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SUSTAINABLE HOUSING DELIVERY IN LAGOS: COST AND HEALTH IMPLICATIONS

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ABSTRACT

The aim of this study is to compare the capital cost of sustainable and conventional housing as well as examine the health implications of sustainable housing in Lagos. Using a systematic random sampling technique a total of 312 questionnaires were retrieved from the occupants of the three housing estates used as a case study in this research. Data on cost was provided through historical cost data on the estates while analysis was by the use of frequencies, percentiles and mean item scores. The study revealed that the capital cost of sustainable housing is lower than conventional housing in the estates attributed to the use of cost effective sustainable materials and realistic project planning and management. Diarrhea, typhoid fever, cholera and dysentery were associated with water inefficiency, poor design quality to malaria and respiratory infection to energy inefficiency. The satisfaction index for kitchen and toilet facilities, windows/doors, concrete works and electrical works is satisfactory. In conclusion, it is important to use cost effective sustainable materials and effective project management and communication in the development of sustainable housing.

Keywords: Sustainable Housing, Health, Sustainable Factors, Lagos, Conventional Housing

INTRODUCTION

More than the dwelling structure and the location it occupies, an understanding of housing should incorporate an acknowledgement of the life it permits us to live. Housing is thus (and more than) a place with access to social networks, employment and services; a home from which we draw our identity and store much of our wealth; and a shelter that permits comfort and security. Many of these ways of understanding housing are inter-connected (for example, a poorly located dwelling may inhibit employment and wealth creation). As is commonly stated, housing is not 'bricks and mortar' alone, it needs to be adequate, affordable, appropriate, and secure (UNCHS, 2001).

However, a sustainable housing is one that is designed to reduce or eliminate the impact on human health and the natural environment. This is accomplished by incorporating materials and operational elements that are environmentally responsible and resource efficient throughout the life cycle of the building (Winston, 2007).How "sustainable," a building can become depends upon the number of the incorporated elements that are used and their associated impact on human health and the environment. Sustainable housing is designed to meet certain objectives such as protecting occupant health; improving employee productivity; using energy, water, and other resources more efficiently; and reducing the overall impact to the environment (Aribigbola, 2011).Sustainable housing are designed to reduce the overall impact of the built environment on human health and the natural environment by: efficiently using energy, water, and other resources and protecting occupant health and improving employee productivity as well as reducing waste, pollution and environmental degradation. Sustainable housing has emerged over the past decade as a robust movement to create high performance, energy-efficient structures that improve occupant comfort and well being while minimizing environmental impacts. Provision of sustainable housing in Lagos has been limited because of focus on first costs, government policies and a finance system that fails to recognize the long term value of sustainable housing.

A common perception has been that sustainable housing costs is more and is therefore not suitable for affordable housing. Recent studies have documented the costs and benefits of sustainable development in commercial and institutional sector (Aribigbola, 2011) reporting that sustainable development has a modest initial cost premium, but that long term benefits far exceed the incremental capital costs. These findings have encouraged sustainability in these sectors, but their applicability to sustainable housing development has been viewed with considerable doubts. The Construction Industry Environmental Forum (CIEF, 2005a) stated that it is commonly asserted that "sustainable" buildings are expensive to build. However, it is suspected that practice still finds it problematic to know how much more it will cost to build in a sustainable manner. The research of BRE (2001) and Elhag and Boussabaine (2001) explained that the significance of the consideration of sustainability early in a potential project's life cycle was likely to result in less of an increase in capital costs as compared to those projects in which sustainability issues were considered at a later stage. For example, sustainable housings may incorporate sustainable materials in their construction (e.g., reused, recycled-content, or made from renewable resources); create healthy indoor environments with minimal pollutants (e.g., reduced product emissions); and/or feature landscaping that reduces water usage (e.g., by using native plants that survive without extra watering) (Winston, 2007).

Another important aspect of sustainable housing is the use of building materials. This starts with the materials already on site, such as earth and vegetation. The designer needs to consider whether to use low or high impact materials. A low impact material for example is less toxic or carcinogenic. A good example would be choosing insulation made from low VOC (volatile organic compounds) emitting materials. Another example is water based lead free paint. A product may be considered sustainable for more than one reason. Recycled plastic lumber, is an example of multiple reasons for being considered sustainable: it is made from recycled waste, highly durable, and will not need pesticide treatment. On the other hand, wood treated with preservatives may have an advantage in terms of durability, but would represent a health risk for the occupant of the building (Winston, 2007). Energy use within a structure is also an important consideration in sustainable housing. The types of windows and the positioning of the structure to take advantage of the cooling breeze and sunlight can reduce demands on energy use.

