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Perception on Environmental Innovations and Smart City Projects among Residents in Lagos Metropolis, Nigeria

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ABSTRACT

The increasing process of urbanization and swift growth in population in many nations has continued to attract researchers' attention. Studies in this direction are looking on how to create appropriate strategies so that the built environment can continue to be cool, habitable and sustainable. The proposition of Green Infrastructure (GI) has been advocated in various nations as a means to revitalize depleted green areas in the environment and provide numerous ecosystem services and benefits to man. This study assessed perception on environmental innovations and smart city projects among selected residents in Lagos Metropolis, Nigeria. A multi-stage sampling technique was employed to select 1144 residents who participated in a questionnaire survey. The results of the descriptive statistics and independent t-test analysis reveal that 72.0% and 57.1% of residents were aware of the GI and smart city innovation projects respectively in the study area. About 66.0% were not interested in collecting information from the smart information/advertisement boards. While there is no significant difference in the perception of the effect of GI on environmental quality from smart city projects by male and female participants examined. With suitable governmental policies, increased awareness campaigns, and expansion of GI facilities and smart city technological innovations, Lagos state can continue to develop sustainably which will in turn have multiple effects on the quality of life of city dwellers in Lagos and similar settings.

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1. Introduction

The ongoing environmental crises in the built environment are reaching a critical level. Many of these challenges have been triggered by industrial advancements and technological progress, predominantly visible in urban areas worldwide as opposed to rural regions (Ziter, Pedersen & Kucharik, 2023; Salisu, 2015; UN-Habitat, 2014). Scholars are persistently exploring strategies to ensure the sustainable development of the built environment. A solution to address the ongoing deterioration of the human environment is the promotion of Green Infrastructure (GI) as an environmental innovation with the potential to restore the

depleted green spaces in the environment and provide various ecosystem services and benefits.

Green Infrastructure (GI) refers to a variety of versatile green components and amenities that are capable of reconnecting already fragmented spaces to one another and providing essential ecosystem services to man and the built environment (Goddard, Dougill & Benton, 2023; Dipeolu & Onamade, 2021; Mexia et al., 2018; Byrne, Wolch & Zhang, 2009). These encompass natural or semi-natural areas like bodies of water, gardens, parks, sports fields, green roofs, grasslands, horticultural spaces, community forests, and other human-designed systems that offer essential ecosystem services capable of sustaining a healthy environment (Triguero-Mas, Dadvand & Nieuwenhuijsen, 2023; Ziter et al., 2023; Dipeolu & Ibem, 2022; Adegun, 2018; Ahern, 2013). Their functions span from the capacity to reconnect fragmented spaces within the environment (Jim & Shan, 2013), enhance physical and mental well-being (Maes et al., 2015), foster a sense of community and social unity (Dipeolu, Ibem & Fadamiro, 2020, Cramm & Nieboer, 2015; Conedera et al., 2015; Cramm, van Dijk & Nieboer, 2013), offer environmental services such as carbon sequestration, mitigate the urban heat island effect, reduce wind speed (Ziter et al., 2023; Venter, Krog, & Barton, 2020), and contribute to enhancing the perception and balances of the built environment (Dipeolu & Ibem, 2022; Roe & Mell, 2013; Byrne, Wolch & Zhang, 2009).
The emergence of smart cities concept as an innovative strategy to address challenges stemming from urban population growth and rapid urbanization is currently gaining momentum. The notion of a smart city implies that with timely access to accurate information, residents, service providers, and authorities can make informed decisions leading to an enhanced quality of life for urban dwellers and increased the city's resilience (Khansari, Mostashari & Mansouri, 2013; Tranos & Gertner, 2012). Despite the myriad challenges linked to urban agglomerations, there has been a consistent trend of global population concentration in urban areas (Caragliu, Del Bo & Nijkamp, 2011). Consequently, sustainable urban development has been a focal point for both researchers and policymakers over the past several decades.

