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Enhancing urban resilience through greenbelts development in Epe, Lagos State, Nigeria

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ABSTRACT. Urbanisation and rapid urban growth have intensified environmental challenges in many cities, including pollution, urban heat island effects, biodiversity loss, flooding, and the conversion of agricultural land. These challenges have affected urban residents' access to natural resources, food, livelihoods, and other essential opportunities. Greenbelts are increasingly recognised as important ecological and socio-economic assets that can support urban resilience. This study assessed the contribution of greenbelts to urban resilience in Epe, Lagos State, Nigeria. A survey research design was adopted, and primary data were collected from 384 respondents using structured questionnaires. Data were obtained on respondents' socioeconomic characteristics, perceived benefits of greenbelts, and the contribution of these benefits to community resilience. Descriptive statistics, including frequencies, percentages, and charts, were used to summarise the respondents' characteristics and reported greenbelt benefits, while multiple regression analysis was employed to examine the relationship between greenbelt benefits and urban resilience. The findings show that residents derived several benefits from the greenbelt, including food supply, medicinal resources, livelihood opportunities, environmental regulation, and preservation of flora and fauna. The regression results indicate a statistically significant relationship between greenbelt benefits and urban resilience, $F = 2.759$, $p = 0.013$. The correlation coefficient, $R = 0.482$, suggests a moderate positive relationship, while the coefficient of determination, $R^2 = 0.240$, indicates that greenbelt benefits explained 24% of the variation in urban resilience in the study area. The remaining 76% may be attributed to other social, economic, infrastructural, and environmental factors not captured in the model. The study concludes that greenbelts play an important role in strengthening urban resilience in Epe and recommends legal protection, community-based conservation, and sustainable use of greenbelt resources to enhance environmental quality, livelihood security, and long-term urban sustainability.

Key words: Environment, Greenbelts, City resilience, Urbanization, Epe

1. INTRODUCTION

Population growth and rapid urbanisation have precipitated the pervasive phenomenon of urban sprawl, presenting significant environmental, social, and economic challenges for cities worldwide. In response, the greenbelt has emerged as a cornerstone of international planning policy for over a century, designed to contain urban expansion, protect agricultural land, and preserve natural areas (Goode, 2022; Dey & Greeshma, 2014; Amati, 2008a). Greenbelts were conceived as permanent zones of open land surrounding urban centres, intended to prevent coalescence, distinguish urban cores from satellite towns, and safeguard land for recreation, agriculture, and forestry (Amati, 2008b).

According to Tia (2023), greenbelt is a policy and land-use zone designation used in land-use planning to retain largely undeveloped, wild, or agricultural land surrounding or neighboring urban areas. City resilience, on the other hand, refers to the capacity of a city's systems, businesses, institutions, communities, and individuals to survive, adapt,

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and thrive, regardless of the chronic stresses and acute shocks they encounter. A city is said to be resilient if it has the capacity or ability to absorb a certain amount of disturbance without a change in its structure and composition. This is its ability to resist damage or degradation and to recover quickly from disturbances such as urban floods and pollution, among many others. The urban ecosystem, comprising biotic components (plants, fauna, and humans) and abiotic components (soil, water, geology, and air), suffers from degradation as humans struggle to enhance urban development. These ecosystem components are thus subject to stress as humans struggle to find more space for settlement, materials for the construction, and for food cultivation (Lipton, 2004). These stressors are aspects of the urban environment that when exacerbated, can in turn affect the living conditions for man, plants, and animals in the city. Hence, as the city of Lagos, Nigeria, continues to grow in population, the region has experienced devastating environmental problems, including phenomena such as flooding, erosion, and pollution. It has been observed that most of these problems arise due to the lack of green belts in this city.