In order to better understand the housing influences on health, it is important to view housing in wider terms than those of basic housing needs. Just as good health is more than the absence of disease (WHO, 2006), good or sustainable housing is more than the absence of need. Housing is the place we spend the majority of our lives and one of "the main settings that affect human health" (Bonnefoy et al, 2004; p. 13). The exact relationship between housing and health is complex and difficult to assess. However, research based on the various sources of housing and health data suggests that unsustainable housing is associated with increased risk of cardiovascular diseases, respiratory diseases and depression and anxiety. Housing-related hazards that increase the risk of illness include damp, mould, excess cold and structural defects that increase the risk of an accident (such as poor lighting, or lack of stair handrails). The strength of the evidence linking such factors to ill health varies. Other housing conditions include water and energy efficiency. Access to clean water is essential for healthy living. Diseases associated with the consumption of water of poor quality include gastroenteritis, diarrhoea, typhoid fever and hepatitis. Inadequate power and electricity supply may restrict the capacity of people to carry out healthy living practices such as washing, cooking, food storage, temperature control and lighting. Poor electricity supply or inadequately maintained power supply may also cause trauma and injury. The number of studies that have evaluated the costs and health implications of sustainability in the housing sector generally is limited. Such studies also rarely exist in Nigeria. This study, therefore, attempts to fill this gap. In addition, it attempts to find answers to the following questions; does sustainable housing cost more than the conventional housing? What is the level of satisfaction of the occupants in terms of the selected sustainable housing factors? And, does sustainable housing have any health implications on the occupants? The study focused on three selected estates in Lagos where one of the authors was a project consultant and therefore conversant with the cost details. The study, therefore, examines the cost and health implications of sustainable housing in Lagos. To achieve this aim the study attempts to compare the capital cost of sustainable housing with traditional or conventional housing; determine the occupant's satisfaction index of elements of sustainable housing and evaluate the relationship between sustainable housing factors and health of occupants.

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

The Cost of Sustainable Housing

Extant literature points to the fact that the initial cost of sustainable housing is more expensive than the conventional type. This may be because the technologies being implemented were new and architects who specialized in sustainable design were few and this enables them to charge full professional scale of fees. Added to this is that contractors who were unfamiliar with changes in the construction and management process of sustainable housing experienced inefficiency and productivity losses (Langston and Mackey, 1998). According to Kats (2003) manufactured costs for components installed in sustainable housing have also reduced, progress continues in building technology advancement, product reliability is improving and lower pricing is becoming a reality in the market place. The premium paid to contractors, architects and engineers for sustainable housing experts is also diminishing with time as the learning curve flattens. Sustainable housing has challenges and barriers, the most common of which is the cost associated with sustainable housing. Although research varies on sustainable housing incremental costs (with studies indicating a 0-10% sustainable premium over conventional projects), a survey of building industry professionals conducted by McGraw – Hill Construction (2006) indicates the perception of higher costs is the most commonly cited barrier to sustainable housing. While most of the main stream attention on sustainable housing focuses on its positive environmental impacts, research shows a developer’s decision to go into sustainable housing remains rooted in its financial viability. Langdon (2004) found that there are wise variations in costs associated with sustainable projects and conventional projects. According to Langdon (2004), initial cost of sustainable projects can be higher than conventional projects; it is widely held that longer-term cost savings in operations and maintenance can help recover those costs. Sustainable housing are expected to decrease operating costs between 8-9%, increase total building value by 7.5% and increase occupancy rates by 3.5% (U.S Green Building Council, 2006a,b). A commonly noted challenge to containing costs in conventional construction projects is lack of effective communication among various technical experts who tend to use their own tools, protocol, and industry standards for making decisions and tracking information (Sappe 2007).

Sustainability Factors

The sustainable factors considered in this study include energy efficiency, site selection, water efficiency and materials used for construction. The factors are used to determine the occupant’s satisfaction index of housing sustainability as well as evaluate the relationship between these sustainable housing factors and health of occupants. They are described in details below.

