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Sustainable Urban Infrastructure Delivery in Enugu, Nigeria: The Role of the Private Sector

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Abstract: ***The sustainability status of the Enugu urban infrastructure was examine using seven urban sustainability indicators, based on three dimensions of economic, social and environmental well-being of the citizens. Survey research method was used in which well-structured questionnaires were administered on 625, 000 respondents. Based on a 5-point scale measure of sustainability indicators, the total mean scores were as follows: urban mobility indicator (UMI = 1.6383);waste management indicator (WMI = 1.8183); housing quality indicator (HQI = 1.8983); urban safety indicator (USI = 1.9850); economic urban sustainability indicator (ESI = 1.8217); green public space and heritage indicator(GPI = 2, 5117); citizens participation indicator (CPI = 2.6550). Only the GPI and CPI showed relatively high sustainability levels while the rest were very low indicating ineffectiveness. This suggests that the urban development plans and policies are deficient and fall below the global environmental friendly stipulations. A complete overhauling of the development strategies is therefore proposed for better results.***

Keywords: Indicator; Infrastructure; Private Sector; Sustainability.

1. Introduction

Diverse urban projects involving urban planning, design, water, transportation and waste water management, contribute to the development of urban infrastructure which invariably is an important factor in the achievement of the Millennium Development Goals (MDG). Achieving sustainable development and ensuring environmental sustainability are key goals for the international community, as a means to ensure human well-being (Danko and Lourenco, 2011). Thus, sustainable development must strive to achieve a balance in the environmental, social and economic systems of the urban environment. According to Zavrl and Zeren (2010), apart from the well-known Brundtland definition of sustainable development, where sustainable development is seen as "development that meets the needs of the present without compromising the ability of the future generation to meet their own needs" (WCED, 1987), it has been commonly accepted that sustainable urban infrastructure focuses on prevention of unnecessary consumption of natural resources(especially non-renewable ones) and mitigation of harmful emissions.

Moreover, in accordance with The Triple Link Sustainability Model (Howes and Robinson, 2005), every project may be evaluated in terms of environmental, social and economic aspects of sustainability (Camagni, Capello and Nijkamp, 1998), where integration and optimal balance of all three dimensions and objectives are needed for overall sustainability, Zavrl and Zeren, further cited. Yigitcanlar and Dur (2010), citing Hemphil, Berry, McGreal (2004) and Hezri (2005), stated that the increased and urgent environmental agenda has engendered the need for employing sustainability assessment frameworks as key mechanisms for measuring the impacts of development on the environment, and as key policy instrument for supporting the transition to sustainable urban development path. Experts agree on the use of sustainability indicators for assessment of sustainability status of a city. A principal challenge for the government is the development of sustainable urban infrastructural policies and the absence of appropriate measuring tools for sustainability assessment of her programmes.

In this paper, relevant urban sustainability indicators were carefully identified and selected consistent with peculiar needs, to measure the performance and effectiveness of the infrastructural development strategies in Enugu, based on the three dimensions of economic, social and environmental well-being of the citizens. This will guide the attainment of Enugu urban sustainability goals and aspirations and further assist in the design of new urban development plans and policies consistent with global environmental friendly stipulations. Beyond this, the indicators will help expose areas of deficiencies in the existing plan and create the platform for necessary amendments.

2. Statement of the Problem

There is a continuous movement of people into the cities in search of improved services, employment opportunities, and better prospects of social and economic activities. Thus, the urban population has been increasing and is estimated to reach 70% of the total population in the world by 2050, (Shen, Ochoa, Sha, and Zhang, 2011). Enugu has witnessed this unprecedented population growth in its urban population in recent times. As the population density increases, access to services and other factors that are promoters of quality-of-life become threatened by increasing social conflict, unacceptable environmental degradation and the collapse of basic services (Basiago, 1999). As spatial distribution and human activities change, so does the call for increased urbanization and associated negative environmental impacts (Danko and Lourenco, 2011). The problem of this study is thus encapsulated in the above imperatives.

3. Aim and Objectives

The aim of this study is to critically assess the urban infrastructural delivery system in Enugu metropolis with a view to determining the sustainability status and further explore the possible role of the private sector.