The benefits of greenbelt in cities cannot be over emphasized. It is mentioned that a greenbelt is a green open space that serves as a buffer area, restricting land use development and other activities. A greenbelt acts as a city boundary or region separator, restricting activity to one region and not another, without interfering with each other, and ensuring the safety of the surrounding environmental factors. It should be noted that greenbelt is a significant element in the control of pollution due to their absorption of dangerous gases or fumes released into the atmosphere and maintenance of the quality of life of urban communities. The main purpose of green belts is that the vegetation serves as a cleanser for absorbing pollutants in the form of gases and pollutants through the leaves, which are going to be planted to serve as a form of resilience to the city. Greenbelt encompasses local biodiversity and heritage assets, while also capturing carbon, providing spaces for water to prevent flooding, and protecting the water supply.

The main element of greenbelt is the vegetation that naturally serves as an atmospheric cleanser by absorbing pollutants in the form of gases and particles through the leaves. Vegetation serves as a life filter that lowers the level of pollution that absorbs, detoxifies, accumulates and or regulates metabolism in the air, so that air quality can increase with the release of oxygen in the air (Shannigrahi et al. 2003). The benefit of the greenbelt designated areas is to make the air cleaner and healthier. High-sensitivity plant species are useful for early warning of the presence of pollution material in the air, while plant species with a high tolerance level will reduce the level of pollution in the air thoroughly. Here is the role of Green Belt for urban public health, especially as pollution control or air pollution. According to Kirby et al. (2023), a greenbelt is the physical separation of urban and rural areas, in the form of free zones of building or green open space that surrounds the outer urban area or the central area of activities that cause pollution. Greenbelts are a significant element in urban areas, serving as a key component in pollution control and maintaining the quality of life for urban communities. While the primary historical function of greenbelts has been growth containment, contemporary studies highlight their multifunctional role in enhancing urban sustainability. Beyond their land-use demarcation function, greenbelts are increasingly recognised for their critical ecosystem services. They act as natural infrastructure that improves air quality by absorbing atmospheric pollutants, mitigates urban flooding through water capture and infiltration, supports biodiversity, and provides essential recreational spaces for community well-being (Shannigrahi et al., 2003; Adeyemi et al., 2015). Furthermore, when conceptualised as a

form of urban agriculture, greenbelts can contribute to socio-economic resilience by promoting food security, generating income, and spurring local employment opportunities (Moustier, 1998; Harrow Council, 2013).

Previously, most urban areas in Nigeria were of considerable size, with easy access to farmlands in the countryside. In many developing nations, the theoretical benefits of greenbelts clash with the realities of rapid, often unplanned, urbanisation. Nigeria exemplifies this crisis. Cities like Lagos have experienced explosive population growth, leading to the relentless conversion of greenbelts and open spaces into built-up areas (Dipeolu & Ibem, 2020; Obi et al., 2021). This loss triggers a cascade of negative consequences: increased vulnerability to flooding and erosion, loss of biodiversity, ecosystem imbalance, and heightened exposure to pollution (Dipeolu & Ibem, 2020). Consequently, the very environmental problems that greenbelts are designed to mitigate are exacerbated by their systematic depletion. The use of greenbelts originated from Ebenezer Howard's 1898 conception of the garden city, where he used greenbelts to separate residential from industrial areas. Arising from this, greenbelts are described as areas comprising of undeveloped, wild or agricultural land within or around urban areas that prevent the outward sprawl of spatial development. In Nigeria, previous studies have identified several benefits of greenbelts. Dipeolu & Ibem (2020) for instance identified space for relaxation, leisure and recreation, provision of medicinal and ethno-botanic resource and food tree species, as well as for socio-cultural to religious, commercial and agricultural activities. Adeyemi et al. (2015) considered urban greenbelts as promoting biodiversity, conserving soil, purifying water and air and preventing land degradation, while they are also seen as relevant in socio-economic development of the cities by promoting food security, health and well-being of the population.

