

People's perception and involvement in improving urban greenery in Benin (West Africa)

Bokon Alexis Akakpo^{1,2} · Appollonia A. Okhimamhe¹ · Vincent A. O. Orekan³

Received: 26 November 2022 / Accepted: 13 January 2023

Published online: 27 February 2023

© The Author(s) 2023 [OPEN](#)

Abstract

Urban sustainable development is a feat to achieve, particularly within African nations. Current patterns of urban expansion are creating multiple problems to urban greenery and quality of life. Assuming urban resident's perception varies between and within cities, this paper claims to document resident's perceptions on the existing greenery spaces, the prerogative for environmental safeguard, and the determinant of resident's willingness for urban greenery improvement within the cities of Parakou and Porto-Novo in Benin. A semi-structured interview was randomly conducted with 400 people including residents and institution officers in each city. The data collected are related to socio-economic characteristics and the perception on urban greenery characteristics, urban greenery importance and urban greenery management and planning. The test χ^2 was applied to understand the independence between cities and city boroughs. Correspondence analysis was also used to display some relationships and binary logistic regression to examine the variables that explain people's willingness to get involved in improving urban greenery in each city. The results revealed that around 80% of existing urban greeneries are mostly located in the core of the town and the state of the density and diversity of these greenery areas were differently perceived in the districts of each city. The main benefits lost from urban greenery were air quality (45.25%) for Parakou and cooling effect (74%) for Porto-Novo and the causes of these losses depended also on the cities and the districts within the cities. Public participation was perceived to be low (> 85%) and the institutional cooperation with local communities, educational level and knowledge on greening main impacts must be improved to foster the involvement of people in urban greenery development. This study is relevant to support literature data and to further studies. It will also serve as a guideline for policymakers, urban planners, and managers, cityscape architects, and projects of urban sustainability regarding the urban greenery in Benin.

Keywords Urban greenery · Resident's perception · Benefits lost · Public involvement · Determining factors · Benin

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s43621-023-00121-1>.

✉ Bokon Alexis Akakpo, ab_akakpo@yahoo.fr | ¹WASCAL, Climate Change and Human Habitat, Doctoral Research Programme, Federal University of Technology, PMB 65, Minna, Niger, Nigeria. ²Laboratory of Applied Ecology, Faculty of Agronomic Sciences, University of Abomey-Calavi, 01 BP 526, Cotonou, Benin. ³Laboratory of Biogeography and Environmental Expertise, Geography Department, Faculty of Human and Social Sciences, University of Abomey-Calavi, BP 677, Abomey-Calavi, Benin.



1 Introduction

The built-up areas including a variety of land use categories such as commercial, institutional, and residential areas predominate urban areas. However, it may also consist of some non-built areas that can be summarized mostly by greenery and open spaces. But there is growing evidence for the decrease of urban natural areas and particularly the greenery due to urban development processes worldwide and especially for African cities and towns where greenery looks globally uneven, non-aesthetic, and increasingly under pressure [1]. Urbanization—i.e. increasing concentration of population in towns and cities [2]—is still a tangible phenomenon that strongly degrades the state of the natural environment and alters urban ecological processes [2–4]. It is agreed that African cities are experiencing the fastest rate of urbanization than any continent and will continue to be at the centre of the mass of rural migration due to its multiple opportunities [5]. Therefore, by 2050, around 1.26 billion people across Africa will be living in cities [6, 7].

Achieving urban sustainable development is a real challenge. Current patterns of urban expansion are creating multiple problems to urban greenery and threatening the quality of life [4]. Consequently, the questions on urban greenery are rapidly earning interest in the planning strategy of urban areas and the sustainability of these environments [8]. Potential interests are given to greenery for contributing significantly to urban landscape quality and the health of its inhabitants. Thus, the improvement of urban greenery can help a town achieve the Sustainable Development Goals, especially, those on climate change, sustainable cities, and life on land [7]. Likewise, there is a recognition of the interest of residents' perception on the improvement of urban green spaces and the necessity of their involvement in urban greenery planning and initiative of the establishment [9–11]. Therefore, the questions of the city's household perception in greenery development are currently increasing in urban landscape planning and management as well as in policy discourse [9].

The spatial agenda of Benin has revealed that the cities of Porto-Novo and Parakou as stable metropolis must be based on suitable planning and rigorous management of urban landscape and economic activities by capitalising on holistic data [12]. But the city residents are sometimes ignored about the importance of their attitudes and perceptions on their surrounding greenery protection and improvement. Many national projects and programmes are implemented in the domain of suitable cities to follow climate change adaptation appeals internationally requested [6]. Porto-Novo and Parakou are cities undergoing restructuring in which the development approach takes less account into all stakeholder perceptions and attitudes for urban development [12]. The restriction of residents' attitudes, perceptions, and preferences can cause failure to achievement of desired goals and development targets [9, 10]. In other words, the master of residents' perceptions and attitudes toward urban sustainability programmes is crucial to their voluntary and personal involvement and then to the success of the programme [7, 8].

This paper aims to assess resident's perceptions on the existing urban greenery spaces and the determinant of resident's willingness for the green space development in Porto-Novo and Parakou. It attempted to find answer to where urban greenery is mostly occurred? What is the density and diversity of these green entities in comparison of the case study cities? It also sought to address the lost benefits and the main causes of these losses in comparison of the cities. Moreover, the answer to the kind of determinants of residents' willing to involve in urban greenery development were also evaluated for each study case city. Thereat, authors assume that the resident's perceptions, attitudes, and preferences about urban greenery spaces are independent not only to the cities but also to the boroughs in each city.

2 Literature review of the study

In many African countries, studies have been done on urban green spaces development. There are case studies on resident attitudes towards urban tree care programs in Nigeria [7], the perception, the use, and the importance of urban green infrastructures distribution as an ecosystem approach in South Africa [10, 13–15], attitude and perception of residents towards the benefits, challenges, and quality of urban parks in Ethiopia [11], perceptions of slum residents and attitudes towards accommodating green spaces in Accra (Ghana) [16], state of urban parks and factors contributing to their loss in Kumasi (Ghana) [17], assessing the variance between urban greenery and urban development [18].

Little documentation is known about the case study on stakeholder attitudes for urban greenery development in Benin. The few works that were done in this field of urban forestry are related to the applying of GIS for the

management of green space in the city of Porto-Novo [19], the typology and the distribution of public green spaces in some southern cities [20] and the importance of urban forest effects on climate change in Cotonou (Benin Republic) [21]. Recently, Zohoun et al. [22], have characterized the ecosystem services in association with urban trees according to the urban dwellers in the city of Parakou.

