends of diverse approaches, as well as their suitability as affordability standards. This will permit clearer theoretical explanations of the identified approaches. In the end, the chapter constitutes a firm background for methodological discussions and proffers insight into future directions in housing affordability agenda.

4.1 Qualitative Research Methods

Qualitative research is 'subjective' in nature. It emphasizes meanings, experiences (often verbally described), and description etc. Simply put, it is concerned with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind. This type of research according to Kothari (2004) is aimed at discovering the underlying motives and desires, using in depth interviews for the purpose, other techniques of such research are word association tests, sentence completion tests, story completion tests and similar other projective techniques.

The literature survey was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist as reference methodology (Moher et al. 2009 [see Appendix B]). PRISMA consists of systematic reviews and meta-analyses. A systematic review describes a review of well thought

out questions that employ explicit and systematic methods (Pickering and Byrne, 2014). Meta-analysis describes the application of statistical techniques in a systematic review to blend results of selected articles (Moher et al., 2009). PRISMA checklist guides researchers to conduct transparent reporting of a literature review (Ziersch and Due, 2018). According to De Bruijn and Gerrits, (2018) systematic reviews of scholarly publication reports are imperative for acquiring a deeper understanding of a concept, its approaches and applications. A systematic quantitative research method allows researchers to comprehensively identify what is known and not know on a subject, to establish and understand the inconsistencies among research findings, and help ascertain whether findings can be applied to specific situation (Pickering and Byrne, 2014; Pickering et al., 2015; Xiao and Watson, 2019). This systematic review is quantitative because it quantifies a wide collection of research related to the subject, and reveals the gaps in the research. This methodology has seen wide applications in diverse research areas such as housing and health related studies (Ziersch and Due, 2018); housing research (Wallace et al, 2006); and urban planning studies (De Bruijn and Gerrits, 2018). Therefore, to undertake a PRISMA methodology in this research, three key protocols must to be completed. These protocols comprise of literature search, eligible papers selections, and extraction and summarizing of data.

4.2 Literature search

Six (6) electronic databases were selected in this stage, to provide extensive application of HAM approaches. These databases include ScienceDirect, Wiley Online Library, Sage Journals, EmeraldInsight, Taylor & Francis, and Springer. Journal article publications by these six databases are perceived to be reliable and worthy of comment. The search for relevant literature was conducted in accordance with the following descriptors: “Housing affordability measurement methods and application”

as well as their combinations. Because researches on HAM approaches are continuous and evolving, the period of time restrictions were not considered by the authors. Hence, article collection ranged from 2000 to 2018. In summary, about 17,808 academic articles were extracted and 237 potentially relevant articles remained, after subtracting duplicate articles with redundant information. Then titles and abstracts were vetted and irrelevant papers removed, leaving behind a total of 160 potentially relevant articles (see Fig. 7).

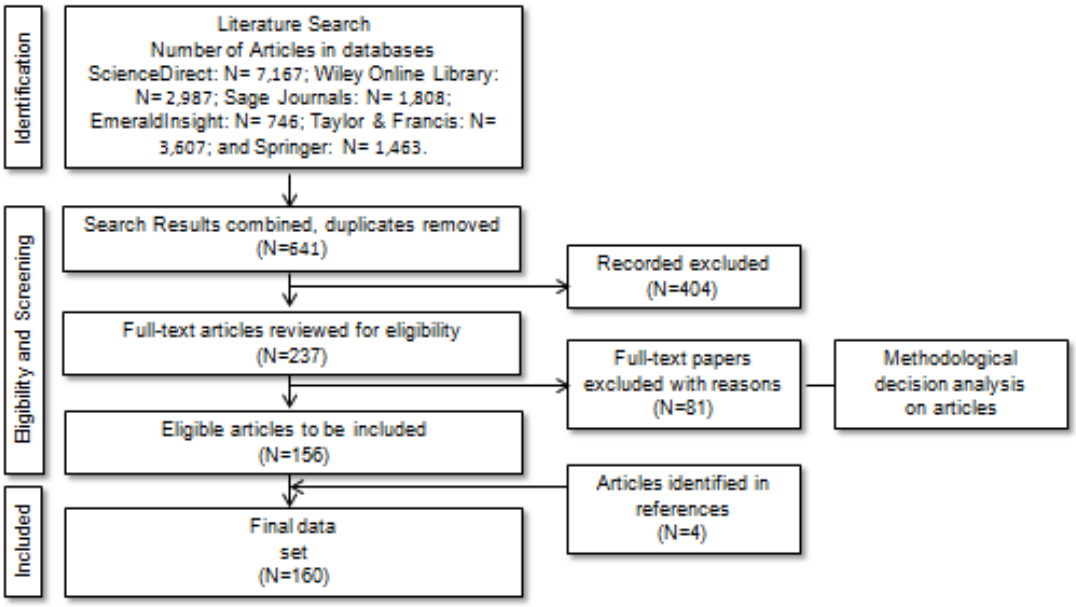

Figure 7: Flow Diagram of the Systematic Search, Indicating the Numbers of Excluded and Included Articles in the Review

4.2.1 Study Selection and Eligibility (Inclusion and Exclusion) Criteria

Here the full text of extracted articles from the prior stage was independently reviewed by the authors for eligibility purpose. A clear rationale was formulated for paper selection to arrive at a consensus. Articles which had used HAM approaches and techniques in affordability and related problems were chosen. Grey literature searches using Google searching site like (.gov or .edu and file type: ProQuest, .pdf, OpenGrey, WHOLIS and MedNar) were completely avoided. Textbooks, master and doctoral

dissertations, unpublished working papers, book chapters, abstract only papers and non-English articles, were also excluded as shown in Table 4 below. In addition, Housing affordability indexes (HAI) were excluded because they are not readily used in housing and planning research (as no empirical study published under Web of science adopted these indexes).

Table 4: Qualitative Research Design Protocol

	Criteria for Exclusion and Inclusion		
	Exclusion	Inclusion	Rationale
Timeline	• Not Within 2000 – 2018. • Published online after review period (November 2018 onwards)	• Within 2000 – December, 2018 • 2000 (inclusive) until October 2018 (inclusive)	• The selected timeline reveals the state of knowledge on the subject. • Synonymous with the development of measures for assessing housing needs, problems and the calculation of affordable housing areas; which are the hallmark of Millennium Development Goals (MDGs) Target 11 of Goal 7.
Nature of Publication	Book Chapters, Book Reviews, Non-Empirical articles, Review Papers, commentary, Literature reviews, Monographs, News items, Short case study Brief report, studies electronically unavailable or by other medium, Duplicates, Editorials and Encyclopedia articles.	• Reports of Empirical Studies • Paper accepted • In print. • Online journal.	• Selecting only peer-reviewed studies, guarantees that the methodologies and conclusions of relevant articles assessed, had already been evaluated within its discipline, hence appropriate and deserving of publication in academic literature.
Peer-review	• Editorial peer-reviewed • No documented peer-review	• Article underwent documented peer-review process	
Theme	• Housing affordability Indexes (HAI) formulated by professional bodies and associations. • Not dealing explicitly on housing affordability and measurement methods.	• Normative methods, Basic Measurements Approaches and Concepts of Housing Affordability, as well as Mathematical Models (basically adaptations from the basic approaches with more robust methodologies). • Explicitly dealing on housing affordability and measurement methods.	• HAI – fails to accurately reveal housing affordability problems of households with very low-income, as they merely integrate average figures. • Article is selected if it discussed a validation of existing method or utilized or proposed or developed a method of housing affordability analysis
Language	Non-English Publications	English or Translated in English	• English is the dominant language for reporting scientific results of scholarly publications to wide academic audience. • Authors' lingua franca.
Interdisciplinarity	• Other disciplinary descriptions of certain search terms (e.g. housing stability, housing vacancy rates).	• Studies from diverse disciplines potentially relevant to housing affordability. • Multidisciplinary and Wide-ranging.	• To accommodate various authors on the subject with diverse orientation.

	• Housing affordability measurement constitutes a marginal portion of the study.		
Research score	• Rents or trends in housing prices or the increments of both. • Determinants of housing affordability. • Effects of housing policy on affordability.	• Measurement of affordability; rather than reviewing and recommending housing related policies. • Applications of affordability measures. • Housing cost burden.	• Affordability description based on Rents or trends in housing prices or the increments of both, only posses anecdotal value, and are no indicator of affordability without any form of comparison to incomes.
Search method	Verbatim, Boolean and Word Combination		
Data source	Print (Hard); Online (Soft).		
Data Collection Technique	Title, Abstract, Keywords, Key arguments, Research methodologies, Conclusions and Findings.		
Selected Databases	Web of Science Core Collection (Social Sciences Citation Index; Arts & Humanities Citation Index; Science Citation Index Expanded; Scopus and Emerging Sources Citation Index)		

Selecting only peer-reviewed empirical studies, guarantees that the methodologies and techniques of relevant articles assessed, had already been evaluated within its discipline. Hence, the authors did not independently assess the reliability of relevant articles because doing so would be tantamount to questioning the appropriateness of diverse research methods, thereby raising epistemological issues, particularly in a phrase like housing affordability, where studies have been undertaken in several disciplines. Furthermore, no meta-analysis was conducted due to the diverse designs and aims of the empirical studies.

The researcher using a predefined protocol, extracted essential characteristics of the articles, as illustrated in Table 5 above. The supervisor cross-checked this information, all titles and abstracts were independently vetted by both. Four housing affordability experts in parallel screened the quality of selected studies (see Appendix C) and informed the classification framework, based on data extraction form (see Appendix D).

4.2.2 Quality Assessment

In line with exclusion/inclusion, quality assessments of the included studies are also important (Moher et al. 2009). The reason behind quality assessment in this study is for clearer consideration of the weaknesses of every single included paper during data synthesis. Several criteria were used in quality assessment of selected articles as suggested by researchers (Pickering and Byrne, 2014; Pickering et al., 2015). During data extraction of the included studies, the quality criteria were employed as a checklist, and each question was answered with Yes or No (see Appendix C).

4.2.3 Extraction and Summarizing of Data

In the last phase of the methodology, a standardized data collection form was used to retrieve important information to address the research questions (see Appendix D). Retrieve information was screened by the authors and four independent experts to expunge uncertainties. Prior to the conduct the full-scale systematic review, a pilot study was conducted with the data extraction form to test its efficacy. Some challenges were discovered and addressed amicably by the authors and independent experts through discussions. In cases of multiple publications and duplicates, the latest results were considered during extraction and synthesis of data. Then, these 160 selected articles were summarized and important criteria were established (Third and fourth sections). The action of article summarization and classification enabled the researcher to discover several impressive and critical suggestions. Consequently, a number of potential future themes and recommendations were revealed (Chapter 7). It is worthy to note that the major challenge in performing PRISMA methodology was about implicit expression of methods in abstract and methodological aspects of the studies. Thus, the researcher had to read the entire text of articles with deep compression to establish the precise method applied for which affordability evaluation. Though this procedure consumed a lot of time in the selection phase, it helped identify most suitable studies selected for this review.

4.3 HOUSING AFFORDABILITY MEASUREMENT APPROACHES (HAMA)

Housing affordability measurement approaches (HAMA) that is employed by housing researchers can be broadly classified into three distinctive approaches. According to their frequency of application and developmental trend such as conventional approach, scarcely used approach, and emerging innovative approach. This is shown in Figure 8

below. Each approach is unique, but fundamentally describes the assumptions of a reasonable payment for housing (O'Dell, et al., 2004) and the interaction between income and housing cost (Jewkes & Delgadillo, 2010); as well as the ability for mortgage repayment (Duffy, 2004). However, measuring housing affordability based on the capability to meet loan/mortgage requirements is generally flawed, due to the leniency of qualification criteria for a mortgage (Eakes, 2007). Researchers have recently argued that housing affordability can only be measured in comparison to income. Yet, many professionals, journalists and analysts often use rents or housing prices and/or the increments of both with no references to income in describing housing affordability. The weakness in such description is that prices alone and trends in house prices or rent possess only anecdotal value, but are no indicator of housing affordability without any form of comparison to incomes (Cox, 2018a).

This is because when income rises proportionately with house price, housing affordability remains unchanged. There are several other technical and methodological weaknesses regarding HAMA, these weaknesses largely reflect what constitutes costs of housing and household income measurement (Jewkes & Delgadillo, 2010; O'Dell et al., 2004) collective concern about survey data quality (Abelson 2009) profound insensitivity to other costs linked with housing quality and choice (Fisher, et al., 2009; Mattingly & Morrissey, 2014).

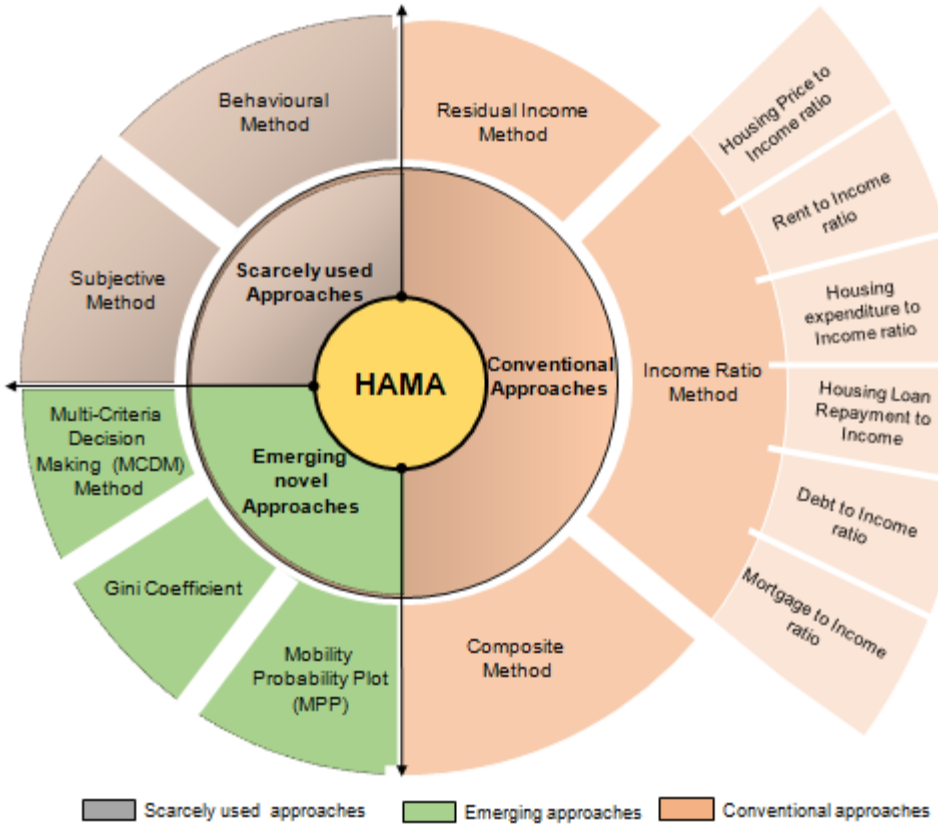

Figure 8: Classification of HAMA based on Literature Survey**.**

4.4 Conventional Approaches

There are three kinds of conventional approaches as identified in literature. These are Income ratio method (IRM), residual income method (RIM) and composite method (CM). However, IRM and RIM are generally classified as normative measures. It refers to the certain threshold value of a standard or a limit of housing affordability (Stone, 2006a). This implies that a list of benchmarks is set to determine if a given household income can offset housing cost. Normative measures have been dominant and frequently utilized in housing affordability research.

4.4.1 Income Ratio Method (IRM)

The IRM designates a threshold value or percentile level of housing cost to income ratio in assessing the housing consumption ability of households (Abeysinghe, & Gu, 2011). It assumes that no matter the household income, a certain percentage of their

income will always be devoted to housing-related expenses. This offers a method that enables researchers, to set a benchmark for housing affordability based on empirical data analysis. The IRM has a long history of development and are of several types such as: housing-expenditure-to-income-ratio, rent-to-income-ratio, ongoing-housing-cost-to-income, house-price-to-income-ratio, housing-loan-repayment-to-income, debt-to-housing-price and mortgage-to-income.

Usually, new IRM is coined to address the weaknesses in an older method. For instance, Wegmann, (2014) modified IRM and coined a replacement metric called the subsidy per housing affordability equivalent (SHARE) ratio. Nonetheless, traditional approach of IRM is simply the same as the definition. That is, households suffer housing affordability stress when the ratio of income to housing cost (the affordability ratio) go beyond a given threshold ratio. Mathematically, IRM states that:

$$Housing\ Affordability = \frac{House\ Price}{Income\ of\ the\ Household} \quad (1)$$

The most common of this method is the Price to Income Ratio (PIR) method. It refers to the ratio of median house price and median annual household income. In essence, it measures the number of years that a household needs to accumulate their wealth from their disposable annual incomes in order to purchase an average housing unit:

$$\text{PIR} = \frac{\text{Average Unit Price of Housing} \times \text{House Size}}{\text{Per Capita Annual Disposable Income per Household} \times \text{Population per Household}}$$

$$\text{HA} = \text{f}(\text{Price}, \text{Long} - \text{term Income}, \text{Government Policy}).$$

This model is highly associated with Paldam Macau's (1970) equilibrium model which states that:

$$\text{D}(\text{P}, \text{Y}_\text{o}, \text{G}_\text{o}) - \text{Q}^\text{d} = 0$$

$$\text{S}(\text{P}) - \text{Q}^\text{s} = 0$$

$$\text{Q}^\text{d} = \text{Q}^\text{s}$$

Where, the demand for residential properties (Qd) is a function of price (P), the long-termed income (Yo) and the government policy (Go). The supply of residential properties (Qs) is a function of price (P).

Use of IRM: IRM has often been used due to its relative ease of application. For instance, to determine social housing qualification, and in estimating the size of groups with affordability issue, as well as to assess the prospective borrowers' ability to service a mortgage. Dong & Zhou, (2016) used the ratio of rent to income (RIR), to empirically analyze the impact of housing affordability on the permanent migration will of rural-urban migrants. Similarly, Rowley, et al. (2015) examined how the use of ratio measures could give consideration to broader financial stress.

Weaknesses in IRM: IRM suffers multiplicity of weaknesses like the inability to consider quality changes over time of housing stock, and the influence of housing cost appreciation (Linneman & Megbolugbe, 1992). It designates a small value for a certain cordon of income to housing cost (Hancock, 1993) and erroneously assumes that households with different income can afford all non-housing expenditures with 70 percent of their income. IRM is unable to estimate the amount of new households that should have emanated if individuals did not share houses or had remained in their parents' houses as a result of their inability to afford rental or mortgage payments (Gan & Hill, 2009; Kutty, 2005; Stone, 2006a).

Most prominently, the ratio measures generally do not consider the spatial dimensions of transport cost, irrespective of the enormous effect housing location exerts on household commuting expenditure (Mattingly & Morrissey, 2014). Hence, underestimates the number of households over burdened by combined commuting and housing costs. Fundamentally, IRM focuses on the "typical" (median) property and

'typical' (median or average) household; hence it neglects the price and property type variations which the first home buyers as well as those low- and moderate-income households would preferably demand. It can also underestimate the affordability burden of lower-income households and could overestimate such burden for households with higher income. Consequently, its adoption as a measure of HA has always faced criticism.

4.4.2 Residual Income Method (RIM)

RIM was developed as a better alternative to IRM. It perceives housing affordability from a basic non-housing consumption perspective. Thus, it reveals the interaction between housing cost, income and non-housing expenditure (Yang & Shen, 2008). RIM is hinged on the idea that housing affordability is the ability of households to offset their housing cost, yet retain the capacity to meet non-housing expenditures (Stone 2006a). Simply put, the income left after housing payment. It is the belief of the protagonists of this method that it makes more sense to evaluate if households possess enough income to meet other none housing expenses after offsetting housing cost, instead of assessing an arbitrary percentage of income consumed by housing (Yang & Wang, 2011). Relying on this notion the "shelter poverty" concept was introduced. It describes as "shelter poor" households whom having paid for decent housing, becomes incapable of meeting other non-housing needs at a minimum socially acceptable standard (Stone, 1993). A phenomenon described as 'after housing' poverty, in poverty literature. This implies that RIM cares whether the income left after housing expenses plummet beyond shelter poverty or housing-induced poverty levels (Kutty, 2005). Recently, Luckey (2018) introduced a location-sensitive residual income (LSRI) technique, which considers the benefits and impacts of transportation

decision on housing affordability. However, mathematically RIM is given generally by:

$$Housing\ Affordability\ (HA) = f(income, Housing\ costs, expenditure\ on\ non - housing\ necessities)$$

Such that: $HA = f(Inc, \mathrm{HC}, \mathrm{NHExp})$ (2)

Hence, RIM posits that expenditure on one item would mean the potential sacrifice of others (Li *et al*, 2017).

RIM = residual income − housing costs

= (Household disposable income − basic non-housing living expenses) − monthly mortgage repayments.

When RIM is less than 0, monthly disposable income of the household after meeting the basic living expenses is not enough for mortgage loan repayment, and vice versa (Duan, 2011).

Use of RIM: Yang, et al., (2014) used this method in Beijing to analyze the relationship between affordable housing programs and household accessibility to public services and affordability of decent housing. Revington & Townsend, (2016) identified affordable rental housing locations when rapid public transit services are considered using RIM. More recently, Mundt, (2018) applied a comprehensive RIM where affordability is at risk to determine household types and market segments.

Weaknesses in RIM: Yip, (1995) allergies its confusion with poverty measurement, while Henman & Jones, (2012) claim that a separate benchmark is required for each household rather than a uniform percentage, This implies that in solving problems of housing affordability, data requirement transcends housing and labor markets, thus,

making it more burdensome. RIM like the IRM is economically focused, and as a result do not assess the non-monetary and qualitative aspects of housing. It problematizes affordability study in the sense that it relies on the minimum housing and non-housing consumption, which is considered subjective and differs among different classes of income, regions and cities, and therefore, should not be used in the analysis of HA on a macro level.

4.4.3 Composite Method (CM)

As the debate over the methodological superiority of the RIM over IRM rages, other studies seem to favor CM (Napoli, 2017; Ndubueze, 2007). Indeed, arguments have been raised by earlier studies that it is not possible to account for all the concerns associated with housing affordability in one simple measurement approach. The protagonists of CM maintain that housing affordability should not be assessed using one approach (McCord et al; 2011) but combining a number of concepts (Haffner & Heylen, 2011) and developing multiple overlapping measures (Tang, 2012; Napoli, 2017) that can provide better understanding of housing affordability which is more reliable; and reduces the methodological weaknesses in IRM and RIM.