In line with the study aim, three strategic objectives were planned out to guide this work:

i. To identify relevant infrastructural sustainability indicators in Enugu urban;
ii. To measure the urban infrastructural sustainability status;
iii. To explore the role of the private sector in the provision of sustainable urban infrastructure.

4. Materials and Methods

2.1 Study Area

Enugu, the capital of Enugu State, is in the South-eastern Nigeria with Ebonyi State, Kogi and Benue States, Anambra State, Abia and Imo States bordering it.

With its good soil, beautiful landscape and excellent climatic conditions, it grew to become a centre of attraction for prospective escapees and returnees from the troubled sections of the country. It therefore provides visitors a fascinating place for leisure and business activities, as it presents them with her rich cultural diversity, beautiful sceneries and undulating plateau.

The principal cities in the state are Enugu, Agbani, Awgu, Udi, Oji River, Nsukka and Nkalagu. Enugu has good climatic conditions all year round, sitting at about 223 metres (732 ft) above sea level, and the soil is well drained during its rainy seasons. The mean temperature in Enugu State in the hottest month of February is about 87.16 °F (30.64 °C), while the lowest temperatures occur in the month of November, reaching 60.54 °F (15.86 °C). The lowest rainfall of about 0.16 cubic centimetres (0.0098 cu in) is normal in February, while the highest is about 35.7 cubic centimetres (2.18 cu in) in July, (Wikipedia),.The average annual rainfall in Enugu is around 2, 000 millimetres (79 in) which arrives intermittently and becomes very heavy during the rainy season(Egboka, 1985).Adegun Balogun and Adeaga (2012) citing (Egboka, 1985) posited that the rainfall often occurs as violent downpours, which may be accompanied by thunderstorms, heavy flooding, soil leaching, erosion, gullying and groundwater recharge.

2.2 Methodology

The study adopted the survey research method with well-structured questionnaire administered on the respondents to elicit relevant information for the study. The basic characteristics of the respondents were sought with the questionnaire which included the sex, age, marital status, educational attainment and occupation. These were used in assessing their suitability for use in the study. Other data used in this study include their responses on some sustainability indicators as presented by Mega and Pedersen (1998). Respondents were randomly drawn from the high density, medium and low density areas of the city. A sample of 625, 000 was taken from the population of Enugu urban which is 722, 664according to 2006 national population census (NPC, 2006), to form the study population using the Taro Yamani's Formula: $n = N / 1 = N (e)^2$, having projected the total population to 2014 using 2.8% growth rate (NPC, 1991) to give 901, 162 with the formula: $P_t = P_o (1+r\ \%)^t$.

Six hundred (600) valid responses were obtained from the entire questionnaires distributed, and these were used for the analysis.

5. Data Presentation

Regarding the demographic result from the study area, 314(52.3%) of the respondents are males while 286(47.7%) of the respondents are females. In terms of age, 81(13.5%) of the respondents are below the age of 25, 230 (38.3%) are between 25 and 50 years of age while 289(48.2%) are above 50 years of age. Meanwhile, 269 (44.8%) of the respondents in this study, are married, 265(44.2%) are single while 66(11%) are divorced.

Level of education indicates that 68(11.3%) of the respondents have attained primary education, 233(38.8%) have attained secondary education while 255(42.5%) are graduates from tertiary level of education and 44(7.3%) of the respondents have attained vocational education.

In terms of occupational status, the study further reveals that 204(34%) of the respondents are public servants. 133(22.2%) are self-employed, 148(24.7%) are unemployed while 115(19.2%) of the respondents are retired.

For the purpose of unveiling the impact of the sustainability indicators identified in this study, the researchers used the following statistical tools; Mean Standard deviation and Cluster Analysis.

The indicators used in this study were measured based on 5 point scale: 5=very effective, 4= effective, 3=moderately effective, 2= ineffective, 1=very ineffective.