Many developed nations have successfully leveraged high digital literacy, widespread internet access, and strong institutional frameworks to implement smart city initiatives that enhance urban living. These cities emphasize the Internet of Things (IoT), Artificial Intelligence (AI), and data-driven governance to optimize energy consumption, traffic flow, and waste management (Clark, 2020). Notable examples include Barcelona's smart lighting and waste collection systems, Amsterdam's smart mobility solutions, and Copenhagen's smart grids, all of which integrate technology with sustainability goals.
Interestingly, most of these smart city projects are well-funded and strategically aligned with climate resilience and carbon neutrality objectives (Musa, 2028; Clark, 2020; Paiho et al., 2020). Beyond technology, they prioritize sustainable urban planning, incorporating green roofs, permeable pavements, urban forests, and wetland restoration. New York's High Line, Singapore's extensive vertical gardens, and London's Green Grid exemplify such approaches.

However, in developing countries like Nigeria, the adoption of environmental innovations and smart city projects faces significant challenges. Key barriers include funding constraints, weaker regulatory frameworks, infrastructure deficits, unreliable electricity supply, and a persistent digital divide (Musa, 2018). Unlike in advanced economies, where governments drive smart urban projects, many initiatives in cities like Lagos often rely on community-driven efforts or support from international NGOs due to limited public sector investment. This financial and infrastructural gap affects residents' perceptions, leading to skepticism about the feasibility and sustainability of smart city innovations in the Lagos metropolis

Urban areas necessitate precise and up-to-date information regarding the status of urban services to enhance public safety and provide essential infrastructure-based services like potable water, electricity, transportation, and communication systems. Several scholars have argued that the efficiency of urban management and performance relies not only on a city's physical infrastructure but also significantly on the availability and quality of information communication and social amenities (Caragliu et al., 2011; Yovanof & Hazapis, 2009).

Acknowledging the pivotal role of smart technologies in enhancing knowledge dissemination, communication, and operational efficiency across various economic sectors, governments worldwide are taking measures to enhance facilities and align with the standards and systems of smart cities. The government of Lagos State is actively involved in this endeavour, implementing numerous projects such as smart transportation, information/advertisement boards, healthcare services, street lighting systems, and smart buildings to elevate Lagos state's smart city status. In addition to these smart city initiatives, the Lagos State Parks and Gardens Agency (LASPARK) was created in 2011 to oversee the innovative Nature-based solution projects in the Lagos (Dipeolu, 2017). LASPARK has continuously worked on developing and maintaining various GI facilities in Lagos State, some of which have been integrated with smart city projects, serving as supplementary services.However, there has been very little evidence regarding the evaluation of residents' awareness levels concerning these amenities within their vicinity. This lack of adequate data has clouded the comprehension of the residents' level of awareness and appreciation of these projects in the city. Against these assertions, this study sought to assess the residents' perception on environmental innovations and smart city projects in Lagos Metropolis Nigeria, under this objectives:
i. assess resident's awareness of GI and smart city innovations projects in Lagos Metropolis, Nigeria;
ii. examine the effectiveness of smart electronic/display boards as a mean of information dissemination to residents of Lagos Metropolis, Nigeria; and
iii. investigate the residents' perception of GI facilities on the environmental quality from smart city projects of Lagos Metropolis Nigeria.

This research contributes to the existing knowledge by shedding light on the awareness levels of Lagos Metropolis residents regarding smart city technology projects and GI facilities in their vicinity, as well as their perceptions of the environmental quality

based on the availability of GI facilities. It also examines the effectiveness of smart electronic boards in disseminating information to residents of Lagos Metropolis. The findings of this study are anticipated to provide insights for city managers, planners, and policymakers on the appropriate strategies for providing, safeguarding, and upkeeping these facilities to meet the evolving needs of residents in a rapidly expanding city like Lagos.