Generally, this method uses the composite regression equation as specified thus:

$$Y \sim N(\theta, \sigma^2) \quad (3)$$

Where, Y is the Dependent (or Response) variable; θ is the constant or intercept of the regression model, σ^2 is the variances and covariances of the random term. Hence, the model can be written as:

$$Y_{ij} = \beta_o + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \beta_3 X_{3ij} + \mu_{ij} \quad (4)$$

Such that,

$$Y_{ij} = \begin{bmatrix} Y_{i,1} \\ Y_{i,2} \\ Y_{i,3} \\ \vdots \\ Y_{i,\mathrm{k}} \end{bmatrix}; \ \beta_{\mathrm{o}} = \begin{bmatrix} \beta_{oj,1} \\ \beta_{oj,2} \\ \beta_{oj,3} \\ \vdots \\ \beta_{oj,\mathrm{k}} \end{bmatrix}; \ \beta_{\mathrm{j}} = \begin{bmatrix} \beta_{j,1} \\ \beta_{j,2} \\ \beta_{j,3} \\ \vdots \\ \beta_{j,\mathrm{k}} \end{bmatrix}; \text{ and } \mu = \begin{bmatrix} \mu_{i,1} \\ \mu_{i,2} \\ \mu_{i,3} \\ \vdots \\ \mu_{i,\mathrm{k}} \end{bmatrix}$$

μ = Error associated with the model.

Y is the estimator for affordability while X_1, X_2, and X_3, are identified housing challenges (factors) in the study area; $\beta_j^{'s}$ and coefficients of $X_i^{'s}$ in the model.

Use of Composite Method: Thalmann, (1999) combined the three indicators of affordability: rent-to-income ratio, housing consumption and quality-based measures. Updating his studies in Thalmann, (2003), the author used the RIM rather than the rent-to-income ratio (RIR) and computed it along with housing consumption measure and quality-based measure to quantify and determine over consumption and over payments of housing services. Ndubueze, (2007) refined and updated in Ndubueze, (2009) combined the RIM and PIR while adjusting for housing quality to formulate an aggregate measure of HA. Recently, Tang, (2012) used RIM (budget and poverty-line standard), along with RIR in order to complement their weaknesses and optimize their strengths for rental affordability measurement. Similar to Sunega & Lux (2016), Sarı & Khurami, (2018) assessed housing affordability using a composite of subjective approach, RIM and IRM.

Weaknesses in CM: It considers household income as the only financial source of housing purchase. But other distortion factors such as family savings, housing subsidies and other capital incomes are neglected. CM does not address what gets back to households for what is spent on housing in terms of neighborhood and housing quality (Mulliner, 2012). CM produces misleading result when presented as an

independent measurement unit since it identifies good or bad policy, but fails to provide how the policy can be improved. In application, the composite is faced with challenges of which indicators should be used to devise the composite in the first place? What should the individual influence of each sub-indicator on the composite be? Are the data sources comparable when measuring the same phenomenon in a cross-country perspective? These weaknesses must be considered before applying the technique.

4.5 Scarcely Used Measurement Approaches

4.5.1 Behavioral Approach

The behavioral approach assesses affordability by examining the housing decisions of individual households. It simply reviews the housing consumption behavior of a household. This implies that the behavioral approach focuses on the normal housing decisions while adjusting for what households with certain incomes and compositions confronted by certain prices opt to pay for housing (Bramley, 1994). Behavioral approach deals with understanding the choices households make regarding location, type, tenure, and size of housing. It also deals with the problem of mortgage arrears and repossessions, so as to investigate the household's affordability based on their decision.

Households housing consumption behavior is a veritable tool for housing affordability assessment. However, the outcome of the research performed by Fein, et al., (1997) and Maclennan, et al., (1990) were inconclusive. Yet, the advocates of behavioral approach believe that when housing affordability problem is assessed as an explicit issue and the empirical data available is sufficient to support an in-depth research, this approach would better reveal households' spending pattern towards developing

indicators of housing affordability (Yip, 1995). It is also believed that the threshold developed from a behavioral point of view, that is, the point at which the increments in cost of housing indicates a different qualitative model in its interaction with household income, suggests an indication of housing in-affordability, and can be employed as well to validate affordability outcomes of other measurement approaches.

Use of Behavioral Approach: Arguably, the behavioral approach can be integrated into the normative measures in determining the threshold affordability ratios. Using this approach, Wood et al., (2009) observed that the behavioral effects of several kinds of housing allowances are insufficiently examined, because housing subsidies could discourage unemployed households from seeking employment opportunities in other locations. Similarly, Grinstein-Weiss, et al., (2010) observed that low income households saving behaviors are mainly influenced by the structured opportunities they are offered. Recently, Olanrewaju & Woon, (2017) combined both internal and external criteria that influence household decision-making to study homebuyer/homeowner behaviors.

Weaknesses in the Behavioral Approach: The behavioral approach is considered difficult to compute and many a time unable to present a real evidence of the behavioral path of people's housing consumption. However, with the invention of behavioral economics and the perceived weaknesses in normative measures, behavioral approach is believed to have potential for further development.

4.5.2 Subjective Approach

Given that both behavioral and normative measures are regarded as objective measurements. Kearns et al., (1996) offered a completely different approach, called the subjective approach. Subjective approach summarizes the subjective evaluation of

households' perception of their housing need (Seelig & Phibbs, 2006) in relation to housing quality and condition, affordability dilemma and overcrowding. It directly asks respondents if they consider their house affordable or not, as the qualitative and subjective measurements are checked against their financial position and other quantitative criteria. The data generated are used to establish a threshold cordon of their HA with the conviction that households are better positioned to offer the best assessment of their housing situation. This approach rests on the assumption of *homo economicus*. Following this approach housing affordability is a function of household income. Mathematically, it states that,

$$Housing\ Affordability = f(Household\ income) \quad (4)$$

Use of Subjective Approach: Subjective indicators are often employed as predictors controlling price of property (Chasco & Le Gallo, 2013) or as a complement for objective indicators. Stiglitz, et al. (2009) noted that obvious difference between objective and subjective indicators which is impossible to explain under human psychology or money illusion could lead to ineffective distribution of public resources and weakening trust in official statistics, in some countries (e.g. the UK). Nevertheless, it is believed that subjective measures can offer other information left out under standard objective measures, and can support cost-benefit analysis and policy evaluation as well as aid the identification of potential policy problems (OECD, 2013). It is therefore remarkable, that studies in housing have marginally devoted interest in developing alternative housing affordability measures that responds more precisely to subjective perceptions of housing stress (Sunega & Lux, 2016).

Weaknesses in the Subjective Approach: Subjective indicators easily fluctuate over time more than the objective measures (Sarı & Khurami, 2018). This approach requires normative assessments of what represents the "living costs". However, it seems that

adopting some sort of normative basis for definition and measurement is unavoidable in any HA analysis (Robinson, et al., 2006).

4.6 Emerging Innovative Methodologies

New methods of measuring housing affordability are emerging as a result of improved understanding of affordability burden, and the fact that the existing housing affordability measures focus mainly on the fiscal dimension while other modified approaches mostly re-emphasized the weaknesses of the methods they tried to amend. Three emerging novel methods (which are essentially adaptations from the distinctive measurement approaches, but with more robust methodologies) were identified in the literature. Examples are; multiple criteria decision making (MCDM); Gini coefficient and mobility probability plot (MPP) methods.

4.6.1 Multiple Criteria Decision Making (MCDM) Method

MCDM is a tool involving both qualitative and quantitative factors (Mardani, et al., 2015). It is a set of methods that supports the consideration and aggregation of several criteria, often numerous, mostly at variance, decision criteria (Zavadskas, et al., 2014), which is used to describe, choose, rank or sort, a range of alternatives to support a decision process (Mardani, et al., 2015).

Use of MCDM: Several models within the MCDM methodological framework have been suggested (Zavadskas, et al., 2014). The most commonly used MCDM models include; the Complex Proportional Assessment (COPRAS), Analytical Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) (Mulliner, et al., 2016). A novel study by Mulliner, (2012) refined and updated in Mulliner, et al., (2013) adapted the COPRAS model to assess HA, as an instance on how to apply MCDM for housing affordability analysis. The findings

indicate that taking into account additional criteria that clearly consider housing location and community sustainability, housing quality amongst others; against mere economic considerations alone, can significantly impact affordability calculations.

Adopting the same method in Sabah, Malaysia Said, et al., (2016) assessed the best locations for the development of sustainable affordable housing programs. Mulliner, et al., (2016) investigated the applicability of several models within the MCDM methodological framework, for optimal housing affordability assessment. The study revealed that various MCDM models can be applied for sustainable housing affordability assessment, as a result of the model's ability to address the numerous conflicting decision criteria and the multidimensionality of issues found in housing affordability problems. Mathematically put;

$Housing\ Affordability = f(Alternatives)$ in their ranking order. Such that:

$$HA = \beta_i; i = 1, 2,\ldots, n \quad (5)$$

For instance, the COPRAS method is represented as

$$d_{ij} = \frac{q_i}{\sum_{j=1}^{n} x_{ij}} x_{ij} \quad (6)$$

where x_{ij} is the value of the i-th criterion of the j-th alternative, and qi is the weight of the i-th criterion.

Weaknesses in the MCDM: When several models within the MCDM methodological framework are employed to assess same problem, they often generate different results (Zavadskas, et al., 2017). MCDM is susceptible to manipulation which could alter the degree of result accuracy. Daniel, et al., (2018) remarked that though the complex nature of this measure deepens the overall understanding of multiple concerns which

breed, housing affordability problem, there is a chance that its complexity could weaken the uptake by analysts and researchers.

4.6.2 Gini Coefficient Method

The Gini coefficient measures the inequality within the income distribution of a given population (by means of a ratio analysis). It captures the influence of income inequality in estimating housing affordability. Various approaches are applicable here, for instance, RIR estimate based on average. However, the method is based on net PIR. Mathematically,

$$GH = \frac{Housing\ Price}{Household\ Net\ income}$$

Such that the HA at a period t, can be estimated as;

$$GH_t = \beta_o + \beta_1 GA_t + \beta_2 \left(\frac{P}{A}\right)_t + \bar{\beta}_3 CONTROLS + \varepsilon_t \quad (7)$$

where, t is a time period index, GA and GH are net income and housing affordability Gini coefficients, respectively, $\frac{P}{A}$ is the average housing price-to-net income ratio (across all households at time t), CONTROLS is a matrix of macroeconomic variables, including gross domestic product (GDP), unemployment rate (UNEPR), exchange rate (EXR), among others. Meanwhile, $\beta_o\ to\ \beta_2$ are parameters, $\bar{\beta}_3$ is a vector of parameters and ε_t is a random disturbance term associated with the model.

Use of Gini Coefficient Method: The Gini coefficient method can be applied in the comparison of income distributions across different sub-populations (Dong, 2018). A novel study by Ben-Shahar & Warszawski, (2016) adapted the Gini coefficient method to estimate income inequality in housing affordability, and to evaluate the factors associated with the time-varying inequality measures of housing affordability. More

recently Dong, (2018) used this method to evaluate the effect of growing income inequality on low income tenant families' worsening rental affordability.

Weaknesses in Gini Coefficient Method: The Gini coefficient mainly lies on its relative nature; then information on absolute regional and individual income is lost, and fails to consider the causes of inequality (Wang, et al., 2012). Also, as a measure of inequality and the fact that it only isolates the inequality in the distribution of a particular macroeconomic variable. Thus, it isolates the magnitude of the variable to a relative rather than an absolute degree which implies that a country can witness simultaneously, for instance a rising income inequality and a reduction in absolute poverty (Kwok, 2010).

It is also quite possible to have countries of disparate income levels having similar or even in some cases, identical Gini coefficients, which implies a high income country having the same Gini coefficient as a very low income country, or moreover a region with predominantly low income and low quality housing, having the same housing affordability inequality index as a region with higher income and predominantly higher housing quality. Consequently, Gini coefficients should not be used as a stand-alone quantitative measure of a particular variable such as wealth and housing affordability. Instead, it is advisable to augment it with other measures that capture the variable on an absolute scale.

4.6.3 Mobility Probability Plot (MPP)

MPP was originated by Cheong & Wu (2015) for studying regional inequality. It is based on PIR which is obtained by dividing the house price by income (Cheong & Li, 2018). MPP is the transitional dynamics of housing affordability based on the Markov transition matrix approach and the stochastic kernel technique. It is however used to

analyze the mobility of PIR for cities, thereby measuring city-level trends of housing affordability. MPP is expressed in percentages (ranges between −100 and +100).

A positive value of MPP suggests that the city will have a net probability of moving upward in the distribution of PIR, thereby indicating that the PIR of the city will become higher and higher, and the housing price will be more unaffordable. In contrast, a negative value of MPP indicates that the city has a net probability of moving downward in the distribution of PIR which indicates that the city has a high tendency of registering a decline in the PIR.

MPP can be computed by calculating $p(x)$ as:

$$p(x) = \int_x^{\infty} g_r(z/x)dz \; - \; \int_0^x g_r(z/x)dz \tag{8}$$

Where, $\int is\ the\ function\ of\ integration$, X is an observed value of relative household income at time t; and $g_r(z/x)$ is the transition probability kernel which maps the distribution from time t.

Use of MPP: A novel study by Cheong & Li, (2018) adopted the MPP to study the transitional dynamics of HA indicators. Li, et al., (2017) employed the MPP method to analyze the mobility of housing price growth and impact the enactment and withdrawal of home purchase restrictions (HPR) policy have on changes in housing price.

Weaknesses in MPP: Li, et al., (2017) remarked that although the contour maps and three-dimensional plot generated provides much salient information on the distribution dynamics, the interpretation may be very difficult and challenging.

4.7 Applications of Housing Affordability Measurement Approaches (HAMA)

As a result of wide applications of HAMA in the real affordability problems, there is a need to classify these applications across several domains/field. The papers that used HAM approaches are classified into three groups: HAMA utilizing study, HAMA approach developing study, and HAMA proposing study. In cases where an article falls into several categories, relying on the article's objectives as determined by the targeted audience, the most suitable option was chosen. This enabled the elimination of possible duplication of studies in the classification scheme. In subsequent sections, themes (fields/domains) are presented in brief and further summarized with corresponding tables. At every table, studies are summarized and described in accordance with their intent and reporting technique. These studies used different methods for different applications, it was observed that each method possess its unique features in providing best outcome. Table 4 shows articles distribution based on application domains /fields.

4.7.1 Rental Housing Affordability (RHA)

RHA is the difficulties experienced by households in accessing rental housing and/or the financial burden imposed on households for securing accommodation in either private or public housing sector. Several scholars have explored this area using several HAM techniques and approaches which include sub-categories of econometric/regression modeling such as logit regression model (Williamson, 2011; Anacker and Li, 2016; Meltzer and Schwartz, 2016; Blanco et al., 2015), hedonic price equations (Fisher, Pollakowski & Zabel, 2009), regression models (DiPasquale & Murray, 2017; Lux 2007; Braakmann & McDonald, 2018; Lens 2018; Laidley, 2014; Anenberg & Kung, 2018), simulation methodology (Wood et al., 2005), partial

regression plots (Dewilde & De Decker, 2016), Canonical Spatial Equilibrium model (Bieri & Dawkins, 2018). Others methods are residual income method (Revington and Townsend, 2016); ratio-based method (Dong and Zhou 2016; Quigley and Raphael 2004; Murdie 2003; Boeing and Waddell, 2017; Yates and Wulff, 2000; Yates and Wulff, 2005; Marks and Sedgwick, 2008). Wegmann, (2014) modified ratio measure to a replacement metric called the subsidy per housing affordability equivalent (SHARE) ratio; subjective method (Morris 2009; Ruming and & Dowling, 2017; Seelig and Phibbs, 2006; Teixeira 2014; Preston et al., 2009); composite method (Tang 2012; Ho and Chiu, 2002; Haffner and Boumeester, 2015; Dewilde 2018; Thalmann 2003); Gini coefficient method (Matlack and Vigdor, 2008; Dong 2017). A total of 35 articles have applied HAM approaches and techniques, in this field of application.

4.7.2 Home-ownership Affordability (HOA)

HOA is the difficulties experienced by households in accessing their own housing and/or the financial burden imposed on households for securing accommodation in the housing and mortgage market. In domain/field of HOA some of prior articles developed and/or utilized HAM approaches and techniques. For instance, in the case of econometric model (Meen and Andrew, 2008; Brown et al., 2011), and its subset like ordinary least square regression (Lee and Reed, 2014), hedonic house price model (Bryant 2017), multivariate regression (Minchenko and Nozdrina, 2017). In the case of residual income method (Lee et al., 2000; Li et al., 2017a; Yang and Shen, 2008), subjective method (Cai and Lu, 2015; Hackett, Saegert, Dozier & Marinova, 2018), ratio based method (Lau and Li, 2006; Camilleri 2011; Niu 2008; Wood and Stoakes, 2006; Kupke and Rossini 2011), behavioral method (Grinstein-Weiss, AN Chowa and Casalotti, 2010) and composite method (Yuen, KWEE and Tu, 200); Bramley and Wakins, 2009). HOA domain/field had second to the lowest ranking with 18 previous

scholars (11.25%) haven applied only 5 out of the 12 identified HAM approaches and techniques.

4.7.3 Purchase and Repayment (Amortization) Affordability (PRA)

PRA is the ability of a household to borrow adequate funds for a house purchase and the stress undergone by a household to repay. According to this review in the field/domain of PRA only 7 studies out of 160 selected studies used 5 out of 12 identified HAM approaches and techniques. These include regression model (Sánchez-Martínez, Sanchez-Campillo and Moreno-Herrero, 2016) and its other form such as multinomial logit estimation (Yates and Wood, 2005). Other examples are ratio-based measures (Gan and Hill, 2009; Anthony, 2018), residual income method (Yang and Wang, 2011), behavioral method (Yi, Huang and Fan, 2016), and data envelopment analysis (Li, Xu and Chiang, 2014).

4.7.4 Combined Housing and Transportation Affordability (CHTA)

The concept of CHTA holds that actual housing affordability must include transportation cost as a substantial and related household cost burden. Such that housing is perceived affordable if less than 45% of household income is spent on combined H + T costs. Some scholars have applied various HAM approaches and techniques in this domain/field such as econometric model (Miller et al., 2004; Acolin and Green, 2017; Mattingly and Morrissey, 2014; Saberi, et al., 2017;), and its subset like microstimulation (Vidyattama, Tanton and Nepal, 2013), logistic regression (Kramer 2018), hedonic approach (Ben-Shahar, Gabriel and Golan, 2018a), monocentric modeling (Coulombel (2018)), multi-level regression models (Renne et al., 2016; Hamidi et al., 2016; Hamidi, Jahan and Moazzeni, 2018; Hartell 2018), least-squares regression models (Deka 2015). Luckey (2018) proposed a location-sensitive residual income (LSRI) approach. In the case of subjective method (Tremoulet et al.,

2016), data envelopment analysis method (Dewita, Yen and Burke, 2018), location affordability index (Isalou, Litman and Shahmoradi, 2014; Haas, Newmark and Morrison, 2016), and composite method (Hamidi and Ewing, (2015); Cao and Hickman, 2017). The results of Table 11-22 in Chapter 4 indicated that, 20 articles were published in this field/domain.

4.7.5 Housing and Mortgage Market Affordability (HMMA)

HMMA describes the affordability of housing stock, the housing assistance available, household's eligibility, and forecasts the profitability of erecting and sales of new houses in a particular area. Therefore, could aid in determining new areas for developing affordable housing, and areas in dire need of housing subsidy. Results of Table 19 showed that, in field/domain of HMMA 59 articles out of 160 selected articles applied 9 out of the 12 identified HAM approaches and techniques. Residual income method (Stone 2006a; Stone 2006b; Yang et al., 2014), econometric modeling (Yang and Turner, 2004, Chen, Hao and Stephens 2010; Kim and Cho, 2010; Meen 2011; Baker, Mason and Bentley, 2015), quantitative model-based simulation method (Fingleton 2008; Fingleton et al., 2018; Wood, Watson and Flatau, 2006), Markov-switching (MS) model (Tsai 2018; Pitros and Arayici, 2017), autoregressive distributed lag (Worthington and Higgs, 2013), probit model (Flambard, 2018), hedonic pricing parameters (Burge 2011; Carmona, Lampe and Rosés, 2017; Mathur 2014; Roy 2018). Others are subjective method (Lazarovic, Paton and Bornstein, 2016; Gilmour and Milligan, 2012; Yap and Ng 2018; Cai and Lu, 2015; McGreevy 2018), composite method (Bramley 2012; Haffner and Heylen, 2011; McCord et al., 2011; Duan 2011; Micallef 2018; Mengjie, Reed and Wu, 2008; Hou 2010; Sari and Khurami 2018), scenario technique (Yates and Berry, 2011), ratio-based measures (Beer, Baker, Wood and Raftery, 2011; Bentzien, Rottke and Zietz, 2012; Kallakmaa-Kapsta

and Kolbre, 2013; Konadu-Agyemang 2001; Chang 2013; Bramley and Karley, 2005; Tu, de Haan and Boelhouwer, 2018; Kuang and Li, 2012; Öztürk, Kapusuz and Tanrıvermiş, 2018; Jones, Watkins and Watkins 2011; McClure 2005; Burke and Hayward, 2001; Abeysinghe and Gu, 2011), behavioral method (Blunden 2016), MPP (Cheong and Li, 2018; Li, Cheng and Cheong, 2017b), Gini coefficient method (Ben-Shahar and Warszawski, 2016; Zhang, Jia and Yang, 2016), MCDM (Mulliner, Smallbone and Maliene, 2013; Mulliner, Malys and Maliene, 2016; Said et al., 2017).

4.7.6 Individual Household Affordability (IHA)

For most households with limited income, every housing stock is unaffordable until offered at no cost. While for most with high income, every housing stock is affordable regardless of the cost. These phenomena are referred to as IHA, it is important to determine, because uncontrollable emotion or over excitement of perceived fall in house prices, as well as individual weakness of never to be out priced could force households to secure apartments beyond their capacity to sustain. However, research is limited on this area, Borrowman, Kazakevitch and Frost, (2015); McConnell (2012); Heylen and Haffner, (2013) employed residual income method to assess this field/domain, Moore and Skaburskis (2004); Lin et al., (2014); Nepal, Tanton and Harding, (2010); Temkin, Theodos and Price, (2013); Haffner & Boumeester, (2010); Tanton and Phillips, (2013); Ben-Shahar, Gabriel, and Golan (2018b); Randolph and Holloway, (2002); Rowley, Ong and Haffner (2015); Bunting, Walks and Filion, (2004) used ratio-based measures. Borrowman, Kazakevitch and Frost (2017); used composite method. Sunega and Lux, (2016); Lau and Wei, (2018), Emslie (2011) used subjective method. Bentley, et al., (2016); Okkola and Brunelle (2018); Wood and Ong (2011); Aurand (2014); Kropczynski and Dyk, (2012); used regression model. Other regression techniques used are ordinary least squares (OLS) regression (Daniel, Baker

and Lester, 2018), logistic regression (Temple 2008), and bivariate probit models (Skaburskis 2004), residual income method (Kutty 2005).

