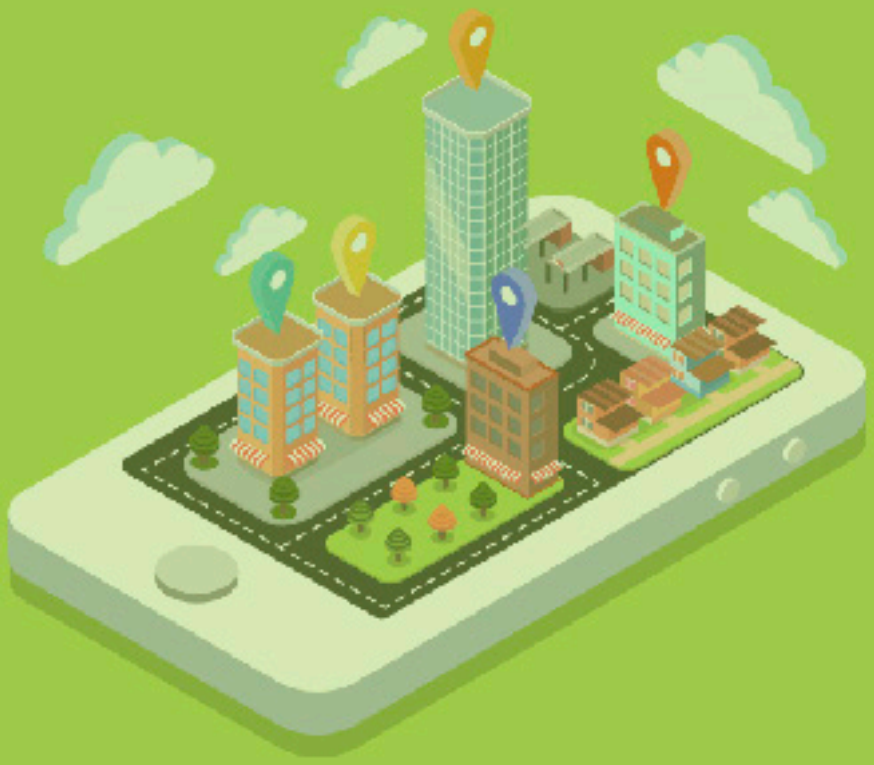
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Assessing Housing Development as an Indicator of Urban Sustainability in Douala, Cameroon: A Smart Growth Approach

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ABSTRACT

This research assessed housing development and its impact on sustainable city development and smart growth. A cross-sectional survey was carried on 200 households using stratified random sampling. Structured questionnaires, observations, and interviews with Council representatives were conducted to collect the data. Data analysis included descriptive statistics and chi-square test of sustainability indicators such as town planning, building materials, regulatory compliance, waste management, housing facilities, accessibility, and smart homes. Results indicated that poor town planning was the main cause of dilapidation and insecurity in 30.5% of houses, population density (25.5%), and poor roads and inaccessibility (23.5%). Although 60.5% of houses used cement blocks, 39.5% of houses use wooden or other poor materials. Compliance with regulations was low since many did not have land ownership, location plans, Council inspection, and building permits. Even though HYSACAM was the main waste operator (59.0%), 80.0% reported inadequate waste management. Irregular water and electricity services were experienced by 49.5% while 54.0% had smart homes. The results indicate significant associations between sustainable development and housing planning (χ^2=41.755, p<.001), building materials (χ^2=9.213, p=.010), and causes of dilapidation (χ^2=26.246, p<.001), but not inspection agencies (χ^2=5.858, p=.210). Improved development control, infrastructure, waste management, zoning, land regularization, and durable affordable houses are very important for sustainable and smart urban development.

INTRODUCTION

Urbanization continues to be one of the most significant problems of the 21st century. According to UN-Habitat, the developing world cities gain five million new residents each month (2019). Urban transition is unique in Africa and it is the largest one in terms of speed and magnitude: the continent's urban population is predicted to increase from 395 million in 2010 to 1.339 billion people in 2050, making up 21% of the world's urban population (United Nations, 2019). The rapid urban growth is connected with migration from rural areas and is concentrated in several primate cities that are not equipped with the necessary infrastructure. As a result, the majority of African cities suffer from the problem of widespread slums, shortage of housing, poverty, poor transport systems, pollution, and lack of resources (Vince & Morrissey, 2020). Smart growth and smart city concept serves as a solution of the current urban challenges in the continent by using technologies and inclusive planning to enhance living conditions, bring investments, and promote sustainable urban development. Otherwise, urban systems will face the threat of failure.

The cities of Cameroon, such as Yaounde, Douala, Bamenda, Kumba, and Limbe have already grown beyond their socio-economic infrastructure. The manifestations include the lack of clean water, poor sewage system, absence of planned housing, inefficient transport system, lack of health care and educational institutions, as well as electricity. Thus, the shift in the way of creating and managing urban space, including affordable public housing, slum improvement, public transit, green spaces expansion, and inclusive planning will help to achieve sustainable urbanism (Fedorov *et al.*, 2012). It can be achieved through SDG11 and national initiatives, like the National Development Strategy 2020-2030 (NDS30) and Vision 2035 of Cameroon.

The study analyses housing development as a proxy indicator for measuring sustainability in Douala, which is the economic capital and most rapidly growing city in Cameroon. The study considers Douala III and Douala IV Sub-Divisions as the entry gate of the city facing high rates of sprawl and unplanned development. It analyzes: (a) actors involved in housing construction, (b) quality of housing considering building materials and state of the building, (c) basic amenities such as water supply, electricity, solid waste management, and sanitation, and (d) road networks for accessibility. The study aims at contributing to the discussion on whether the growth of urban areas in secondary African cities fits smart growth criteria or not.

LITERATURE REVIEW

Concept of Smart Homes and Urban Housing Development

Adam Hayes (2023), in Urban housing development and smart city growth, defines a smart home as a convenient residential setup in which appliances and devices can be automatically controlled remotely from anywhere with an

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internet connection using a mobile or other networked device. Devices in a smart home are interconnected through the internet, allowing the user to control functions such as security access to the home, temperature, lighting, and a home theatre remotely. The researcher here wants to assess the practicality, functionality, and security of these home devices in the smart growth of homes in the town of Douala.

Evolution of the Smart City Concept

According to Wynn *et al.* (2023), the smart city concept has evolved significantly over the past two decades, with many of the world's leading cities now implementing comprehensive smart city programs. While these initiatives could assist in resolving challenges related to network infrastructure, traffic flow, and parking, they might also facilitate the growth of knowledge-based hubs. Nonetheless, it is important to acknowledge that smart city projects and plans have yet to address the dire housing conditions of many major cities. The researche in this work wants to observe the effective provision of housing as a fundamental requirement in a smart city in the town of Douala.