It is holistically acknowledged, that any urban settlement in Benin is traditionally greenly established, while rapid urbanization is driving to the loss of natural green areas in many cities in the country like it is the case in other African countries [17, 23]. The studies on urban forestry have shown shortness of urban green space in Cotonou and Lokossa (Benin) with the street trees poorly diversified [21, 24]. More beyond the scientific issue, the needs of knowledge are formulated by city managers and land planners for optimal management and balanced greenery spaces [19, 24].

Admitting the gap of scientific studies on the perceptions and attitudes of stakeholders towards their contribution and involvement in urban greenery planning, management, and development, this paper claims to document the perceptions of urban residents on the prerogative, importance for environmental safeguard, and the determinant of resident's contribution for the improvement of urban greenery spaces within the two towns with differing climatic and socio-economic contexts in Benin.

3 Materials and methods

3.1 Study area

This study was carried in two (Porto-Novo and Parakou) of the three cities with special status in the country of Benin (West Africa). They are among the largest and the fastest growing cities within the country and have a, independent way of managing their urban areas. In addition, Porto-Novo and Parakou are socio-ethnically and climatically different. They are challenges cities in the country in terms of environmental and climatic events and economical potentialities due to their urbanization. Porto-Novo is in the southern region when Parakou is located in the northern region (Fig. 1).

The city of Porto-Novo has a wet tropical climate. The average temperature is 28 °C. The month of March is the warmest (32 °C), and the month of August is the least hot (24 °C). The annual rainfall is estimated at 1200 mm/year [25]. The climate in the city of Parakou is a tropical dry climate. The temperature range is on average around 30 °C and may increase to 33 °C in the warmest month (eg. March). The average annual rainfall recorded at the synoptic weather station of Parakou is around 1170 mm/year [26, 27]. The natural vegetation is almost non-existent in urban area of Porto-Novo [19]. While the tree plantations and gallery forests are mostly observed in urban areas of Parakou [26].

The population of 264,320 inhabitants is registered unequally in five (05) city boroughs of Porto-Novo, while the population of 255,478 inhabitants is recorded in three (03) cities boroughs of Parakou (Table 1) [28]. As for the studied cities, the city boroughs differ from each other in each city regarding the inhabitant's density and socio-economic characteristics, housing estate level, urbanization level and finally urban environment management. This could have impacts on the availability of urban greenery and the provided services.

3.2 Sampling method

The survey was carried out considering the city boroughs of each city. The number of interviewees was sampled by using the following formula of Dagnelie [29];

$$N = \frac{Z^2 pq}{e^2}$$
 where z is the value of random statistic found in the tables at 95% and is 1.96; p is the proportion of people able to respond to questions; q is the $1 - p$ and e is, the desired level of precision which is 0.05. In these cities, 55% (p) of residents have at least 15 years old [28] and can be attributed as interviewees in this study [10]. Therefore, N was around 380 people for each city. However, in order to increase the representation of the sample of the interviewees [8], 20 people were added to augment the sample size from 380 to a total of 400 interviewees in each city. Furthermore, the 400 interviewees of each city were proportionally distributed to the city boroughs or sub-cities based on the inhabitant size of each city borough (Table 1). At each public place and urban-related institution, people 15 years old and older were randomly asked for the interview. Interviews were also made in the randomly selected resident's houses in each city borough where the head of household or an elder of the household was politely asked for the interview after giving the purpose of the visit.

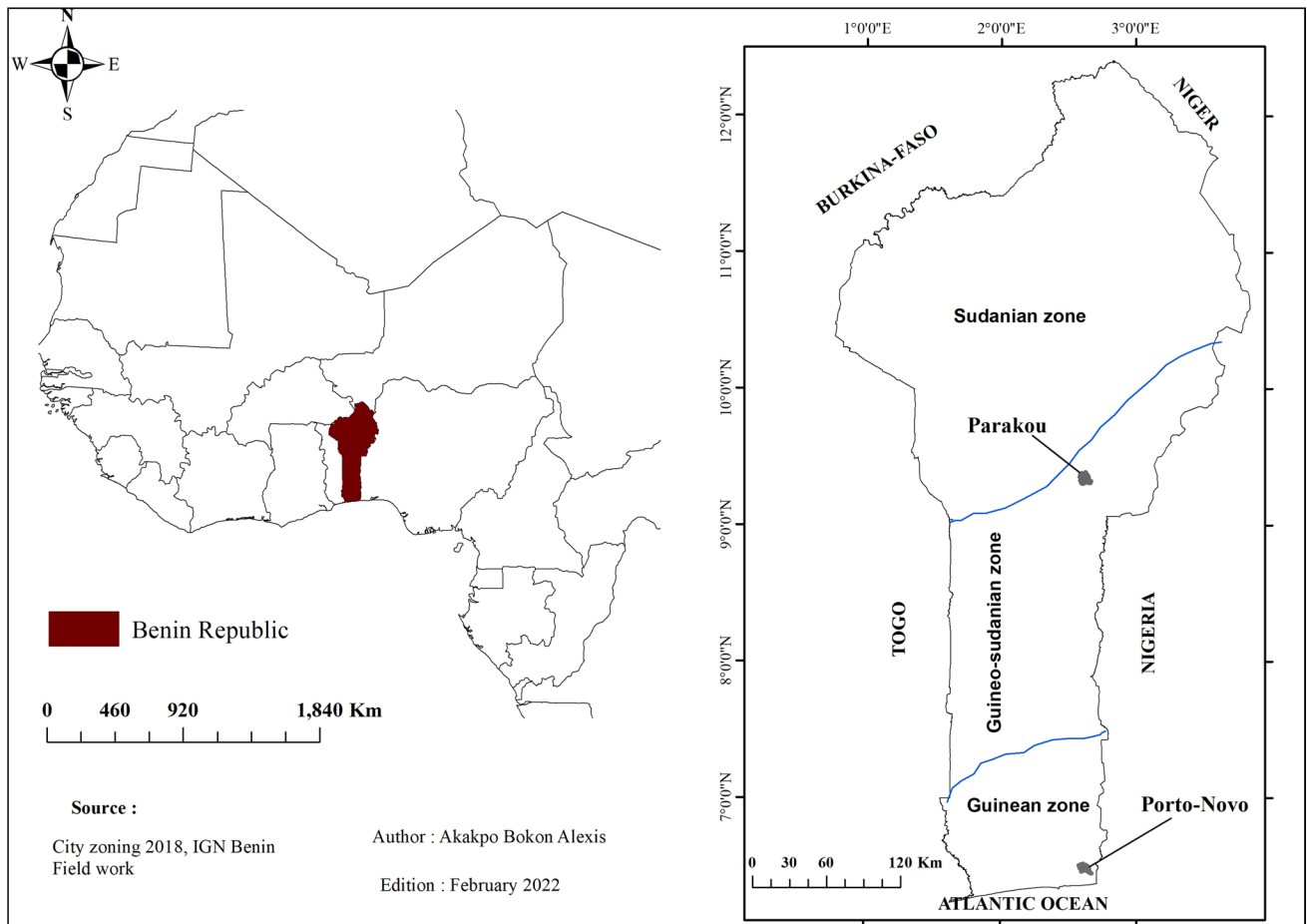


Fig.1 Location map of the study cities

Table 1 Distribution of respondents among urban districts of study cities. Source: INSAE, 2016