4.8 Methodological Considerations (Strength and Weaknesses)

It is advisable to consider the validity, suitability, and planning objectives while applying the identified methods. Each approach and method possess some weaknesses and strength, and it cannot be categorically stated that certain approach or method is more suitable than another, thus, there are no ideal affordability measure. The notion that the cost of housing should not surpass a particular percentage of household income is common to all metrics. However, small differences (such as inclusion of certain criteria like transportation cost, location efficiency, among others) make each class more suitable for other applications.

The choice of methodology, however, affects the conclusions drawn. Various HAM approaches generally disagree on what should include as constituent elements, which is the most valid and suitable. It was observed that many planners simply view housing affordability as a "white or black" issue, that is, housing is either affordable or unaffordable, based on the measurement threshold as determined by normative methods. More in-depth metrics such as behavioral method examines how households behave when confronted with housing market that is unaffordable.

Furthermore, it should be realized that using different techniques and approaches in same problem will probably generate different outcomes. There could be measurement errors in each approach or method; hence, planners and early-career researchers employing these approaches must be mindful of the weaknesses in each method and should interpret them as estimates that are subject to error. The suitability of each

approach and circumstances in which it can be applied has been described alongside their strengths and weaknesses (Table 5).

Table 5: Summary of selected strengths and weaknesses of HAM approaches based on the literature reviewed

Approach/Method		Strengths	Weaknesses	Common Application Areas
Conventional (Normative) Approaches	Income Ratio Method	Ease of application and data collection. Ease of affordability comparisons across regions. Easy to explain to non-experts (easily comprehensible). Relies on a 30% threshold Based on a small number of regularly available variables. Subjective assumptions of people's housing consumption are limited. Enjoys global acceptance and recognition. Applicable in a range of areas to study the differences across households and affordability trends over time. Measures the actual household expenditure relative to their actual income.	Not very accurate Arbitrary benchmark, no clear rationale behind affordability thresholds. Does not account for household structure, unless modified. Does not consider the difference in households' level of income of various families, unless modified. Does not address housing quality and adequacy. Concentrates on economic aspects only. Erroneously assumes that every family and individual has equal capacity to pay for housing. Fails to address non-housing expenditure. Misclassifies households that have strong preferences towards housing consumption. Could over and under estimate affordability problems. 30/40 ratio measure estimates individuals at risk of having affordability stress, but inefficient at determining others truly affected.	RHA HOA HMMA IHA
	Residual Income Method	Effective where the economic realities are similar for all chosen samples. Addresses the living standards of household. Considers household structure and different levels of income among different households. Sensitive to housing market realities in income and housing. Acknowledges that people have different spending needs. Addresses equity concerns. Incorporates housing quality. The correlation flanked by housing and non-housing expenditure is well articulated.	No methodological advantages have been established in literature, when applied in a comparative context. Its confusion with poverty measurement. Insensitive to the living cost of different areas. Does not account for the influence of housing quality on location preference on housing cost (no account of location tradeoffs). Creates a certain threshold above which affordability becomes increasingly subjective. Household expenditure is based on subjective assumptions.	RHA HOA IHA HMMA

		Examines the low-income households housing affordability more efficiently. Makes a distinction of the probable affordability outcome of different household types over an array of income, for rental and house purchase. Considers household spending pattern and the leverage effect. Captures housing investment sustainability.	Time-consuming and complex than ratio approach (more data requirements on expenditure of goods and services). Focuses on the economic dimension of affordability. Requires an element of generalization and judgment about household type.	
	Composite Method	Could identify locations in urban areas that are affordable and not affordable. More sensitive to the ability of households to confront their housing and non-housing expenses, as compared to both ratio and residual income approaches. Addresses the concept of opportunity cost, that is perceived as the fundamental nature of housing affordability i.e., tradeoffs that is made to acquire housing and if such tradeoffs are rational or extreme.	'Costs of living' are determined by some form of normative assessment. Fails to address other important issues, such as; the return in investment for housing expenditure, in terms of neighborhood and housing quality. Insensitive to the tradeoffs between cheap and affordable housing. Focuses on the economic dimension of affordability (involving owning or renting housing). Excludes household savings, wealth and other financial aids while depending entirely on household income. Superficially defines appropriate housing locations and what households should be paid for housing; as well as commuting cost, from residential areas to work environments. Superficially defines the point at which individuals' acquires the right to live independently.	RHA HMMA HOA PRA IHA
	Econometric/Regression Modeling	Can reveal new insight by revealing relationships and patterns that may have been previously neglected. Aid in correcting planning errors and thinking, e.g. a planner may believe that increasing numbers of housing units may reduce affordability problem. A regression analysis could show that mere increases in housing unit have little or no effect on affordability. It provides quantitative support for decision.	Econometric equations are likely to be improperly specified in that fundamental values are a highly non-linear function of many variables. Econometric analysis results depend heavily on time series data which may be misleading, since there are deep-seated challenges in determining the market fundamentals.	RHA HOA PRA CHT HMMA IHA

			The extent to which econometric analysis based on the fundamentals have revealed the presence of affordability stress, is still under debate. They merely offer predictions of the dependent variables and over time the accuracy of the prediction models would depend largely on the possibility of forecasting the identified explaining variables, which is considerably difficult. Econometric models and analyses are intractable and require the generation of new data, and tend to be very data hungry and hard to operate.	
Scarcely Used Approaches	Behavioral	Considered to be more accurate in demonstrating the households' expenditure pattern. Integration into normative approach is possible, for determining the benchmark affordability ratios.	Difficulty in accessing the data required for its assessment. Sometimes shows a vague proof on the behavioral pattern of people's housing consumption.	RHA HOA HMMA -
	Subjective	Enables respondents to reveal various scenarios and issues that shape their housing stability, which are rarely measured. Accounts for differences of what informs housing choice, like taste and experience. Provides reliable data about the nature of people's housing realities, which are rarely captured by objective measures. Subjective indicators could offer some deeper insight for better understanding of housing affordability. Hence, could potentially influence housing policy.	Fluctuates more often than objective measures in the course of time. Subjective indicators are derived from researches with a narrow scope, such as, small sample size and frequency. These indicators are often derived from samples that do not represent the entire population. Therefore, the generalizability of findings could be limited. It is problematic to base political decisions entirely on the opinions and desires of the population.	RHA HOA HMMA
Emerging Innovative Approaches	MCDM	Aids in network and complex decision making by providing a quantitative and qualitative media with various intangible criteria, where often conflicting and multiple goals are measured in diverse units. Such as household wellbeing and welfare. Offers a means of problem structuring and working through information.	Time consuming with large numbers. Ignores the different effects among clusters. Perfect consistency is very difficult. Some forms of MCDM may be deterministic. Does not take into account the uncertainty in weightings. Different models of MCDM can provide dissimilar outcome if used for the same problem.	RHA HOA PRA HMMA CHTA IHA

		Helps in better understanding of a problem from one's and others' viewpoints. Without all measures being converted into the same unit; social, cultural, economic and environmental considerations can be traded off. Addresses housing quality and adequacy.	Prone to manipulation.	
	Gini Coefficient	Easy interpretability, since it is founded on ratio analysis. Estimates income inequality. Considers segmentation and examines inequality in housing affordability. Allows the comparison of income distribution in different countries, regions over time.	As a relative measure, its use and interpretation is controversial. Neglects the causes of inequality. Data on absolute regional and individual income is lost. Very difficult to compute.	RHA HOA PRA HMMA CHTA IHA
	MPP	Permits a better exploration of housing price dynamics. Can offer salient information on future evolution trends of housing prices. Enables the comparison of effectiveness of housing policy on price trends in various housing units' sizes across cities over time. Could determine the net upward and downward probability in growth rate of housing prices in cities within a given distribution. It is absolutely data-driven, and no assumptions are imposed on the model.	The contour maps and three-dimensional plot provides much salient information on distribution dynamics, but the interpretation is very difficult and challenging.	RHA HOA PRA HMMA CHTA IHA

4.8.1 Suggestions for Methodological Improvement of Selected HAMA

Many researchers of diverse orientation have put forward several recommendations and suggestions on how different HAMA can be enhanced, in order to eradicate their various inherent weaknesses. Some of the key recommendations as suggested by housing researchers are presented in Table 6.

Table 6: Summary of the Suggestions for the Improvement of Selected HAMA

Key Reference	Approach/Method	Suggestion/Recommendations
Chen, et al., (2010); Mulliner & Maliene, (2014); Mulliner, et al., (2013, 2016); Haffner & Heylen, (2011); Daniel, et al., (2018)	Housing Affordability Concept	In conceptualizing HA, the social, economic and ecological aspects that determine households' wellbeing must be considered. Broadening the concept of housing affordability measure to incorporate material deprivation, would capture individuals truly having HA problems (not merely individuals at risk).
Gabriel, et al., (2005); Jewkes, & Delgadillo, (2010); Rowley et al. (2015); Sunega & Lux, (2016); Hancock, (1993); Thalmann, (2003); Bramley, (2012); Kutty, (2005); Bramely, (2012); Chen, et al., (2010);	Normative Measures (IRM and RIM)	Apply equivalent income in place of income, while adjusting household incomes for household composition. This modification could reclassify more single person households that were wrongly classified as low income. The ratio measure can be improved by considering the experiences of individuals over time (i.e. use of longitudinal data). Especially, with regards to the negative and positive life circumstances that breed HA stress. Use of subjective approach to improve the normative measures. However, this suggestion underestimates the role households' subjective assessment play in comprehensive understanding of the HA problems. Formulate objective indicators to consider households subjective perception of problems of housing. This may offer a more precise approach of measuring housing needs. To improve the IRM, compare poverty lines with housing cost deducted income. Also provide data disaggregated by household type and develop many ratio measures for different types of household. Use residual income or disposable income against housing cost rather than overall household income for its better captures housing cost induced poverty. Subjective evidence of material hardship and payment problems could be employed to validate ratio measures and identifies the best thresholds to apply.
Ndubueze, (2007); Haffner & Heylen, (2011); Tang, (2012); Daniel, et al., (2018)	Composite Method	Develop multiple overlapping measures of affordability. Take into account all qualitative and quantitative criteria that affect household wellbeing. Material deprivation measure if applied in combination with the 30/40 ratio, offers a more precise measure of poor HA experience which is naturally associated with wider concerns in which these issues are suffered.
Sarı & Khurami, (2018) Talen, (2010); Ruming et al., (2011)	Subjective Approach	Use of a scale, while collecting housing cost burden data as reported by households, instead of reducing it into categories. Case study may provide more support for developing the subjective approach.

4.9 Data Analysis and Presentation of Literature Survey Results

4.9.1 Article Distribution Based on HAMA and Techniques

Table 19 presented the frequency of applications of identified HAM approaches and techniques in variants of housing affordability stress. Based on the results, a total of 160 articles have used 12 HAM approaches and techniques. The table reveals that econometric/regression modeling (36.87%) has been used more than other methods and techniques. The second in this ranking is the ratio-based method (23.75%) and composite method (11.25%) the third. The frequency of other approaches and techniques are also shown in Table 19. Tables 7–18 show implementation of each HAM approach and technique. Selected articles are sorted alphabetically in all tables by author name.

Table 7: Article Distribution based on Ratio-based Method

Authors	Year	Study type	Intent and Techniques
(Abeysinghe and Gu)	2011	HAM proposing research	Presented a methodology (ratio of lifetime income to house price) to compute lifetime income from predicted annual household earnings.
(Anthony)	2018	HAM proposing research	Implemented the ratio of cost-burdened households for the evaluation of housing affordability.
(Beer, Baker, Wood and Raftery)	2011	HAM utilizing research	Used the PIR to calculate the housing stress levels.
(Ben-Shahar, Gabriel and Golan)	2018b	HAM proposing research	Introduced a new normative measure that adjusts for normative variation in housing consumption.
(Bentzien, Rottke and Zietz)	2012	HAM utilizing research	Applied the ratio-based measure on the housing market.
(Boeing and Waddell)	2017	HAM utilizing research	Utilized ratio measures to calculate rent proportion.
(Bramley and Karley)	2005	HAM developing research	Developed a model-based measure of access to owner occupation and intermediate housing market.
(Bunting, Walks and Filion)	2004	HAM utilizing research	Tabulated and mapped the spatial distribution of households spending large portions of their income on rent.

(Burke and Hayward)	2001	HAM utilizing research	Examine the in-house prices and affordability trends using ratio measures.
(Camilleri)	2011	HAM utilizing research	Analyzed developments in house prices using long-term approach based on ratio measures.
(Chang)	2013	HAM utilizing research	Used PIR to investigate two living scenarios (basic and comfortable).
(Dong and Zhou)	2016	HAM utilizing research	Employed the ratio of rent to income to analyze the impact of housing affordability on the permanent migration will.
(Gan & Hill)	2009	HAM developing research	Extended the PIR to consider the whole income and house prices distribution.
(Haffner and Boumeester)	2010	HAM utilizing research	Calculated expenditure-to-income ratios of average cost of housing for tenants and homeowners.
(Jones, Watkins and Watkins)	2011	HAM utilizing research	Employed PIR to address the variations in affordability between local housing market areas (HMAs).
(Kallakmaa-Kapsta and Kolbre)	2013	HAM proposing research	Proposed an index based on ratio measure that is peculiar to Estonian housing market.
(Konadu-Agyemang)	2001	HAM utilizing research	Compared and contrasted housing affordability by housing prices and income ratios, using standard measurement criteria.
(Kuang & Li)	2012	HAM developing research	Defined the dynamic upper boundary of PIR via Engel's coefficient to estimate the housing affordability severity.
(Kupke and Rossini)	2011	HAM utilizing research	Determined affordable areas for moderate single income earners and percentage of suburbs affordable to key workers.
(Lau, and Li)	2006	HAM utilizing research	Utilized (PIR) to gauge housing affordability.
(Lin, Chang, and Chen)	2014	HAM utilizing research	Examined housing affordability using price-to-income ratio (PIR).
(Marks and Sedgwick)	2008	HAM utilizing research	Used the standard "rule of thumb" to examine the incidence of housing stress for renters and owners separately.
(McClure)	2005	HAM proposing research	Proposed a tabulation-based measure via ratio measures.

(Moore and Skaburskis)	2004	HAM utilizing research	Used the PIR to describe changes in the number of low-income households dissipating over 50% of their income on housing.
(Murdie)	2003	HAM utilizing research	Evaluated the rental experiences of migrant groups using a housing career strategy.
(Nepal, Tanton and Harding)	2010	HAM utilizing research	Examined the comparative effects of several affordability definitions on the ratio of households in housing stress.
(Niu)	2008	HAM developing research	Computed the homeownership affordability rates using ratio-based measures.
(Öztürk, Kapusuz and Tanrıvermiş)	2018	HAM utilizing research	Used the PIR to investigate the housing sector situation and affordability issues.
(Quigley and Raphael)	2004	HAM utilizing research	Utilized the ratio measure to assess housing assistance programs.
(Randolph and Holloway)	2002	HAM utilizing research	Analyzed housing affordability using the upper boundaries of both income and rent bands via ratio measures.
(Tanton and Phillips)	2013	HAM developing research	Extended housing stress measure proposed by Chaplin and Freeman (1999) to incorporate the 30/40 rule.
(Temkin, Theodos and Price)	2013	HAM utilizing research	Identified the time lapse in which low income households can afford a unit when resold using the ratio measures.
(Tu, de Haan and Boelhouwer)	2018	HAM proposing research	Presented the interest-to-income ratio (IIR) concept to establish a simple affordability model.
(Wegmann)	2014	HAM proposing research	Proposed the subsidy per housing affordability equivalent (SHARE) ratio as a replacement metric.
(Wood and Stoakes)	2006	HAM utilizing research	Examined housing affordability trends across income groups using customized matrices.
(Yates and Wulff)	2005	HAM utilizing research	Evaluated how the availability and supply of low rent housing aid affordability problems via ratio measures.
(Yates and Wulff)	2000	HAM utilizing research	Accessed housing un-affordability using the ratio of rent paid to gross household income.

Source: Researchers Summarization

Table 8: Articles Distribution based on Residual Income Method

Authors	Year	Study type	Intent and Technique
(Borrowman, Kazakevitch and Frost)	2015	HAM developing research	Developed an Ordered Probit model that identifies factors which forecast housing and financial stress in household types through residual stress measure.
(Heylen and Haffner)	2013	HAM utilizing research	Presented the application of budget standards in two countries.
(Kutty)	2005	HAM proposing research	Introduced the housing-induced poverty concept to examine situations that emerge when after paying for housing, a household cannot afford non-housing goods.
(Li, L, Wu, Dai, Gao and Pan)	2017a	HAM utilizing research	Examined the impact of housing affordability via Residual Income Affordability model (RIA) complemented by Housing Affordability Time (HAT) analysis.
(Luckey)	2018	HAM developing research	Evaluated the benefits and impacts linked to transportation decisions by proposing a location-sensitive residual income (LSRI) approach.
(McConnell)	2012	HAM utilizing research	Examined possible residual racial differences associated with housing affordability.
(Revington and Townsend)	2016	HAM utilizing research	Operationalized residual income method to specify affordable market rental housing.
(Stone)	2006a	HAM utilizing research	Analyzed the potential utility and implications of the residual income method in mortgage underwritings.
(Stone)	2006b	HAM utilizing research	Demonstrated how the shelter poverty version of residual income concept can be operationalised using non-housing elements.

(Yang and Shen)	2008	HAM developing research	Developed a ‘‘residual income’’ whose value is calculated using a hedonic price equation.
(Yang and Wang)	2011	HAM utilizing research	Compared the residual measure against the ratio measure results realized from down payment and amortization affordability assessment.
(Yang, Yi, Zhang and Zhang)	2014	HAM utilizing research	Used the residual income method to measure housing affordability.

Source: Researchers Summarization

Table 9: Articles Distribution based on Composite Method

Authors	Year	Study type	Intent and Techniques
(Borrowman, Kazakevitch and Frost)	2017	HAM developing research	Employed a composite of budget standard, household disposable income and the Consumer Price Index to model a measure that identifies households’ types suffering affordability stress and its duration.
(Bramley and Wakins)	2009	HAM utilizing research	Adopted lending multipliers (loan-to-income ratios) while utilizing a secondary residual income test.
(Bramley)	2012	HAM utilizing research	Used subjective evidence of material hardship and payment problems to validate ratio measures while residual measures play supporting role.
(Cao and Hickman)	2017	HAM developing research	Modeled a composite index of car dependence and housing affordability (CDHA) using indices of oil vulnerability associated with housing affordability and car travel.
(Dewilde)	2018	HAM utilizing research	Used the composite of ratio and residual measures to explain housing affordability trends in the private rental sector (PRS).
(Duan)	2011	HAM utilizing research	Applied PIR and housing affordability index (HAI) approaches to measure housing affordability.
(Haffner and Boumeester)	2015	HAM utilizing research	Utilized the ratio measure to assess housing affordability of tenants and

			the residual measure to identify households with housing and energy affordability stress.
(Haffner and Heylen)	2011	HAM utilizing research	Combined the concepts of short-term and long-term affordability to evaluate financial accessibility and payment ability for housing.
(Hamidi and Ewing)	2015	HAM utilizing research	Combined multilevel modeling, location affordability index (LAI) and metropolitan compactness index to determine urban sprawl affordability after transportation costs consideration.
(Ho and Chiu)	2002	HAM utilizing research	Combine RIR and residual measure to prove that application of different affordability measure yields contrasting results.
(Hou)	2010	HAM utilizing research	Examined housing price bubbles via combination of housing market prices, rational expectation price, mortgage loans, PIR and RIR.
(McCord, McGreal, Berry, Haran and Davis)	2011	HAM utilizing research	Analyzed interrelationships between mortgage liquidity and housing affordability using PIR, access, deposit gap and residual measure.
(Mengjie, Reed and Wu)	2008	HAM utilizing research	Used the composite of PIR and HAI model to measure housing affordability.
(Micallef)	2018	HAM developing research	Used multiply affordability indicators to capture households, investors and system-wide factors.
(Sari and Khurami)	2018	HAM utilizing research	Employed Income and Living Conditions survey to examine the housing affordability through ratio, residual income, and subjective methods.
(Tang)	2012	HAM utilizing research	Combined RIR and residual income standards to maximize their strengths and complement their weaknesses in rental affordability measurement.
(Thalmann)	2003	HAM developing research	Combined residual measure, housing consumption and quality-based measure to determine over consumption and overpayments of housing services

(Yuen, KWEE and Tu)	2006	HAM utilizing research	Examined homeownership affordability via composite of ratio measure, housing accessibility, housing mismatch and residual approach.

Source: Researchers Summarization

Table 10: Article Distribution based on Econometric/Regression Modeling

Authors	Year	Study type	Intent and Techniques
(Acolin and Green)	2017	HAM developing research	Presented a novel measure of affordability that combines housing and transportation cost (CNT).
(Anacker and Li)	2016	HAM utilizing research	Analyzed rental housing affordability using descriptive statistics and multinomial logit analyses.
(Anenberg and Kung)	2018	HAM utilizing research	Used an estimated model to stimulate rental rates reactions to an exogenous increase of housing units in a neighborhood.
(Aurand)	2014	HAM utilizing research	Used regression analysis to examine the strength of local planning towards affordable housing and its relationship with companying changes in housing affordability.
(Baker, Mason and Bentley)	2015	HAM utilizing research	Determined via econometric model the range of households' cohorts moving between unaffordable and affordable housing states ('slippers'), and those that experience long-term ('stickers').
(Ben-Shahar, Gabriel and Golan)	2018a	HAM developing research	Used the hedonic approach to estimate prices of normative consumption bundles in a superstar city.
(Bentley, Pevalin, Baker, Mason, Reeves and Beer).	2016	HAM utilizing research	Evaluated changes in people's mental health traced to unaffordable housing using econometric model.
(Bieri and Dawkins)	2018	HAM developing research	Developed a version of the Canonical Spatial Equilibrium model to test the situation in which ongoing HCV program design maybe deemed problematic from perspective of welfare.
(Blanco, Kim, Ray, Stewart and Chung)	2015	HAM utilizing research.	Utilized logistic regression model and a survey of former assisted properties to determine their post subsidy trajectories.
(Braakmann and McDonald)	2018	HAM utilizing research	Modeled the possibility of rental subsidies contributing to affordability problems, while helping recipients afford expensive properties.