Urbanization and Challenges of Large Dense Cities

Harrison & Donnelly (2011) noted that as we entered the 21st century, there was a strong global trend towards increasing population concentration in a relatively small number of large cities. Large, dense cities can be highly productive, innovative, and per capita very green and hence desirable for our future. However, the rapid influx of new citizens presents overwhelming challenges to their governments. Along with the positive benefits that accumulate from dense, diverse cities come in equal measure the negative aspects such as informal development, traffic congestion, waste management, and access to resources and crime. The demand for services is immediate, but the tax revenues to fund them come later. These challenges lead to experiments with new approaches to the planning, design, finance, construction, governance, and operation of urban infrastructure and services that are broadly called Smart Cities.

According to Fouepe *et al.* (2024), sustainable development of housing in secondary cities of Cameroon has revealed that Douala III and IV are experiencing significant shortages of housing planning because of insufficient development control, road networks, and compliance with building codes. According to these authors, the concept of smart growth will continue to be purely theoretical without incorporation of basic infrastructure including water and energy.

In the same vein, Tchakounte and Ndongo (2022) analyzed the urban sprawl and housing shortages in Cameroon, and they found that the increasing population pressure in Douala is one of the major factors contributing to the proliferation of slums and degradation of the environment. There is a clear link between uncontrolled expansion and inadequate waste management.

Requirements for Housing in a Smart City

According to Korniyenko *et al.* (2021), the main requirements for housing in a smart city have been systematized to align with the principles of technological integration, sustainability, and improved quality of urban life. These requirements are the basis for building a system of notions necessary for the development of a "smart city" complete concept. The purpose of this article is finding ways of increasing habitat sustainability in residential areas of the first mass series. Systematization and synthesis of data on "green" construction allow outlining principal ways of improving habitat sustainability of residential development and preserve the quality of environment for future generations.

Smart Cities and Affordable Housing Nexus

According to Wynn *et al.* (2023), "smart cities" are urban areas that utilize technology to deliver efficient services, including the provision of "affordable housing"—defined as housing that is reasonably priced and accessible to a broad segment of the population. It seeks to give a complete picture of how these factors support the expansion of the city. This paper investigates the connection between smart cities and affordable housing as a means of addressing the issues raised by urbanization, highlighting the need for a comprehensive strategy to promote balanced development. This work examines the urban development pattern of Viksit Bharat, highlighting areas that require attention for affordable housing, inclusivity and various housing needs. In their paper regarding smart growth and housing affordability in Sub-Saharan Africa,

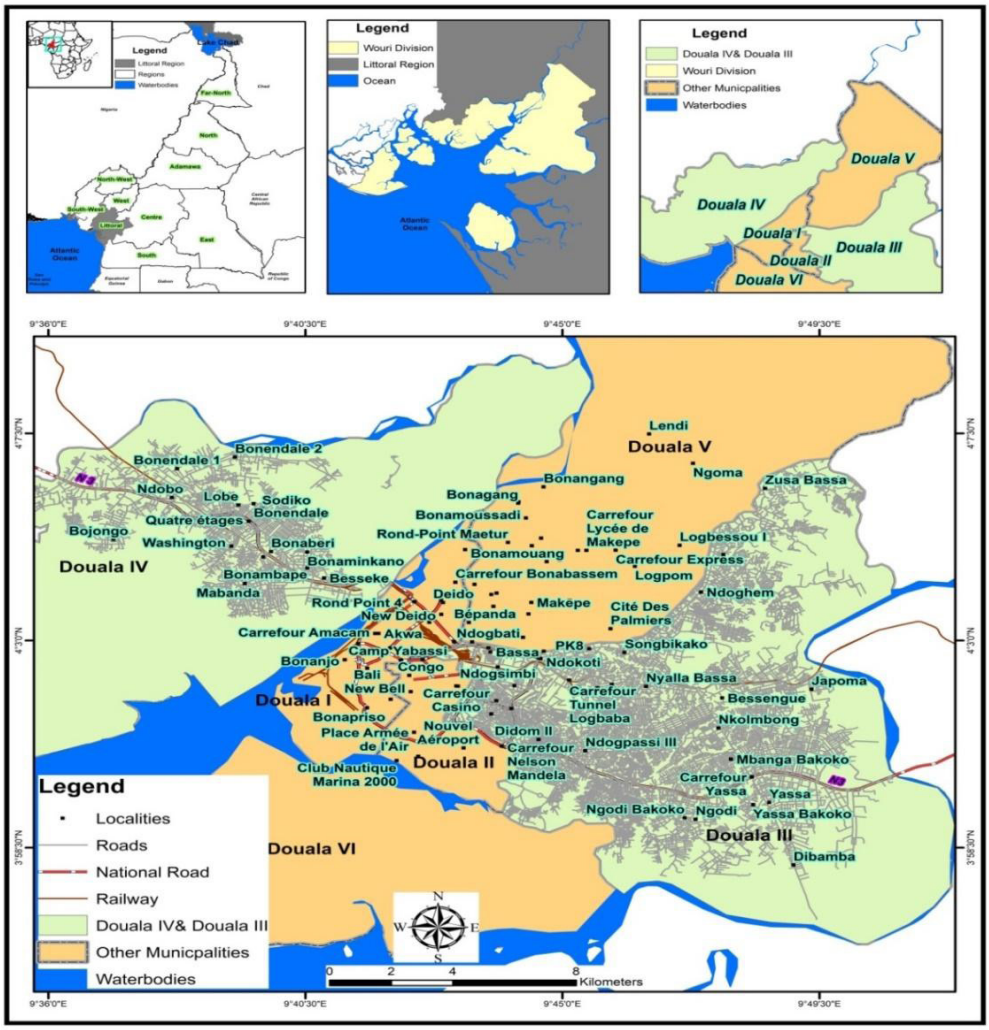
Okafor and Mboh (2023) found out that smart city technology cannot be effectively implemented without tackling problems such as land tenure insecurity, cost of construction material, and digital divide. In this regard, the authors suggested adopting a low-tech solution before implementing smart home.

MATERIALS AND METHODS

Study Area

Douala is the economic capital and capital of Cameroon's Littoral Region. The town of Douala is situated on the River Wouri estuary, in the centre of the Cameroon coastline. It is located between Latitudes 3050' and 50 00' N and Longitudes 90 36' and 10050' E (CDP 2022). The boundaries and the geographical layout of the study area are illustrated in Map 1 below, which provides a detailed representation of Douala III and IV Sub Divisions in the Wouri Division.

The research was carried out in Douala III and Douala IV sub-divisions that are found in the Wouri Division, Littoral Region of Cameroon. Douala, which is the economic capital of Cameroon, is found at the mouth of the Wouri River in the central position along the Cameroon coastline, within latitudes 3°50' to 5°00' N and longitudes 9°36' to 10°50' E (City Development Plan [CDP], 2022). The map below shows the geographical



Map 1: The location of Douala

Source: Adapted from Satellite Image (www.earthexplorer.usgs.gov). Resolution = 15meters

location of the study area.