Energy Efficiency

According to Santoli and Matteo (2003), the energy performance of a building must be calculated using standards that indicate the insulation of buildings, the position and orientation of the building in relation other climatic aspects, exposure, its own capacity for renewable energy sources and other factors, such as indoor environmental quality, that could influence the energy requirements of the building. As opined by Reed and Gordon (2000) the under listed points are very essential in achieving energy efficiency.

(a) Design and install insulation to minimize heat transfer and thermal bridging
(b) Minimize energy consumption caused by uncontrolled air leakage into and out of air conditioned spaces
(c) Maximize the energy performance of windows.
(d) Reduce the consumption of non-renewable energy sources by installing and operating renewable electric generation systems.

(e) Select and test air-conditioning refrigerant to ensure performance and minimize contributions to ozone depletion and global warming.

Site Selection

Site selection is essential as this ensures that the site can legally and physically accommodate the type and size of project being envisaged. When selecting sites for developmental purposes avoid sites in noisy areas and ensure compatibility with existing facilities. Determine what else is planned for the site in the future (Nwafor, 2006).The united stated Department of Energy (USDOE) states that both site selection and planning have a major impact on the relative “sustainability” of any facility. The selection includes issues such as transportation and travel distances for building occupants impacts to wildlife, storm water flows and wetlands etc. placement of the building on the site promotes energy conservation by taking advantage of natural site features such as topography, sunlight, shade and breezes (Reed and Gordon, 2006).In site design and planning phase efforts are made to minimize resources costs and site disruption according (Sappe, 2007) (a) Natural site features – preserve natural drainage systems, locate driveways, parking, entrances on the buildings south side (b) to locate and size facilities to avoid cutting mature vegetation (c) locate and design the building to minimize impact on erosion and natural hydrological systems (d) minimize excavation and disturbance of groundwater

(a) Site stewardship – minimize long term environmental damage to the building during the construction process.
(b) Design landscaping features
(c) Design site features to minimize erosion and runoff from the site.
(d) Make use of compact development patterns to conserve land and promote community livability, transportation efficiency, and workability

Water Efficiency

According to (Kibert, 2005) water efficiency is the planned management of overuse and exploitation of water resource. Government policy in this regard is to provide water-efficient practices, both indoor and outdoor. The emphasis is on the under listed points

(a) Use of pipe borne water from public water works
(b) Minimize indoor demand for water through water-efficient fixtures and fittings
(c) Limit or eliminate the use of potable water or other natural or sub-surface water source available on or near the project site.
(d) Maximize water efficiency within the building to reduce the burden on public water works or water corporations.

Materials

The emphasis is efficient utilization of materials, selection of environmentally preferable materials and minimization of waste during construction. There in need to minimize waste factor to 10% (b) use locally sourced materials with low emissions and environmentally friendly (c) use rapidly renewable building materials and products.

Sustainable Housing and Health

Figure 1 focuses on three important and inter-related aspects of residential housing and their links to health: The physical conditions within homes, conditions in the neighbourhoods surrounding homes, and housing affordability, which not only shapes homes and neighbourhood conditions but also affects the overall ability of families to make healthy choices.

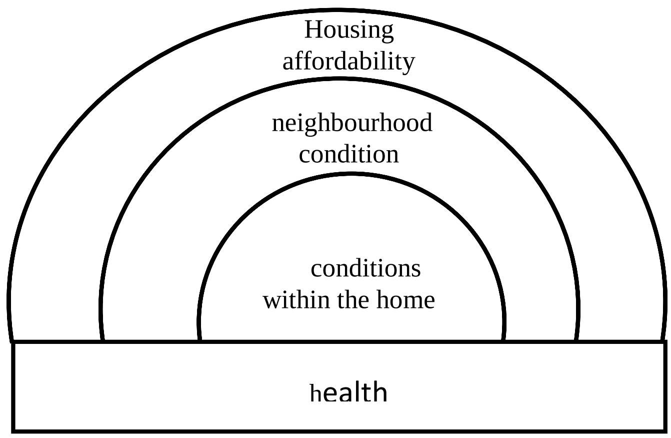

Figure 1: Housing influences health in many ways; Source: commissionhealth.org

Housing protects individuals and families from harmful exposures and provides them with a sense of privacy, security, stability, and control, it can make important contributions to health. In contrast, poor quality and inadequate housing contributes to health problems such as infectious and chronic diseases, injuries, and poor childhood development (Krieger and Higgins, 2002;Shaw, 2004).