Category of interviewee	Urban district	Porto-Novo		Parakou	
		Population	Sample size	Population	Sample size
Residents	1st city borough	33,161	50	114,558	179
	2nd city borough	52,571	79	71,121	112
	3rd city borough	33,535	51	69,799	109
	4th city borough	63,306	96	–	–
	5th city borough	81,747	124	–	–
	Total		264,320	400	255,478

3.3 Data collection

A semi-structured questionnaire was used to collect primary data from socio-economic characteristics (age, gender, ethnic, religion, matrimonial, polygamy, school education, residence acquisition, main activity, monthly income, urban and living duration) and variables on stakeholder’s perceptions of urban greenery improvement (urban greenery characteristics, urban greenery importance and urban greenery management and planning) (Additional file 1). Interviews were randomly completed with either female or male using the Kobo Collect application. At each randomly selected resident or institution officer, a greeting and the goal of the rapprochement was carefully made to stimulate the willingness to participate in the survey. The visited urban-related institutions were the Departmental Direction of Living Environment and Sustainable Development, Departmental Direction of Planning and Development, Town

Agency of Territory Management, Technical Councils of Town Hall, Departmental Direction of Forestry and, Departmental Institute of Geography. At each institution, the data collected are mostly the deeply details about respondent's perception on urban greenery management and planning and greenery improvement perspective in the related city.

3.4 Data analysis

Frequencies and percentages were interpreted on the socioeconomic data according to each city. The purpose was also to explain the possible significance of the relationship between cities, city borough of each city, and the perception of residents on urban greenery variables (location of availability, state of density and diversity of the existing urban greenery, benefits lost from urban greenery and the causes) and resident's involvement attitudes towards greenery improvement [7, 8]. Therefore, the test of Pearson Chi-square was executed in SPSS 23 software [30]. The Correspondence Analysis (CA) was also applied to show the association between city boroughs, lost benefits, and causes of the loss of benefits for each city using SPSS 23 software [30]. Finally, a binary logistic regression using SPSS 23 software environment [30] was used to examine the variables that explain people's willingness to get involved in improving urban greenery in each city of the study area. Logistic regression is the statistical technique used to predict the relationship between predictors (our independent variables) and a predicted variable (the dependent variable) where the dependent variable is binary. This model supplied an appropriate fit for the binary choice events where the dependent variable can only take two values [7]. In the current case, the dependent variable was interviewee participation in greenery development (PGD) by manpower, personal initiative, or financial contribution to improve urban greenery that assumed a value 1 if the response is yes and 0 otherwise. The model was performed using fourteen explanatory variables including the city boroughs, sex of respondent (male and female), interviewee age, marital status (single; married; divorced and widower), religion (traditional; christianism and islam), polygamy (yes and no), education (tertiary; senior high school; junior high school; primary school; literacy and none), residence (owner; free accommodated and rental), activity (agriculture; state employment; private employment; trade; pension; own business and student), income (less than 71.63 USD; 71.63–143.25 USD and more than 143.25 USD), duration of stay (less than 5 years; 5–10 years and more than 10 years), knowledge of the general impact of urban greenery (yes and no), house greenery existence (yes and no), institutional collaboration with local people (yes and no). The conclusion as the explanatory variable significantly influences dependent variables was gotten if $p\text{-value} \leq 0.05$.

4 Results

4.1 Profile of respondent

The questionnaires were spread equally between the cities of Parakou (N = 400; 50%) and one of Porto-Novo (N = 400; 50%). About 67.0% of males were surveyed over the two cities with 61.0% in Parakou and 73.0% in Porto-Novo (Additional file 2). The class of age (25–44 years) covered more than 50% of the surveyed population for the two cities (Additional file 2). Christian religion was most practiced in these cities (Parakou is 54% and Porto-Novo is 72%). People with married status dominated in Parakou (69%) when single status (57.7%) invaded the city of Porto-Novo. It can be understood that monogamous couples have dominated the surveyed householder in Parakou (79.7%) as well as in Porto-Novo (87.7%). It was noted that most of the surveyed people in Parakou have the level of senior high secondary school (33.3%) while the level of tertiary (43.5%) has been dominated in Porto-Novo.

The monthly income of most people in Porto-Novo was less than 71.63 USD (63.2%) while the amount between 71.63 USD and 143.25 USD characterized the surveyed people in Parakou (44.0%). Additionally, it was recognized that people were renting more in Parakou (55.7%) than in Porto-Novo (35.2%). Finally, the two cities experienced a high rate of people (Additional file 2) with a stay duration of more than 10 years (67.0% in Parakou and 63.2% in Porto-Novo).

4.2 Resident's perception towards the location of availability, state of density and diversity of the existing urban greenery between and within the cities

In the understanding of the perceived localisation of more greenery entities in each study city, there was a positive perception at the core of the town (85.0% and 77.2%, respectively for the city of Parakou and Porto-Novo) (Table 2, Additional file 3A). A significant dependence was found between this perception and the study cities ($\chi^2 = 86.67$; $p\text{-value} = 0.000$).