Douala III sub-division is found in the southwest region of the Douala City Council. The sub-division occupies an area of about 113 km² and has an estimated population of 1,479,147 people (CDP, 2022). Douala III sub-division has two chiefdoms of first degree known as Bakoko and Bassa, which consist of 105 villages. Douala IV sub-division, which was created through Decree No. 87-1366 of September 24, 1987 and modified through Decree No. 92-187 of September 1, 1992, is found in the western part of Wouri Division. The sub-division occupies an area of 94.21 km² and has a population of 424,939 people with a density of 11,301 persons/km² (CDP, 2022). There are 17 main settlements in Douala IV sub-division.

Geographically, both sub-divisions are found in the Douala Sedimentary Basin, which is a depression with an average height of 30 m above the sea level with the Cameroon Estuary as one of the key features (CDP, 2022). The low-lying topography makes construction easy but contributes to the sprawling nature and increases the risk of flooding. Geologically, the region is located on the Wouri and belongs to the Mpundu Formation characterized by gravelly sandstone with clay matrix that is very rich in quartz and clay minerals, thus making very deep and highly permeable reddish-brown soils (CDP, 2022). Vegetation cover consists of mangrove forests in the Wouri estuary and Atlantic coast of Douala-Edea Wildlife Reserve (Ajonina, 2008; Ndongo, 1993). Mangroves provide construction timber, furniture, boats, and firewood.

Douala has an equatorial climate under a tropical monsoon regime (Köppen Am). Douala receives heavy precipitation of 4,000 mm per year, stable average temperature of 27.0°C with slightly cooler temperatures in July-August (~24°C) and stable average humidity of 83% (CDP, 2022).

Socio-economically, Socio-economically, Douala is the commercial and economic hub of Cameroon and the CEMAC region. It hosts Cameroon's principal seaport and an international airport, supports extensive primary (agriculture, fishing, sand/gravel extraction), secondary (breweries, textiles, palm oil, soap, building materials, plastics, metalwork), and tertiary (commerce, transport) activities (CDP, 2022). Over 70% of these activities are informal. This economic pull has driven continuous in-migration, expansion of housing and infrastructure, and the emergence of a core-periphery urban dynamic.

Research Design and Data Collection

Data were collected from both primary and secondary sources. Some of the primary data sources used include field observation, structured questionnaires, key informant interviews, focus group discussion, photographs, and mapping. The structured questionnaire was the most used quantitative source of data collection aimed at collecting statistical information on urban growth, housing facilities, and housing development pattern. Interviews and FGDs gave qualitative information on the views and problems associated with housing provision by stakeholders.

Secondary data were sourced from published and unpublished materials such as books, journals, thesis/ dissertations, official report and maps. Douala City Development Plans (CDP) were sources of base map, surface area, and population statistics of the two sub-divisions (2022).

The target population was adult inhabitants (both male and female) of Douala III and Douala IV municipalities. A stratified sampling design was adopted to ensure that various settlements and socio-economic strata within the two sub-divisions were captured. A total of 200 questionnaires were distributed proportionally based on population of sub-divisions: 120 in Douala III and 80 in Douala IV.

Data Processing and Analysis

Data obtained were subjected to statistical analyses through the use of descriptive, inferential, and cartography methods.

The use of descriptive statistics helped to characterize characteristics of housing such as agencies that regulate housing development, the type of construction materials used, housing availability and accessibility as well as access to basic amenities like water and electricity services. The variables were analyzed using frequencies, percentages and mean scores, and cross-tabulations.

Inferential statistics was used to identify correlations between housing development parameters and sustainability parameters. Cartographic methods including the use of Geographic Information Systems were used to depict the distribution of housing facilities, road access and growth trends in the intervention area. Data collected through the use of quantitative questionnaires was analyzed using Statistical Package for Social Sciences (SPSS) while the qualitative data collected through interviews and focus groups discussions was analyzed thematically.

RESULTS AND DISCUSSION

The objective of this research was to look into the issues of town planning and housing situation in Douala as aspects of urban sustainability. The data collected include; spatial distribution of Housing in Douala III and IV, characteristics of smart housing infrastructure, perception of town planning effectiveness, agencies in building construction, nature of building materials, causes of dilapidated state of houses and insecurity, stakeholders in charge of waste management, steps taken before constructing houses, housing supply and facilities and challenges to housing development. The findings are as follows.

Spatial Distribution of Housing in Douala III and IV

The distribution of houses is illustrated in Figure 2.

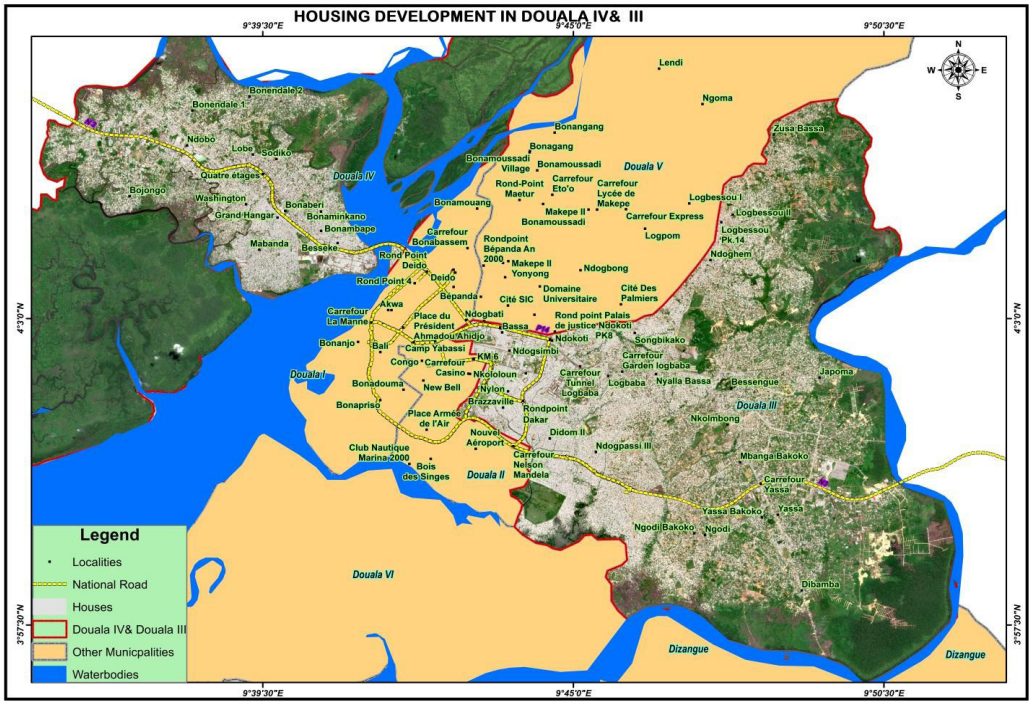


Figure 2: Distribution of houses in Douala III and IV municipalities

Source: Adapted from Satellite Image (www.earthexplorer.usgs.gov). Resolution = 15meters

The spatial distribution of housing in Douala III and IV Sub-Divisions (Figure 2) can be described as being unplanned, discontinuous and corridor oriented.