Greenbelt as a form of urban agriculture is a practice that is carried out within or on the outskirts of a city where a non-agricultural use of local resources is a real option (Moustier, 1998). Urban agriculture can spur or help sustain a range of new industries and employment opportunities in and near cities, which include compost production and supply, seed, tool and related supply houses, marketing and distribution, including rejuvenated farm markets, farmer-consumer cooperatives and exchange trading systems. Urban agriculture as a form of resilience supports new industries and also offers employment opportunities which include; marketing, supply, distribution, farming tools and compost making (Harrow Council, 2013). Urban agriculture also generates income for urban dwellers involved in urban farming, the money is often spent on non-food items, such as healthcare, transportation, and housing, thereby contributing to poverty alleviation among the urban poor. Urban agriculture complements rural agriculture to a large extent, and increases the efficiency of the national food system by providing products that rural agriculture cannot supply easily e.g. perishable products and produce that require rapid delivery upon harvest. Despite this recognised importance of greenbelts and the documented severity of their loss in Nigeria, there is a need for localized, empirical studies that explicitly investigate the role of remaining or potential greenbelt areas in enhancing urban resilience. While the literature establishes the general benefits of greenbelts and laments their disappearance, few studies systematically explore how they function as a mechanism of resilience within the specific socio-ecological context of a rapidly urbanizing Nigerian city like Lagos. This study, therefore, seeks to address this gap by exploring the potentials of greenbelts to enhance urban resilience. Using the case study of Epe, a developing area within Lagos State, Nigeria, this research investigated how greenbelt strategies encompassing ecological conservation, recreational

use, and urban agriculture can contribute to building a more resilient city in the face of environmental and socio-economic pressures.

2. LITERATURE REVIEW

2.1. Planning Around Green Spaces

Planning around green spaces employs the garden city, green urbanism and green planning models, while efficient land-use or land preservation entails compact city, smart growth and new urbanism models. Each of these models/theories provides significant measures on how to integrate green spaces to/within urban areas or urban development. Influencing new towns or developing countries, the role of these models/theories is to guide the usage of land, preserve and conserve the natural environment, encourage sustainable form and their incorporation into the planning agenda of developing countries.

Significantly, the garden city model, which is among the key landmark urban utopian models, the likes of Charles Fourier's Fantasy Villages (Phalansteries), Ernest Callebach's novel (Ecotopia) and Le Corbusier's (green city), which presses on the need to preserve and conserve the natural environment (Baycan-Levent & Nijkamp, 2009). It was introduced by Ebenezer Howard (1850-1929) to solve the issue of overcrowding and pollution that were brought about by the industrial revolution in the 18th century. Howard stated that to address unhealthy lifestyles in cities, towns and villages must be integrated. Accordingly, cities and the countryside entail qualities that attract people to them. For the countryside, nature's beauty, fresh air, sunshine and the fruits of the earth are magnets pulling people while city attracts people with employment opportunities, networking and cultural activities. The garden city model is to bridge the gaps separating society from natural environment.

According to the Town and Country Planning Association (2021), greenbelts within the garden city are to promote healthy living through the availability of shared parks and gardens for social interaction, sports interaction, and sports and leisure activities. Subsequently with the garden city model setting into motion the incorporation of green spaces into the urban landscape, the green planning model among many others emerged. Greenbelt emerged from the garden city model as a measure to curb urban sprawl. Its main function is to prevent urban sprawl into the periphery for recreation, agriculture and forestry. The green finger model denotes a radial form of greenbelt from the city centre outwards. The greenway model is a recent urban greening management model which is sometimes called green wedges and is the green space created along linear features such as roads, railways, rivers and ridges.

Identifiably, green roof is adopted to enhance greening of cities with its benefit to include; minimization of air pollution, wildlife habitat and form of landscape aesthetics. In addition, green urbanism guides policies and projects that aim to develop new urban areas in a bit to protect the natural environment. Walsh (2004) defines green urbanism as an act of creating beneficial communities for humans and the environment as a whole. It involves applying green building principles, processes and technologies at the neighborhood scale of linking buildings, infrastructure and natural systems.

2.2. Efficient Land-Use or Land Preservation

This gives credence to compact city theory, smart growth and new urbanism. Compact city which is built around the concepts of efficient land-use and urban containment facilitates land use sustainability by utilizing it efficiently, minimizing pollution and conserving natural environment, soil cohesion, cultural development and supporting economic viability. Compact city reduces land usage, hence providing space for green vegetation, agricultural land, brownfields and recreational centers. Hence, integration of green spaces in the likes of parks and gardens into a city's physical landscape makes provision for accessibility to recreational opportunities and encourages physical activities such as walking and cycling (Jim & Chen, 2013).