(Brown, Brown, O'connor, Schwann and Scott)	2011	HAM utilizing research	Utilized the acquisitions, payments, and the use approach to measure the cost of owner-occupied housing.
(Bryant)	2017	HAM utilizing research	Applied a hedonic house price model to examine the effect of infrastructure charges on housing affordability.
(Burge)	2011	HAM developing research	Extended hedonic pricing parameters and compared low income housing tax credit (LIHTC) ceiling rents and predicted market rents.
(Carmona, Lampe and Rosés)	2017	HAM utilizing research	Investigated the reactions of urban housing markets to war and migration which increases housing demand using a new hedonic index.
(Chen, Hao and Stephens)	2010	HAM developing research	Refined static measures (point-in-time) via a dynamic analysis to develop a method that identifies patterns of affordability.
(Coulombel)	2018	HAM utilizing research	Used a monocentric model to show that capping housing burden drives low-income households toward suburban areas, where they suffer high transportation cost.
(Daniel, Baker and Lester)	2018	HAM utilizing research	Used an Ordinary Least Squares (OLS) regression model to examine housing affordability stress (HAS) and material deprivation effects on mental health.
(Deka)	2015	HAM utilizing research	Used three-stage least-squares models to analyze CHTA.
(Dewilde and De Decker)	2016	HAM utilizing research	Compared trends in housing affordability over time within countries using partial regression plots.
(DiPasquale and Murray)	2017	HAM utilizing research	Used the housing services model and the hedonic price model to measure rents and housing consumption.
(Fingleton)	2008	HAM utilizing research	Used simulation method to examine a government's policy impact on housing supply.
(Fingleton, Fuerst and Szumilo)	2018	HAM proposing research	Predicted the future housing supply effects on the residential space affordability using quantitative model-based simulation method.
(Fisher, Pollakowski and Zabel)	2009	HAM developing research	Extended hedonic price equations to assess location-related quality housing, affordable to different households.
(Flambard)	2018	HAM proposing research	Modeled an original application of probit model with a double sample selection to show how housing allowance recipients cope with financial difficulties.

(Hamidi, Ewing and Renne)	2016	HAM utilizing research	Utilized MLM to assess housing affordability of low-income renter households and its relationships to travel outcomes and transportation cost.
(Hamidi, Jahan and Moazzeni)	2018	HAM utilizing research	Followed Hamidi et al., (2016) study utilizing a rigorous methodology which consists of solid transportation cost modeling with disaggregated data available at property level for housing assistance programs.
(Hartell)	2018	HAM utilizing research	Probed household cost burdens and its relationship with CHTA multi-level regression models.
(Kim and Cho)	2010	HAM utilizing research	Conducted an econometric analysis to explore long-run housing prices determinants and impact of structural changes.
(Kramer)	2018	HAM utilizing research	Tested the relationship between housing cost and transit access using descriptive statistics and logistic regression.
(Kropczynski and Dyk)	2012	HAM utilizing research	Examined through an ordered logistic regression common forces affecting people in various rural communities (monthly housing costs and income).
(Laidley)	2014	HAM utilizing research	Utilized first-difference models of tract-level data to examine the relation between poverty rates, student populations, and housing affordability metrics.
(Lee and Reed)	2014	HAM utilizing research	Applied ordinary least squares (OLS) regression to assess the effectiveness of the First Home Owner Grant (FHOG) scheme in improving housing affordability.
(Lee, Myers and Park)	2000	HAM utilizing research	Examined the utility of the multifamily housing sector via household tenure decision models.
(Lens)	2018	HAM utilizing research	Used regression models to evaluate how less affordable rental housing is for households of Extremely Low-Income (ELI).
(Lux)	2007	HAM utilizing research	Applied a method based on the estimation of economic quasi-norms on rent levels in rent-controlled (social) housing.
(Mathur)	2014	HAM utilizing research	Used hedonic regression and spatial econometrics to explore an urban growth boundary (UGB) impact on land and housing prices.
(Mattingly and Morrissey)	2014	HAM developing research	Examined combined housing and transport (CHTA) affordability by utilizing disaggregate zonal data.

(Meen and Andrew)	2008	HAM developing research	Developed an alternative economic model that better suits the post-Barker era, covering both tenure choice and household formation.
(Meen)	2011	HAM utilizing research	Examined long-run affordability as affected by different levels of housing construction on via econometric model of regional housing market.
(Meltzer and Schwartz)	2016	HAM utilizing research	Applied Ordinary least squares and logit regression analysis to estimate household health tradeoffs occasioned by housing affordability stress.
(Miller, Roorda, Haider and Mohammadian)	2004	HAM utilizing research	Applied travel cost models and transportation network assignment models to compute average annual travel and housing expenditures.
(Minchenko and Nozdrina)	2017	HAM utilizing research	Conducted a multivariate assessment of affordability dynamics, to trace households gaining ownership of housing.
(Okkola and Brunelle)	2018	HAM developing research	Developed a quantile regression models for households in the top, median and bottom quartiles of the housing affordability stress spectrum.
(Pitros and Arayici)	2017	HAM proposing research	Modified the house price self-correction pattern (SCP) of Tsai (2013) to propose a pattern for the housing affordability cycle.
(Renne, Tolford, Hamidi and Ewing)	2016	HAM utilizing research	Utilized Multilevel modeling (MLM) to examine how CHTA differ in fixed-route transit station areas.
(Rowley, Ong and Haffner)	2015	HAM proposing research	Investigated the extent ratio measure (30/40 HAS) reflects broader financial stress and housing stress.
(Roy)	2018	HAM utilizing research	Estimated the hedonic price function using ordinary least squares (OLS) and Box-Cox functional forms to estimate the implicit prices of housing characteristics.
(Sánchez-Martínez, Sanchez-Campillo and Moreno-Herrero)	2016	HAM utilizing research	Utilized the econometric model to show how financial health of the mortgaged families has deteriorated.
(Skaburskis)	2004	HAM developing research	Extended bivariate probit models to predict the combined probability that households housing cost exceeds half of their income, which is below poverty line.
(Temple)	2008	HAM utilizing research	Used Rare event logistic regression to measure the prevalence and correlates of housing affordability stress among community-dwelling older persons.

(Tsai)	2018	HAM utilizing research	Applied Markov-switching (MS) model to estimate the duration of increasing severity and mitigation of the housing affordability problem.
(Vidyattama, Tanton and Nepal)	2013	HAM utilizing research	Used spatial microsimulation technique to show how the outcome of housing stress measure that integrates transport costs paints a different picture of housing stress from a measure that neglects cost of transport.
(Williamson)	2011	HAM utilizing research	Applied logistic regression using the dependent variable CBALL, a dummy variable that indicates if households experience cost burden exceeding 30% of their gross monthly income.
(Wood and Ong)	2011	HAM utilizing research	Explore research issues on housing affordability dynamics using econometric model.
(Wood, Forbes and Gibb)	2005	HAM utilizing research	Examine the efficacy of housing-demand component in addressing housing affordability within a new microsimulation model.
(Wood, Watson and Flatau)	2006	HAM utilizing research	Employed microsimulation model estimate to stimulate the potential impacts on housing market of low-income housing tax credit (LIHTC).
(Worthington and Higgs)	2013	HAM utilizing research	Used autoregressive distributed lag (ARDL) approach to model housing affordability measured by the housing price-earnings multiplier (HPE) and the Housing Industry Association's Housing Affordability Index (HAI).
(Yang and Turner)	2004	HAM utilizing research	Explored how regional variation in house prices could lead to affordability problem using regression model.
(Yates and Wood)	2005	HAM utilizing research	Utilized Multinomial logit estimation to model the likelihood of an existing rental housing maintaining the same real rent value, or filters down or up, or exits the private rental market over a given period.
Saberi, Wu, Amoh-Gyimah, Smith and Arunachalam)	2017	HAM developing research	Presented a modeling approach based on point estimates as an improved housing affordability measure that accounts for CHTA.

Source: Researchers Summarization

Table 11: Article Distribution based on Behavioral Method

Authors	Year	Study type	Intent and Techniques
(Blunden)	2016	HAM utilizing research	Used critical discourse analysis to examine why negative gearing continues to enjoy political support though it is unfair, makes housing unaffordable and enables market distortion.
(Grinstein-Weiss, AN Chowa and Casalotti)	2010	HAM utilizing research	Utilized data collected from 1176 participants saving for home purchase to examine individual and program characteristics that are critical in explaining saving behaviors.
(Yi, Huang and Fan)	2016	HAM utilizing research	Used a data set of household-level survey to examine the essential social capital effects on house-purchasing decisions of households.

Source: Researchers Summarization

Table 12: Article Distribution based on Subjective Method

Authors	Year	Study type	Intent and Techniques
(Cai and Lu)	2015	HAM proposing research	Case study approach employed data generated by two questionnaire surveys while using Binary Logistic Regression Model (BLRM) to analyze how over-crowding problem breeds amongst survey respondents.
(Emslie)	2011	HAM utilizing research	Conducted a face-to-face, semi-structured and individual interview with randomly selected 10 youth housing workers to assess their pay and conditions, housing costs and experiences.
(Gilmour and Milligan)	2012	HAM utilizing research	Utilized information from interviews, organizational case studies and documentation, to assess the drivers of hybridity growth in Not-for-Profit housing organizations

Hackett, Saegert, Dozier and Marinova)	2018	HAM utilizing research	Surveyed the experiences of 91 respondents of community land trusts (CLTs) home-owners while using grounded theory approach for data analysis.
(Haslam McKenzie and Rowley)	2013	HAM utilizing research	Utilized data from interviews and focus group discussions in a case study methodology to investigate experiences of a housing market failure.
(Lau and Wei)	2018	HAM utilizing research	Conducted survey interviews with 136 micro-flats residents to investigate their socio-economic background and their perceptions of living space.
(Lazarovic, Paton and Bornstein)	2016	HAM utilizing research	Conducted 25 key informant interviews to demonstrate a range of policy responses that challenge affordable intermediate housing.
(McGreevy)	2018	HAM utilizing research	Examined the subjective experience of renters and home buyers.
(Morris)	2009	HAM utilizing research	Applied Amartya Sen's functioning's and capabilities concepts using semi-structured interviews, to explore and compare the of older renter's life experiences.
(Preston, Murdie, Wedlock, Agrawal, Anucha, D'Addario, Kwak, Logan and Murnaghan)	2009	HAM utilizing research	Explored the housing experiences of immigrant households and interviews from local community organizations representatives serving low-income and immigrant populations.
(Ruming and Dowling)	2017	HAM utilizing research	Examined the lived experiences of PhD students similar to the poorest segments of the housing market.
(Seelig and Phibbs)	2006	HAM utilizing research	Exposed important issues and problems with sole reliance on quantitative analyses of housing affordability and examined how low-income private renters

			perceive their housing situation, focusing on affordability.
(Sunega and Lux)	2016	HAM utilizing research	Assessed the distance between the outcomes of subjective evaluations and the objective measures of household's affordability problems, using same EU-SILC data source.
(Teixeira)	2014	HAM utilizing research	Used focus groups with immigrants, informant interviews and semi-structured interviews from 15 professionals dealing with provision of housing services and immigrant settlement to examine housing experiences and coping strategies of low-income immigrants.
(Tremoulet, Dann and Adkins)	2016	HAM utilizing research	Utilized focus-group data and information from interviews to explore the challenges Housing Choice Voucher Program (HCVP) participants experience in searching for location-affordable housing.
(Yap and Ng)	2018	HAM utilizing research	Conducted semi-structured interviews with industry practitioners to explore the affordability of Malaysian housing market.

Source: Researchers Summarization

Table 13: Article Distribution based on Location Affordability Index

Authors	Year	Study type	Intent and Techniques
(Haas, Newmark and Morrison)	2016	HAM utilizing research	Chose one urban and one suburban area to explore how potential changes in the exogenous variables might affect transportation choices and housing costs.
(Isalou, Litman and Shahmoradi)	2014	HAM utilizing research	Used a survey of 900 households to measure the combined H + T costs in different areas of a city, using

			housing and transportation affordability index.

Source: Researchers Summarization

Emerging Novel (hybrid) Approaches – State of the Art Developments (2011-2018)

Authors began proposing robust methodologies from other disciplines. For instance, two methodologies were borrowed from Operations research (MCDM and DEA). Many references exist in the literature that deal on HAMA, but most relied solely on the economic dimension. There seems to be few research evidence (e.g. Mulliner, et al 2013; Mulliner, et al 2016) buttressing the efficacy of incorporating sustainability principles into HAMA for improved affordability outcome/result. This concept is entirely novel and is yet to be fully adopted by many housing researchers, as its effectiveness is not well established through literature. The poor adoption may be the result of deficiencies in their feedback to researchers and policy makers.

Table 14: Article Distribution based on Scenario Technique

Authors	Year	Study type	Intent and Techniques
(Yates and Berry)	2011	HAM proposing research	Employed the scenario technique to sketch a stimulation of possible continued rising housing prices and a sharp downward correction.

Source: Research Summarization

Table 15: Article Distribution based on MultiCriteria Decision Making (MCDM) Method

Authors	Year	Study type	Intent and Techniques
(Mulliner, Malys and Maliene)	2016	HAM utilizing research	Investigated the applicability of six models within the MCDM methodological framework, for optimal housing affordability assessment.

(Mulliner, Smallbone and Maliene)	2013	HAM proposing research	Proposed a novel concept of how affordability can be measured using COPRAS method of multi-criteria decision making (MCDM).
(Said, Daud, Esha, Majid and Najib)	2017	HAM utilizing research	Employed the COPRAS model in the MCDM methodological framework to demonstrate the need for a shift towards sustainability quality affordability value from the common price income cost genre.

Source: Researchers Summarization

Table 16: Distribution based on Data Envelopment Analysis Method

Authors	Year	Study type	Intent and Techniques
(Dewita, Yen and Burke)	2018	HAM proposing research	Proposed a new method of ranking and measuring CHTA in various combinations of residential location and housing type using the Econometric Frontier Approach otherwise called Data Envelopment Analysis (DEA) method.
(Li, Xu and Chiang)	2014	HAM developing research	Modified housing affordability indicator to account for the impacts of household disposable income and urban population density on the ability of households to afford a house.

Source: Researchers Summarization

Table 17: Article Distribution based on Gini Coefficient Method

Authors	Year	Study type	Intent and Techniques
(Ben-Shahar and Warszawski)	2016	HAM proposing research	Proposed a new measure of housing affordability inequality based on the net income-to housing price ratio by computing the Gini coefficient of housing affordability inequality.
(Dong)	2017	HAM utilizing research	Examined the impact of income inequality and increases in GINI coefficient exact on rental affordability of low-income tenant households.
(Matlack and Vigdor)	2008	HAM utilizing research	Modeled potential relationship that, income boom of the rich cause the poor problems of housing affordability.

(Zhang, Jia and Yang)	2016	HAM utilizing research	Examined the impacts of income inequality on the PIR and housing vacancy rate to show that the income GINI coefficient is positively related to the housing vacancy rate and PIR.

Source: Researchers Summarization.

Table 18: Article Distribution based on Mobility Probability Plot (MPP) Method

Authors	Year	Study type	Intent and Techniques
(Cheong and Li)	2018	HAM proposing research	Proposed a recently developed framework called the mobility probability plot (MPP) which is based on the stochastic kernel technique and Markov transition matrix approach, to assess city-level trends of housing affordability.
(Li, Cheng and Cheong)	2017b	HAM utilizing research	Employed the MPP method, to analyze the mobility of housing price growth in main urban areas and to evaluate the impact of enactment and withdrawal of home purchase restrictions (HPR) policy have on changes in housing price.

Source: Researchers Summarization

Table 19: Article Distribution based on Application Domain/Fields

HAM approaches and techniques	RHA	HOA	PRA	CHTA	HMMA	IHA	Frequency of application	Percentage
Conventional Approaches								
1. Ratio-based Method	07	05	01	-	13	12	38	23.75
2. Residual Income Method	02	03	01	01	02	03	12	7.5
3. Composite Method	05	02	-	02	08	01	18	11.25
4. Econometric/Regression Modeling and Simulation Methodology	14	05	02	13	18	08	59	36.87
Scarcely Used Approaches								
5. Behavioral Method	-	01	01	-	01	-	03	1.87
6. Subjective Method	05	02	-	01	05	03	16	10
7. Location Affordability Index	-	-	-	02	-	-	02	1.25
Emerging Novel Approaches								
8. Scenario Technique	-	-	-	-	01	-	01	0.62
9. Multi Criteria Decision Making (MCDM) Method	-	-	-	-	03	-	03	1.87
10. Data Envelopment Analysis (DEA) Method	-	-	01	01	-	-	02	1.25
11. Gini Coefficient Method	02	-	-	-	02	-	04	2.5
12. Mobility Probability Plot (MPP) Method	-	-	-	-	02	-	02	1.25
Total	35	18	06	20	54	27	**160**	100

4.9.2 Article Distribution Based on Journal Name

Table 20 presents article distribution based on the journal names which were selected for this survey. That is, the studies regarding HAMA which are distributed across 160 journals indexed in Web of Science database. The first in rank is the Housing Studies Journal with 28 articles. The result of this table indicates that this journal plays a leading role on HAM issues. The International Journal of Housing Markets and Analysis had the second rank with 17 articles; Housing Policy Debate with 13 articles had the third rank. Urban Policy & Research with 11 articles was ranked fourth; while the Journal of Housing and the Built Environment and Urban Studies Journal with 10 articles each had fifth rank. In other journal ranking; a total of 21 journals had the lowest rank with 1(one) article contribution each. The sum total of articles published in other journals is presented in Table 20.

Table 20: Article Distribution based on Name of Journal

S/No	Name of Journal	Frequency
1	Applied geography	01
2	Australian Economic Review	01
3	Australasian journal on ageing	01
4	Australian Social Work	01
5	Canadian Geographer	03
6	China Economic Journal	01
7	Chinese Journal of Urban and Environmental Studies	01
8	Cities	03
9	Economic Modelling	01
10	Economic Papers: A journal of applied economics and policy	02
11	Economic Record	02
12	Emerging Markets Finance & Trade	01
13	Environment and Planning A	02
14	Environment and Planning C	01
15	Habitat International	04
16	Housing Policy Debate	13
17	Housing and Society	02
18	Housing Studies	28
19	Housing, theory and society	02
20	International Journal of Housing Markets and Analysis	17
21	Journal of Applied Economics and Policy	02

22	Journal of Comparative Asian Development	01
23	Journal of Design and Built Environment	01
24	Journal of Economic Perspectives	01
25	Journal of Housing and the Built Environment	10
26	Journal of Housing Economics	05
27	Journal of Planning Education and Research	02
28	Journal of Regional Science	02
29	Journal of Transport Geography	01
30	Land Use Policy	02
31	Local Economy	01
32	Omega	02
33	Oxford Review of Economic Policy	01
34	Property Management	02
35	Planning Practice & Research	01
36	Real Estate Economics	02
37	Research in Transportation Business & Management	01
38	Regional Science and Urban Economics	03
39	Studies in Economics and Finance	01
40	Studies on Russian Economic Development	01
41	The Australian Economic Review	01
42	The Economic History Review	01
43	Transportation Research Record: Journal of Transportation Research Board	05
44	Transport Policy	02
45	Urban Affairs Review	01
46	Urban Policy & Research	11
47	Urban Studies	10

4.9.3 Article Distribution Based on Year of Publication

Figure 9 shows the distribution frequency by article publication year. The results are indicative of the fact that from 2000 through 2018, the evidence on the applications of HAMA and techniques has increasingly grown. The results of this sub-section also show that only two articles applied these approaches and techniques in 2000, 2001, 2002 and 2003 respectively. The numbers grew to 6 articles each in 2004, and 2005; and to 7 papers in 2006. Amazingly, between 2008 through 2014 these numbers grew exponentially. Although the use of HAM approaches and techniques grew yearly, the number of studies dropped to 1 in 2007. The most amazing outcome of this is about 2018, in which prior papers applied HAM techniques and approaches more as

compared to previous years. It has the most amounts of published articles (29). Therefore, it can be deduced that scholars of diverse orientation use HAM approaches and techniques nowadays in their studies, hence it is possible that the coming years will experience even further surge in numbers. Other results in the years of publication are presented in Figure 9.

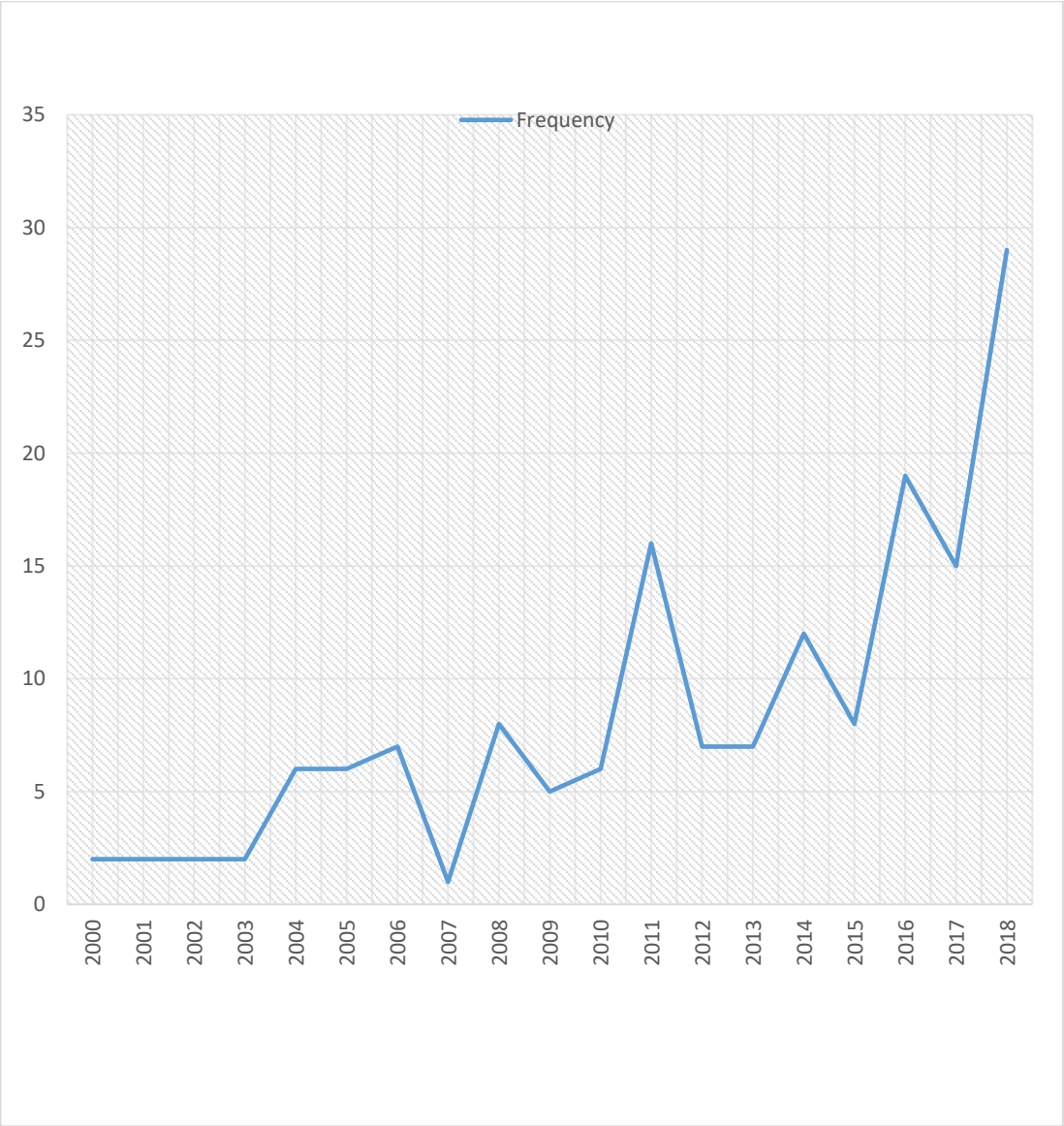

Figure 9: Article Distribution based on Publication Number per Year.