Housing clusters along the access corridors - the Douala-Yaounde corridor for Douala III Sub-Division and the Bonaberi-Bekoko corridor for Douala IV Sub-Division - exhibiting ribbon development as opposed to planned development. The distribution of Douala III Sub-Division is more compact and dense, while that of Douala IV Sub-Division is more scattered and leap-frog type, punctuated by wetlands and areas of flood risk due to its low lying nature [30 m a.s.l.]. Many houses are situated within environmentally vulnerable and risky areas due to poor development control, poor building permit compliance and informal land acquisition.

Characteristics of Smart Housing Infrastructure in Douala III and IV

Assessment of smart housing infrastructure used seven indicators which include accessibility, water supply, energy supply, internet connection, smart doors/locks, smart lighting, and building materials used. Table 1 summarizes the results obtained.

Table 1: Characteristics of smart housing infrastructure in Douala III and Douala IV

s/n	Characteristics of smart housing infrastructure	Situation in Douala III	Situation in Douala IV	Remarks
1	Accessibility	Moderate	Low	Low density
2	Water supply	Present	Present	CAM Water, Boreholes and wells
3	Energy supply	Present	Present	Eneo, Solar enery, Generators
4	Internet facilities	Present	Present	Present
5	Smart doors and locks	Few	Very few	Present in public buildings
6	Smart lighting	Mostly in public buildings	Mostly in public buildings	Absent in private homes.
7	Type of building materials	Mix	Mix	Wood and blocks

It is evident from Table 1 that there is a lack of smart housing infrastructure in both municipalities.

Accessibility in Douala III is moderate whereas in Douala IV is low. Houses situated in areas where there are paved main roads can be accessed easily but the interior houses cannot be accessed since there are poor roads which are not paved. The situation worsens during the rainy season. Water is supplied by CAMWATER, though the supply is very unreliable. The community relies on their own private wells and boreholes. The council of Douala III has constructed two boreholes for water supply to solve the problem of water scarcity. The water is mainly used domestically for flushing toilets and cleaning purposes. There is electricity supplied by ENEO, but the supply is characterized by regular power outages. The community uses solar energy and fuel generators for lighting, ventilating, water pumping from boreholes, and power for internet devices.

The internet connection service is available by companies like CAMTEL/BLUE, MTN, and ORANGE, hence providing some level of connectivity. However, there are no smart home technologies like smart locks and smart lights that are common even in residential areas. They are only found in some few public and business buildings.

The building materials used are mainly mixed; wooden and concrete blocks, which indicates that there are many semi-permanent houses.

Perception of Town Planning and Housing Effectiveness in Douala III and IV

The respondents' perception on the state of town planning and housing was measured using a four-point scale which includes 'good,' 'bad,' 'improving' and 'declining.' The results are presented in Table 2.

Table 2: Perception of Town Planning and Housing in the Douala III and IV Municipalities

Statement	Response	Frequency	Percent
Describe the state of house planning in the Douala Municipality	Good	11	5.5%
	Bad	97	48.5%
	Improving	53	26.5%
	Declining	39	19.5%
	Total	200	100%

From Table 2, most of the respondents 97 (48.5%) considered the state of house planning to be bad while 11 (5.5%) were of the view that the state of house planning was good. This percentage is supported by field observations. This perception emanated from people who live along major paved roads. However, 53 respondents (26.5%) viewed the housing condition as being improved. There is proof of this perception from the field. There are some ongoing road constructions to improve the accessibility of the housing, though the process is too slow. According to council officials, there are ongoing plans to regulate the construction especially in Douala IV, which is a poorly housed area. Control of construction is done by quarter heads and council agents who monitor building permits, though logistics and manpower needed for development control are lacking. Some 19.5% were of the view that it was declining. These negative perceptions show that the state of house planning and

housing in Douala, even though it is the economic capital of Cameroon is poor.

The findings were supported by field data and photographs (Plate 1). Field data showed that many houses are difficult to access, especially during the rainy season; many houses are built in swampy and flood-prone sites which are ecologically inappropriate; there are irregular settlement patterns with poor road network connections; and solid waste management is poor, characterized by indiscriminate dumping. These findings reveal poor development control and a lot of violations of the planning principles, as the Douala City Development Plan is poorly implemented. This has led to poor smart growth principles, hindering the achievement of SDG11.

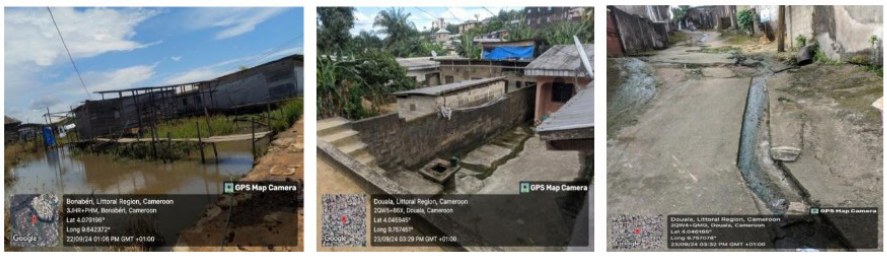


Photo 1a: Poor housing and inaccessibility

Photo 1b: Poor planning of housing facilities

Photo 1c: Poor management of waste

Plate 1: Evidence from Field Survey on Housing Conditions and Planning Deficiencies in Douala III and IV

Field survey confirm the negative impression of town planning, as seen in Plate 1 below.

Plate 1a indicates poor quality and access to housing. The buildings are made of wood and poor quality building materials, built in flooded swamps that are not only difficult to construct roads in but are also expensive.

Plate 1b shows poor spatial planning. This can be noted from the unplanned layout of houses with no provision of roads for accessing the houses, infrastructure and emergency services.

Plate 1c shows poor waste management practices in residential areas. Poor sanitation in terms of stagnant wastewater and improper solid wastes disposal has been observed.

Although some positive changes have been recorded with regard to the intervention measures and infrastructure project by the council, the continuous use of poor quality building materials, occupation of unsuitable ecological land and poor waste management continue to hinder sustainable housing development in the Douala III and IV Sub-divisions.