2. Methodology

2.1 Description of Study Area

Lagos lies on longitude 20 421E and 30 421E and latitude 60 221N and 60 521N and currently accommodating an estimated population exceeding 21 million individuals (NBS, 2023).
The present study concentrated its samples from the residential neighbourhoods in the Metropolitan Lagos, which encompasses 16 out of the 20 Local Government Areas (LGAs) in Lagos State. (see figure 1). The remaining four (Epe, Ikorodu, Badagry and Ibeju/Lekki) were left out of the study because they are located outskirt the Metropolitan coverage of Lagos State.
The region was documented to have a land area of 2797.72 Km2 and a water area of 779.56 Km2, with a population density of around 4,193 individuals per km2, and a land area of 1,171.28km2 (BudgIT, 2018). Lagos is a swiftly developing city in Southwest Nigeria and was once the official capital of the Federal Republic of Nigeria. The state continued to daily experience influx of people from many other regions of the nation and outside the shores of Nigeria. This swift population expansion, coupled with vibrant economic endeavours, has reportedly led to the depletion of Lagos State's original forest covers (Dipeolu et al., 2021; Oluwafeyikemi & Julie, 2015; Dipeolu & Fadamiro, 2013). Thus, the state government has set up principal environmental agencies to see to the environment greening of Lagos state.

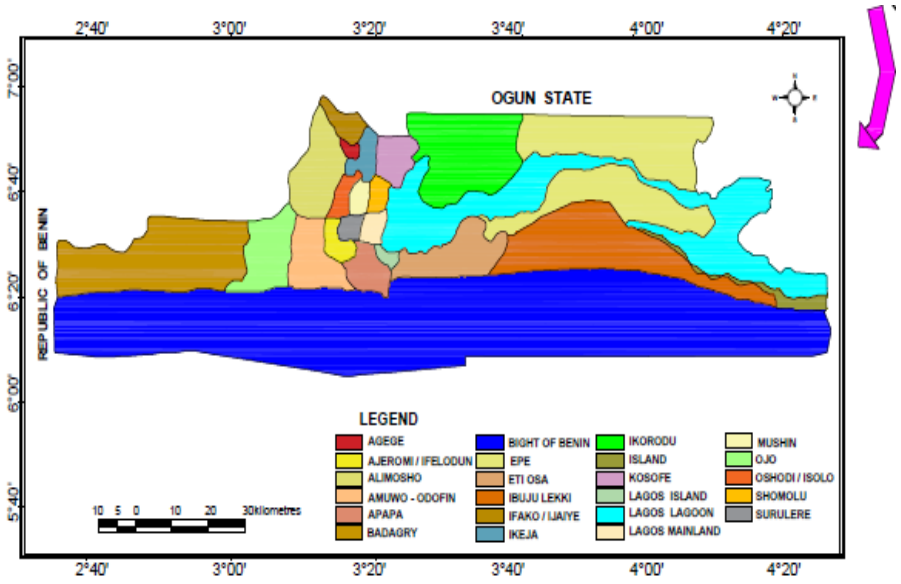

Figure 1: Lagos state map and the adjoining lands (Lagos State Ministry of Environment, 2023)

2.2 Research Design

A cross-sectional survey approach was adopted for this study due to its suitability for the research objectives and fastness in gathering quantitative data. In addition to this reason, previous authors in this research area have equally adopted cross-sectional surveys to achieve cogent results from such studies (see for example Dipeolu et al., 2021; Cramm & Nieboer, 2015; Conedera et al., 2015).
From the sixteen LGAs in the Lagos metropolis, four LGAs namely; Ikeja, Lagos Island, Surulere and Kosofe were randomly selected for this study. An initial visit to the National Population Commission (NPC) office in Lagos produced Enumeration Areas (EAs) records and maps which indicated the existence of 17 EAs (Ikeja = 3 EAs, Lagos Island = 4 EAs, Surulere = 5 EAs, and Kosofe = 5 EAs) in the four selected LGAs.