Table 2 Proportion of location, state of density and diversity of the existing urban greenery between cities

Variable	Qualification level	Frequency of respondent's perception		z-value	p-value
		Parakou	Porto-Novo		
Location of urban greenery	Commercial areas	3 (0.8%)	3 (0.8%)	0.00	1.000
	Core of the town	340 (85.0%)	309 (77.2%)	2.80	0.007
	Extension areas	26 (6.5%)	0 (0.0%)	5.18	0.000
	Service areas	16 (4.0%)	87 (21.8%)	- 7.49	0.000
	Suburb areas	15 (3.7%)	1 (0.2%)	3.54	0.000
Density of urban greenery	Excellent	0 (0.0%)	20 (5.0%)	- 4.53	0.000
	Adequate	195 (48.7%)	172 (43.0%)	1.63	0.118
	Inadequate	155 (38.7%)	155 (38.7%)	0.00	1.00
	Very poor	50 (12.5%)	53 (13.3%)	- 0.32	0.833
Diversity of urban greenery	Excellent	0 (0.0%)	27 (6.7%)	- 5.29	0.000
	Adequate	190 (47.5%)	217 (54.3%)	- 1.91	0.066
	Inadequate	147 (32.7%)	120 (30.0%)	2.02	0.051
	Very poor	63 (15.8%)	36 (9.0%)	2.90	0.005
Attraction of urban greenery	Excellent	0 (0.0%)	31 (7.7%)	- 5.68	0.000
	Good	100 (25.0%)	196 (49.0%)	- 7.03	0.000
	Acceptable	222 (55.5%)	128 (32.0%)	6.70	0.000
	Weak	78 (19.5%)	45 (11.3%)	3.23	0.002

This dependence should be due to the perceived service areas mostly in Porto-Novo (21.8% vs 4.0%) and extension areas mostly in Parakou (6.5% vs 0.0%). However, there was no significant dependence with city boroughs for this variable in each ($\chi^2 = 12.24$; p-value = 0.14 and $\chi^2 = 19.8$; p-value = 0.07 respectively for Parakou and Porto-Novo).

Regarding the perception of the state of the density, diversity, and attraction of urban greenery, residents in any study cities perceived mostly that the urban greenery has an adequate state (Table 2). However, there was found a significant dependence with the city boroughs within each city (p value = 0.000). In Parakou, the perception was mostly inadequate for the 1st city Borough while in the 2nd and 3rd city Borough the perception was that the density and the diversity of the greenery were mostly in an adequate state (Additional file 3AA and CA). For urban greenery attraction, the perception was both good and acceptable in the city boroughs (Additional file 3DA). In Porto-Novo, there was mostly perceived in 1st city Borough that urban greenery density and diversity were in a poor state and its attraction was also weak. Moreover, in 5th city Borough, they perceived greenery density and diversity in adequate state (Additional file 3).

4.3 Resident's perception on the main benefits lost and the causes of these losses

The loss of the benefits as air quality and cooling effect was respectively mostly perceived in Parakou and Porto-Novo. The benefits of sound control and biodiversity conservation were not perceived in Parakou. Likewise, the benefits of flooding control and sound control were carelessly perceived in Porto-Novo (Table 3). Furthermore, the test Chi-square showed a significant dependence of these losses of benefits between the cities ($\chi^2 = 348.11$; p-value = 0.000) and also between the city borough in Parakou ($\chi^2 = 13.67$; p-value = 0.03 and in Port-Novo ($\chi^2 = 41.79$; p = 0.003). In Parakou, the

Table 3 Resident's perception on the loss's benefits supplied by urban greenery between cities

City	Important benefits lost in the cities					
	Air quality	Sound control	Beauty/aesthetic	Cooling effect	Flooding control	Sink of biodiversity
Parakou	181 (45.3%)	0 (0.0%)	80 (20.0%)	79 (19.7%)	60 (15.0%)	0 (0.0%)
Porto-Novo	16 (4.0%)	6 (1.5%)	62 (15.5%)	296 (74.0%)	1 (0.3%)	19 (4.7%)
z-value	13.54	- 2.46	1.67	- 15.37	7.86	- 4.41
p-value	0.000	0.031	0.115	0.000	0.000	0.000

lost air quality benefit was perceived similarly in the city boroughs (Fig. 2). However, the loss of cooling effect benefit was mostly perceived in the 4th and 5th city boroughs of Porto-Novo (Fig. 3).

The causes of the losses of greenery benefits were therefore differently perceived in the cities and in the city boroughs of each city. Pearson Chi-square test revealed very high significant dependence between cities ($\chi^2 = 214.88$; p-value = 0.000); between city boroughs of Parakou ($\chi^2 = 35.12$; p-value = 0.000) and somehow inside of Porto-Novo ($\chi^2 = 30.19$; p-value = 0.017). The most cause perceived in both cities was the weakness of urban greenery density. However, the weakness of greenery diversity was mostly mentioned in Parakou. In Porto-Novo, the lack of greenery management and planning strategies and the weakness of the size of urban greenery space constituted also the important perceived causes of the loss of greenery benefits (Table 4).

It could also see in Fig. 2 that there was a relationship between the loss of air quality and cooling effect benefits and the weakness of greenery density, the lack of greenery management, the weakness of the size of greenery spaces and 2nd city Borough (Parakou). The loss of beauty or aesthetic and flooding control benefits was associated to the weakness of greenery space diversity and the 1st city Borough. 5th city Borough in Porto-Novo could be mostly associated to the weakness of the size of urban greenery spaces and no greenery planning strategy (Fig. 3). The loss of cooling effect benefit can in turn be mostly give to the greenery density weakness in 4th city Borough of Porto-Novo. Moreover, the loss of beauty or aesthetics, biodiversity sink and air quality benefits can be in relation to 1st, 2nd and 3rd city Boroughs and greenery management strategies lack and the weakness of greenery spaces diversity (Fig. 3).

4.4 Resident's participation for urban greenery development

Globally, the degree of public involvement in urban greenery development was significantly dependent on the cities ($\chi^2 = 12.74$; p-value = 0.002). Therefore at least 93.0% residents in Parakou and 86.5% in Porto-Novo could perceive the low level of public involvement (Table 5). No significance was found for city boroughs in the cities (Parakou: $\chi^2 = 0.88$; p-value = 0.644; Porto-Novo: $\chi^2 = 2.25$; p-value = 0.688).

Only institutional cooperation can positively determine local community willingness to involve in greenery development in both Parakou and Porto-Novo (Additional file 4). Otherwise, the residents of Parakou and Porto-Novo can increase their willingness to participate in urban greenery development when the institutions in charge of urban management

Fig. 2 Positioning of greenery lost benefits, causes of losses and city boroughs of Parakou