Agencies in Building Construction in Douala III and IV

The agencies involved in regular inspections on the construction of buildings and urban development in Douala III and IV include the Municipal Council, the Ministry of Housing and Urban Development (MINDUH), and Urban Land Initiative Groups to a lesser degree. The results of the distribution is presented on Table 3.

As seen on Table 3, the largest number of respondents,

Table 3: Agencies conducting regular inspections of building construction and urban development

Question	Response	Frequency	Percent
What is the agency that do regular checks on building or urban advancement in the municipality?	Council	147	73.5%
	Urban Land Initiative Group	13	6.5%
	Ministry of Housing and Urban Development Staff (MINDUH)	27	13.5%
	None	12	6.0%
	Others	1	0.5%
	Total	200	100%

147 people (73.5%), stated that the Council is the body which is responsible for regular inspections of building construction and urban development. Only 27 respondents (13.5%) noted that MINDUH is the organization involved in such inspections, and 13 people (6.5%) mentioned the Urban Land Initiative Groups as the organizations carrying out inspections. Twelve respondents (6.0%) claimed that there are no organizations conducting regular inspections, and 0.5% mentioned other organizations. It was also proven in the interviews conducted with key informants that, according to the decentralization law and policy in Cameroon, the Council should carry out building controls. However, the evidence from the field shows that, despite the legal provision, the Council lacks the necessary resources and capabilities to conduct inspections.

Nature of building materials in Douala III and IV sub Divisions

The nature of building materials in Douala III and IV was identified and presented on Table 4 and Plate 2.

The survey showed that most of the people interviewed, 121 (60.5) use cement blocks as the main building materials for their housing structures. Nonetheless, around 40%

Table 4: Agencies conducting regular inspections of building construction and urban development

Question	Response	Frequency	Percent
Houses in this quarter are constructed with what materials?	Wood	41	20.5
	Blocks	121	60.5
	Substandard Materials	38	19.0
	Total	200	100%
Do you have a building permit for the house?	Yes	76	38.0
	No	27	13.5
	Don't Know	97	48.5
	Total	200	100%

said that buildings in the area were built using poor quality materials such as wood. This shows that there is a combination of different types of housing in Douala III and IV, probably because of the cosmopolitan nature of the place.

Plate 2 reveals that the construction materials used in

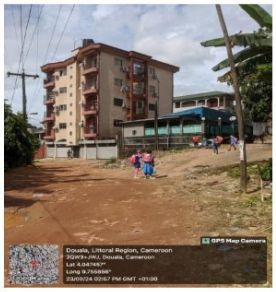


Photo 2a: Modern block houses

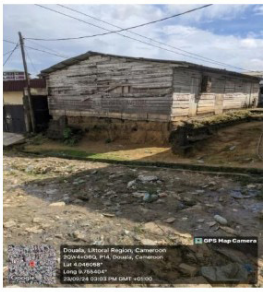


Photo 2b: wooden houses

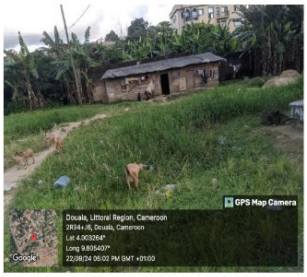


Photo 2c: Block and wooden houses in the same neighbourhood

Plate 2: Building materials in Douala III and IV

Douala III and IV sub divisions are composed of modern and local materials. It is important to highlight that the zoning of the city is not well defined from this area since the building materials are mixed.

A considerable number of 97(48.5%) respondents stated that they do not know whether their houses have building permits while 38% admitted that their houses have building permits. The high number of people who do not know that their houses have building permits indicates that most people in Douala III and IV are tenants and not the owners of the house. The high number of people who admitted that their houses have building permits signifies that most houses in Douala III and IV are under supervision during the process of building.

Causes of dilapidated state of houses and insecurity in Douala III and IV

Causative factors leading to dilapidation and insecurity were analyzed with regard to seven factors, including bad town planning, poor roads and lack of accessibility, overcrowding, no law enforcement, unemployment, and others. The results are shown in Table 5.

Table 5: Causes of dilapidated state and insecurity in Douala III and IV sub Divisions

Question	Response	Frequency	Percent
What are causes of dilapidated state of houses and insecurity in your neighbourhood?	Poor town planning	61	30.5
	Bad roads and inaccessibility	47	23.5
	High population density and congestion	51	25.5
	The absence of law enforcement officers	10	5.0
	Unemployment	18	9.0
	High cost of living	11	5.5
	Others	2	1.0
	Total	200	100.0

The most significant cause was poor town planning (30.5%), as confirmed by field visits showing many substandard buildings without access roads [Plate 1 and Plate 2]. The poor planning is brought about by ineffective development control and lack of proper monitoring of the construction agencies. Council representatives interviewed pointed out that although there is the willingness to intervene, the logistics, manpower and funding constraints have hampered the interventions. High density/congestion (25.5%) was another significant cause. Douala III and IV are among the major industrial centers of the coastal industrial area; hence the influx of

migrants looking for employment. Those who do not succeed in finding employment because of low skills or lack of opportunities opt to occupy the fragile ecological areas, resulting into many slums and the construction of poor quality houses with inadequate facilities. Bad roads and inaccessibility (23.5%) also contributed significantly. They hindered service delivery, mobility, and surveillance and consequently exacerbating both the physical dilapidation and insecurity.

Socio-economic causes such as unemployment (9.0%) and high cost of living (5.5%) limit households' ability to afford durable and well-maintained houses. Lack of law enforcement agents (5.0%) brings about insecurity in these poorly planned and enclave areas.

Stakeholder in charge of Waste Management as a sustainable approach in Douala III and IV

Management of wastes is an important factor that defines whether or not a city is sustainable, as it reduces waste dumping and enhances public health and sanitation. The stakeholders that participate in waste management in Douala III and IV consist of waste management firms, the Council, private group projects, and community residents as shown on Table 6.

Table 6: Stakeholder in charge of Waste Management in Douala III and IV sub Divisions

Question	Response	Frequency	Percent
Who are those in charge of waste management within your community?	Waste management companies	118	59.0
	The council	43	21.5
	Private Groups initiatives	18	9.0
	Community dwellers	18	9.0
	Others	3	1.5
	Total	200	100%
Is the community waste properly managed?	Yes	40	20.0
	No	160	80.0
	Total	200	100%

From Table 6 above, a majority of the respondents, 118 (59%), use waste management companies for waste collection and disposal. It was found out through field interviews that HYSACAM was the major player charged with the task of collecting waste from the communal dump sites and disposing of the waste away from the settled communities. In addition, another 43 respondents (21.5%) use the Council while private group efforts and community dwellers make up 9.0% each.

Although there are formal players involved, waste management is highly ineffective. The majority of the respondents, 160 respondents (80%), stated that the community waste is not managed properly compared to the 20% that said it was managed properly. This has made the majority rely on HYSACAM that is understaffed and irregular in low-income, hard-to-reach places.