The period when institutional actors for urban development in the USA began to promote an alternative growth paradigm to their existing sprawl developments was when smart growth was developed (Goetz, 2005). The United States Environmental Protection Agency (2006) described smart growth as an urban growth that possesses the features of mixed land uses, compact building structure designs, multiple housing opportunities, walkability, reliance on participatory planning and a predictable decision process to preserve and strengthen existing settlements. The relevance of green spaces lies in the preservation of natural resources which is one of the main elements of smart growth.

Closely related to smart growth is new urbanism whose main goals are to minimize the dependence on usage of automobiles and create livable and walkable neighborhoods with an array of housing, jobs and commercial sites (Han et al., 2022). The only identifiable difference between new urbanism to smart growth is that it concentrates on the development of compact land forms in cities, towns and villages to promote mixed land usage, transit-friendly environment and a diverse range of housing.

2.3. Concept of City Resilience

Broadly speaking, different academic disciplines invoke resilience to describe the response of a given system to a disturbance of some kind (Vale, 2014). Most fields also recognize the distinction between positive resilience and negative resilience. While both types enhance the ability of the subject to cope with stress, negative resilience does so with undesirable externalities and long-term consequences that add vulnerability, risk and ultimately undermine resilience. Efforts to bolster resilience across different disciplines, therefore, emphasize positive adaptation despite adversity (Vale, 2014). Beyond these underlying themes, however, most academic disciplines employ a unique understanding of the concept. Given that cities are multi-dimensional entities and fragility is also multifaceted, defining resilience in an urban context will include insights from multiple professions and disciplines. Definitions of resilience from different fields vary on two key spectrums, the first of which is the entity being described as resilient. In disciplines such as engineering and other material sciences, resilience is used to describe the reaction of a material object or entity to stress. In other fields, it is applied instead to describe people, communities, or systems (both man-made and natural). Originally, the concept of resilience emerged in the field engineering and other material sciences to describe the capacity of materials and other physical structures to withstand stress and shocks without structural

change or collapse. Resilience is an output or state of being based on how a material can withstand stress given "something inherent in the composition of the object" (Vale, 2014). In this conceptualization then, resilience is used to describe the maintenance of a pre-crisis status quo for entities. Hence, resilience is an outcome measure with an end goal of limiting change or damage most similar to robustness (Cutter et al., 2010).

3. METHODOLOGY

3.1. Study Area

This research was carried out in the Epe Local Government Area of Lagos State (Figure 1 and Figure 2). Epe is located between latitude 6°35′N and longitude 3°59′E (Geodatos, 2021). It is located on the north side of Lekki Lagoon and about 90 km from Ibadan, the Oyo State capital. The Lagos area is traditionally in the Mangrove Forest Vegetation belt of Nigeria. This is characterised by grasslands (sedges used in mat making) and saltwater ferns, which grow to a height of three metres. There are also date palms, which thrive most on sandy soils. This is found in relatively large numbers along the Ocean Creeks area. Other elements of vegetation in the area are; the raffia palm species and coconut palms. It is worth noting that the character of the vegetation has also influenced the fauna in the area, which is diversified in nature. More so, there is a seasonal variation in the salinity of the Atlantic Ocean. The mean maximum temperature of the area varies between 27 °C and 37 °C, while the mean minimum temperature varies between 22 °C and 26 °C. The months of August and September are the coolest while the months of January to March are usually the hottest. The relative humidity at dawn is about 80% resulting in precipitation in the mornings during the rainy season. It, however, drops to about 70% in the afternoons, making people sweat and uncomfortable.