To deal with the sample size for this study, the formula posited by Turner (2003) was adopted (See equations 1 & 2).

Accordingly, n denotes sample size, Zα is the critical value of normal distribution at a confidence level of 95%, shown at 1.96, r is the estimates of the percentage of respondents in the study, shown at 50%, f is the design effect, shown at =4, k denotes percentage of non-responses, shown at 20%, p=0.03x18 =0.54, and r is the reference parameter. 0.03 signifies each year of age represented within the target population, where h denotes the average household size, typically presumed to be 6

individuals in most developing nations, and e represents the error margin (i.e., 0.05) or at 5% of r.

Therefore, 1520 (380x4) questionnaires were given out for the survey and distributed within four randomly selected Local Government Areas of Ikeja, Surulere, Kosofe and Lagos Island in Lagos Metropolis. These four LGAs represent a quarter of the 16 LGAs in Lagos State.

$$n = \frac{(Z_\alpha)^2 r(1-r) fk}{phe^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$n = \frac{(1.96^2 \times 0.5 \times 0.5 \times 4 \times 0.2)}{[0.54 \times 6 \times (0.05 \times 0.5)^2]} = 379.4 \approx 380 \cdots (2)$$

Data were obtained for this study with the aid of structured questionnaire designed at three different levels. The first segment consists of variables pertaining to the participants' demographic characteristics, the second segment raised issues on residents' awareness of GI and smart city innovation projects, while the last segment examined the residents' perception of availability of GI facilities on the environmental quality of Lagos Metropolis.

2.3 Data Collection

The selection of survey participants was based on predetermined sampling intervals (t) derived from dividing the number of households in each of the identified 17 Enumeration Areas (EA) by the designated sample size for each EA, as per the Lagos state office of the National Population Commission (NPC). Household heads were then systematically chosen from the numbered list of houses within each EA until the required number of household heads per EA was achieved. A questionnaire was administered to each consenting household head within the housing units. Out of the 1520 questionnaires distributed, 1144 were completed and returned, resulting in a response rate of 75.3%.

2.4 Data Analysis and Results

2.4.1 Socio-Demographic Profile of Respondents

From the 1144 participants in this survey, 57.3% were male while 42.7% were female (Table 1). Nearly half of the participants (48.3%) were aged 30-49 years old while only 19.6% of the participants were 30 years or lesser. Participants were predominantly married (59.1%) and resided in households consisting of two-four (50.5%) and more than four (33.8%) individuals per household. According to Table 1, over half of the participants (52.6%) had post-secondary education, with a small percentage (4.7%) having no formal education. A portion of the participants (37.4%) held positions as managers, while 35.1% and 23.1% were junior and senior staff respectively in their enterprises.

Table 1: Respondents' Socio-Demographic Profile

Variables	Frequency (Total=1144)	Percentage (%)
Sex		
Male	656	57.3
Female	488	42.7
Current age		
<30	224	19.6
30-49	552	48.3
>=50	324	28.3
Not Reported	44	3.8
Marital Status		
Not Yet Married	308	27.0
Already Married	676	59.1
No Longer Married	126	11.0
Not Reported	34	2.9
Household Size		
1	110	9.6
2-4	578	50.5
> 4	386	33.8
Not Reported	70	6.1
Ethnic Origin		
Yoruba	804	70.3
Others	334	29.2
Not Reported	6	0.5
Religious Affiliations		
Christianity	498	43.5
Islam	594	52.0
Others	38	3.3
Not Reported	14	1.2
Highest Educational Qualification		
No Formal Education	54	4.7
Primary Education	118	10.3
Post Primary Education	344	30.1
Post Secondary Education	602	52.6
Not Reported	26	2.3
Profession		
Not Employed	156	13.6
Self Employed	486	42.5
Private/Public Sector	408	35.7
Students and Others	94	8.2
Rank in Income level		
Junior Staff	402	35.1
Senior Staff	264	23.1
Manager/Business owners	428	37.4
Not Reported	50	4.4