The ineffectiveness is seen through many dumpsites that can be found all around the neighbourhoods. Photo 3a depicts the indiscriminate disposal of solid waste in residential places while Photo 3b shows the direct discharge of the liquid waste into the road and in water bodies, leading to environmental pollution. The results show poor coordination of the stake holders, inadequate coverage, and non-enforcement of the sanitation laws that are contrary to the principles of smart growth and SDG 11.

These practices contribute to environmental degradation, including land and water pollution, thereby undermining efforts toward sustainable environmental management.



Photo 3a: Waste dumps in Douala IV



Photo 3b: Poor disposal of liquid waste from houses in Douala IV

Plate 3: Poor management of waste in Douala III and IV sub Divisions

Source: Fieldwork, 2025

Steps taken before constructing houses in Douala III and IV sub Divisions

Given the steps taken by individuals before constructing their houses in the area (Table 7), it was reported that 45.5% of respondents obtained a recent proof of land ownership, while 54.5% did not. Similarly, the majority 57.5% of respondents mentioned that they did not obtain a location plan from the cadaster. This explains the existence of unplanned housing and unsustainable development of housing facilities.

Compliance with statutory procedures before construction of houses was measured by four variables namely proof of land ownership, location plan from the survey department, on-site inspection by the Council, and building permit. The findings are presented in Table 7 and Figure 3 below.

Results showed a poor compliance with pre-construction procedures. A total of 91 (45.5%) respondents were found to have proof of land ownership before construction while 109 (54.5%) did not have it. Similarly, a total of 115 (57.5%) respondents did not have location plan from

Table 7: Steps taken before constructing houses in Douala III and IV according to participants

Question	Yes (%)	No (%)
Obtain a recent proof of land ownership	91 / 45.5%	109 / 54.5%
Obtain a location plan from the survey department	85 / 42.5%	115 / 57.5%
Receive on-site inspection by the council	91 / 45.5%	109 / 54.5%
Obtain building permit	105 / 52.5%	95 / 47.5%
Overall	372 / 46.5%	428 / 53.5%

Source: Field work, 2025

the survey department while only 85 (42.5%) had. With regards to development control, a total of 109 (54.5%) respondents did not have on-site inspection by the Council while 91 (45.5%) had on-site inspection. This shows the absence of follow up on sustainable housing development in Douala III and IV. For building permits, 105 (52.5%) respondents had building permits before construction, while 95 (47.5%) constructed without building permit. In general, a total of 428 responses (53.5%) reflect poor compliance with formal procedures while 372 (46.5%) show compliance with formal procedures.

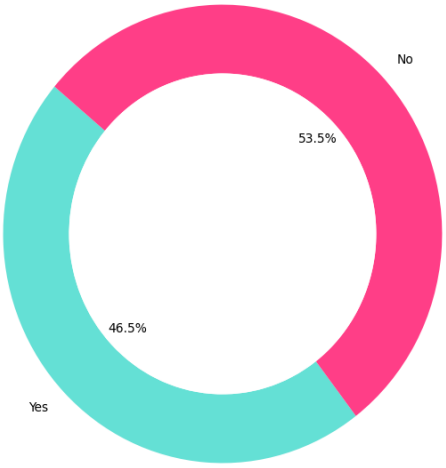


Figure 3: Overall Views on the Considerations before Constructing a House in Douala III and IV
Source: Fieldwork, 2025

Figure 3 provides evidence that most that most people in Douala town do not follow necessary procedures before building houses. The non-adherence of these procedures undermines the effective implementation of smart city policies in Douala III and IV Sub-Divisions.

Residents in the town of Douala do not follow the necessary procedures before constructing their

Housing Supply and facilities in Douala III and IV

The supply and facilities for housing needs were analyzed based on three criteria: quality of facilities, accessibility, and type of housing. The views expressed by respondents were recorded using a five-point Likert scale as shown on Table 8.

Table 8: Respondents' Views on Housing Supply and facilities in Douala III and IV sub Divisions

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Facilities					
The houses have regular supply of light and water	24 (12.0%)	58 (29.0%)	19 (9.5%)	47 (23.5%)	52 (26.0%)
Smart installation	8 (4.0%)	27 (13.5%)	49 (24.5%)	58 (29.0%)	58 (29.0%)
AI-controlled entertainment systems	17 (8.5%)	14 (7.0%)	53 (26.5%)	56 (28.0%)	60 (30.0%)
Poor waste management	60 (30.0%)	83 (41.5%)	22 (11.0%)	26 (13.0%)	9 (4.5%)
Lack of social utility	62 (31.0%)	67 (33.5%)	38 (19.0%)	22 (11.0%)	11 (5.5%)
Smart home appliances	12 (6.0%)	46 (23.0%)	31 (15.5%)	56 (28.0%)	55 (27.5%)
Smart home security system	13 (6.5%)	33 (16.5%)	46 (23.0%)	50 (25.0%)	58 (29.0%)
Accessibility					
Houses are linked with good roads	11 (5.5%)	47 (23.5%)	21 (10.5%)	67 (33.5%)	54 (27.0%)
Houses are very accessible	10 (5.0%)	52 (26.0%)	32 (16.0%)	56 (28.0%)	50 (25.0%)
Nature of housing					
Houses are constructed with modern materials	30 (15.0%)	68 (34.0%)	31 (15.5%)	29 (14.5%)	42 (21.0%)
The state of the houses are good	23 (11.5%)	58 (29.0%)	44 (22.0%)	39 (19.5%)	36 (18.0%)
Housing structure need regular maintenance	82 (41.0%)	73 (36.5%)	16 (8.0%)	21 (10.5%)	8 (4.0%)

Source: Field work, 2025

Housing Facilities

With regards to basic facilities, 82 (41.0%) respondents claimed that there is regular provision of electricity and water to housing units whereas 99 (49.5%) respondents opposed this claim. Investigations on the ground reveal the availability of both electricity and water network in Douala III and IV. However, there is no regularity in supply due to frequent power and water cuts, as illustrated in Plate 4. Smart city aspect remains non-existent. The majority was against the availability of smart equipment (58.0%), AI-powered entertainment system (58.0%), smart home equipment (55.5%), and smart home security system (54.0%). On the other hand, poor waste disposal and absence of social facilities were reported by 143 (71.5%) and 129 (64.5%) respondents respectively.