According to Bailie and Runcie (2001), Bailie, *et al;* (2002), Thomson (2003) and Pholeros, Rainow & Torzillo, (1993), the effect of the physical environment on the health status of a population is well recognised – the absence of functional health hardware can have a negative impact on health, particularly with regard to infectious and parasitic diseases (such as diarrhoeal diseases and rheumatic fever), eye and ear infections, skin conditions, and infections of the respiratory tract. Similarly, the Australian Bureau of Statistics, Australian Institute of Health and Welfare (2003) noted that the important aspects of the physical environment that influence the health status of many indigenous Australians are: general housing characteristics, overcrowded houses, high housing costs relative to income, and inadequate sanitation and water supply. Substandard and badly maintained housing together with the lack of functioning infrastructure can create serious health risks. Direct means are associated with the material condition of housing on physical health, for example, inadequate water supply, washing facilities, sanitation and overcrowding. This can in turn influence the mental health and wellbeing of households due to the many social issues which arise from inadequate material conditions. Indirect means are about individual and community elements, including the location of the housing, closeness to essential services and the overall functioning of the community. Also Taylor (2001) observed that the health effects of housing can be mediated by the design, function, cleanliness and crowding of a dwelling.

Overcrowding is linked with poor health. Studies are now confirming that it is important to assess its actual impact, independent of associated factors (such as poverty, poor housing condition, limited health hardware, and the like). For example, a study undertaken in Sydney, NSW has now found that a strong association between overcrowding and health still exists when factors including education, income, ethnicity, poverty and unemployment are controlled for (Beggs & Siciliano, 2001). However, the study by Pholeros, et al (1993) and data from Office of the Deputy Prime Minister (2004) reveal that overcrowding appears to have its main impact on the health of children, particularly in terms of respiratory conditions, skin infections and meningitis, and possibly mental health. Overcrowding also puts increased stress on health infrastructure, such as water supply and sewage disposal systems, and is closely linked to housing standards and conditions. Access to electricity and gas allows for the operation of health-related infrastructure, such as lighting, heating and cooling, water heating, refrigeration of foods, power supply for kitchen appliances, communication, education, and the use of other electrical equipment.

STUDY METHOD

Case-Study

Recently completed housing estates in Lekki Phase 1, Ikeja and Ebute Metta of Lagos (Figure 1) comprising 40 No sustainable, 3-bedroom Apartments, 24 No 2-bedroomm Apartments, 24 one bedroom Apartments and 16 No flatlets in each of the housing estates were compared with of the same prototype. One of the researchers is the project cost consultant for these housing estates; hence compilation of cost data was based on historical cost data compiled on each of the housing estates. The cost data was limited to capital cost because the housing estates were just completed hence operating and running cost were omitted.