Table 1: Report

Sustainability Indicators	*Density*											
	High Density Area			*Medium Density Area*			*Low Density Area*			*Total*		
	Mean	*N*	*Std. Deviation*	*Mean*	*N*	*Std. Deviation*	*Mean*	*N*	*Std. Deviation*	*Mean*	*N*	*Std. Deviation*
Urban Mobility Indicator (UMI). The use of environmental-friendly means of transport	1.6588	296	.97865	1.6900	200	.97913	1.4808	104	.69646	1.6383	600	.93755
Waste Management Indicator (WMI). Efficiency of waste disposal mechanism	1.8615	296	.99033	1.8100	200	.88760	1.7115	104	.84386	1.8183	600	.93280
Housing Quality Indicator(HQI) The degree to which inhabitants suffer from poor housing conditions	1.9122	296	1.07627	1.9700	200	1.06053	1.7212	104	1.02831	1.8983	600	1.06453
Urban Safety Indicator (USI) The degree to which people surfer from lack of urban safety (security infrastructure)	1.9527	296	1.08821	2.0750	200	1.17742	1.9038	104	.91926	1.9850	600	1.09244
Economic Urban Sustainability Indicator (ESI) The viability of the urban economy	1.8581	296	1.02848	1.7150	200	.92088	1.9231	104	1.04920	1.8217	600	.99910
Green, Public space and heritage Indicator(GPI) The degree of improvement required for green, public space and heritage	2.6115	296	1.37079	2.4800	200	1.37076	2.2885	104	1.33419	2.5117	600	1.36735
Citizens Participation Indicator (C PI) The degree to which the local population participates in the decision-making and improvement in quality of life	2.7297	296	1.31275	2.6700	200	1.29983	2.4135	104	1.35540	2.6550	600	1.31866

Source: Researchers' Computation

Table one which shows the means and standard deviations of each indicator across the density areas and reveals that the mean values of urban mobility indicator are 1.66 for the high density area, 1.69 for medium density and 1.48 for low density area. Based on the 5 point scale measure of sustainability indicators, the mean scores indicates ineffectiveness of urban mobility which suggests lack of sustainable environmental friendly means of transport.

Waste management indicator shows mean score of 1.86 for high density area, 1.81 for medium density area and 1.71 for low density area; this result shows that waste management in the study area seems to be ineffective. The housing quality indicator shows that the high density area mean score is 1.91, medium density mean score is 1.97 while low density means score is 1.72; this also does not portray effectiveness in housing quality across the three density areas.

Urban safety indicator unveils mean score of 1.95 from high density area, 2.08 from medium density area and 1.90 from low density area. This low mean scores also show that" Urban Safety" in the study area lies within the ineffective region of the mean scores.

Regarding the economic urban sustainability indicator, mean score from high density area shows 1.86, medium density reveals mean score of 1.72 while the low density area shows mean score of 1.92. These figures do not seem to be good enough in terms of economic urban sustainability.

Green public space and heritage indicator shows mean score of 2.61 from high density area, while the medium density area shows mean score of 2.48; at the same time, low density area reveals mean score of 2.29. Citizens' participation indicator reveals mean scores of 2.73 from high density area, 2.67 from medium density area and 2.41 from low density area, relatively showing increased sustainability levels.

Cluster Analysis was performed for the purpose of classifying the respondents in the area of study into homogeneous clusters and to further bring about heterogeneity between the clusters, in order to obtain cluster of respondents that are defined by the sustainability indicators used in this study.

The researchers used a two-step approach to find the number of clusters. Hierarchical cluster analysis was first

performed which generated agglomeration schedule from which the researchers determined the number of clusters to be used while performing the non-hierarchical cluster with the aid of k-means procedure.

Three clusters were determined as shown in table2, comprising 166(27.7%) of the respondents in cluster one, 270(45%) of the respondents in cluster two and 164(27.3%) of the respondents in cluster three.

Table 2: Cluster Number of Case

		Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
Valid	1	166	27.7	27.7	27.7
	2	270	45.0	45.0	72.7
	3	164	27.3	27.3	100.0
	Total	600	100.0	100.0	

Source: Researchers, Computation

Analysis of variance (F-test) as shown in table 3 reveals a significant difference between the clusters with respect to each of the indicator variables ($p<0.05$). Thus, the clusters are heterogeneous.