Photo 4a: supply of electricity and water as housing facilities

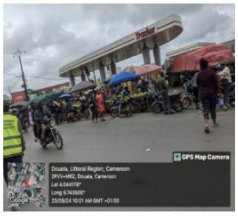


Photo 4b: Supply of other energy sources from fuel stations (Bonne Dix)



Photo 4c: Water supply tanks to houses

Plate 4: Supply of housing facilities in Douala III and IV sub Divisions
Source: Fieldwork 2025

Photo 4a indicates the electricity supply grids in Bonaberi, Photo 4b shows fuel station in Bonne Dix Yassa. It supplies fuel for use in vehicles and other house automations especially during electricity failures. Photo 4c shows modern houses with reserve water tanks. This is to ensure water supply in the water system houses. These are efforts to ensure sustainable city development and smart growth in Douala.

Accessibility

The accessibility level is not enough. For the statement "houses are connected by good roads," 121 respondents (60.5%) disagreed, while 58 (29.0%) agreed. Likewise, for the statement "houses are highly accessible," 106 respondents (53.0%) disagreed, while 62 (31.0%) agreed. The results are similar to the observation that houses are enclave in nature and lack road connectivity (see Plate 1).

Nature of Housing

In terms of building materials, 98 respondents (49.0%) agree that houses are constructed using modern materials, while 71 (35.5%) disagreed, which is in line with the diverse housing types found earlier. With regard to the condition of houses at present time, opinions are divided into 81 respondents (40.5%) said that the condition of the houses is good, 75 (37.5%) said that it is poor, and 22.0% are neutral. It is interesting that 155 respondents (77.5%) agreed that the housing structures need constant maintenance because of rapid deterioration caused by poor building materials and unsuitable ecological location. Thus, the findings show inadequacy of basic amenities, accessibility, and smart facilities, poor waste management and lack of social utilities.

The explanations from Table 8 were further illustrated using the Figure 4.

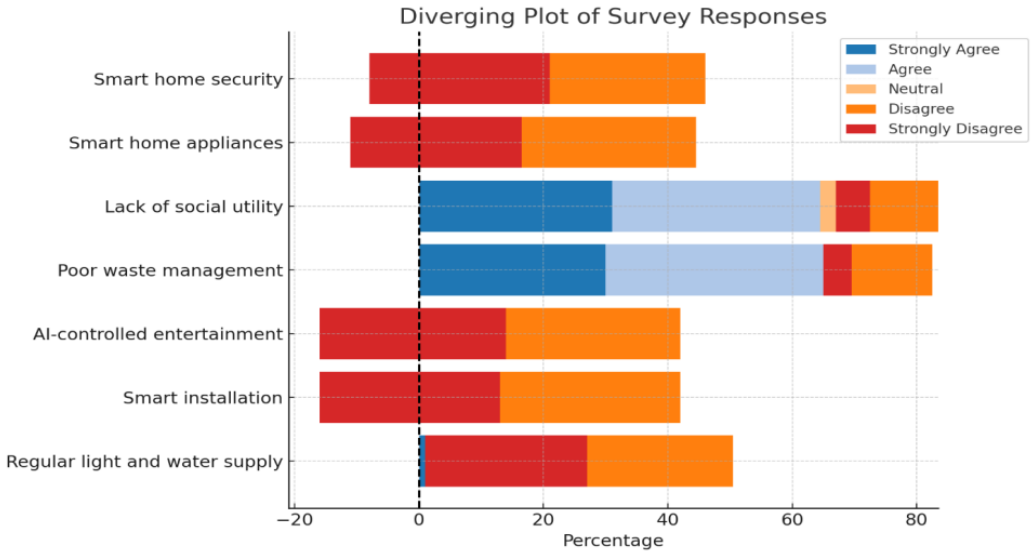


Figure 4: Divergent views of respondents on housing supply and facilities in Douala III and IV
Source: Field work, 2025

Verification of Hypothesis

H: Housing Development in Douala III and IV Sub Divisions contributes to Sustainable Cities Development and Smart City Growth.

In order to test the hypothesis, Chi-square test was conducted to establish the relationship between housing-related variables and sustainable and smart city development. Results are shown in Table 9 below.

Table 9: Chi-square test of association between housing conditions and sustainable / smart city development

Variable	Variable Categories	Agree (f, %)	Disagree (f,%)	
The state of housing planning in the Douala Municipality	Good	6 (54.5%)	5 (45.5%)	41.755 (.000)
	Bad	25 (26.6%)	69 (73.4%)	
	Improving	32 (62.7%)	19 (37.3%)	
	Declining	30 (85.7%)	5 (14.3%)	
Agencies that do regular checks on building or urban advancement in the municipality	Council	67 (47.5%)	74 (52.5%)	5.858 (.210)
	Urban land initiative group	9 (75.0%)	3 (25.0%)	
	Ministry of Housing and Urban Development staff (MINDUH)	14 (51.9%)	13 (48.1%)	
	None	3 (30.0%)	7 (70.0%)	
	others	0 (0.0%)	1 (100.0%)	
Houses in this quarter are constructed	Wood	11 (27.5%)	29 (72.5%)	9.213 (.010)
	Blocks	61 (53.5%)	53 (46.5%)	
	Substandard Materials	21 (56.8%)	16 (43.2%)	
Causes of dilapidated state and insecurity in your neighborhood	Poor town planning	18 (29.5%)	43 (70.5%)	26.246 (.000)
	Bad roads and inaccessibility	23 (52.3%)	21 (47.7%)	
	high population density and congestion	37 (75.5%)	12 (24.5%)	
	The absence of law enforcement officers	3 (30.0%)	7 (70.0%)	
	Unemployment	8 (53.3%)	7 (46.7%)	
	High cost of living	3 (30.0%)	7 (70.0%)	
	Others	1 (50.0%)	1 (50.0%)	

Source: Field work, 2025

The chi-square test shows a significant relationship between the state of housing planning and sustainable/ smart city development, $\chi^2(1) = 41.755$, $p = 0.000$, $p < 0.05$. The people that rated housing planning as either improving or declining were more likely to be in agreement that housing development adds to sustainability while most people that rated it as poor largely disagreed (73.4%). This implies that the quality of town planning has a great influence on sustainable city development.

There was no significant relationship among the agencies that do regular oversight, $\chi^2(1) = 5.858$, $p = 0.210$, $p > 0.05$. It means that having these regulatory agencies such as Council, MINDUH and Urban Land Initiative Groups does not really matter when it comes to sustainable and smart city development, which supports the fact that they have a weak capacity in enforcing laws according to the field interviews.

In the case of the material used in building, there was a significant relationship found, $\chi^2(1) = 9.213$, $p = 0.010$, $p < 0.05$. People living in block houses (53.5% agree) and the houses that were constructed using poor materials (56.8% agree) had a higher chance of agreeing that they add to sustainability while people living in wooden houses largely disagreed (72.5%).

Likewise, a highly significant relationship was found between the reasons behind dilapidation and insecurity, $\chi^2 = 26.246$, $p < 0.001$. High population density and poor state of roads were linked to more agreement, while bad town planning and lack of law enforcement to more disagreement, suggesting that the reasons behind urban decay affect sustainable city development to a great extent.