2.4.2 Resident's Awareness of GI and Smart City Innovation Projects in Lagos Metropolis

Results of the awareness of Lagos Metropolis residents on GI and smart city innovation projects showed that 72.0% of the participants were aware of GI innovation projects while 21.2% claimed not aware of these projects. From the categories of GI mostly common in the locality, 30.8% of the participants

reported that green spaces GI types were the most common, while 23.3%, 35.3% and 6.1% reported that tree features, water features and other GI types (that neither fall in green, tree nor water category) respectively were the most common type of GI (Table 2).

Similarly, 57.1% of the participants reported their awareness of smart city innovation projects in Lagos Metropolis while 37.1% of the respondents reported not aware. When asked to mention the type of smart city projects mostly common in their neighbourhood, 30.2% of the participants reported that smart electronic/display boards were the most common, 19.4% reported that the most common were the smart street lighting systems. However, 16.3%, 9.8%, 13.6% and 7.9% of the participants reported smart urban transport systems, smart buildings, smart healthcare services and others respectively, as the most common smart city innovation project in Lagos Metropolis (Table 2).

2.4.3 Effectiveness of smart electronic/display boards as a mean of information dissemination to residents of Lagos Metropolis

In an attempt to ascertain the effectiveness of the smart electronic/display boards as a mean of information dissemination to residents of Lagos Metropolis, the participants were asked their level of interest in collecting information or news from the smart electronic/display boards. Findings revealed that 32.7% of participants expressed interest in collecting information from smart display boards, while the majority (65.9%) stated their lack of interest in obtaining information from such devices (Table 2).

Moreover, the survey explored how frequently participants accessed information from smart electronic/display boards. Results showed that 29.4% of respondents never retrieved information from these boards, while 12.8%, 21.5%, and 20.6% occasionally (once a year), sometimes (once a month), and frequently (once a week) collected information from the smart electronic/display boards, respectively. Conversely, only 8.4% of participants reported daily information retrieval from the smart electronic/display boards in Lagos Metropolis.

Table 2: Residents' awareness of green infrastructure and smart city innovation projects in Lagos Metropolis, Nigeria

Variables	Freq.	Percent (%)
Awareness of green infrastructure projects in the neighbourhood		
Yes	824	72.0
No	242	21.2
Not Reported	78	6.8
Awareness of smart city innovations projects in the neighbourhood		
Yes	654	57.1
No	424	37.1
Not Reported	66	5.8
Category of green infrastructure types mostly common in the neighbourhood		
Green space GI	352	30.8
Tree features GI	266	23.3
Water feature GI	404	35.3
Others	70	6.1
Not Reported	52	4.5
Type of smart city projects mostly common in the neighbourhood		
Smart electronic/ display boards	346	30.2
Smart street lighting systems	222	19.4
Smart urban transport systems	186	16.3
Smart Buildings	112	9.8
Smart Healthcare services	156	13.6
Others	90	7.9
Not Reported	32	2.8
Are you interested in collecting information from the Smart electronic/ display boards?		
Yes	374	32.7
No	754	65.9
Not reported	16	1.4
How often do you collect information from the smart information/ advertisement boards?		
Never (not at all)	336	29.4
Seldom (once a year)	146	12.8
Sometimes (once a month)	246	21.5
Often (Once a week)	236	20.6
Always (Everyday)	96	8.4
Not Reported	84	7.3
Preferred means of assessing "breaking news" or urgent information		
Radio	232	20.3
Television	206	18.0
Friends/Relatives/Neighbours	136	11.9
Smart information/advertisement boards	78	6.8
Social media	446	39.0
Not reported	46	4.0