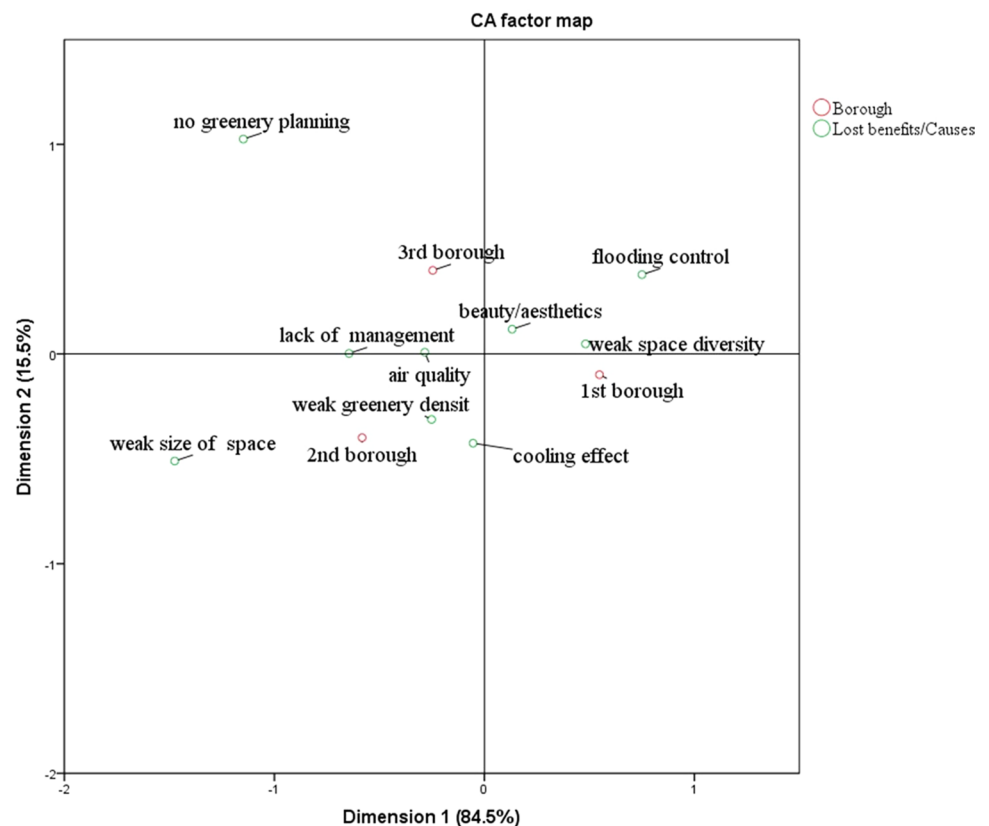


Fig. 3 Positioning of greenery lost benefits, causes of losses and city boroughs of Porto-Novo

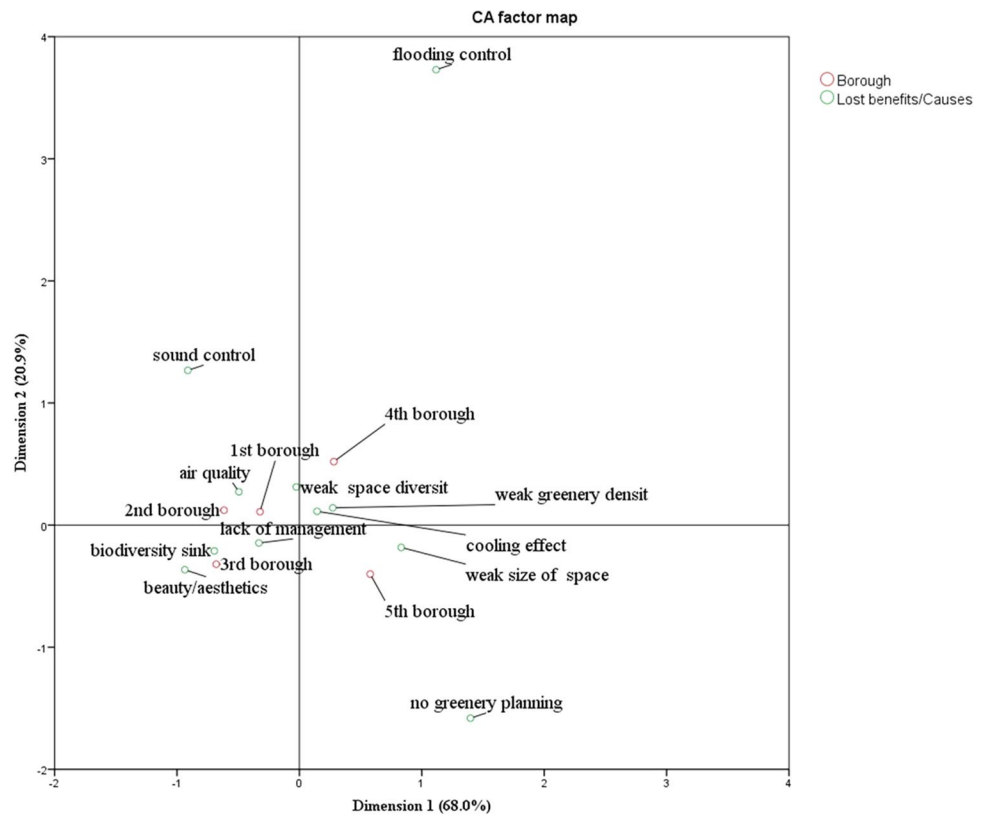


Table 4 Resident's perception on the Causes of the given loss of benefits supplied by urban greenery between cities

City	Causes of loss of benefits by urban greenery				
	Lack of greenery management	No greenery planning	Weak greenery density	Weak greenery space diversity	Weak size of greenery space
Parakou	15 (3.7%)	36 (9.0%)	133 (33.3%)	206 (51.5%)	10 (2.5%)
Porto-Novo	92 (23.0%)	56 (14.0%)	180 (45.0%)	31 (7.7%)	41 (10.3%)
z-value	- 8.00	- 2.22	- 3.40	13.55	- 4.49
p-value	0.000	0.035	0.001	0.000	0.000

Table 5 Interviewee perception on public involvement in urban greening improvement

City	Public involvement in urban greening improvement		
	Low involvement	Average involvement	High involvement
Parakou	372 (93.0%)	26 (6.5%)	2 (0.5%)
Porto-Novo	346 (86.5%)	54 (13.5%)	0 (0.0%)
z-value	3.5	- 3.32	1.42
p-value	0.002	0.001	1.156

or planning work more with them. Beside the institutional cooperation, the level of education is the factor that can lead residents in Parakou to perform their willingness to get involved in urban greenery development (Additional file 4). Thus, most people attain Senior high school, better they manifest feeling to be involved in urban green space development.

However, the Stay Duration, House Greenery and Knowledge on general impact of urban greenery can also significantly determine community involvement in Porto-Novo (Additional file 4). Furthermore, new residents (< 5 years of stay) in the city of Porto-Novo can mostly manifest their willingness to urban greenery improvement. The previous house

greening is a factor that can actively excite people to contribute to greenery development in Porto-Novo. Finally, having some insights on the benefits supplied by greenery in urban area was known to strengthen people's motivation for the development of urban greenery in Porto-Novo.