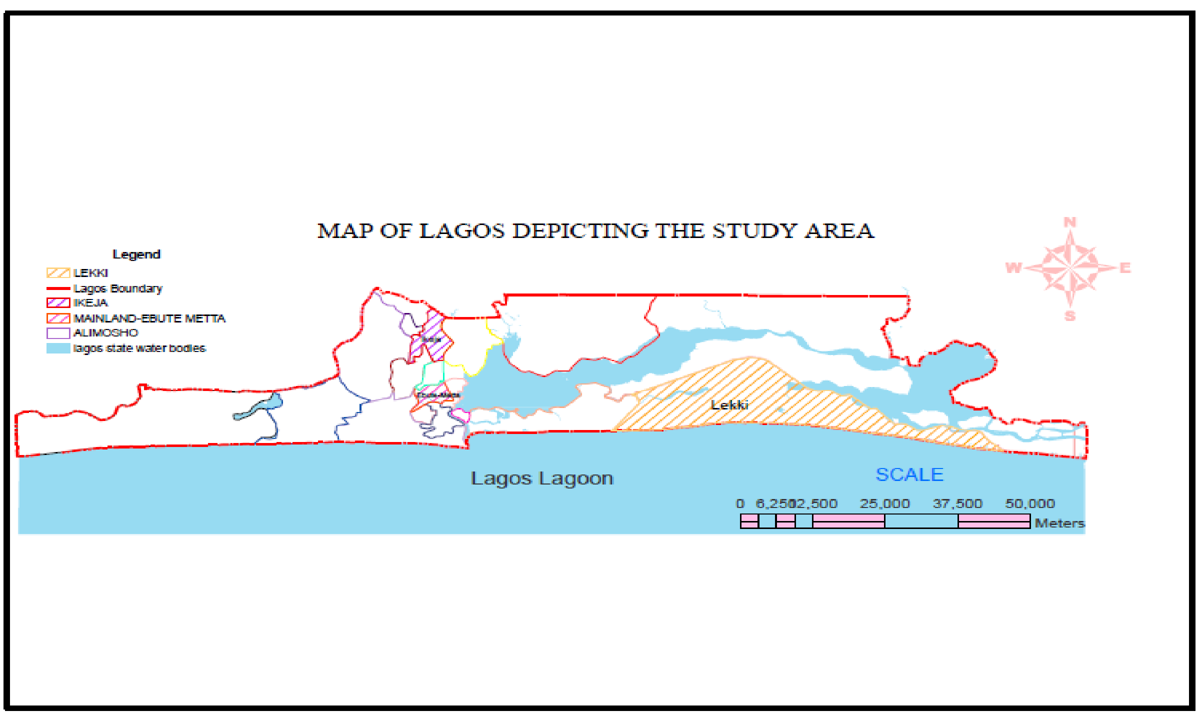

Figure 2: Map of Lagos depicting the study area

Research Instrument

A research instrument was developed to evaluate the relationship between sustainable housing factors and health of the occupants. Respondents were asked to indicate their judgment on identified socio-economic factors and the impact of design quality, materials, water and energy efficiency on health of the occupants. They were also asked to signify their level of satisfaction on the elements of the building. A 5 point likert scale was used to assess the satisfaction level of the respondent and the impact of sustainability factors on the health of occupants. Three housing estates were used as case study in this research. The total number of housing units in Ebute Metta housing Estate is 324 units, in Ikeja is 302 units and 310 units in Lekki Phase 2. The total number of housing units in the three estates is 936 units. Using a systematic random sampling technique of selecting one out of every three housing units, a total number of 312 housing units were selected for the administration of the research instrument. Cronbach's alpha is a measure of internal reliability, this bound by O and I, with measures closer to 1 representing strong reliability for the items in the research instrument. Data collected are analyzed using descriptive statistics. The sustainability and health instrument recorded a Cronbach' alpha value of 0.89 and the data collected were analyzed using statistical packages for social sciences (SPSS).

RESULTS

Cost Comparison between Sustainable and Conventional Housing

The cost comparison is based on capital cost of sustainable and conventional housing. In order to deliver a sustainable housing project within acceptable financial parameters the client and the project manager must set sustainability goals before site selection, design and construction are initiated, this approach was adopted in the three housing estates. The design approach for the sustainable housing entails the following: Need definition- environmental goal, market conditions and capital investment for the project was clearly defined at pre design stage. An experienced project manager who is familiar with the product type and is exposed to all phases of sustainable housing was hired for the project. The economic and ecological goals are based on cost benefit analysis. The preliminary budget is aligned with the goals of the project. The design concept and site selection involved all the project stakeholders. The conditions of contract included performance agreements, incentives and bonuses for performing sustainable practices. The construction period involves weekly site meetings and sustainable education practices on the installation of prefabricated materials used for the construction. The construction process is divided into two separate highly integrated operations which ensure efficient continuous flow of activities as follows:

- Production of standardized/ modularized building components under workshop conditions for high productivity and improved workmanship
- Rapid site assembly of pre- fabricated building components

The conventional housing comprises framed structure on raft foundation.

The cost of four different design concepts (Three bedroom apartments, two bedroom apartments, one bedroom apartment and flat lets) were considered. The results are tabulated in Tables (1-4). The capital cost of the sustainable housing prototypes is cheaper than equivalent conventional types. The cost comparison of the three bedroom apartments indicates that sustainable housing is cheaper than conventional housing by (22.86%). A similar cost comparison for the two bedroom apartments indicates that sustainable housing is cheaper than conventional housing by (20.90%). For the one bedroom apartments, the cost of sustainable housing is cheaper than conventional housing by (34.14%) and finally the cost comparison for the flat lets indicates that sustainable housing is cheaper than conventional housing by (30.84%).This finding is not consistent with the report of Langdon (2004) where the findings of the study posits that conventional buildings are cheaper than sustainable buildings within a cost premium of (0-10%). A further analysis by Langdon (2004) showed that some sustainability issues had a zero premium. Their study also showed that the cost comparison between sustainable and conventional housing focused more on environmental issues rather than economic aspects of housing. Extant literature points to the fact that the long term cost benefit of sustainable housing far exceeds that of conventional housing. The finding of this study indicates that if cost effective sustainable materials is used and the project planning / management of sustainable housing is right the capital cost can also be lower than conventional housing most especially when the communication among the project team is cohesive.