4.10 Chapter Summary

This chapter first presented the research methodology employed in the qualitative study. It described and justified the methods and processes of data collection, and sampling. It presented the various stages and phases that were undertaken during the course of the literature review. Secondly, the chapter described the various housing affordability measurement approaches (HAMA) used in affordability analysis in housing studies. This Chapter raises concern over the nearly sole reliance on the conventional approaches in the reformations of policy instrument, despite their overwhelming weaknesses. It reiterates the need for reconsideration and offers new insight, but not conclusive information on better ways to conceptualize and measure housing affordability. It, therefore argues that, if debates on housing affordability must be sought to address rising costs escalations, then the conventional definitions and traditional methods of measuring housing affordability must be re-examined.

In summary, this Chapter is considered an attempt for the generation of further and evolving discussions within housing affordability research domain, which would ultimately lead to a clearer and more holistic insight into the dynamic nature of housing affordability. It could also inspire a renewed research agenda for conceptual refinement and the development of more assessment methods that can draw closer links with sustainability principles by taking into account the social, environmental and economic criteria that impact on the quality of life of households.

Chapter 5

CRITERIA SYSTEM FOR SUSTAINABLE HOUSING AFFORDABILITY

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. However, it is an uncommon approach to assess housing affordability by means of incorporating 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). Embedding sustainability into the criteria contributing to housing affordability has been the call of recent studies on housing affordability. 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. Therefore, the key objective of this Chapter is to identify a comprehensive list of criteria system through which housing affordability can be holistically and sustainably assessed.

5.1 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. Conceptualizing 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. 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 of sustainability (Adabre & Chan 2018). 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 Figure 10 was first introduced by Mulliner & Maliene (2011). 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.

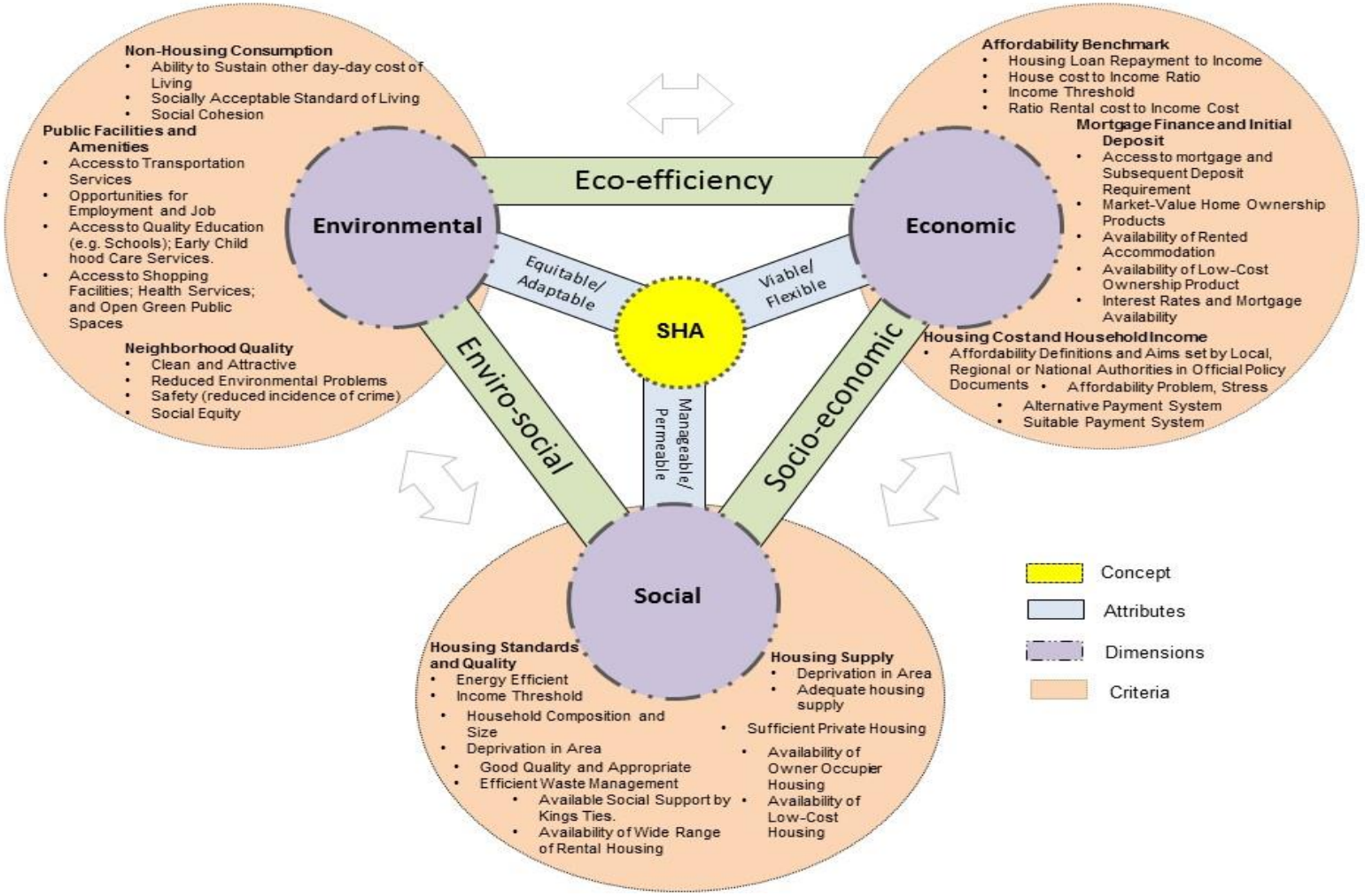

Figure 10: A Conceptual Model for Understanding the Sustainable Housing Affordability (SHA) Concept.

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 (Mulliner, et al 2013; 2016). 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 (MacKillop, 2013). Therefore, it has become evident that not housing cost alone that needs to be considered in order to keep cost criteria in affordable housing in check; energy efficiency of housing, access to amenities (Mulliner, et al., 2013) 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 Mulliner & Maliene, 2011; 2015; Gan, et al., 2017).

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., (2017) identified twenty four (24) key sustainability performance indicators (KSPIs); Chan & Adabre, (2019) 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, (2015) 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 7. 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 efficiency 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.

5.2 Social (cultural) Sustainability Performance Criteria (SSPC)

Poor housing condition is an indicator of poor social conditions (Sidawi, 2008). 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 (Muazu & Oktay, 2011).

Consistent with this, Wiedmann, et al., (2016) 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, (2013) 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.

5.3 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 (Mulliner & Maliene, 2011). 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 (Hashemi, et al., 2015).

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 (Kolarik & Toftum, 2012). 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 (Adegun & Adedeji, 2017).

Green improvements to affordable housing could promote positive health outcomes of low-income households, for instance access to green public space (Ross et al. 2010) which is routinely ignored in affordable housing programs (Dempsey et al., 2012). In recent times, heightened interest in eco-friendly living has led to the emergence of environmentally sustainable construction processes (Chan, et al., 2017) such as green affordable housing concept (Fuhry & Wells, 2013). These "green" housing integrated design practices consist; measures to increase energy efficiency, utilization of non-toxic materials, decrease water usage, and maintain the quality of the indoor air environment (Steinemann, et al., 2017); 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 (Bardhan & Debnath, 2016). Hence, are generally termed as environmentally friendly buildings (Chan, et al., 2017; Ding, et al., 2018).

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 (Lento, 2010). Indeed, affordable housing professionals and designers will increasingly need to understand green building techniques in order 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 (Charoenkit & Kumar, 2014) as well as mixed land using, as it promotes accessibility, minimizes cost of

transportation and encourages efficient land use (Turcotte & Geiser, 2010; Isalou et al., 2014) in addition ensure flexibility and adaptability (Turcotte & Geiser, 2010) which meets the changing needs of households and prevent issues like more resource consumption and environmental disruption (Pullen et al., 2009).

5.4 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 (Isalou et al., 2014; Fuhry & Wells, 2013). Minimizing cost of transportation and energy bill, allows low-income households to spend a larger portion of their income on non-housing necessities (Ibem & Azuh, 2011; Golubchikov & Badyina, 2012).

Studies found that factors such as house size, monthly installment and physical characteristics like number of bedrooms and bathrooms (Alaghbari et al. 2008), desirability by would be occupants (Pullen et al. 2009) 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 (Atolagbe & Fadamiro, 2014; Iwuagwu & Iwuagwu, 2015) like earthen materials (Adegun & Adedeji, 2017).

Also, providing stable financial incentives and subsidy is necessary to secure financial viability for developers (Pullen, et al., 2009) and for individuals who are unable to rent

or pay for a house (Abelson, 2009). Earlier studies raised concerns over governments' disinvestment in public housing and re-placement of public housing mechanisms with market-driven systems (Whitehead, 1991).

This is consistent recent studies which suggest that several countries have reduced or eliminated housing supply subsidies for low incomes (Bratt, 2006); 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 (McClure, 2008). The effectiveness of housing subsidies depends on risk management and the price elasticity of housing demand (Hall & Berry, 2006). 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 (Wood & Stoakes, 2006).

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 (Warnock & Warnock, 2008). However, this has always eluded low-income earners. Rolnik, (2013) 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.

5.5 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. (2008) 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 was undertaken.

As a result, a holistic set of SPC apposite to sustainable housing affordability was established (Table 21). Questionnaire design followed suite, which was pilot surveyed and distributed to urban low- and medium-income residents and affordable housing applicants in the 26 urban areas of the 6 geopolitical regions in Nigeria. Prior to the design of the questionnaire, a pilot survey was carried out on the list of potential of SPC for sustainable housing affordability. The purpose of undergoing this process was to test the significance and the comprehensiveness of the possible SPC. One affordable housing district was used in the pilot study involving low- and medium-income groups, who had experienced or experiencing housing affordability stress.

The respondents were asked to evaluate if the criteria list contained an adequate number of performance criteria and whether other potential critical performance criteria could be added or removed from the list. One criterion was included under the

attribute “Public Facilities and Amenities” and the rest under “Architecture and Innovative Design” in the social sustainability performance criteria. Resultantly, a total number of 13 criteria was included to the holistic set of SPC via the pilot survey as illustrated in Table 21. After the pilot study, the relevance and completeness of the criteria were finalized and confirmed.

Table 21: 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	[Ross et al., 2010; Winston & Montserrat, 2007]
		SS102	Access to health centers e.g. Hospitals, GPs	[Wiedmann, et al., 2016]
		SS103	Access to religious places e.g. Temple, mosque, church etc.	[Muazu & Oktay, 2011]
		SS104	Access to educational centre e.g. School, tuition centre etc.	[Acolin & Wachter, 2017]
		SS105	Access to child day care centre	[Talen & Koschinsky, 2011]
		SS106	Location of shopping mall or market	[Mulliner & Maliene, 2015]
		SS107	Accessibility to working place	[Mulliner & Maliene, 2015]
		SS108	Proximity to government establishment	[Pollard, 2010; Talen & Koschinsky, 2011]
		SS109	Proximity to private establishment	[Pilot survey]
		SS110	Availability of public transportation	[Acolin & Wachter, 2017]
		SS111	Major access road	[Acolin & Wachter, 2017]
		SS112	Minor access road	[Acolin & Wachter, 2017]
	Non-Housing Consumption	SS201	Ability to sustain other day to day cost of living	[Stone, 2006]
		SS202	Social cohesion	[Mulliner et al., 2013; Chiu, 2003]
		SS203	Safety/Security (reduced incidence of crime)	[Wiedmann, et al., 2016]
		SS204	Fire safety	[Pilot Survey]
		SS205	Effective management and maintenance of properties	[Charoenkit & Kumar, 2014; Azevedo et al., 2010]
		SS206	Cultural and heritage conservation	[Chiu, 2003; Muazu & Oktay, 2011]
		SS207	Religious affiliation	[Muazu & Oktay, 2011]
		SS208	Sense of community	[Chiu, 2003; Dempsey et al., 2012]
		SS207	Community participation	[Ross et al., 2010]
		SS210	Minimize social segregation	[Chiu, 2003; Ross et al., 2010]
		SS211	Tenure security	[Azevedo et al., 2010]
		SS212	Equitability and fairness of housing distribution	[Chiu, 2003]
		SS213	Social acceptability	[Pullen et al., 2009; Chiu, 2003]
		SS214	Increased consciousness of environmental protection	[Myerson, 2007]
	Architecture and Innovative Design	SS301	Aesthetic views	[Maliene & Malys, 2009; Gan et al., 2019]
		SS302	Suitability/Appropriateness	[Ibem & Aduwo, 2013]
		SS303	Clean and Attractive	[Maliene & Malys, 2009]
		SS304	Cosy and Comfort (from the social–psychological point of view)	[Maliene & Malys, 2009]
		SS305	Type of building (Apartments, condominiums, semi-detached etc).	[Tibesigwa et al., 2017; Babalola, et al., 2019]

		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	[[Dempsey et al., 2012; Isalou et al., 2014]
		SS314	Presence of heating system	[Pilot Survey]
		SS315	Number of bedrooms	[Pilot Survey; Aliu et al., 2018]
		SS316	Floor spaces	[Pilot Survey]
		SS317	Accessibility	[Pilot Survey]
		SS318	Number of Fireplace	[Pilot Survey]
		SS319	Housing quality/adequacy e.g. meeting decent home standards	[Gan et al., 2017;2019; Babalola, et al., 2019]
		SS320	Lighting quality	[Pullen et al., 2009; Winston & Montserrat, 2007]
	Household Characteristics	SS401	Age groups	[Mulliner & Maliene, 2015; Babalola, et al., 2019]
		SS402	Household size	[Mulliner & Maliene, 2015; Babalola, et al., 2019]
Environmental (Ecological) Sustainability	Presence of Environmental Problems	EN101	Noise pollution	[Mulliner et al., 2013; 2016]
		EN102	Water pollution	[Mulliner & Maliene, 2012]
		EN103	Air quality (Indoor and outdoor)	[Chiu, 2003; Winston & Montserrat, 2007]
	Efficiency	EN201	Waste management e.g. level of recycling, reuse, composting	[Choon et al., 2017; Ross et al., 2010]
		EN202	Use of appropriate materials	[Hashemi, et al., 2015,Atolagbe & Fadamiro, 2014]
		EN203	Energy efficiency	[Ross et al., 2010; Roufechaei et al., 2014]
		EN204	Land-use efficiency	[Charoenkit & Kumar, 2014]
		EN205	Reduced footprint	[Nissinen et al., 2015; Ross et al., 2010]
		EN206	Thermal comfort	[Gan et. al., 2017]
		EN207	Minimized biodiversity loss	[Pullen et al., 2009]
		EN208	Disaster resilience	[Azevedo et al., 2010; Charoenkit & Kumar, 2014]
		EN209	Mixed land using	[Dempsey et al., 2012]
		EN210	High housing density	[Charoenkit & Kumar, 2014; Dempsey et al., 2012]
		EN211	Water efficiency	[Ross et al., 2010; Roufechaei et al., 2014]

Economic (affordability) sustainability	Affordability benchmark	ES101	House price in relation to income	[Mulliner & Maliene,2015;Ezennia&Hoskara,2019]
		ES102	Rental price in relation to income	[Mulliner & Maliene,2015;Ezennia&Hoskara,2019]
		ES201	Availability of rented housing (social and private)	[Mulliner & Maliene, 2015; Chan & Adabre, 2019]
		ES202	Availability of low-cost shared ownership products (shared housing)	[Mulliner & Maliene, 2015; Chan & Adabre, 2019]
		ES203	Availability of market value home ownership product	[Adabre & Chan, 2019; Mulliner & Maliene, 2015]
	Mortgage Finance and Initial Deposit	ES301	Financial viability	[Chiu, 2003; Turcotte & Geiser, 2010]
		ES302	Tenure security	[Mulliner & Maliene, 2015]
		ES303	Interest rates	[Mulliner & Maliene, 2011]
	Affordability Criteria	ES304	Economic trends/Cost effectiveness	[Isalou et al., 2014; Evans, 2014]
		ES305	Desirability	[Pullen et al., 2010]
		ES306	Taxation influences	[Gan et al., 2017]
		ES307	Family income level	[Mulliner & Maliene, 2012]
		ES308	Provide human resource for economic development	[Muazu & Oktay, 2011]
		ES309	Employment opportunities	[Golubchikov & Badyina, 2012]
		ES310	Ensure balanced housing market	[Fuhry & Wells, 2013]
		ES311	Reduced energy bill	[Isalou et al., 2014]
		ES312	Reduced transportation cost	[Roufechaei et al., 2014]
		ES313	Reduced life cycle cost	[Mulliner & Maliene, 2015]

5.6 Chapter Summary

This Chapter demonstrated that uncovering diverse and wide-ranging criteria influencing housing affordability of urban households takes a critical role in enhancing the quality of life, quality of housing layout and environment. It discussed the concept and broader criteria apposite to sustainable housing affordability, which transcends mere economic terms widely adopted in assessing housing affordability, to wider issues of social wellbeing and sustainability.

Chapter 6

ANALYTICAL TOOLS AND TECHNIQUES USED AND RESULTS OF EMPERICAL ANALYSIS

This chapter presents the research methodology employed in the empirical study. It describes and justifies the methods and processes of data collection, sampling, questionnaire administration. It presents the various stages and phases that were undertaken during the course of this empirical analysis. The chapter describes the research design, target population, data collection technique and methods of data analysis.

6.1 Quantitative Research Method

Quantitative research is 'objective' in nature. Naoum (2007) defined it as an inquiry into a social or human problem, based on testing a hypothesis or a theory composed of variables, measured with numbers, and analyzed with statistical procedures, in order to determine whether the hypothesis or the theory hold true. Naoum (2007) further outline the circumstance upon which Quantitative research is selected as:

- When you want to find facts about a concept, a question or an attribute.
- When you want to collect factual evidence and study the relationship between these facts in order to test a particular theory or hypothesis.
- Data collecting techniques included interviews and actual physical measurements of the phenomena such as weight, height, ages, and duration of projects.

6.1.1 Data Collection

This thesis comprised an extant review of literature that enabled the assemblage of a comprehensive set of SPC for sustainable housing affordability. All together 81 SPC was identified from literature review (Table 21), with the first objectives to establish the SPC criticalities from the urban households' view point. Then, finding out the discrepancies (if any) amongst participants based on income group and region of residence on the ranking of the identified CSPC. Finally, classification of the identified CSPC into underlying categories.

The respondents' background data was demanded in the Section A of the questionnaire. Background questions was asked in order to form filters, this enabled 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. Before further analysis is performed on subsequent data, it is imperative to determine the reliability of the responses. On Section B respondents were asked to assess the 81 SPC criticality through a 5-point Likert Scale of 1-5 as follows: 5 = Very critical; 4 = critical; 3 = slightly critical; 2 = less critical and 1 = least critical; which reflects the importance of sustainable housing affordability indicators from the urban households' view point. The adoption of this scale was due to its relative brevity. Interestingly, at the end of the 81st SPC spaces were available for respondents to rate and list the criticality of other SPC for sustainable housing affordability. This resulted in the addition of extra 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.

6.1.2 Sampling Frame

Ethical approval was obtained from the relevant university's Ethics Committee before proceeding with the study. The sampling frame employed in this thesis is the Population and Housing Census of the Federal Republic of Nigeria (NPHC), which was conducted in 2006 by the National Population Commission (NPC). Administratively, Nigeria is divided into states. Each state is subdivided into local government areas (LGAs) and each LGA is divided into localities. In addition to these administrative units, during the 2006 NPHC each locality was subdivided into convenient areas called census enumeration areas (EAs). Although the 2006 NPHC did not provide the number of households and population for each EA, population estimates were published for more than 800 LGA units.

6.1.3 Population of the Study

A population can be defined as the complete set of subjects that can be studied: people, objects, animals, plants, organizations from which a sample may be obtained (Shao, 1999). Simply put, population is the entire group or set of cases that a researcher is interested in generalizing. Therefore, the population of this study constitutes all the households/residents, living in the study area. According to the Demographia's "World

Urban Areas" study (2019) the population of persons in the 24 Urban areas in Nigeria 1s 45,269,000, while the Household population by five-year age groups, sex, and urban residence according to the Nigeria Demographic and Health Survey (2003 NDHS) was 11,887. The distribution of households by urban areas in Nigeria is presented in Table 22.

Table 22: 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

6.1.4 Sampling Technique

The term ‘sample’ means a specimen or part of a whole (population) which is drawn to show what the rest is like (Nauom, 2007). The techniques/Strategies for determining sample size according to Glenn (2013) are;

- Using of census for a small population;
- Using a sample size of a similar study;
- Using published table; and
- Using a formula to calculate the sample size (e.g. Taro Yamani Formular).

However, Cochran’s sample size calculation procedure was employed to determine the appropriate sample size in this study. This gave a sample size of the respondents for this study as 2,584. In choosing the population frame for the respondents and households for this study, the primary data collection was through the convenience sampling technique. In convenience sampling, the administration of questionnaire survey is targeted at accessible, available, and willing respondents (Sekaran & Bougie, 2010). 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 (Sekaran & Bougie, 2010). The case study utilizes data obtained from two questionnaire surveys conducted between January and June 2019, targeted at 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 1,315 participants in the survey, collected by three approaches;

6.1.5 Questionnaires Design and Administration

The questionnaire was constructed along the major themes (i.e. research questions and objectives, please Appendix E) in order to facilitate the process of collecting data relevant to the study:

1. Household characteristics (age, family size, house ownership, education level, household's occupation) These factors influence the capacity of households to cope with, resist and recover from the problems of housing affordability.
2. Experience of housing affordability - frequency of running in and out of housing affordability problems in the study area for past 10 years.
3. Socio-economic conditions of households.
4. Factors contributing to sustainable housing affordability.

The questionnaire was made up of two sections: A & B. Section A dwelled on personal data of the respondents and other general questions while section B addressed the issues of sustainable housing affordability. Generally, the questions were closed ended questions and presented in rating & Likert-scale format. The rating and/or Likert-scales were presented in 5- point. The common set of responses were presented in

Table 23. The wording of the questions was kept simple and straightforward so that they could easily be understood by the respondents.