5 Discussion

5.1 Perception towards the location of availability, state of density and diversity and attraction of the existing urban greenery in relation to the cities

The findings of this study give evidence of the perceived location, state of density, and diversity of urban greenery in Parakou and Porto-Novo. It provides insights into the potential relationship between the core of the city and urban greenery entities. In fact, major public offices and people with high-income usually live the core of the city where greenery entities have chances to be more maintained. This statement echoes the conclusion that the centre of urban areas provides the financial resources and maximum skills required to improve urban greenery [15, 16, 31, 32]. Likewise, the localisation of urban greenery significantly depended on cities. This dependence could be explained by the fact that the city of Parakou is under construction [27] while the city of Porto-Novo is under renovation [33–35]. In addition, no significant dependence on greenery localisation and city boroughs was found in this study. This can be justified by the fact that the centre of the city stretches through all the city boroughs.

The density, diversity, and attraction of urban greenery depend on cities and city boroughs. The cities are located in different climatic and Phytodistrict zones that have influence on species diversity and vegetation development in Benin [36]. Thus, the dependence on urban greenery can be due to the geographical location of the cities [37]. In addition, Parakou and Porto-Novo experience different urban management behaviour as to what cities have peculiar status in the country [38]. The observed dependence in resident perception for urban greenery state can be supported by the relative shifts in the existing urban greenery, urban planning, and city's governance paradigm as concluded by many studies. In Pakistan, a study stated that a significant proportion of residents perceived smoothly the observed changes in the existing greenery in their city [39]. Within the cities, the statistical differences can be justified by the relative change in the existing urban vegetation. Therefore, the urban greenery layer in Parakou was irregularly distributed over the city borough and the effort will be needed to regularly improve street trees development in this city [22]. The different perceptions of urban greenery density, diversity, and attraction between city boroughs can also be attributed to the difference in the benefits procured from these infrastructures. Indeed, the positive relationship was perceived on the health or the quality of urban green spaces and the benefits they procure [10, 40].

5.2 Resident's perception on the main benefits lost and the causes of these losses

Residents in the cities perceived differently the benefits lost from urban greenery. The loss of air quality was mostly perceived in Parakou than Porto-Novo. This can constitute the main issue within the city of Parakou. Thus, air quality regulation is the main ecosystem service required by urban vegetation in Parakou [22]. In Porto-Novo, the cooling effect benefit was mostly perceived to be absent. This result can be supported by the fact that Porto-Novo is a historical city with a high density of built-up areas. Thus, a study on heat drivers determination in southern Benin Republic revealed cooling issues attributed to the rapid growth of built-up areas in Porto-Novo [41]. The significant dependence of the benefits losses to cities and city boroughs can be supported by the above difference in the state of urban greenery. Thus, although there was a difference in urban vegetation type between cities as well as city boroughs, it is obvious that there is unequal perception in the provision of the benefits or disservices [42]. Thus these perceptions are linked to the importance and the interest attributed to the benefits by city's residents [22].

Moreover, the causes of benefit losses were also differently perceived between cities and city's borough. Regarding cities, the difference can be because the same lost benefits were not perceived. Therefore, each city dwellers must attribute the cause to the phenomenon they are experiencing. Any urban area undergo tremendous changes and the main cause of the loss of ecosystem services is the depletion of greenery [43]. Therefore, the weakness of urban greenery density was found as the major cause of the loss of benefits in both cities. The association of the lost benefits and the causes of these losses and the city boroughs of each city must be considered, to succeed the projects on the development of urban greenery in these cities.

5.3 Resident's participation for urban greenery development

Other important focus in this paper was the understanding of residents' attitudes towards involving in urban greenery improvement from diverse perspectives. The results have revealed that local communities' involvement in urban greenery management and development was low. This result corroborated with those of [44] that stated that local communities were generally passive towards involvement in urban greenery initiative. Also, the participation of residents constitute a main driving force for successfully implementing spaces [45]. Thus, Mabelis and Maksymiuk [46] have stated that residents' mostly participate as volunteers and donors which can enhance the development of urban greenery. The study also showed a significant difference of residents' perception for public participation in urban greenery development between the city of Parakou and Porto-Novo. According to Yu et al. [45], the correlation between the existing urban greeneries and the scale of people's involvement in the case of activities leading to greenery development. Thus, because of general unequal vegetation type in the cities, residents must have different perceptions. Moreover, a similar study in Bahir Dar and Hawassa (Ethiopia) has arrived at the same conclusion [8]. Then, the present findings can be supported by the functioning system of urban greenery planning and management that should be specific to each city [47]. In this context, binary logistic regression has been done to examine factors determining resident willingness in greenery improvement in each city.

The result showed that institutional cooperation has positive and significant influence on resident willingness to invest in urban greenery improvement of the cities. This result was similar to the conclusions that the effective improvement of institutional capacities, the collaboration between institutions and local communities have higher impacts on urban development, in general, and urban greenery in particular [8, 16]. Also, the institutional cooperation and collaboration was seen as an effective climate adaptation principle in South Saharan regions [48]. Thus, as institutional reforms are more topical in the republic of Benin, the acquaintance with local population may be more fruitful for suitable development of these cities.

The result also showed that the level of education (senior high school) was significant for people implication in urban green space development in Parakou. This can be due to the impacts of the environmental courses and teachings developed in the secondary school and colleges. Thereby, in Parakou the awareness campaigns for urban green space development must target people with senior high school or students in colleges or high school. In Porto-Novo, the variables such as Stay Duration (stay less than 5 years), House Greenery and Knowledge of the Impact of urban greenery were additionally significant for local population involvement (Additional file 4). The peculiarity in socioeconomical aspects in this city can justify people actions for greenery development. Porto-Novo is undergoing thorough city restructuring which should support the fact that having knowledge of general effect urban vegetation can enhance the motivation to contribute to vegetation maintenance. Also, living in a greening house means to be able to know the impact of greenery. Therefore, for improved willingness of residents to contribute to urban greenery planning and management in Porto Novo, these aspects have also to be considered in Porto-Novo. People reside less than 5 years in Porto-Novo are more favorable to contribute to urban greening improvement. The result can find the obviousness in the interest to increase climate adaptation actions so that the stay be peaceable in the new place.

6 Conclusion

The study has investigated the perception of urban residents on the improvement of urban greenery in contrasting ecological conditions such as the city of Parakou and the city of Porto-Novo in Benin. Overall, there was a significant dependence of cities and city boroughs in terms of urban greenery location and density and diversity of greenery areas. Also, the study showed that greenery benefits lost, and the causes of benefit lost are not similar in the cities and city boroughs. Additionally, local involvement was low and institutional cooperation was found to be inescapable to encourage public involvement into actions of urban greenery development in the cities. Several authors had acknowledged the paucity of previous studies for the comparison of the results. This can be a limitation of the study, but the conclusions drawn would serve as literature for further studies. The findings were also relevant as a guideline for policy makers, urban planners and managers, cityscape architects and projects of urban sustainability regarding the urban greenery in the Republic of Benin.