Cluster Characteristics

Table 3 reveals that the members of cluster one are those who are in serious need of environmental friendly means of transport, followed by economic urban sustainability and their third priority is efficient waste disposal mechanism. Cluster two reveals a set of respondents that need environmental friendly means of transport as first priority, followed by efficiency of waste disposal mechanism which is also at par with the need for housing quality.

Table 3

Indicator	*Cluster 1*	*Cluster 2*	*Cluster 3*	*F*	*Sig*
Urban Mobility Indicator: Use of environmental friendly means of transport	2.04	1.20	1, 95	65.72	0.00
Waste Management Indicator: Efficiency of waste disposal mechanism	2.37	1.27	2.15	120	0.00
Housing Quality Indicator	2.47	1.27	2.35	120.05	0.00
Urban Safety Indicator	2.41	1.33	2.64	130.65	0.00
Economic Urban Sustainability Indicator	2.16	1.34	2.27	69.43	0.00
Green Public Space and Heritage Indicator	4.14	1.76	2.09	374.14	0.00
Citizens Participation Indicator	4.19	2.04	2.10	325.15	0.00

Source: Researcher's Computation

Cluster three shows a set of respondents whose top-most priority is the use of environmental friendly means of transport followed by green public space. The researchers further performed cross tabulation between the clusters and some demographic variables.

Table 4

	Cluster 1	*Cluster 2*	*Cluster 3*
	%	%	%
AGE			
Below 25 yrs	10.2	15.2	13.5
25-50 yrs	47.0	33.3	38.3
Above 50 yrs	42.8	51.5	48.2
OCCUPATION			
Public Service	52.4	24.8	30.5
Self Employed	21.1	25.2	18.3
Unemployed	18.7	25.2	29.9
Retired	7.8	24.8	21.3
LEVEL OF EDUCATION			
Primary	13.3	10.7	10.4
Secondary	38	39.6	38.4
Tertiary	45.1	42.6	39.6
Vocational	3.6	7	11.6

Source: Researchers' Computation

Table 4 shows that in terms of age categories in cluster one, respondents of age 25-50 years are in the majority (47%). With respect to occupation categories in cluster one, 52.4% being the highest are public servants.

The highest percentage among the levels of education categories in cluster one is 45.1% possessed by the members who have attained tertiary education. Among the age categories in cluster two, majority of the respondents are those who are above 50 years of age (51.5%) while in terms of occupation in cluster two, majority are the self

employed and unemployed; they represent 25.2% each, of the cluster two occupation respondents.

In terms of level of education categories in cluster two, members who have attained tertiary level of education dominate (42.6%). Respondents above age 50 dominate among the age categories in cluster three and the percentage is 48.2 while in the same cluster three, public servants are more in number among the occupation categories, the percentage is 30.5.

Further to this, cluster three reveals level of education categories dominated by members who have acquired tertiary level of education being 39.6%

6. Discussion

Regarding urban mobility indicator, the lowest mean score emerged from the low density area. Thus, it appears that the worst victim as regards the lack of environmental friendly means of transport is the low density area of Enugu metropolis. This lowest position in mean score remains the same for the six sustainability indicators out of the seven of them used in the study. Meanwhile, the medium density area scored the least in economic urban sustainability. But overall, from the mean scores, urban mobility appears to be the least in the sustainability scale, while the highest is the citizens' participation indicator. Five, out of the seven sustainability indicators lie between ineffective and very ineffective (1.6383-1.9850), representing 71.43% of the total infrastructure provisions studied. The remaining two were marginally moderately effective (2.5117-2.6550) representing 28.57%.

The area of deficiency in the sustainability requirements of the urban infrastructure in Enugu has been clearly identified. This suggests the presence of obvious deficiency in urban development plans and policies which fall below the global environmental friendly stipulations.