Table 23: Likert-scale Responses and Meanings

Scale	Meaning		
1	Very unsuitable	Strongly Disagree	Very Poor
2	Unsuitable	Disagree	Poor
3	Indifferent	Indifferent	Indifferent
4	Suitable	Agree	Good
5	Very suitable	Strongly agree	Very Good

From these options in option/scale in Table 23, the respondents were expected to tick the most suitable option for each question. The questionnaires were distributed and administered by the researcher and his assistants through the following means.

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 1,864 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 weblink 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 3,036 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.

6.2 Method and Instrument for Data Analysis

From the data collected, the data were analyzed to determine the direction of the study. Data obtained from the literature was analyzed using content analysis, that is, presenting who say what, to whom, why, to what extent and with what effect in the quantitative or qualitative manner. The techniques or processes involved in this analysis are:

a) Documentation of the data and the process of the data collection.
b) Organization/categorization of the data into concepts.
c) Connection of the data to show how one concept may influence the other.
d) Corroboration/legitimisation by evaluating alternative explanation, disconfirming evidence and researching for negative cases.
e) Representing the account (reporting the finding).

On the other hand, the analysis of data obtained through questionnaires were categorized into descriptive and inferential statistics. The descriptive statistics employed include the use of frequency tables, charts, mean and standard deviation while the inferential statistics used were the Pearson product moment correlation, one-sample and independent t-test, z-test, and Principal component and factor analysis. The benchmark for judgment was placed at 95% confidence interval which in other words

is 0.05% level of significance. All analyses were done using Statistical Package for Service Solution (SPSS) version 25.

6.3 Validity and Reliability of the Instruments

Validity and Reliability are used to ensure that the research outcome is accurate and credible. Validity is the degree to which a thing measures what it tends to measure. That is, it is the extent to which the results of a study can be verified against its objective (Okolie, 2011). On the contrary, Okolie (2011); Anol (2013) defined reliability, as the degree to which the measure of a construct is consistent or dependable. That is, the degree to which the findings of a research are independent to accident circumstance. Simply, reliability measures consistency and not accuracy.

The instrument especially the questionnaires and interview guide were subjected to content validity test by distributing the instrument to the project supervisor and some key professional in this field of study to validate the questions. Also, a pilot survey was carried out to check for ambiguities in the questions, and on the potential list of SPC for sustainable housing affordability. The reason for this procedure was to test the significance and the comprehensiveness of the potential SPC. One affordable housing district was used in the pilot study involving low- and medium-income groups, who had experienced or experiencing housing affordability stress. The respondents were asked to evaluate if the criteria list included adequate number of performance criteria and whether additional possible critical performance criteria could be added or removed from the list. From this, Cronbach alpha test and coefficient of concordance was carried out to determine the consistency of the questions and consistency of the opinion of the respondents respectively.

6.4 Results of Empirical Survey

6.4.1 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;

$$\bar{x} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i} \quad \text{(equation 1)}$$

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;

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

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 ≥ 3 independent populations is estimated as;

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

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.

Factor Analysis: Principal Component Method

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;

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

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

6.4.2 Respondents Profile: Socio-Economic Characteristics

The socio-demographic characteristic of the respondents in Table 24 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 show that a total of 543 representing 21.5% of the respondents are home-owners; 1,243 (49.2%) reside in 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 N100,000 (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 5kilometers away from the respondent's residence.

Table 24: 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
	Less than 2 Km	1867	73.9

Distance from house to religious places	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
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

6.4.3 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 25, 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 (Ibem et al., 2013; Obiadi et al., 2019) largely because of the high cost of housing units offered (Iwuagwu & Iwuagwu, 2015). Turok, (2016) 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).

Table 25: Opinion Poll of Respondents Housing Affordability Stress Experience

Question items	SA (%)	A (%)	I (%)	D (%)	SD (%)	$\bar{\bar{X}}$	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:							
Constraint (e.g. illness or serious injury, unemployment).	925 (36.62%) 898 (35.55%)	1010 (39.98%)	470 (18.61%) 301 (11.92%)	113 (4.47%) 28 (1.11%)	8 (0.32%) 1 (0.04%)	2.91	1.676
Choice (e.g. more desirable location, larger house).	290 (11.48%)	1298 (51.39%)	70 (2.77%)	925 (36.62%)	1005 (39.79%)	4.21	0.691
Others factors		236 (9.34%)				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: Researchers Field Survey (2019)

6.4.4 Ranking of Sustainable Housing Affordability Criteria Based on Households Opinion

A total of eighty-one (81) list of criteria apposite to sustainable housing affordability were extracted from literature. These 81 set of potential criteria comprises of nineteen (19) economic sustainability criteria, forty-eight (48) social sustainability 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 26 below;

Table 26: Ranking of the Comprehensive List of Potential SPC representing Sustainable Housing Affordability

Potential Sustainability Performance criteria	Code	$\overline{\overline{X}}$	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
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

6.4.5 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 27 below. These criteria which are considered most critical by the household respondents form the target for further analysis in this study.

Table 27: 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

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.

6.4.6 Comparison Analysis 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, (2015) 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, (2015) at 15th position. Stakeholders did not consider safety at all amongst the top 20 criteria in Gan et al., (2017) 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, (2013) 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 28 presents other comparison results of the top 20 critical criteria as adjudged by industry professional, stakeholders and households.

Table 28: Comparison Analysis of Household Views with Industry Professionals and Stakeholder's Opinion on the first 20 Criteria apposite to Sustainable Housing Affordability

Criteria Ranking	Subjective Opinions		
	Industry Professionals (Mulliner & Maliene, 2015)	Stakeholders (Gan et al., 2017)	Households (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	Reduced transportation cost

		management of properties	
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

6.4.7 Household Perceptions Based on the Geopolitical Region and Income Group

Test of Hypothesis: In order to compare group differences so as to answer the research questions and hypothesis shown in Table 29; the Kruskal-Wallis test was adopted.

Table 29: Research Questions and Hypothesis

Research Questions	Research Hypothesis	Groups Compared
Do household respondents residing in different regions in the study area have differing opinions on criteria importance	Is there any significant difference in the households' opinion on the evolving concept of housing affordability and the criteria representing sustainable housing affordability based on geopolitical zones in Nigeria?	Region of residence
Do the opinions on criteria importance vary based on the respondent's income group (e.g., low or medium income)?	Is there any significant difference in the households' opinion on the evolving concept of housing affordability and the criteria representing sustainable housing affordability based on the respondents' income group in Nigeria?	Income group

6.4.8 Households Geopolitical Region of Residence in Nigeria

From the ranking statistics across the six (6) geopolitical regions in Nigeria, as presented in Table 30, 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.

Table 30: Comparison of Criteria Importance by Geopolitical Region

	NE (n=265)		NW (n=184)		NC (n=399)		SE (n=740)		SW (n=397)		SS (n=541)		All (N = 2526)	
Code	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

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 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.

6.4.9 Household Income Group

The variation in the average rankings of criteria importance based on the participant's income group is as shown in Table 31. 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.

Table 31: 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

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.

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 32 presents the 21 criteria importance and their respective comparison result using the Kruskal-Wallis H test technique.

Table 32: 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)

The result in Table 32 indicates significant variations in household rankings of the factors at 5% level of significance. Table 33 shows the key criteria importance as extracted using principal component method of factor analysis.

Table 33: 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.					

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 Figure 11.

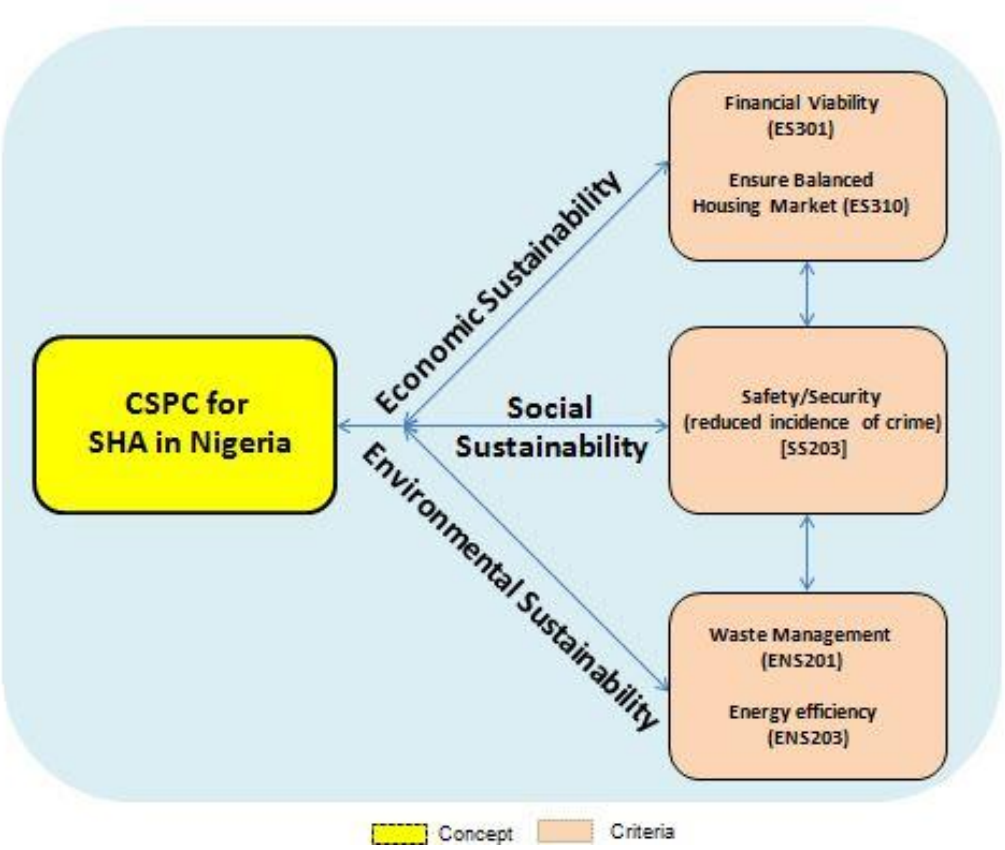

Figure 11: Framework for Achieving Sustainable Housing Affordability in Nigeria

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.

6.5 Chapter Summary

This chapter presented the research methodology employed in the empirical study. It described and justified the methods and processes of data collection, sampling, questionnaire administration. It presents the various stages and phases that were undertaken during the course of the empirical analysis. The chapter described the research design, target population, data collection technique and methods of data

analysis. The Chapter argued that households have distinct and unique views on the criteria system when compared to the industry professionals and stakeholder's opinion. Results of this Chapter revealed that household views on these issues differ significantly across the six geopolitical regions of Nigeria, while no significant difference exists based on income group. This Chapter posits that at present the housing affordability concerns in Nigeria cannot be restrictedly defined by financial attributes.

Chapter 7

DISCUSSIONS AND CONCLUSION

The findings from the systematic literature review and the results of the questionnaire analysis, as well as the hypotheses, which are mentioned under Chapter 1, are discussed in this Chapter.

7.1 Discussions based on Literature Review Findings

The literature findings revealed several conceptual irregularities of HA definitions which exists in most references included in this study. However, whether explicitly or implicitly defined, or formulated methodically on an operational basis, such as, loan/rent/mortgage to income ratio, the vital constituents of the definitions like monthly rent or gross monthly income differ considerably, depending on the context, research objectives and data available. An accurate definition and measurement of HA would inform appropriate policy intervention, but a narrowly construed definition would promote other agendas with little interest in affordability.

Furthermore, several HAMA have been developed by researchers, and applied in varied situations over the last few decades building on past research findings, in an attempt to influence policy responses more precisely. Some of these approaches like the ratio measures are often utilized due to their ease of computation, and appeal to peoples' common-sense experience; since they generally require data on housing cost and income. However, some others are underutilized due to their high subjectivity demand or complexity. It is notable that, except for the emerging innovative

approaches, many of the other measures do not consider household size, transportation cost, housing choice and household preference. They erroneously assume that there are no distinctions between household and household characteristics. In addition, most approaches experienced similar nature of development and modification, for instance, the transition of the income ratio measures from housing expenditure and income ratio to loan/mortgage/rent and income ratios; as well as the innovation of residual measure, amongst others. In recent years, due to the observed weaknesses of prevalent approaches, researchers began combining different methods of HAMA. It was also observed from literature that in identifying problems of affordability, the results of several HAMA are weakly correlated when applied independently to the same problem of same time frame. But a strong level of congruity has been reported on affordability results when they are combined. This combination of multiple approaches is intended to check the weaknesses that are preponderant in certain approaches, especially in normative measures and to further enhance the reliability of measurement outcomes.

It is believed that the modified approaches, along with some approaches in their original form, can reach "extreme heights of success" in their application (Sarı & Khurami 2018), that is, can lead to more accurate measurement outcome e.g. ratio, residual, and subjective measure combinations, amongst others, if proper evaluations of their strengths alongside their weaknesses are conducted. More so, the recent realization by researchers for the need to consider the multiple dimensions of affordability stress, such as social and ecological dimensions as well as economic dimension have allowed more complex (innovative) methods to emerge and earlier ones, modified. Thus, offering new insights into the HA concept. As summarized and presented in Table 3, this study identifies the commonly and scarcely used as well as the emerging innovative approaches for measuring HA. It also determines their

applicability in a particular circumstance by examining which strengths and weaknesses that are prevalent in each approach. Other range of issues involved in undertaking HA assessment was expounded upon, in order to avail researchers with multiple choice of several types and caveats of concern to the validity of measurement approaches for solving specific affordability burden, housing stress and calculating areas for affordable housing development. However, the determination of the most appropriate affordability measurement approach could be influenced by the description of research objectives, the orientation of the researcher, policy guidelines and available data. The assessment of HAMA performed in this review offers a framework on how these approaches could be applied in specific circumstances.

In summary, the systematic literature review performed in this thesis could be considered as an attempt for the generation of further and evolving discussions within housing affordability research domain, which would ultimately lead to a clearer and more holistic insight into the dynamic nature of housing affordability. It could also inspire a renewed research agenda for conceptual refinement and the development of more assessment methods that can draw closer links with sustainability principles by taking into account the social, environmental and economic criteria that impact on the quality of life of households.

7.1.1 Overview on Discussions based on Literature Review

This research reviewed studies published in 18-year period (2000–2018) regarding HAM approaches in 47 high impact journals indexed in Web of Science database system. It systematically reviewed studies relating to HAMA and applications. Consequently, 160 publications regarding HAMA were carefully and systematically selected. Based on the predefined objectives of this review, selected articles were summarized based on title, abstract, introduction, methodology and conclusion. In this

survey, the results obtained were acquired in line with six research questions, which are:

RQ1: Which HAMA have been used?

The review reveals the existence of a high number of HAM approaches and all of the identified methods can be applied in addressing one, more or other variants of affordability problem. Results collected also show that all HAM approaches are conceptually very similar, but little variations make each class more suitable for different applications. To answer question one, the results presented in Table 4 is considered. It shows the number and percentage of the identified HAMA. The table also shows that the econometric/regression modeling was the first in ranking amongst other methods with 59 studies, while ratio-based method was ranked second with 38 articles.

The growth in application of econometric/regression modeling could come from convenience, simplification justification and conventionality; instead of sound theoretical mathematical or logical justification or as more robust and accurate method. It was also observed that the mobility and probability plot (MPP) and data envelopment analysis (DEA) had 2 articles each; while scenario technique is the least method in use with 1 article. These could be as a result of their complexity, heterogeneity, and econometric expertise requirement, which may have weakened their uptake and loss of traction amongst researchers and planners.

RQ2: What type of study has been performed on these HAM approaches?

The authors read carefully the methodological aspect of individual studies and classified them into three types, in order to answer this second question. According to these readings, some articles utilized already established HAM approaches to analyze

affordability problems. Relying on discussions held with four housing affordability experts and authors' experience, this type of studies was classified as HAM approach utilizing research. Attempts were also made by some scholars to develop or modify HAMA. Thus, HAMA developing research was used as the second type of study. In addition; some researchers proposed new approaches which was considered as the third type of study and was called HAMA proposing research, as indicated in Table 34.

Table 34: Distribution of Articles based on Research Type

Type of Research	Number of Articles	Percentage (%)
HAM utilizing research	124	78
HAM developing research	19	12
HAM proposing research	17	10
Total	160	100

Source: Researchers Summation.

RQ3 & RQ4: Which of the 6 domains/fields has used these HAMA approaches more; and which types of HAM approaches have been applied over 18-year period based on 6 domains/fields?

Chapter 4.9 and Tables 11 – 18, 19 presents the answers to questions three and four. These tables reveal that out of selected 160 articles, HMMA was ranked first with 54 studies (33.75%), many of the studies categorized in this area either developed or improved HAM approaches. Furthermore, out of the 6 application fields/domains, the RHA was ranked second with 35 articles (22.29%). More so, Table 4 results shows that prior papers used the econometric/regression modeling more as compared to other methods with 59 articles in these 6 applications fields/domains. The ratio-based

method and composite method were second and third in rank with 37 and 18 articles respectively. Moreover, subjective method and residual income method had the fourth and fifth rank with 16 and 12 articles respectively. In addition, MPP (2 articles), MCDM (3 articles), and DEA (2 articles) had next subsequent ranks according to the findings in Table 4.

RQ5: Which journal published articles regarding these HAM approaches?

The answer to question number five is presented in Table 23. It can be observed from this table that out of 47 journals; the journal of Housing Studies was ranked first with 28 articles. Based on this result, International Journal of Housing Markets and Analysis and Housing Policy Debate are the second and third ranking, with 17 and 13 articles respectively. The Urban Policy & Research Journal was ranked fourth with 11 articles, in other journal ranking. The total numbers of publications of other journals are presented in Table 23.

RQ6: What year did authors publish most papers regarding HAM approaches based on the 6 domains/fields?

Important evidence is illustrated in Figure 7 regarding the distribution frequency of relevant articles according to publication year. The result of this Figure reveals a dramatic growth in the information regarding the use of HAM approaches from 2000 to 2018. Based on this section finding, the usage of approaches in 2000; 2001, 2002 and 2003 was two articles respectively, and it grew to 6 articles in 2006. As from 2006 researchers began proposing and developing new HAM approaches; which is a result of better understanding of diverse (economic, social and environmental) dimensions of housing affordability and obvious weaknesses in the well accepted normative

measures. Table 34 shows that from 2006 to 2018 a total of 19 HAMA was developed and 15 proposed.

7.2 Discussions based on Empirical Findings

The quantitative survey performed in Chapter 6 Section 6.4 presents the analysis of 2,526 questionnaires, under taken with households residing in 26 urban areas in 6 geopolitical regions of Nigeria. The survey allowed the researcher to determine 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 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 astonishing, 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 (Li, T., et al, 2018). It is worthy of note that a very high rank of importance (5th) of criterion "Ensure balanced housing market" reflects Baranoff,

(2016) 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, (1988) 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 et al., (2019) 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 (Abolore, 2012; Makinde, 2017).

Given that researchers of diverse orientation have employed different interpretations in housing affordability analysis (Makinde, 2014), non-parametric statistics was used in the questionnaire data analyses. The reason was to determine whether there are significant differences in opinions of 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 (Aliu et al., 2018) and increasing rates of hostilities reported in the North East and North West regions than in other parts of the country (Apuke & Tunca, 2019).

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., (2005) 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 (Maina, 2013); poor solid waste management system (Oguntoyinbo, 2012), problems of open/recreational space delivery and management (Officha et al., 2017), spatial variations in housing quality (Morenikeji et al., 2017), and improper utilization of natural resources available in the housing environment (Ogunde et al., 2018) as well as low user participation in housing delivery processes in Nigeria (Ibem & Amole, 2013) amongst many others.

7.3 Conclusion

Housing affordability problem is a crucial issue affecting several cities across the globe in both developing and developed countries. An extended systematic review of housing affordability literature over an 18-year period (2000 – 2018) revealed that housing prices are becoming too expensive and extremely difficult for households with

limited resources to acquire adequate housing. Measuring housing affordability dates back more than 40 years, since 1970's. During this timeline a huge number of approaches were developed by researchers of diverse orientation, leading to what has been referred to as 'methodological chaos' and according to Wilcox (1999) a 'vexed' concept (as cited in Lee & Reed, 2014). This is reflected in the fact that HA literature reveals an abundance of differences and at times contradictory definitions, concepts, techniques and methodological ideas about housing affordability.

Therefore, this research recommends that the immediate need for the future of housing affordability literature is amongst other things to resolve the confusion over 'the definitions/concepts and measurement approaches/methods/techniques of housing affordability analysis. This thesis makes a beginning at this need by tracing the origin, theoretical underpinnings and growth of HAMA; as well as the subsequent evolution of the various methodologies. A classification of the methodologies into three main approaches is provided and the salient characteristics (weaknesses and relative strengths) of these approaches are compared and contrasted.

Moreover, this thesis did not include methods developed and applied in books as well as housing affordability indexes (HAI) developed and applied by housing professionals and associations. However, it is worthy to note that the studies reviewed in this paper allow at least a partial representation of the structure of those HAM approaches, which are attracting wider application and acceptability. Recently developed modular and hybrid methods are becoming increasingly important such as location-sensitive residual income (LSRI) method. Which are based on previously established and well-accepted normative methods, and their modification, as well as the combination of several other affordability indicators to formulate an aggregated

measure. Relatively, recently adapted MCDM and DEA methods, in addition to newly developed MPP method were speedily developed and used to address reoccurring problems of affordability. Although there is insufficient evidence in the studies using these emerging methodologies, due to their complexity, reporting technique and heterogeneity. However, they may be effective and efficient methods for measuring housing affordability problems of low-income families. To most effectively assess the potential benefits of these methods, it will be important for future research to utilize these novel methodologies. Thus, it will be necessary for future reviews to publish on these issues.

This research revealed the lack of consensus on the most appropriate approach. However, the best method can be obtained by analyzing the various weaknesses and strengths inherent in each method. Researchers and policy makers must be detailed about which HAMA they adopt, why they adopt it, and if the method being adopted is appropriate for its purpose. The study then calls for continued conceptual refinement and further development of more appropriate approaches that could better consider the multi-dimensionality inherent in HA problem. The issues discussed in this thesis will assist in formulating techniques that can be used in measuring housing affordability in a sustainable manner. Measuring housing affordability transcends housing price and income terms. Therefore, an ideal HA metric must take into consideration a range of social, environmental and economic criteria; which borders on the broader concept of housing appropriateness covering accessibility, affordability, amenity and adequacy, that impact on residents' quality of life. This will ensure that both sustainability and affordability concerns are tackled concurrently in any HA analysis. It is hoped that this research will inspire future studies to establish a broader housing affordability concept and metric that is better aligned with sustainability.