Acknowledgements Authors acknowledge data collectors and the respondents for their availability for the survey.

Author contributions ABA spearheaded the data collection and cleaning and all analysis of the data used in this paper. ABA mainly invested in the writing of the paper. OAA made the comments and suggested the relevant inputs in the writing of the paper. OAOV was involved in facilitating and undertaking data collection. All authors read and approved the final manuscript.

Funding This research work was fully supported by West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL) under the Doctoral Research Programme (DRP) of Climate Change and Human Habitat (CC-HH).

Data availability The data used in the study is mostly drawn from semi-structured interviews. It is confidential, yet some aspects of coding and analysis can be provided if requested.

Declarations

Ethics approval and consent to participate All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research requirements. The study got ethical approval prior to the field data collection from the Ethics Committee at WASCAL, CC and HH and the municipality of Porto-Novo and Parakou in April 2021. In addition, informed consent was sought from each respondent and confidentiality assured before the conduct of interviews.

Competing interests The authors announce no declarations of interest.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

1. Cilliers S, Cilliers J, Lubbe R, Siebert S. Ecosystem services of urban green spaces in African countries-perspectives and challenges. *Urban Ecosyst.* 2013;16:681–702. <https://doi.org/10.1007/s11252-012-0254-3>.
2. Cobbinah PB, Darkwah RM. African Urbanism: the geography of urban greenery. *Urban Forum.* 2016;27:149–65. <https://doi.org/10.1007/s12132-016-9274-z>.
3. Cilliers S, du Toit M, Cilliers J, Drewes E, Retief F. Landscape and urban planning sustainable urban landscapes: South African perspectives on transdisciplinary possibilities. *Landsc Urban Plan J.* 2014;125:260–70.
4. Lu L, Weng Q, Guo H, Feng S, Li Q. Assessment of urban environmental change using multi-source remote sensing time series (2000–2016): a comparative analysis in selected megacities in Eurasia. *Sci Total Environ.* 2019;684:567–77. <https://doi.org/10.1016/j.scitotenv.2019.05.344>.
5. Xu G, Dong T, Brandful P, et al. Urban expansion and form changes across African cities with a global outlook: spatiotemporal analysis of urban land densities. *J Clean Prod.* 2019;224:802–10. <https://doi.org/10.1016/j.jclepro.2019.03.276>.
6. UN-HABITAT. Urban planning and design labs: tools for integrated and participatory urban planning; 2016.
7. Arabomen JO, Babalola DF, Idumah OF, Oforu SC. Resident's attitudes towards tree care programs in cityscapes. *Res Prod Dev.* 2021. <https://doi.org/10.32358/rpd.2021.v7.462>.
8. Gashu K, Gebre-egziabher T, Wubneh M. Local communities' perceptions and use of urban green infrastructure in two Ethiopian cities: Bahir Dar and Hawassa. *J Environ Plan Manag.* 2019. <https://doi.org/10.1080/09640568.2019.1578643>.
9. Gwedla N, Shackleton CM. Perceptions and preferences for urban trees across multiple socio-economic contexts in the Eastern Cape, South Africa. *Landsc Urban Plan.* 2018;2019(189):225–34. <https://doi.org/10.1016/j.landurbplan.2019.05.001>.
10. Yeshitela K. Attitude and perception of residents towards the benefits, challenges and quality of neighborhood parks in a sub-saharan africa city. *Land.* 2020;9(11):1–17. <https://doi.org/10.3390/land9110450>.
11. Barau AS. Perceptions and contributions of households towards sustainable urban green infrastructure in Malaysia. *Habitat Int.* 2015;47:285–97. <https://doi.org/10.1016/j.habitatint.2015.02.003>.
12. PAG. Government Actions Programme. Cotonou; 2016.
13. Venter ZS, Shackleton CM, Van Staden F, Selomane O, Masterson VA. Green Apartheid: urban green infrastructure remains unequally distributed across income and race geographies in South Africa. *Landsc Urban Plan.* 2020;203(0349):103889. <https://doi.org/10.1016/j.landurbplan.2020.103889>.
14. Shackleton CM, Blair A. Perceptions and use of public green space is influenced by its relative abundance in two small towns in South Africa. *Landsc Urban Plan.* 2013;113:104–12. <https://doi.org/10.1016/j.landurbplan.2013.01.011>.
15. Shackleton CM, Blair A, De Lacy P, et al. How important is green infrastructure in small and medium-sized towns? Lessons from South Africa. *Landsc Urban Plan.* 2018;180:273–81. <https://doi.org/10.1016/j.landurbplan.2016.12.007>.
16. Cobbinah PB, Asibey MO, Zuneidu MA, Erdiaw-Kwasie MO. Accommodating green spaces in cities: perceptions and attitudes in slums. *Cities.* 2021;111:103094. <https://doi.org/10.1016/j.cities.2020.103094>.
17. Narh SN, Takyi SA, Asibey MO, Amponsah O. Garden city without parks: an assessment of the availability and conditions of parks in Kumasi. *Urban For Urban Green.* 2020;55:126819. <https://doi.org/10.1016/j.ufug.2020.126819>.