2.4.4 Residents' Perception Of GI Facilities On Environmental Quality From Smart City Projects In The Study Area

The study also evaluated residents' perceptions regarding the availability of GI facilities and their impact on the environmental quality of Lagos Metropolis. Participants were asked to evaluate statements concerning the presence and perceived importance of GI facilities. The analysis revealed that 32.0% of participants strongly disagreed, 39.2% disagreed, 11.7% agreed, and 9.4% strongly agreed that there are sufficient green areas in their neighbourhood. When assessing residents' perception of disappearing green spaces, 9.8% strongly disagreed, 12.9% disagreed, 42.8% agreed, and 22.9% strongly agreed. Additionally, 17.1% strongly disagreed, 18.4% disagreed, 26.4% agreed, and 24.8% strongly agreed that a garden or park for interaction exists in their neighbourhood (Table 3).

Interestingly, 18.2% of participants strongly disagreed, 27.6% disagreed, 30.1% agreed, and 19.6% strongly agreed that the availability of GI facilities has enhanced the environmental quality of their neighbourhood. Furthermore, 9.4% strongly disagreed, 13.3% disagreed, 47.6% agreed, and 22.4% strongly agreed that sufficient provision of GI facilities in their neighbourhood would create more recreational opportunities and improve social life (Table 3). Similarly, the result from the independent t-test carried out in the study showed that there is no significant difference in the perception of the effect of GI on environmental quality from smart city projects by male and female participants (Table 4).

Table 3: Residents' perception of GI facilities on the environmental quality from smart city projects in Lagos Metropolis

Variable	Freq.	Perc (%)
There are enough green areas in this neighborhood		
Strongly disagree	366	32.0
Disagree	448	39.2
Undecided	88	7.7
Agree	134	11.7
Strongly agree	108	9.4
Many green areas in this neighbourhood are fast disappearing		
Strongly disagree	112	9.8
Disagree	148	12.9
Undecided	132	11.6
Agree	490	42.8
Strongly agree	262	22.9
Residents have to access the services of parks and gardens in other neighbourhoods		
Strongly disagree	150	13.1
Disagree	302	26.4
Undecided	252	22.0
Agree	238	20.8
Strongly agree	202	17.7
There is at least a garden or a park in this neighbourhood where people interact		
Strongly disagree	196	17.1
Disagree	210	18.4
Undecided	152	13.3
Agree	302	26.4
Strongly agree	284	24.8
Availability of green infrastructure facilities have improved the environmental quality of this neighbourhood		
Strongly disagree	208	18.2
Disagree	316	27.6
Undecided	52	4.5
Agree	344	30.1
Strongly agree	224	19.6
Adequate provision of GI facilities in this neighbourhood will enhance more opportunity for recreation and improved social life.		
Strongly disagree	108	9.4
Disagree	152	13.3
Undecided	84	7.3
Agree	544	47.6
Strongly agree	256	22.4

2.4.5 Test of Hypotheses

Ho: There is no significant difference in the perception of the effect of green infrastructure (GI) on environmental quality from smart city projects by male and female participants in the study area.

Table 4: Testing factors related to perception of GI on environmental quality from smart city projects by male and female participants ($\alpha = 0.05$)

Variable	Mean	Std. Deviation	t value	df	P value	Remark
Male	2.8455	0.55304	-0.456	1385.873	0.868	Not Significant
Female	2.8585	0.55496				

Since P value > 0.05, the null hypothesis is not rejected. Therefore, both the male and female participants in the study area have equal perception on the effect of green infrastructure on environmental quality from smart city projects.