Tables (1-4) Cost Comparison between Sustainable and Conventional Housing (160 Naira = one Dollar)

Table 1: Three Bedroom Apartments (160 Naira = One USD)

Elements	**Cost for Sustainable Housing**		**Cost for Conventional Housing**	
	₦	**K**	**₦**	**K**
Substructure	785,687	.83	799,020	.83
Insitu/Precast Concrete	1,090,149	.34	1,693,958	.33
Masonry	746,396	.17	823,216	.67
Carcassing Timbers	165,187	.83	76,096	.67
Cladding/covering	145,887	.50	175,012	.50
Linings/Partitioning	81,300	.00	93,750	.00
Fittings/Fixtures	764,596	.67	1,149,596	.67
Windows/Doors/Stairs	912,470	.83	995,804	.17
Surface Finishes	785,170	.00	1,278,778	.33
Electrical Installation	473,968	.06	541,666	.67
Plumbing Installation	705,308	.33	787,500	.00
Total Cost	**6,490,934**	**.73**	**8,414,400**	**.84**

Table 2: Two Bedroom Apartments

Elements	Cost for Sustainable Housing		Cost for Conventional Housing	
	₦	K	₦	K
Substructure	523,791	.89	532,680	.56
Insitu/Precast Concrete	726,766	.23	1,129,305	.56
Masonry	497,597	.45	548,811	.11
Carcassing Timbers	110,000	.00	50,731	.11
Cladding/covering	97,258	.33	116,675	.00
Linings/Partitioning	54,200	.00	62,500	.00
Fittings/Fixtures	509,731	.11	766,397	.78
Windows/Doors/Stairs	608,313	.88	663,869	.78
Surface Finishes	523,446	.67	852,518	.89
Electrical Installation	315,978	.71	361,111	.11
Plumbing Installation	470,205	.55	525,000	.00
Total Cost	**4,437,289**	**.82**	**5,609,600**	**.56**

Table 3: One Bedroom Apartments

Elements	Cost for Sustainable Housing		Cost for Conventional Housing	
	₦	K	₦	K
Substructure	392,843	.92	399,510	.42
Insitu/Precast Concrete	545,074	.67	846,979	.17
Masonry	373,198	.09	411,608	.34
Carcassing Timbers	82,593	.92	87,506	.25
Cladding/covering	72,943	.75	46,875	.00
Linings/Partitioning	40,650	.00	574,798	.34
Fittings/Fixtures	382,298	.34	766,397	.78
Windows/Doors/Stairs	456,235	.42	497,902	.09
Surface Finishes	392,585	.00	639,389	.17
Electrical Installation	236,986	.03	270,833	.34
Plumbing Installation	352,654	.17	393,750	.00
Total Cost	**2,770,991**	**.31**	**4,207,200**	**.46**

Table 4: Flat lets

Elements	Cost for Sustainable Housing ₦ K	Cost for Conventional Housing ₦ K
Substructure	261,895 .95	266,340 .28
Insitu/Precast Concrete	363,383 .12	564,652 .78
Masonry	248,798 .73	274, 405 .56
Carcassing Timbers	55,000 .00	25,365 .56
Cladding/covering	48,629, .17	58,338.00
Linings/Partitioning	27,100 .00	31,250 .00
Fittings/Fixtures	254,865 .56	383,198 .89
Windows/Doors/Stairs	304, 156 .94	331,934 .72
Surface Finishes	261,723 .34	639,389 .17
Electrical Installation	157,989 .36	270,833 .34
Plumbing Installation	235,102 .78	393,750 .00
Total Cost	**2,218,644 .95**	**3,208,208.30**

Elements of Sustainable Housing

Satisfaction index for eleven elements of sustainable housing are shown in Table 5. From the table, the respondents were satisfied with six elements (based on the ranking of the mean item scores (MIS). These elements are: Kitchen facilities (0.704), Partitions (0.675), toilet facilities (0.675), windows and doors (0.658), in situ /precast concrete (0.629) and electrical installation (0.629). The remaining five elements recorded moderate satisfaction. The elements that there is still room are surface finishes (0.583), substructure (0.579), masonry (0.579), plumbing installation (0.575), roof and roof covering (0.527). Generally this result indicates that there is still room for improvement from all stakeholders involved in development of sustainable housing so that post occupancy satisfaction level will range between (0.800-0.999).