4.1. Private Sector Participation

While it may be true that existing public funding sources might be inadequate to meet the infrastructure needs of the cities, it is equally believed that a broader and more robust approach to urban infrastructure provision is required, hence the need for public intervention at every stage of urban development planning. The most fundamental role of the government in urban infrastructural provision is policy formulation which essentially defines the scope of the project, priority areas and regulates the activities of the various stakeholders. Experience has shown that the absence of legal and institutional frameworks impedes output in the various sectors and ensures collapse of even the best sustainable development plan. The private sector requires a reliable and effective implementation of the policies to ensure return on investments which are usually very high and irreversible.

Huge investment capital is required to meet the basic infrastructure needs of the urban population and the private sector is seen as a sustainable way of ensuring efficiency backed-up with steady finance to achieve the desired economic goal. Privatization encourages competition. As opined by Vickers and Yarrow (1989), operational and economic efficiency have more to do with competition than with type of ownership. Ownership, risks and profit are shared in a Public-Private Partnership (PPP) arrangement. However, full privatization, which in economic terms, is the transfer of ownership and/or management of supply of goods and services from public sector to private sector (Bakker, 2003a), may not augur well with the consumers as concerns are often raised on the likely high cost of the services/goods if not regulated. Therefore a PPP arrangement is advocated by some researchers where the public sector fundamentally as the regulatory body in the interest of all concerned. In which case, the public sector is responsible for regulating and monitoring performance. The regulatory aspect reduces financial and other risks for the private sector while performance monitoring ensures efficiency, quality output and consumer protection.

7. Conclusion

The apparent massive urban renewal and development efforts of the Enugu State government have been dwarfed by the influx of people from outside the city, thus creating unprecedented urban growth. The ever-growing urban population mounts enormous pressure on the existing urban infrastructures, thus drastically reducing the sustainability levels. It therefore becomes imperative that the government urgently reviews its development strategies to come up with a more sustainable approach towards the provision of infrastructural facilities in the state. According to Alitheia (2010), PPP is a sustainable effort between the public and private sectors, in which each contributes to planning and resources needed to accomplish a mutually shared objective. Since lack of public fund limits the activities of the state, the private sector could team-up with the government to form a partnership which will ensure broad-based strategies for the provision of basic urban infrastructure.

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Appendix: Questionnaire for Prospective Respondents

SECTION A: Personal Data of the Respondents

Please tick as appropriate.

1. Sex: (a) Male [ ]; (b) Female [ ]
2. Age: (a) Below 25 years [ ]; (b) 26-50 years [ ]; (c) Above 50 years [ ]
3. Marital Status: (a) Married [ ]; (b) Single [ ]; (c) Divorced [ ]; (d) Widowed [ ]
4. Level of Education: (a) Primary [ ]; (b) Secondary [ ]; (c) Tertiary [ ]; (d) Vocational [ ]; (e) Others Specify [ ]
5. Occupation: (a) Public Service [ ]; (b) Self Employed [ ]; (c) Unemployed [ ]; (d) Retired [ ]
6 Ethnic Origin: (a): Ibo [ ] (b) Hausa [ ]; (c) Yoruba [ ]; (d) Other Nigerian [ ]; (e) None of the Above [ ].

SECTION B: Measurement of the Sustainability Performance of Enugu Infrastructure (weighted according to their contributions to the sustainability levels)

5=very effective, 4= effective, 3=moderately effective, 2= ineffective, 1=very ineffective.

S/No	*Sustainability Indicators proposed by The European Foundation*	*Rating*				
		Very Effective	*Effective*	*Moderately Effective*	*Ineffective*	*Very Ineffective*
1	**Urban Mobility Indicator (UMI).** The use of environmental-friendly means of transport					
2	**Waste Management Indicator (WMI).** Efficiency of waste disposal mechanism					
3	**Housing Quality Indicator(HQI)**The degree to which inhabitants suffer from poor housing conditions					
4	**Urban Safety Indicator (USI)**The degree to which people surfer from lack of urban safety (security infrastructure)					
5	**Economic Urban Sustainability Indicator (ESI)** The viability of the urban economy					
6	**Green, Public space and heritage Indicator(GPI)**The degree of improvement required for green, public space and heritage					
7	**Citizens Participation Indicator (C PI)**The degree to which the local population participates in the decision-making and improvement in quality of life					