3. Discussion and Implication of Findings

This study investigated the perception on environmental innovations and smart city projects by residents in Lagos Metropolis, Nigeria. To sufficiently achieve the objectives of this study, the major findings worth further elaboration. First, the results on the awareness of GI and smart city innovation projects among the study participants revealed that higher proportion of the respondents in this study are aware of the current

innovations on GI and smart city projects in Lagos. This level of awareness may have stemmed from the fact that majority of the GI and smart city projects identified are mostly concentrated in Lagos Metropolis unlike the sub-urban areas. This finding is consistent with that by Conedera et al. (2015) who reported high availability of GI in the Central Business Districts of Bellinzona in Southern Switzerland compared to other settlements in the Southern Switzerland. Similarly, the studies of Byrne et al. (2009) and Wolch et al. (2014) indicated that distribution of urban GI is often based on region, income, affordability and ethno-racial characteristics. The fact that the Lagos State government started and concentrated the environmental greening campaign at the Metropolitan areas, have highly influenced the awareness level of urban dwellers in this study about the facilities provided.

Moreover, the initiatives undertaken by the Lagos State government starting from 2011 through the LASPARK may have contributed to the awareness of GI and smart city innovation projects among the residents examined. In certain areas of Lagos Metropolis, various GI amenities such as gardens, community woodlands, and fountains have been integrated with smart city initiatives in the State, serving as complementary services to each other (refer to figures 2-7). This combined approach, which involves incorporating features like smart electronic advertisements into GI sites, has not only enhanced the physical environment of Lagos Metropolis but has also provided recreational spaces for residents, opportunities for physical activities, improved mental well-being, and positively influenced the environmental perception of many Lagos State residents as highlighted by Dipeolu et al. (2021).

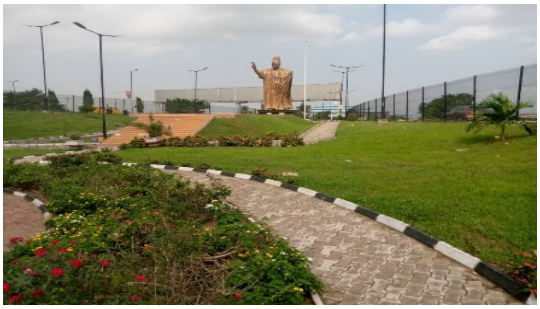

Figure 2: Pictorial view of a green garden along Oworonshoki Road, Chinese Village-Lagos State

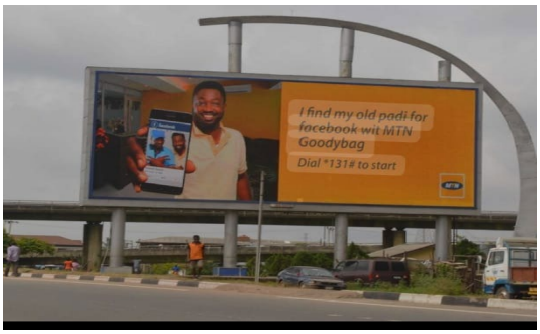

Figure 3: Pictorial view of a advertisement display board along Victoria Island, Lagos State

Figure 4: Pictorial view of an advertisement display board along Owode Onirin Road, Kosofe LGA, Lagos State

Figure 5: Pictorial view of Ojota garden, Lagos State

Figure 6: Pictorial view of an advertisement display board along Iponri, Surulere-Lagos State

Figure 7: Pictorial view of an electronic display board fixed on a green infrastructure site at 7up area Alausa, Ikeja-Lagos State

The second objective was to investigate the effectiveness of smart electronic/display boards as a mean of information dissemination to residents of Lagos Metropolis. Findings revealed that a significant portion of the residents showed little interest in obtaining information from the smart electronic/display boards within Lagos Metropolis. This disinterest can be attributed to the lifestyle patterns of Lagos State residents. In Lagos, it is common to find individuals within a household owning various mobile devices such as android phones, tablets, laptops, and other computing devices, reducing the need for reliance on others to access up-to-date information about the state, nation, and global events. The results were further supported by a large percentage of participants who indicated that they primarily gather information on global events through social media platforms like Facebook, Instagram, Twitter, WhatsApp, LinkedIn, and other similar channels. These findings align with previous studies by Winter (2010) and Yigitcanlar and Velibeyoglu (2008), which emphasized the potential of urban residents to leverage Information and Communication Technology (ICT) for information access. Despite these trends, some Lagos Metropolis residents still prefer to rely on the smart electronic display boards installed at key locations in the city as their primary source of breaking news and current affairs updates, indicating their appreciation for the efforts of the Lagos State government in deploying these boards strategically.