Since MCDM method fairly takes into account the dynamism of housing affordability indicators, which addresses the major measurement weaknesses in the conventional approaches. Though there are insufficient studies that employ the MCDM method due to its complexity, reporting technique and heterogeneity. It may be an effective and efficient method of measuring housing affordability problem. Therefore, to effectively explore the potential benefits and validate the soundness of this emerging novel method, future studies and policy makers are encouraged to utilize it.

In furtherance, many criteria influence housing affordability and recent studies emphasized the need for reconsideration in the way housing affordability is assessed and conceptualized. From this thesis, 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 (Makinde, 2017; Teck-Hong, 2012) 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.

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 in order 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 none family 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.

7.4 Research Recommendations

This research, as earlier stated serves as a precursor for more studies in this research domain. Therefore, this research recommends that further studies should;

1) Based on research findings, the study recommends that future studies should include temporal and historical perspectives while answering salient research questions like: (a) What difference are there between approaches and methods published in the early 2000s, and those of recent decades? (b) What changes are observed in this field within the last 18 years? Such a historical context may throw more light on the repackaging or recycling of older methods (e.g. residual income method into "new" ones, e.g. location-sensitive residual income [LSRI] method). In this view, understanding how models and concept evolve over time and how these trajectories reshape and change housing affordability concept over the years would be of immense international interest.
2) This study recommends periodic assessment of household views on the CSPC as such a subjective perception is characterized by instability over time.

7.5 Implications for Practice and Research

The practical purposes of the study are;

1) The challenges of operationalising robust approaches (aside ratio-based measures) as affordability standard with respect to their onerous data and expertise requirements, constrain their applicability, especially in most developing countries, where availability of reliable data is a persistent challenge. The implication for research is therefore evident in the need to evolve a housing affordability metric that can reflect the practices of housing market system in developing countries. This also implies that the governments in developing countries must set up machineries for regular availability of up-to-date data on welfare and establish welfare systems that set minimum living standards.
2) The study's policy implication is that the views and perceptions of households should be routinely assessed and drives the delivery of affordable housing.

The theoretical purposes of this thesis are;

1. To guarantee that households are contented with the houses and that "reasonable" profit margin is made by developers.
2. It makes available quantitative data to further the arguments and debates on the criteria system for sustainable housing affordability.
3. The thesis weighs the level of understanding of urban households on the criteria system representing sustainable housing affordability.

7.6 Research Contribution

This study makes the following contributions to the international housing affordability literature.

1. It developed a classification scheme of HAMA that is based on the frequency of application and developmental trends.

2. It structurally reviewed existing literature to guide the research on HA concept and measurement.
3. It identified several approaches and weaknesses of HAMA; as well as suggested techniques that can be effectively used to improve different HAMA.
4. It identified issues of interest to be undertaken by future studies. This study will be a guide for improving HAMA, as well as aid policy makers in shaping policy framings and informing on appropriate housing policy direction.
5. This study satisfies early-career researchers' need for an easy reference to HAMA studies and publications.
6. This study developed a classification scheme focused on structurally reviewing of literature to reveal guide for further research, proposed themes for future studies and, practical considerations of HAM approaches.
7. Two new perspectives were considered in this study, namely categorization of studies in 6 fields/domains and evaluation of the study type (HAM utilizing study, HAM developing study and HAM proposing study).
8. This study provides further methodological and empirical evidence on the various application areas of different housing affordability measurement methods at the planning level.
9. By bringing a wide collection of scholarly papers on HAM approaches over a relatively long period (from 2000) and presenting the state of art (2011-2018) methodological developments in housing affordability measurement under a single platform, this review makes a valuable contribution to international housing affordability literature.
10. The classification framework provides architects, planners and researchers with insights and guidelines for future effective research relating to HAM

approaches and applications. These insights as provided by this thesis can help direct research efforts, and satisfy planners and early-career researchers' need for an easy reference to HAM studies and publications.

11. The systematic approach of the literature review extends prior survey attempts in this field. It heeds to the call of Xiao & Watson (2019) on the need to adopt rigorous systematic reviews in the field of planning. Regarding this, the researchers' adoption of PRISMA as a reference methodology improved the rigor and quality of the literature review. Consequently, it unraveled new dimensions in the housing affordability phenomena and promotes measurement methods that were recently adopted from other research areas (e.g. MCDM from operations research). Thus, this thesis has contributed in establishing HAMA as a sub-area within architecture and planning research (planning for housing).
12. This thesis provides a repository of extant empirical evidence on HAM, for scholarly use in developing new theories and methods.

In furtherance, from the empirical survey this thesis makes the following research contributions;

13. The research findings fill the knowledge gap in the housing affordability literature as identified by Mulliner & Maliene, (2015) and Chan & Adabre, (2019) through the analysis of the households' opinion on criteria importance and providing a comprehensive as well as a holistic set of indicators representing sustainable housing affordability.
14. This thesis proposed a framework for achieving sustainable housing affordability in the study area through the established and validated CSPC as evaluation criteria.

15. This study also employed larger respondents as compared to similar studies on this subject and utilized higher statistical tools. This enhanced the statistical rigor and enabled an in-depth comparison as well as the determination of statistical differences within the views of households based on groups and present residence in the 6 geopolitical regions of Nigeria.
16. Fourth, architects, developers, government agencies and international organizations can depend on the salient information passed by this study to allocate resources in delivering sustainable affordable housing.
17. The established CSPC can aid policy makers in determining suitable locations for affordable housing programs. In the same manner, these CSPC can be useful to potential households and future affordable housing applicants in identifying the most energy efficient housing facilities and the best affordable location when making a choice of housing that could be deemed affordable.
18. Assessing households' views on the criteria representing sustainable housing affordability revealed other important indicators that would have been ordinarily neglected by other assessment exercise like industry professionals and stakeholder's perception analysis.
19. Utilizing the established CSPC from this study, policy makers can easily evaluate the performance rate of affordable housing programs and possible improvement policies to minimize housing abandonment.

7.7 Literature Gaps and Suggestions for Future Research

1) There is a dearth of research focus comparing HA issues between developing and developed economies, and the appropriateness of applying normative measures in developing economies. Almost no study in the last decade compared the distinctive approaches of affordability except partly for Sunega

& Lux, (2016) and Sarı & Khurami, (2018), who compared and/or combined the objective and subjective affordability measures.

2) The literature review affirms the dominance of the IRM despite the overwhelming weaknesses except for RIM in a few quarters. Other measures are yet to gain traction amid academics, researchers and analysts. The remote and immediate causes of these disparities beg for attention.
3) More studies are encouraged to utilize the emerging methodologies advocated by this study in different regions and context for a revalidation of the benefits attributed to it. Furthermore, future studies are encouraged to research on newer approaches that can utilize and incorporate the strengths of other approaches, while addressing or altogether eradicating their weaknesses.
4) A number of approaches were studied in this review, as individual methods and which can be combined or integrated with other methods. However, some HAM approaches have been understudied and rarely applied (e.g. Behavioral and Subjective methods). Future research on this subject should investigate on the distinct similarities and differences among HAM approaches.
5) Although the literature suggests that incorporation of different affordability indicator and a combination of several methods can improve measurement results, there is a dearth of empirical research conducted with this approach, particularly in a developing country context.
6) Due to deeper understanding of the multi-dimensionality of affordability problem and the wider uptake of robust methodologies from other research fields (e.g. MCDM, DEA, MPP), more current empirical evidence is needed to strengthen their suitability in housing affordability research.

7) No study used the quality adjusted method to estimate any of the 6 domains/fields of housing affordability problem, which focuses on appropriateness and quality of housing (decent, safe and sanitary). This method supports sensitivity analysis and enables the measurement of affordability while applying multiple concepts for the standard unit. Theoretical basis for comparing inter- and intra-city is made possible, given that it supports the definition of the standard unit by deploying several attribute packages in line with the regionally different levels of development. There is a need to test the strength of this method.
8) The affordability measurement criteria that constitutes' various approaches neglect the effect of housing supply, and fail to take into account the heterogeneous behaviors of individuals amidst the same group of income. Future studies are encouraged to develop or propose methodologies to cater for these weaknesses.
9) Affordability measurement has been dominated by quantitative approach (e.g. normative measures) the feasibility of qualitative approaches (e.g. subjective and behavioral methods) is research worthy.
10) It is evident from the literature that housing affordability studies dealing with measuring access to homeownership have either focused on housing markets where homes are usually purchased as finished products with formal mortgages, or applied models designed for such markets to markets that function differently. The literature has not explored housing affordability measurement for markets operating on informal financing and incremental building as in many developing countries (except for Isalou, Litman and Shahmoradi, 2014; Sari and Khurami, 2018). Hence, literature does not

provide affordability measurement options relevant to these markets. As a result, it provides no empirical evidence of housing affordability situations of households in the markets. These are important gaps in the literature. Future studies are encouraged to fill this gap.

11) Although most HAMA are relatively simple and understandable, hybrid methods (e.g. MCDM, DEA and MPP) are more sophisticated hence less understandable. There are some other robust HAM methods which were not considered in review, we suggest that they be considered in subsequent studies.

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APPENDICES

Appendix A: Results Found per Database.

S/N	Database Name	Total Found	Items selected for consideration (using title and abstract)	Items identified as relevant to this theme (using full text)
1	ScienceDirect	7,167	32	25
2	Wiley Online Library	2,987	38	17
3	Sage Journals	1,808	31	22
4	EmeraldInsight	746	33	22
5	Taylor & Francis Online	3,607	78	63
6	Springer	1,463	25	11
	Total	17,808	237	**160**

Appendix B: PRISMA Checklist

Section/Topic	No.	Checklist Item	Reported on Page No.
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable, background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number	iii-iv
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known	2–6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS)	6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number	N/A
Eligibility criteria	6	Specify study characteristics (e.g., PICOS and length of follow-up) and report characteristics (e.g., years considered, language, and publication status) used as criteria for eligibility, giving rationale	9-10
Information sources	7	Describe all information sources (e.g., databases with dates of coverage and contact with study authors to identify additional studies) in the search and date last searched	8-9
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated	8-9

Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis)	9-10
Data collection Process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators	12
Data items	11	List and define all variables for which data were sought (e.g., PICOS and funding sources) and any assumptions and simplifications made	13
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	N/A
Summary measures	13	State the principal summary measures (e.g., risk ratio and difference in means)	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I2) for each meta-analysis	N/A
Risk of bias across Studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias and selective reporting within studies)	9-10
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses and metaregression), if done, indicating which were pre-specified	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram	8
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, and follow-up period) and provide the citations	N/A
Risk of bias within Studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12)	N/A
Results of individual Studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates	N/A

		and confidence intervals, ideally with a forest plot	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency	N/A
Risk of bias across Studies	22	Present results of any assessment of risk of bias across studies (see Item 15)	N/A
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses and metaregression [see item 16])	N/A
Discussion			
Summary of Evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., health-care providers, users, and policy makers)	35-38
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research and reporting bias)	40-41
Conclusions	26	Provide a general interpretation of the results in the context of other evidence and implications for future research	42-44
Funding			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review	N/A

Appendix C: Quality of Selected Studies according to Quality Assessment Criteria.

Articles	Q1: Is introduction provided?	Q2: Is the research methodology defined?	Q3: Is the design of the study stated?	Q4: Is the study design cohesive?	Q5: Are validity threats reported?	Q 6. Are negative findings reported?	Q7. Is there any restrictions or limitations reported?
Abeysinghe, Tilak, and Jiaying Gu. 2011.	Y	Y	Y	Y	Y	Y	Y
Acolin, Arthur, and Richard K. Green. 2017.	Y	Y	Y	Y	Y	Y	Y
Anacker, Katrin B., and Yanmei Li. 2016.	Y	Y	Y	Y	Y	Y	Y
Anenberg, Elliot, and Edward Kung. 2018.	Y	Y	Y	Y	Y	Y	Y
Anthony, Jerry. 2018.	Y	Y	Y	Y	Y	Y	Y
Aurand, Andrew. 2014.	Y	Y	Y	Y	Y	Y	Y
Baker, Emma, Rebecca Bentley, Laurence Lester, and Andrew Beer. 2016.	Y	Y	Y	Y	Y	Y	Y
Beer, Andrew, Emma Baker, Gavin Wood, and Peta Raftery. 2011.	Y	Y	Y	Y	Y	Y	Y
Ben-Shahar, Danny, and Jacob Warszawski. 2016.	Y	Y	Y	Y	Y	Y	Y
Ben-Shahar, Danny, Stuart Gabriel, and Roni Golan. 2018a.	Y	Y	Y	Y	Y	Y	Y
Ben-Shahar, Danny, Stuart Gabriel, and Roni Golan. 2018b.	Y	Y	Y	Y	Y	Y	Y
Bentley, Rebecca J., David Pevalin, Emma Baker, Kate Mason, Aaron Reeves, and Andrew Beer. 2016.	Y	Y	Y	Y	Y	Y	Y
Bentzien, Verena, Nico Rottke, and Joachim Zietz. 2012.	Y	Y	Y	Y	Y	Y	Y
Bieri, David S., and Casey J. Dawkins. 2018.	Y	Y	Y	Y	Y	Y	Y
Blanco, Andres G., Jeongseob Kim, Anne Ray, Caleb Stewart, and Hyungchul Chung. 2015.	Y	Y	Y	Y	Y	Y	Y
Blunden, Hazel. 2016.	Y	Y	Y	Y	Y	Y	Y

Boeing, Geoff, and Paul Waddell. 2017.	Y	Y	Y	Y	Y	Y	Y
Borrowman, Luc, Gennadi Kazakevitch, and Lionel Frost. 2015.	Y	Y	Y	Y	Y	Y	Y
Borrowman, Luc, Gennadi Kazakevitch, and Lionel Frost. 2017.	Y	Y	Y	Y	Y	Y	Y
Braakmann, Nils, and Stephen McDonald. 2018.	Y	Y	Y	Y	Y	Y	Y
Bramley, Glen. 2012.	Y	Y	Y	Y	Y	Y	Y
Bramley, Glen, and Noah Kofi Karley. 2005.	Y	Y	Y	Y	Y	Y	Y
Bramley, Glen, and David Watkins.2009.	Y	Y	Y	Y	Y	Y	Y
Brown, Rayna, Rob Brown, Ian O'connor, Gregory Schwann, and Callum Scott. 2011.	Y	Y	Y	Y	Y	Y	Y
Bryant, Lyndall. 2017.	Y	Y	Y	Y	Y	Y	Y
Bunting, Trudi, Alan R. Walks, and Pierre Filion. 2004	Y	Y	Y	Y	Y	Y	Y
Burge, Gregory S. 2011.	Y	Y	Y	Y	Y	Y	Y
Burke, Terry, and David Hayward. 2001.	Y	Y	Y	Y	Y	Y	Y
Cai, Wenjie, and Xinhai Lu. 2015.	Y	Y	Y	Y	Y	Y	Y
Camilleri, Denis. 2011.	Y	Y	Y	Y	Y	Y	Y
Cao, Mengqiu, and Robin Hickman. 2017.	Y	Y	Y	Y	Y	Y	Y
Carmona, Juan, Markus Lampe, and Joan Rosés. 2017.	Y	Y	Y	Y	Y	Y	Y
Chang, Hsiao-Chuan. 2013.	Y	Y	Y	Y	Y	Y	Y
Chen, Jie, Qianjin Hao, and Mark Stephens. 2010.	Y	Y	Y	Y	Y	Y	Y
Cheong, Tsun Se, and Jing Li. 2018.	Y	Y	Y	Y	Y	Y	Y
Coulombel, Nicolas. 2018..	Y	Y	Y	Y	Y	Y	Y
Daniel, Lyrian, Emma Baker, and Laurence Lester. 2018.	Y	Y	Y	Y	Y	Y	Y
Deka, Devajyoti. 2015.	Y	Y	Y	Y	Y	Y	Y
Dewilde, Caroline. 2018.	Y	Y	Y	Y	Y	Y	Y
Dewilde, Caroline, and Pascal De Decker. 2016.	Y	Y	Y	Y	Y	Y	Y
Dewita, Yulia, Barbara TH Yen, and Matthew Burke. 2018.	Y	Y	Y	Y	Y	Y	Y

DiPasquale, Denise, and Michael P. Murray. 2017.	Y	Y	Y	Y	Y	Y	Y
Dong, Hongwei. 2017.	Y	Y	Y	Y	Y	Y	Y
Dong, Xin. and Weihua, Zhou. 2016.	Y	Y	Y	Y	Y	Y	Y
Duan, Mingchen. 2011.	Y	Y	Y	Y	Y	Y	Y
Emslie, Michael. 2011.	Y	Y	Y	Y	Y	Y	Y
Fingleton, Bernard. 2008.	Y	Y	Y	Y	Y	Y	Y
Fingleton, Bernard, Franz Fuerst, and Nikodem Szumilo. 2018.	Y	Y	Y	Y	Y	Y	Y
Fisher, Lynn M., Henry O. Pollakowski, and Jeffrey Zabel. 2009.	Y	Y	Y	Y	Y	Y	Y
Flambard, Véronique. 2018.	Y	Y	Y	Y	Y	Y	Y
Gan, Quan, and Robert J. Hill. 2009.	Y	Y	Y	Y	Y	Y	Y
Gilmour, Tony, and Vivienne Milligan. 2012.	Y	Y	Y	Y	Y	Y	Y
Grinstein-Weiss, Michal, Gina AN Chowa, and Adriane M. Casalotti. 2010.	Y	Y	Y	Y	Y	Y	Y
Haas, P. M., G. L. Newmark, and T. R. Morrison. 2016.	Y	Y	Y	Y	Y	Y	Y
Hackett, Kristen A., Susan Saegert, Deshonay Dozier, and Mariya Marinova. 2018.	Y	Y	Y	Y	Y	Y	Y
Haffner, Marietta EA, and Harry JFM Boumeester. 2010.	Y	Y	Y	Y	Y	Y	Y
Haffner, Marietta, and Harry Boumeester. 2015.	Y	Y	Y	Y	Y	Y	Y
Haffner, Marietta, and Kristof Heylen. 2011.	Y	Y	Y	Y	Y	Y	Y
Hamidi, Shima, and Reid Ewing. 2015.	Y	Y	Y	Y	Y	Y	Y
Hamidi, Shima, Reid Ewing, and John Renne. 2016.	Y	Y	Y	Y	Y	Y	Y
Hamidi, Shima, Jinat Jahan, and Somayeh Moazzeni. 2018.	Y	Y	Y	Y	Y	Y	Y
Hartell, Ann M. 2018.	Y	Y	Y	Y	Y	Y	Y
Haslam McKenzie, Fiona M., and Steven Rowley. 2013.	Y	Y	Y	Y	Y	Y	Y

Heylen, Kristof, and Marietta Haffner. 2013.	Y	Y	Y	Y	Y	Y	Y
Ho, Michael HC, and Rebecca LH Chiu. 2002.	Y	Y	Y	Y	Y	Y	Y
Hou, Yongzhou. 2010.	Y	Y	Y	Y	Y	Y	Y
Isalou, Ali A., Todd Litman, and Behzad Shahmoradi. 2014.	Y	Y	Y	Y	Y	Y	Y
Jones, Colin, Craig Watkins, and David Watkins. 2011.	Y	Y	Y	Y	Y	Y	Y
Kallakmaa-Kapsta, Angelika, and Ene Kolbre. 2013.	Y	Y	Y	Y	Y	Y	Y
Kim, Kyung-Hwan, and Man Cho. 2010.	Y	Y	Y	Y	Y	Y	Y
Konadu-Agyemang, K. W. A. D. W. O. 2001.	Y	Y	Y	Y	Y	Y	Y
Kramer, Anna. 2018.	Y	Y	Y	Y	Y	Y	Y
Kropczynski, Jessica N., and Patricia H. Dyk. 2012.	Y	Y	Y	Y	Y	Y	Y
Kuang, Weida, and Xiaowei Li. 2012.	Y	Y	Y	Y	Y	Y	Y
Kupke, Valerie, and Peter Rossini. 2011.	Y	Y	Y	Y	Y	Y	Y
Kutty, Nandinee K. 2005.	Y	Y	Y	Y	Y	Y	Y
Laidley, Thomas M. 2014.	Y	Y	Y	Y	Y	Y	Y
Lau, Ka Man, and Si-Ming Li. 2006.	Y	Y	Y	Y	Y	Y	Y
Lau, Mandy HM, and Xueji Wei. 2018.	Y	Y	Y	Y	Y	Y	Y
Lazarovic, Rebecca, David Paton, and Lisa Bornstein. 2016.	Y	Y	Y	Y	Y	Y	Y
Lee, Chyi Lin, and Richard G. Reed. 2014.	Y	Y	Y	Y	Y	Y	Y
Lee, Seong Woo, Dowell Myers, and Heon Soo Park. 2000.	Y	Y	Y	Y	Y	Y	Y
Lens, Michael C. 2018.	Y	Y	Y	Y	Y	Y	Y
Li, Jing, Ying Xu, and Yat-Hung Chiang. 2014.	Y	Y	Y	Y	Y	Y	Y
Li, Ling Hin, Fan Wu, Mingjie Dai, Yiming Gao, and Jiayun Pan. 2017a.	Y	Y	Y	Y	Y	Y	Y
Li, Victor Jing, Andy Wui Wing Cheng, and Tsun Se Cheong. 2017.	Y	Y	Y	Y	Y	Y	Y
Lin, Yu-Ju, Chin-Oh Chang, and Chien-Liang Chen. 2014.	Y	Y	Y	Y	Y	Y	Y