18. Zakka SD, Permana AS, Majid MR, Danladi A, Bako PE. Urban Greenery a pathway to environmental sustainability in Sub Saharan Africa: a case of Northern Nigeria Cities. *Int J Built Environ Sustain*. 2017;4(3):180–9. <https://doi.org/10.11113/ijbes.v4.n3.211>.
19. Osseni AA, Mouhamadou T, Tohoain BAC, Sinsin B. SIG et gestion des espaces verts dans la ville de Porto-Novo au Bénin. *Tropicultura*. 2015;33(2):146–56.
20. Amontcha AAM, Djego JG, Lougbegnon TO, Sinsin BA. Typologie et répartition des espaces verts publics dans le Grand Nokoué (Sud Bénin). *Eur Sci J*. 2017;13(21):79–97. <https://doi.org/10.19044/esj.2017.v13n21p79>.
21. Tekla O, Togbe CE, Djikpo R, Chabi R, Djossa B. Effects of urban forestry on the local climate in Cotonou, Benin Republic. *Agric For Fish*. 2017;6(4):123–9. <https://doi.org/10.11648/j.aff.20170604.13>.
22. Zohoun PE, Baloubi DM, Azalou-tingbe EM, Yabi I. Characterization of the ecosystem services rendered to the population by trees in the city of Parakou in Central Benin. *Landsc Archit Reg Plan*. 2021;6(1):8–18. <https://doi.org/10.11648/j.larp.20210601.12>.
23. Girma Y, Terefe H, Pauleit S, Kindu M. Urban green spaces supply in rapidly urbanizing countries: The case of Sebeta Town, Ethiopia. *Remote Sens Appl Soc Environ*. 2019;13:138–49. <https://doi.org/10.1016/j.rsase.2018.10.019>.
24. Sogbossi ES, Zakari S, Djego JG. Phytodiversity and spatial development of urban flora in Lokossa, Benin. *Int J Nat Resour Ecol Manag*. 2021;5(4):145–59. <https://doi.org/10.11648/j.ijnrem.20200504.12>.
25. Houngla EJH, Hinson CDT, Gbankoto A, Anani BC. Characteristics of urban market gardening in Porto-Novo, Republic of Benin. *West Africa Int J Agric Sci*. 2019;4:66–76.
26. Lanmandjèkpogni MP, Codo FDP, Yao BK. Urban growth evaluation by coupling descriptive analysis and Zipf’s rank-size model in Parakou (Benin). *Urban Reg Plan*. 2019;4(1):1–8. <https://doi.org/10.11648/j.urp.20190401.11>.
27. Miassi Y, Dossa F. Influence of the types of fertilizers on the economic performance of the market garden production in Parakou Town, Northern Benin. *Agric Res Technol*. 2018;15(1):1–6. <https://doi.org/10.19080/ARTOAJ.2018.15.555944>.
28. INSAE. Effectif de La Population Des Villages et Quartiers de Villes Du Bénin. Rapport Final, RGP4. Cotonou ;2016.
29. Dagnelie P. *Statistique Théorique et Appliquée*, vol. 2. Paris: De Boeck & Larcier; 1998. p. 659.
30. Corp IBM. *IBM SPSS statistics for windows*, version 23.0. Armonk: IBM Corp; 2015.
31. Gwedla N, Shackleton CM. The development visions and attitudes towards urban forestry of officials responsible for greening in South African towns. *Land Use Policy*. 2015;42:17–26. <https://doi.org/10.1016/j.landusepol.2014.07.004>.
32. Richards DR, Passy P, Oh RRY. Impacts of population density and wealth on the quantity and structure of urban green space in tropical Southeast Asia. *Landsc Urban Plan*. 2017;157:553–60. <https://doi.org/10.1016/j.landurbplan.2016.09.005>.
33. Tohazin CAB, Attolou SFB, Dossou Guedegbe O, Agbo FB. Une approche SIG pour la restructuration du Sud-Ouest de la ville de Porto-Novo. *Rev Ivoirienne Sci Technol*. 2014;23:122–36.
34. Boko-haya DD, Li Y, Togbenou K, Liu S, Yao C, Qiang B. Study on strategic planning of road and bridge infrastructure development in city planning: taking Porto-Novo city of Benin republic as example. *MATEC Web Conf*. 2018;153:1–5. <https://doi.org/10.1051/mateconf/201815309002>.
35. Auclair E, Garcia É. Les places traditionnelles de Porto-Novo (Bénin) comme communs : entre mise en valeur des espaces urbains et promotion des pratiques sociales et culturelles. *Dév Durable Territ*. 2019;10(1):1–19. <https://doi.org/10.4000/developpementdurable.13147>.
36. Adomou AC. *Vegetation patterns and environmental gradients in benin: implications for biogeography and conservation*. Wageningen: Wageningen University; 2005.
37. Dobbs C, Hernández-moreno Á, Reyes-paecke S, Miranda MD. Exploring temporal dynamics of urban ecosystem services in Latin America : the case of Bogota (Colombia) and Santiago (Chile). *Ecol Indic*. 2018;85:1068–80. <https://doi.org/10.1016/j.ecolind.2017.11.062>.
38. MDGLAAT. *Politique Nationale de Décentralisation et de Déconcentration*. Benin; 2016.
39. Bokhari SA, Saqib Z, Ali A, Zaman MH. The impacts of socio-economic factors on the perception of residents about urban vegetation: a comparative study of planned versus semi-planned cities of Islamabad and Rawalpindi. *Pakistan Appl Ecol Environ Res*. 2018;16(4):4265–87. https://doi.org/10.15666/aeer/1604_42654287.
40. Rey Gozalo G, Barrigón Morillas JM, Montes González D. Perceptions and use of urban green spaces on the basis of size. *Urban For Urban Green*. 2019;46:126470. <https://doi.org/10.1016/j.ufug.2019.126470>.
41. Falolou LF, Orekan V, Houssou CS, Euloge K. Caractérisation des îlots de chaleur dans la Commune de Porto-Novo et ses alentours. *Int J Prog Sci Technol*. 2020;20(2):442–56.
42. Drillet Z, Fung TK, Leong RAT, Sachidhanandam U, Edwards P, Richards D. Urban vegetation types are not perceived equally in providing ecosystem services and disservices. *Sustainability*. 2020;12:1–14. <https://doi.org/10.3390/su12052076>.
43. Crespin SJ, Simonetti JA. Loss of ecosystem services and the decapitalization of nature in El Salvador. *Ecosyst Serv*. 2016;17:5–13. <https://doi.org/10.1016/j.ecoser.2015.10.020>.
44. Mensah AC, Andres L, Baidoo P, Eshun JK, Antwi KB. Community participation in urban planning: the case of managing green spaces in Kumasi, Ghana. *Urban Forum*. 2016;28(2):125–41. <https://doi.org/10.1007/s12132-016-9295-7>.
45. Yu Y, Xu H, Wang X, et al. Residents’ willingness to participate in green infrastructure: spatial differences and influence factors in Shanghai, China. *Sustainability*. 2019;11:1–15. <https://doi.org/10.3390/su11195396>.
46. Mabelis AA, Maksymiuk G. Public participation in green urban policy: two strategies compared. *Int J Biodivers Sci Manag*. 2009;5(2):63–75. <https://doi.org/10.1080/17451590902978251>.
47. Vaňo S, StahI Olafsson A, Mederly P. Advancing urban green infrastructure through participatory integrated planning: a case from Slovakia. *Urban For Urban Green*. 2021;58:1–15. <https://doi.org/10.1016/j.ufug.2020.126957>.
48. Singh C, Iyer S, New GM, et al. Interrogating ‘effectiveness’ in climate change adaptation: 11 guiding principles for adaptation research and practice. *Clim Dev*. 2021. <https://doi.org/10.1080/17565529.2021.1964937>.