On the residents' perception of availability of GI facilities on the environmental quality of Lagos Metropolis Nigeria, results from the survey observed that there was no significant difference in the perception of the effect of GI on environmental quality from smart city projects by male and female participants. However, majority of the participants agreed that green spaces in their neighbourhood are fast disappearing, and this made the present stock of GI in the neighbourhoods to be small compared to their expectations. Despite this assertion, the residents still perceived that availability of GI facilities in Lagos Metropolis through the efforts of LASPARK agency has brought few additional improvements to the environmental quality of the state. This perception is believed to have been influence greatly by the present efforts of LASPARK in the state through intensive tree planting & maintenance, horticultural research & development, beautification & design, and monitoring, enforcement & compliance as reported by Dipeolu (2017). In particular, Lagos State government have earmarked July 14th of every year for the annual "tree planting day" in Lagos State. These activities have further enhanced planting of trees along selected roads, boulevards, communities, estates and various schools and government offices across the state. The cumulative effects of these are perceived to have influence positively on the environmental quality of Lagos state, Nigeria. These results are not too different from the submissions of Oluwafeyikemi and Julie (2015) and Dipeolu et al. (2020) When they observed the present rate of GI development in Lagos State and concluded that with more efforts from the Lagos State government, GI has potentials to tackle environmental sustainability issues in the city.

4. Conclusions

The overall aim of this study was to investigate the residents' perception on environmental innovations and smart city project in Lagos Metropolis, Nigeria. Upon analysis, three key conclusions were drawn. The initial inference highlights that a significant portion of the survey participants are knowledgeable about the ongoing innovations related to GI and smart city endeavours within the study locality. The subsequent deduction indicates that despite this awareness, the majority of residents in the specified area express disinterest in obtaining information from the smart electronic/display boards situated in Lagos Metropolis. The final deduction suggests that residents presently perceived that the availability of GI facilities in Lagos Metropolis is not contributing adequately to the environmental quality of the city. But they also believed that GI has potentials to contribute positively to the environmental quality of Lagos if there is increase in the provision. These findings carry substantial implications. Firstly, they signify that a considerable number of residents in the neighborhoods under scrutiny are currently cognizant of the innovations pertaining to GI and smart city initiatives. This outcome should serve as an impetus for the state authorities to sustain and enhance the current awareness levels within the city. In pursuing this objective, LASPARK should explore additional avenues for collaboration with related governmental organizations, as well as non-governmental organizations including the community development associations (CDAs) in Lagos State.

Secondly, the outcomes of the study also indicate a lack of interest among Lagos Metropolis residents in utilizing the smart electronic/display boards for information retrieval, favoring instead the utilization of social media platforms. To promote the utilization of these electronic boards for information dissemination, the government must undertake extensive educational campaigns to elucidate the benefits and functionalities of such tools.

To enhance the acceptance and effectiveness of smart city initiatives in Lagos Metropolis, it is essential to expand the deployment of smart electronic/display boards across all Local Government Areas (LGAs). Strategically positioning these boards along major roads and high-traffic zones will improve public awareness and engagement with environmental innovations. Additionally, preserving and revitalizing urban green spaces should be prioritized through sustainable conservation policies. Strengthening access to parks and recreational areas, while increasing tree cover and green infrastructure tailored to diverse demographic groups including children and the elderly which will enhance residents' well-being and promote environmental sustainability. These efforts will not only improve urban aesthetics but also foster a smart, eco-friendly city that aligns with the aspirations of Lagos residents

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Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper

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