Table 5: Satisfaction Index on Elements of Sustainable Housing

Elements	Mean item score	Ranking
Kitchen Facilities	0.704	1
Partitions	0.675	2
Toilet Facilities	0.675	2
Windows and Doors	0.658	4
Insitu /Precast Concrete	0.629	5
Electrical Installation	0.629	6
Surface Finishes	0.583	7
Substructure	0.579	8
Masonry	0.579	8
Plumbing Installation	0.575	10
Roof and Roof covering	0.527	11

The Socio Economic Characteristics

An x-ray of the socio economic characteristics of the respondents shown in table 6 reveal that the respondents are made up of people that are mostly fully employed with 82.3% having full time jobs, and also 76% earning over N71,000 per month. It also showed that the estates are located in predominantly low density areas as the average household size is mostly between 4 and 6 occupying mostly 3 rooms per household. This is a far cry from the average of 5.8 to 8 household sizes across Lagos as identified by Nwokoro and Olayinka (2010, pg.11). We can therefore conclude that given the mentioned characteristics the respondents can afford and maintain sustainable houses.

Table 6: Socio economic Factors of Respondents

Variable s	Options	Frequency	Percentage (%)	Cum (%)
No of Rooms occupied	3	231	70.04	70.04
by Households	4	42	13.46	83.50
	1	39	16.50	100.0
	Total	**312**	**100**	
Household size	6	120	38.46	38.46
	5	78	25.0	63.46
	4	78	25.0	88.46
	3	36	11.54	100.0
	Total	**312**	**100**	
Income per Month(N)	71,000+	237	75.96	75.96
	50,001-70,000	39	12.50	88.46
	30,001-50,000	36	11.54	100.0
	Total	**312**	**100**	
Employment Status	Full-time	257	82.37	82.37
	Part-time	55	17.63	100.0
	Total	**312**	**100**	

Type and efficiency of Housing Facilities

The environmental health statistics shown in table 7 portray the respondents as those with high level of hygiene and efficient housing facilities. This also corresponds with table 5 where toilet and kitchen facilities ranked among the highest on the list of elements of sustainable housing that the respondents are satisfied with. While 75.0% store and dispose their waste water properly, only 25% throw it into drains. Generally 76% of the respondents have access to good sources of drinking water typified by borehole and piped water. Almost 76% use gas which is considered a very good and healthy source of energy for cooking as it does not bring out smoke. All these have implications for the health of the respondents as will be discussed later.

Table 7: Type and efficiency of Housing Facilities

Variable	Options	Frequency	Percentage (%)	Cum (%)
Disposal of Waste water	Store and dispose	234	75.0	75.0
	Throw into drains	78	25.0	100.0
	Total	**312**	**100**	
Sources of drinking water	Borehole	120	38.46	38.46
	Piped water	117	37.50	75.96
	Well	39	12.50	88.46
	Stream or pond	36	11.54	100.0
	Total	**312**	**100**	
Source of Energy for Cooking	Gas	237	75.96	75.96
	Kerosene	39	12.50	88.46
	Firewood	36	11.54	100.00
	Total	**312**	**100**	

Transport Expenses relative to Income

The location of the houses also has implications on the health and income of the respondents. A sustainable housing is that which is located close to the work place and other places the occupant commute to regularly. If the house is located far from the place of work, school, worship, shopping etc., the transport expenses to such places will be very high and take a sizeable portion of the family budget. It will also affect the health of occupants who will have to spend very long hours commuting to such places. However, table 8 reveals that about 76% of the respondents do not spend more than 30% of their monthly income on transport expenses. This supports the earlier assertions that the houses under study are predominantly sustainable.