Decision: Since three of four indicators show $p < 0.05$, the null hypothesis is rejected. H3 is accepted. Housing development in Douala III and IV significantly contributes to sustainable cities development and smart city growth, but this contribution is currently constrained by poor planning, substandard materials, and inadequate infrastructure. Strengthening development control, improving building material standards, and addressing density and accessibility challenges are critical for

realizing SDG 11 and smart growth principles.

Challenges to housing development and facilities in Douala III and IV

The study found that while smart homes offer benefits in convenience, energy efficiency and security, their adoption in Douala III and IV is hindered by interconnected structural, infrastructural and institutional challenges. Key challenges identified are:

Technological and Infrastructural Deficits: Poor, unreliable and costly internet connectivity despite fibre deployment; frequent power outages and low voltage that render smart devices unreliable; and frequent water cuts, low pressure and poor quality from CAMWATER, especially in localities like Boko, Ngoma, Yansoki and Mbanga Pongo.

Institutional and Governance Weaknesses: Severe lack of logistics for development control - e.g. only one poorly maintained pickup for Douala IV without fuel - leading to weak enforcement, proliferation of substandard housing, and non-compliance with building plans; poor and inaccessible road network, notably in settlements like Abatua, Bonaberi; and location of polluting industries within residential areas.

Socio-economic and Security Pressures: Rapid population growth exerting pressure on housing, water and energy, driving up rents and forcing low-income households into slums with poor sanitation; and heightened cyber insecurity and privacy concerns due to low digital literacy and weak regulation.

In sum, infrastructural deficits, institutional weaknesses, and socio-economic pressures collectively hinder the transition to sustainable housing and smart growth in Douala III and IV.

Smart homes bring with them many advantages such as convenience and comfort, energy efficiency and savings, security and safety and aging-in-place and accessibility. Their emergence has also raised several questions and challenges. From privacy and security concerns to technological complexities and the potential financial burden, the path to integrating smart technology into homes is not without its obstacles. Understanding these issues is important for anyone wanting a smart home to be a part of their lives.

Discussion

Housing Development and Smart Growth Compliance

It is clear from this study that most of the housing developments in Douala III and Douala IV deviate significantly from the Smart Growth principles. This includes features such as low density sprawl, monocentricity, and automobile dependent development. While the Smart Growth model proposes compact and walkable developments with a diversity of activities (Duany *et al.*, 2010; Smart Growth Network, 2006), this case study shows leap frog developments with over 72% of new developments in the peri-urban areas of Yassa, Nyalla, and Bonaberi. This observation supports the claim by UN-Habitat (2019) that Africa's urbanization is characterized by inadequate planning, hence horizontal urban expansion as opposed to vertical one.

Additionally, the preponderance of informal developments made of semi-permanent materials such as wood and corrugated iron does not conform to the compact development and creation of unique community characteristics promoted by Smart Growth. This result is consistent with findings from studies conducted in Yaounde and Bamenda whereby more than 60% of the housing developed in peripheral areas does not meet the standards set in the urban planning context (Fokeng *et al.*, 2020; Kimengsi & Fogwe, 2017). It is worth mentioning that Wouri Segment of the Mpundu Formation, on which Douala stands, is described as gravelly sandstones with a clayey matrix and highly permeable reddish brown soils (CDP, 2022), which should allow for dense developments.

Indicators of Sustainability: Housing Facilities and Accessibility

The United Nations Sustainable Development Goal 11 states the importance of availability of adequate, secure and affordable housing along with necessary basic services (United Nations, 2019). As per findings related to facilities, a significant deficit has been seen in terms of access to clean water, electricity and proper waste management, where less than 35% of households in Douala III and IV are connected with CAMWATER system. This is true according to the assertion of Vince & Morrissey (2020) that rapid urban growth without appropriate infrastructure investment creates burden on resources and causes social inequality.

Like facilities, accessibility is another aspect of sustainability, which is quite unsatisfactory. The majority of road network is unpaved, seasonal and broken, which goes against the smart growth theory in terms of having multiple transportation and walkable neighborhoods. This is in line with the findings of Tiafack & Mboning (2018), who stated that in Douala, 68% of access roads in Douala III and IV are earth roads, which make access difficult in rainy season. Use of pit latrine in an area with very porous soil increases the risk of groundwater contamination, which contradicts the sustainable urban management by Fedorov *et al.* (2012).

Constraints to Sustainable Housing Development

According to this research, there are five key constraints: poor enforcement of planning documents, high cost of construction materials, no inclusionary zoning, inadequate stakeholder coordination, and poor community participation. This conclusion agrees with the findings of the City Development Plan (CDP, 2022), where unsustainable development in Douala is attributed to fragmentation of governance in the Douala City Council, sub-divisional councils, and the Ministry of Housing and Urban Development.

Unlike Kigali in Rwanda, where strict implementation of master plan and densification inspired by Smart Growth principles have restricted sprawl (Goodfellow, 2015), development in Douala proceeds market-based and speculative. Due to unpredictable development decisions, which constitute one of the most important principles of Smart Growth (Smart Growth Network, 2006), informal developers ignore building permits. This agrees with Mati's (2019) assertion that Cameroon Vision 2035 and the National Development Strategy 2020-2030 remain aspirational without operational instruments in the local level. Also, while the assessment reveals that use of technology is often viewed as the solution for sustainable development, the key barriers in Douala are institutional and spatial but not technological. Mayors from across the globe agree that integration of smart technologies could enhance the quality of life (Vince & Morrissey, 2020). For Douala III and IV, however, infrastructural development should precede smartness.

CONCLUSION

Housing development in Douala III and IV Sub-Divisions is characterized by informal and poorly planned growth, weak regulatory compliance, inadequate infrastructure, and limited access to reliable basic and smart services, which collectively constrain sustainable urban development and smart growth. Housing development in Douala III and IV sub-divisions is largely unplanned, uncontrolled, with inadequate infrastructure, non-compliance with regulations and limited access to reliable basic and smart services, hence hindering sustainable development of smart cities. Relationships were identified between housing planning and sustainability [χ^2=41.755, p<0.001], building materials and sustainability [χ^2=9.213, p=0.010], and reasons for housing dilapidation/unsustainability [χ^2=26.246, p<0.001]. The results indicate continuing problems with regard to waste disposal services, road accessibility, provision of water and electricity, social utilities, and smart-house technologies. The study reveals that current housing development patterns do not support sustainable and smart-city growth in Douala III and IV.

The study recommends stronger development control, ease in land regularizations, and availability of cadastral documents as well as provision of roads, water, electricity, and IT infrastructure. Waste-disposal services must be improved and conflicts between industrial zones and residential areas need to be addressed through strict zoning laws.

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