Luckey, Kara S. 2018.	Y	Y	Y	Y	Y	Y	Y
Lux, Martin. 2007.	Y	Y	Y	Y	Y	Y	Y
Marks, Gary N., and Stephen T. Sedgwick. 2008.	Y	Y	Y	Y	Y	Y	Y
Mathur, Shishir. 2014.	Y	Y	Y	Y	Y	Y	Y
Matlack, Janna L., and Jacob L. Vigdor. 2008.	Y	Y	Y	Y	Y	Y	Y
Mattingly, Kerry, and John Morrissey. 2014.	Y	Y	Y	Y	Y	Y	Y
McClure, Kirk. 2005.	Y	Y	Y	Y	Y	Y	Y
McConnell, Eileen Diaz. 2012.	Y	Y	Y	Y	Y	Y	Y
McCord, Michael, Stanley McGreal, Jim Berry, Martin Haran, and Peadar Davis. 2011.	Y	Y	Y	Y	Y	Y	Y
McGreevy, Michael Patrick. 2018.	Y	Y	Y	Y	Y	Y	Y
Meen, Geoffrey. 2011.	Y	Y	Y	Y	Y	Y	Y
Meen, Geoffrey, and Mark Andrew. 2008.	Y	Y	Y	Y	Y	Y	Y
Meltzer, Rachel, and Alex Schwartz. 2016.	Y	Y	Y	Y	Y	Y	Y
Mengjie, Liu, Richard Reed, and Hao Wu. 2008.	Y	Y	Y	Y	Y	Y	Y
Micallef, Brian. 2018.	Y	Y	Y	Y	Y	Y	Y
Miller, Eric, Matthew Roorda, Murtaza Haider, and Abolfazl Mohammadian. 2004.	Y	Y	Y	Y	Y	Y	Y
Minchenko, M. M., and N. N. Nozdrina. 2017.	Y	Y	Y	Y	Y	Y	Y
Moore, Eric, and Andrejs Skaburskis. 2004.	Y	Y	Y	Y	Y	Y	Y
Morris, Alan. 2009.	Y	Y	Y	Y	Y	Y	Y
Mulliner, Emma, Naglis Malys, and Vida Maliene. 2016.	Y	Y	Y	Y	Y	Y	Y
Mulliner, Emma, Kieran Smallbone, and Vida Maliene. 2013. decision making method." *Omega* 41, (2): 270-279.	Y	Y	Y	Y	Y	Y	Y
Murdie, Robert A. 2003.	Y	Y	Y	Y	Y	Y	Y
Nepal, Binod, Robert Tanton, and Ann Harding. 2010.	Y	Y	Y	Y	Y	Y	Y
Niu, Yi. 2008.	Y	Y	Y	Y	Y	Y	Y

Okkola, Sinikka, and Cédric Brunelle. 2018.	Y	Y	Y	Y	Y	Y	Y
Öztürk, Akin, Yunus Emre Kapusuz, and Harun Tanrıvermiş. 2018.	Y	Y	Y	Y	Y	Y	Y
Pitros, Charalambos, and Yusuf Arayici. 2017.	Y	Y	Y	Y	Y	Y	Y
Preston, Valerie, Robert Murdie, Jane Wedlock, Sandeep Agrawal, Uzo Anucha, Silvia. A. D'ADDARIO, Min J. Kwak, Jennifer Logan, and Ann M. Murnaghan. 2009.	Y	Y	Y	Y	Y	Y	Y
Quigley, John M., and Steven Raphael. 2004.	Y	Y	Y	Y	Y	Y	Y
Randolph, Bill, and Darren Holloway. 2002.	Y	Y	Y	Y	Y	Y	Y
Renne, John L., Tara Tolford, Shima Hamidi, and Reid Ewing. 2016.	Y	Y	Y	Y	Y	Y	Y
Revington, Nick, and Craig Townsend. 2016.	Y	Y	Y	Y	Y	Y	Y
Rowley, Steven, Rachel Ong, and Marietta Haffner. 2015.	Y	Y	Y	Y	Y	Y	Y
Roy, Debarpita. 2018.	Y	Y	Y	Y	Y	Y	Y
Ruming, Kristian, and Robyn Dowling. 2017.	Y	Y	Y	Y	Y	Y	Y
Saberi, Meead, Hongzhi Wu, Richard Amoh-Gyimah, Jonathan Smith, and Dharmalingam Arunachalam. 2017., Australia." *Journal of transport geography* 65: 134-146.	Y	Y	Y	Y	Y	Y	Y
Said, Rosli, Md Nasir Daud, Zulkifli Esha, Rohayu Ab Majid, and Muhammad Najib. 2017.	Y	Y	Y	Y	Y	Y	Y
Sánchez-Martínez, M. Teresa, Jose Sanchez-Campillo, and Dolores Moreno-Herrero. 2016.	Y	Y	Y	Y	Y	Y	Y
Sarı, Ö. Burcu Özdemir, and Esma Aksoy Khurami. 2018. *and the Built Environment*. 1-20.	Y	Y	Y	Y	Y	Y	Y

Seelig, Tim, and Peter Phibbs. 2006.	Y	Y	Y	Y	Y	Y	Y
Skaburskis, Andrejs. 2004.	Y	Y	Y	Y	Y	Y	Y
Stone, Michael E. 2006a.	Y	Y	Y	Y	Y	Y	Y
Stone, Micheal. E. 2006b.	Y	Y	Y	Y	Y	Y	Y
Sunega, Petr, and Martin Lux. 2016.	Y	Y	Y	Y	Y	Y	Y
Tang, Connie PY. 2012.	Y	Y	Y	Y	Y	Y	Y
Tanton, Robert, and Ben Phillips. 2013.	Y	Y	Y	Y	Y	Y	Y
Teixeira, Carlos. 2014.	Y	Y	Y	Y	Y	Y	Y
Temkin, Kenneth Mark, Brett Theodos, and David Price. 2013.	Y	Y	Y	Y	Y	Y	Y
Temple, Jeromey B. 2008.	Y	Y	Y	Y	Y	Y	Y
Thalmann, Philippe. 2003.	Y	Y	Y	Y	Y	Y	Y
Tremoulet, Andrée, Ryan J. Dann, and Arlie Adkins. 2016.	Y	Y	Y	Y	Y	Y	Y
Tsai, I-Chun. 2018. "Relationships among regional housing markets:	Y	Y	Y	Y	Y	Y	Y
Tu, Qi, Jan de Haan, and Peter Boelhouwer. 2018.	Y	Y	Y	Y	Y	Y	Y
Vidyattama, Yogi, Robert Tanton, and Binod Nepal. 2013	Y	Y	Y	Y	Y	Y	Y
Wegmann, Jake. 2014.	Y	Y	Y	Y	Y	Y	Y
Williamson, Anne R. 2011.	Y	Y	Y	Y	Y	Y	Y
Wood, Gavin A., and Alice K. Stoakes. 2006.	Y	Y	Y	Y	Y	Y	Y
Wood, Gavin A., Matthew Forbes, and Kenneth Gibb. 2005.	Y	Y	Y	Y	Y	Y	Y
Wood, Gavin, and Rachel Ong. 2011.	Y	Y	Y	Y	Y	Y	Y
Wood, Gavin, Richard Watson, and Paul Flatau. 2006.	Y	Y	Y	Y	Y	Y	Y
Worthington, Andrew, and Helen Higgs. 2013.	Y	Y	Y	Y	Y	Y	Y
Yang, Zan, and Yue Shen. 2008.	Y	Y	Y	Y	Y	Y	Y
Yang, Zan, and Bengt Turner. 2004.	Y	Y	Y	Y	Y	Y	Y
Yang, Zan, and Songtao Wang. 2011.	Y	Y	Y	Y	Y	Y	Y
Yang, Zan, Chengdong Yi, Wei Zhang, and Chun Zhang. 2014.	Y	Y	Y	Y	Y	Y	Y

Yap, Jeffrey Boon Hui, and Xin Hua Ng. 2018.	Y	Y	Y	Y	Y	Y	Y
Yates, Judith, and Mike Berry. 2011.	Y	Y	Y	Y	Y	Y	Y
Yates, Judith, and Gavin Wood. 2005	Y	Y	Y	Y	Y	Y	Y
Yates, Judith, and Maryann Wulff. 2000.	Y	Y	Y	Y	Y	Y	Y
Yates, Judith, and Maryann Wulff. 2005.	Y	Y	Y	Y	Y	Y	Y
Yi, Daichun, Yuhong Huang, and Gang-Zhi Fan. 2016.	Y	Y	Y	Y	Y	Y	Y
Yuen, Belinda, Lanny Kurnianingrum Kwee, and Yong Tu. 2006.	Y	Y	Y	Y	Y	Y	Y
Zhang, Chuanchuan, Shen Jia, and Rudai Yang. 2016.	Y	Y	Y	Y	Y	Y	Y

Appendix D: Data Extraction Form

Fundamental information	
1) Data extractor 2) Data checker 3) Date of data extraction 4) Article title 5) Authors' Name 6) Application domain/field 7) Journal 8) Retrieval search query 9) Publication date	
Specific information	
10) Specific information	Academia Practice
11) Research methodology	Case study Proposal Survey
12) Validity threats	Action research Conclusion validity Construct validity Internal validity External validity
RQ1: Which HAM approaches have been used? 13) Method/Technique proposed in Literature 14) Name of presented Method/Technique 15) Methods /Technique used in Affordability analysis RQ2: Which type of study has been conducted on these HAM approaches? 16) On what grounds the Method/Technique is constructed 17) Discussion about any other Method/Technique 18) Practical application of Method/Technique in the form of tool 19) Any limitation of the Method/Technique 20) Are the major strengths and weaknesses of each of the Method/Technique discussed? RQ3: Which one of the 6 fields/domains has further used these HAM approaches? 21) Any requirement selection technique used in the Methods /Technique 22) Name of presented domain/field RQ4: What kinds of HAM approaches have been employed in these years based on 6 fields/domains? 23) Description of presented model 24) Newly presented Method/Technique or extension of already developed Method/Technique- Means of representation (table, diagrammatically, mathematical means, logically) RQ5: Which journal published articles related to these HAM approaches?	

25) Name of presented Journal 26) Name of database RQ6: In which year have authors published further articles relating to HAM approaches based in the 6 fields/domains? 27) Number of Publications	

Appendix E: Questionnaire Survey Sample

Introduction

My name is Ikenna Stephen, Ezennia a Ph.D. candidate with student number 15600142 in the Faculty of Architecture; Department of Architecture, Eastern Mediterranean University, Famagusta, North Cyprus. I am undertaking a research on "**Sustainable Housing Affordability Concept and the Case of Nigerian Urban Housing Sector**". I am currently conducting a questionnaire survey to assess the nature of exponentially rising housing prices which is currently outstripping inflation and the dwindling homeownership rates in Nigeria.

You are being invited to take part in this Ph.D. research study. Please take the time to read the following information. If you would like some more information or something is not clear please ask. The purpose of this study is to examine the nature of housing affordability in Nigeria and explain the determinants of housing choice using households and housing professionals' perspective in the context of sustainability for successful housing delivery.

You will be asked to complete a short questionnaire which should take no longer than 15-20 minutes. Please note that this survey is voluntary and you may withdraw at any point without giving a reason. However, I will be extremely grateful if you could spare a few minutes of your valuable time to complete this questionnaire form based on your experience. Your feedback to this questionnaire is extremely important to explain affordable housing supply and demand in Nigeria. No risks have been identified for taking part in this study and full ethical approval from the Eastern Mediterranean University Research Ethics Committee (REC) has been gained.

The information garnered will be employed to evaluate or assess areas that need improvement; establish the critical factors influencing housing affordability and determinants of affordable housing choice as well as aid the development of a framework for achieving successful deliverability of affordable housing in Nigeria. This will help not just Nigeria but all developing countries in enhancing affordable housing supply in their respective countries.

All information obtained from this survey will be treated strictly as confidential, held anonymously, securely and will be solely used in aggregate for academic purpose and research only. Personal data will not be published. Data from the questionnaires will be kept by the researcher and will not be passed on to third parties. All information you provide will be destroyed by shredding or deleting electronic information within five years of the completion of the study. Thank you for your participation and assistance.

Any questions that you have about your participation, withdrawal and role in the study should be addressed to Ikenna Stephen Ezennia who is organizing this study.

Contact details:

Ikenna Stephen Ezennia, Department of Architecture, Eastern Mediterranean University, Famagusta, North Cyprus. Via Mersin 10 Turkey.
Email: is.ezennia@unizik.edu.ng

For any complaints about the procedure please contact:

Şebnem Önal Hoşkara, Director of Urban Research & Development Centre (URDC) Eastern Mediterranean University (EMU) & Professor in the Department of Architecture, EMU, Famagusta, North Cyprus; 99450, Mersin 10, Turkey.
Email: sebnem.hoskara@emu.edu.tr; sebnem.hoskara@gmail.com

Questionnaire 1 (Household)
SECTION 1: PERSONAL/HOUSEHOLD/GENERAL INFORMATION
Name (*Optional*).....
Town of Residence.....
All questions are **mandatory**.

S/N	Questions	Response (thick)
Gender		
1	Male	
2	Female	
Age		
1	18 – 25 years	
2	26 – 35 years	
3	36 – 45 years	
4	46 – 55 years	
5	More than 55 years	
Ownership Status		
1	Own the house	
2	Rented apartment	
3	Share the house	
Educational Qualification		
1	Diploma	
2	B.Sc.	
3	M.Sc.	
4	MBA	
5	Ph.D.	
6	Others please specify	
Employment Status		
1	Fully employed (permanent)	
2	Partially employed (temporal)	
3	Not employed	
4	Retired	
Which of these best Describes Your Income Group?		
1	Low Income	
2	Medium Income	
3	High Income	
What is your Monthly Household Income		
1	Below #100,000	
2	#100,000 - #200,000	

3	#210,000 - #300,000	
4	#310,000 - #400,000	
5	#410,000 - #500,000	
6	Above #500,000	
Household Number		
1	1 – 2 members	
2	3 – 6 members	
3	More than 6 members	
House Type		
1	Terraced House	
2	Apartments/Flats	
3	Condominium	
4	Others, please specify	
Age of House		
1	Less than 5 years	
2	5 – 10 years	
3	11 – 20 years	
4	More than 20 years	
Vehicle Ownership		
1	Yes	
2	No	
Distance from House to Recreation Facilities		
1	Less than 2 Km	
2	2 Km – 5 Km	
3	More than 5 Km	
Distance from House to Health Centres		
1	Less than 2 Km	
2	2 Km – 5 Km	
3	More than 5 Km	
Distance from House to Religious Places		
1	Less than 2 Km	
2	2 Km – 5 Km	
3	More than 5 Km	
Distance from House to Educational centre		
1	Less than 2 Km	
2	2 Km – 5 Km	
3	More than 5 Km	
Distance from House to Child Day Care Centre		
1	Less than 2 Km	
2	2 Km – 5 Km	
3	More than 5 Km	
Distance from House to Shopping Mall or Market		
1	Less than 2 Km	
2	2 Km – 5 Km	
3	More than 5 Km	
Distance from House to Working Place		
1	Less than 2 Km	
2	2 Km – 5 Km	

3	More than 5 Km	
Distance from House to Public Transportation Station		
1	Less than 2 Km	
2	2 Km – 5 Km	
3	More than 5 Km	

SECTION 2: EXPERIENCE OF HOUSING AFFORDABILITY STRESS

2.1 On a scale of 5 (Strongly agree) to 1 (Strongly disagree) to what extent have you suffered housing need and affordability stress

S/N	Personal Affordability Stress Experience	5(SA)	4(A)	3 (I)	2 (D)	1(SD)
1	You have experienced housing affordability stress in the last 5 years	5	4	3	2	1
2	The affordability stress was as a result of: i. Constraint (e.g. illness or serious injury, unemployment) ii. Choice (e.g. more desirable location, larger house) iii. Others, please specify	5 5 5	4 4 4	3 3 3	2 2 2	1 1 1
3	Have you suffered more than one affordability stress in the past 5 years	5	4	3	2	1
4	Have you lived in any place you did not want to live in the last 5 years	5	4	3	2	1

SECTION 3: CRITICAL PERFORMANCE FACTORS (CPF) INFLUENCING SUSTAINABLE HOUSING AFFORDABILITY

Please circle the level of important each of the following factors will determine your decision to buy or rent a house. Scale of 1-5 as follow: 5= Very important; 4= important; 3= slightly important; 2=less important and 1= least important.

ECONOMIC (AFFORDABILITY) SUSTAINABILITY FACTORS						
S/N	Affordability Benchmark	5(VI)	4(I)	3(SI)	2(LI)	1(LI)
	House price in relation to income	5	4	3	2	1
	Rental cost in relation to income	5	4	3	2	1
S/N	Mortgage Finance and Initial Deposit	5(VI)	4(I)	3(SI)	2(LI)	1(LI)
	Availability mortgage and Interest rates	5	4	3	2	1
	Availability of rented housing (social and private)	5	4	3	2	1
	Availability of low-cost shared ownership products (e.g. shared housing)	5	4	3	2	1

	Availability of market value home ownership product	5	4	3	2	1
S/N	Affordability Criteria	5(VI)	4(I)	3(SI)	2(LI)	1(LI)
	Financial viability	5	4	3	2	1
	Tenure security	5	4	3	2	1
	Interest rates	5	4	3	2	1
	Economic trends/Cost effectiveness	5	4	3	2	1
	Desirability	5	4	3	2	1
	Taxation influences	5	4	3	2	1
	Family income level	5	4	3	2	1
	Provide human resource for economic development	5	4	3	2	1
	Employment opportunities	5	4	3	2	1
	Ensure balanced housing market	5	4	3	2	1
	Reduced energy bill	5	4	3	2	1
	Reduced transportation cost	5	4	3	2	1
	Reduced life cycle cost	5	4	3	2	1
SOCIAL (CULTURAL) SUSTAINABILITY FACTORS						
S/N	Public Facilities and Amenities	5(VI)	4(I)	3(SI)	2(LI)	1(LI)
	Access to recreational facilities e.g. Parks, green open spaces	5	4	3	2	1
	Access to health centres e.g. Hospitals, GPs	5	4	3	2	1
	Access to religious places e.g. Temple, mosque, church etc.	5	4	3	2	1
	Access to educational centre e.g. School, tuition centre etc.	5	4	3	2	1
	Access to child day care centre	5	4	3	2	1
	Location of shopping mall or market	5	4	3	2	1

	Accessibility to working place	5	4	3	2	1
	Proximity to government establishment	5	4	3	2	1
	Proximity to private establishment	5	4	3	2	1
	Availability of public transportation	5	4	3	2	1
	Major access road	5	4	3	2	1
	Minor access road	5	4	3	2	1
S/N	Non-Housing Consumption	5(VI)	4(I)	3(SI)	2(LI)	1(LI)
	Ability to sustain other day to day cost of living	5	4	3	2	1
	Social cohesion	5	4	3	2	1
	Safety/Security (reduced incidence of crime)	5	4	3	2	1
	Fire safety	5	4	3	2	1
	Effective maintenance and management of properties	5	4	3	2	1
	Cultural and heritage conservation	5	4	3	2	1
	Religious affiliation	5	4	3	2	1
	Sense of community	5	4	3	2	1
	Community participation	5	4	3	2	1
	Minimize social segregation	5	4	3	2	1
	Tenure	5	4	3	2	1
	Equitability and fairness of housing distribution	5	4	3	2	1
	Social acceptability	5	4	3	2	1
	Increased consciousness of environmental protection	5	4	3	2	1
S/N	Architecture and Innovative Design	5(VI)	4(I)	3(SI)	2(LI)	1(LI)
	Aesthetic views	5	4	3	2	1

	Suitability/Appropriateness	5	4	3	2	1
	Clean and Attractive	5	4	3	2	1
	Cosy and Comfort (from the social–psychological point of view)	5	4	3	2	1
	Type of building e.g. Apartments, condominiums, semi-detached etc.	5	4	3	2	1
	Unit size	5	4	3	2	1
	Number of bedrooms	5	4	3	2	1
	Interior decoration e.g. Painting, layout etc.	5	4	3	2	1
	Floor tiles marble	5	4	3	2	1
	Number of bathrooms	5	4	3	2	1
	Presence of lift or elevator	5	4	3	2	1
	Presence of parking area	5	4	3	2	1
	Number of fireplace	5	4	3	2	1
	Presence of heating system	5	4	3	2	1
	Number of garage spaces	5	4	3	2	1
	Floor spaces	5	4	3	2	1
	Access and security	5	4	3	2	1
	Housing location e.g. City, countryside etc.	5	4	3	2	1
	Housing quality e.g. meeting decent home standards	5	4	3	2	1
	Lighting quality	5	4	3	2	1
S/N	Household Characteristics/Features	5(VI)	4(I)	3(SI)	2(LI)	1(LI)
	Household size	5	4	3	2	1
	Age groups	5	4	3	2	1
ENVIRONMENTAL (ECOLOGICAL) SUSTAINABILITY FACTORS						

S/N	Presence of Environmental Problems	5(VI)	4(I)	3(SI)	2(LI)	1(LI)
	Noise pollution	5	4	3	2	1
	Water pollution	5	4	3	2	1
	Air quality	5	4	3	2	1
	Litter	5	4	3	2	1
S/N	Efficiency	5(VI)	4(I)	3(SI)	2(LI)	1(LI)
	Waste management e.g. level of recycling, reuse, composting	5	4	3	2	1
	Use of appropriate materials	5	4	3	2	1
	Energy efficiency	5	4	3	2	1
	Land-use efficiency	5	4	3	2	1
	Water efficiency	5	4	3	2	1
	Reduced footprint	5	4	3	2	1
	Thermal comfort	5	4	3	2	1
	Minimized biodiversity loss	5	4	3	2	1
	Disaster resilience	5	4	3	2	1
	Mixed land using	5	4	3	2	1
INNOVATIVE TECHNOLOGICAL SUSTAINABILITY FACTORS						
	Please list other factors that will affect your choice of affordable house	5	4	3	2	1

On a scale of 5 (strongly agree) to 1 (strongly disagree), rate the extent to which the following statements describe the current trend of housing affordability and housing choice in Nigeria? *(Please circle).*

Statement	5(SA)	4(A)	3	2	1
The various forms of housing affordability measurement approaches deployed in the assessment of housing need and affordability stress does not guarantee accurate housing affordability measurement outcome.	5	4	3	2	1
Broader views and wider dimensions of housing affordability indicators/measures and affordable housing choice determinants as propagated by researchers are not presently incorporated in housing delivery practices in the study area.	5	4	3	2	1
Housing professionals and households' opinion on factors influencing housing affordability and affordable housing choice do not significantly differ based on households' income group, housing professionals involvement in a particular sector of housing industry and practice across different regions of Nigeria.	5	4	3	2	1
5-strongly agree; 4-agree; 3-indifferent; 2-disagree; 1-strongly disagree					

Thank you very much for taking the time to complete this survey.

Appendix F: Published Scientific Papers related to this PhD Thesis

Scientific papers in peer reviewed academic journals:

1. Ezennia, I.S, & Hoskara, S. O. (2019). Methodological weaknesses in the measurement approaches and concept of housing affordability used in housing research: A qualitative study. PloS one, 14(8), e0221246. doi: 10.1371/journal.pone.0221246
2. Ezennia, I. S., & Hoskara, S. O. (2019). Exploring the Severity of Factors Influencing Sustainable Affordable Housing Choice: Evidence from Abuja, Nigeria. Sustainability, 11(20), 5792. https://doi.org/10.3390/su11205792

Scientific papers in various stages of review in peer reviewed academic journals:

1- Ezennia, I.S, & Hoskara, S. O. (2019). Assessing the Subjective Perception of Urban Households on the Criteria Representing Sustainable Housing Affordability. *Environment, Development and Sustainability*. Under review since July 5th 2019.

2- Ezennia, I.S, & Hoskara, S. O. (2019). A Systematic Quantitative Literature Review of Housing Affordability Measurement Approaches and their Applications: Research Trends (2000-2018) and Classification. *Journal of Planning Education and Research*. Under review since February 20th 2019.