Table 8: Transport Expenses relative to Income

Options	Frequency	Percentage (%)	Cum (%)
11-30%	159	50.96	50.96
Less than 10%	78	25.00	75.96
31-50%	75	24.04	100.0
Total	**312**	**100**	

Relationship between Sustainable Housing Factors and Diseases

To further ascertain how these sustainable housing factors affect the health of individuals living in them, the respondents were asked to tick the extent to which they believe the inadequacy of the sustainable factors under examination can contribute to the under listed diseases. The diseases usually associated with housing and neighbourhood conditions include malaria, diarrhoea, typhoid fever, cholera, respiratory infection, tuberculosis, dysentery amongst others. Table 9 gives a breakdown of the relationship between these diseases and sustainable housing factors. The major source of diarrhoea, typhoid fever, cholera and dysentery is water inefficiency while poor design quality is the major source of malaria. Respiratory infection is attributable to energy inefficiency and poor site selection contributes to tuberculosis. This is not surprising as many researchers (Nwokoro, 2008, 2010) have agreed that poor sources of water and sanitation methods are associated with these diseases.

Table 9: Relationship between Sustainable Housing Factors and Diseases

Diseases	Factors	Frequency	Percentage (%)	Cumulative Percentage (%)
Malaria	Poor design quality	120	38.46	38.46
	Poor site selection	78	25.0	63.46
	Water inefficiency	75	24.04	87.50
	Energy inefficiency	39	12.50	100
	Total	**312**	**100**	
Diarrhoea	Water inefficiency	117	37.5	37.5
	Energy inefficiency	81	25.96	63.46
	Poor site selection	75	24.04	87.5
	Poor design quality	39	12.5	100
	Total	**312**	**100**	
Typhoid Fever	Water Inefficiency	117	37.5	37.5
	Poor design quality	81	25.96	63.46
	Energy Inefficiency	75	24.04	87.5
	Poor site selection	39	12.5	100
	Total	**312**	**100**	
Cholera	Water inefficiency	117	37.5	37.5
	Energy inefficiency	81	25.96	63.46
	Poor site selection	75	24.04	87.5
	Materials used	39	12.5	100
	Total	**312**	**100**	
Respiratory infection	Energy inefficiency	153	49.04	49.04
	Poor site selection	81	25.96	75
	Poor design quality	39	12.5	87.5
	Materials used	39	12.5	100
	Total	**312**	**100**	
Tuberculosis	Poor site selection	129	41.35	41.35
	Energy inefficiency	87	27.89	69.24
	Water inefficiency	48	15.38	84.62
	Materials used	48	15.38	100
	Total	**312**	**100**	
Dysentery	Water inefficiency	132	42.31	42.31
	Poor Site selection	87	27.89	70.2
	Materials used	48	15.38	85.58
	Energy inefficiency	45	14.42	100
	Total	**312**	**100**	

CONCLUSIONS

This study was set up to compare the capital cost of sustainable housing with that of conventional housing and to examine the health implications of sustainable housing in Lagos, Nigeria. The cost comparison of the three bedroom apartments indicates that sustainable housing is cheaper than conventional housing by (22.86%). A similar cost comparison for the two bedroom apartments indicates that sustainable housing is cheaper than conventional housing by (20.90%). For the one bedroom apartments, the cost of sustainable housing is cheaper than conventional housing by (34.14%) and finally the cost comparison for the flat lets indicates that sustainable housing is cheaper than conventional housing by (30.84%).This finding is not consistent with the report of Langdon (2004) where the findings of the study posits that conventional buildings are cheaper than sustainable buildings within a cost premium of (0-10%). The finding of this study indicates that if cost effective sustainable materials is used and the project planning / management of sustainable housing is right the capital cost can also be lower than conventional housing most especially when the communication among the project team is cohesive. The major source of diarrhea, typhoid fever, cholera and dysentery is water inefficiency while poor design quality is the major source of malaria. Respiratory infection is attributable to energy inefficiency and poor site selection contributes to tuberculosis. The satisfaction index for kitchen and toilet facilities, windows/doors, concrete works and electrical works is satisfactory while surface finishes substructure, masonry, plumbing installation, roof and roof covering recorded moderate satisfaction. The study recommends amongst others that it is important to use cost effective sustainable materials and effective project management and communication in the development of sustainable housing as this ensures realistic capital cost. The post occupancy satisfaction index of sustainable housing elements indicates that there is still room for improvement to achieve very satisfactory level. The causative sustainable factors that contributes to communicable diseases have been identified hence effort should be made to limit the predominance of such factors in sustainable housing.

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