Generally, the drier period from December to February has low relative humidity ranging from 60% to 70%, while a range of between 80% and sometimes over 90% is recorded during the wet season. The annual rainfall is about 1900mm, and rain usually occurs between May and October. One has to envision a gradual change in flora from the wettest to the driest part of the area, as well as differences in flora due to soil type. The study area is situated between the rain forest and dry forest regions of the subequatorial climatic zone. A heavy biotic pressure due to population increase has been imposed on the vegetation and soil pattern as people have cleared large parts of the greenbelt for habitation/physical structures, cash crop farming and urban development. According to the National Population Commission Census (2006), the population of the study area was approximately 181,409; hence, the projected population for the year of study 2021 was estimated to be 296,521. The impact of urbanisation has led to massive changes in natural vegetation and has also had a negative effect on aquatic life and the constituents of the water bodies, which are constantly affected by pollution from various types of waste.

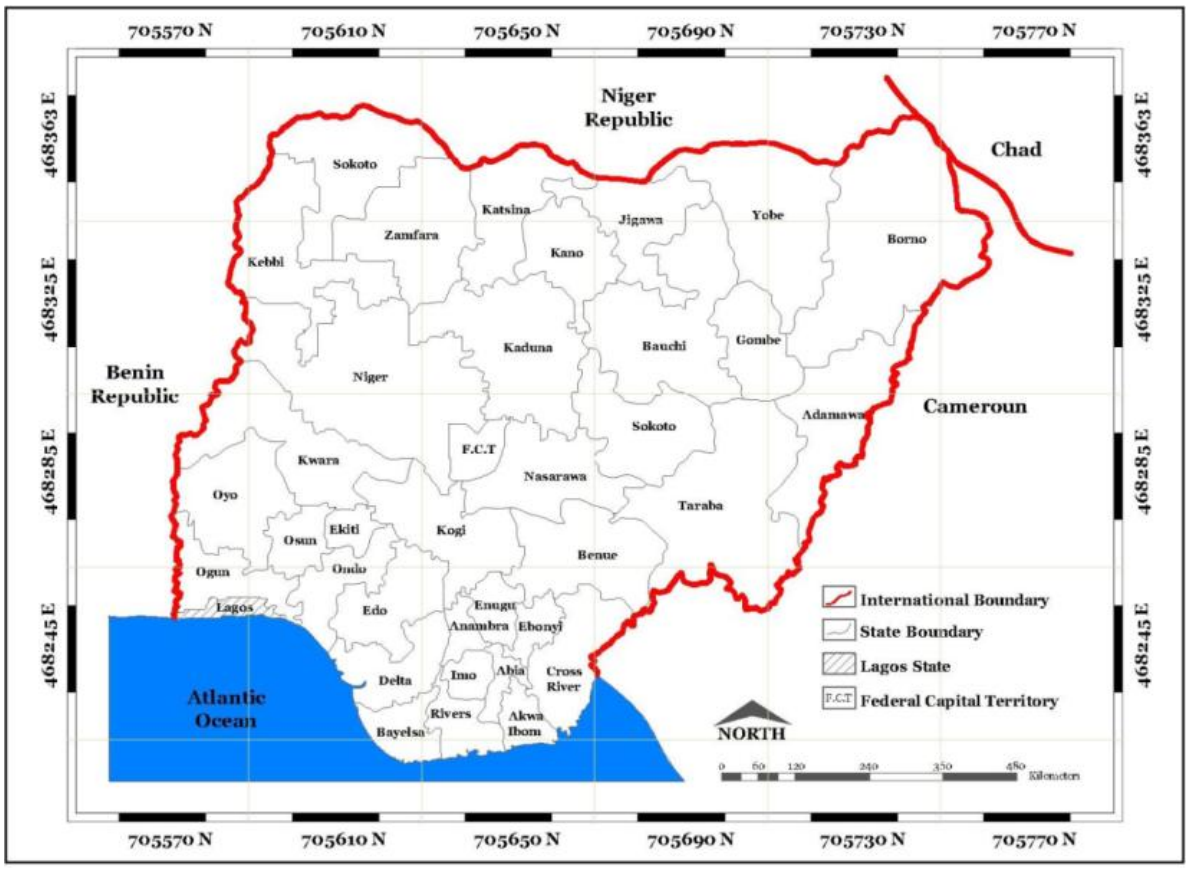

Figure 1. Lagos State in the national context

Source: Lagos State Ministry of Physical Planning and Urban Development (2019)

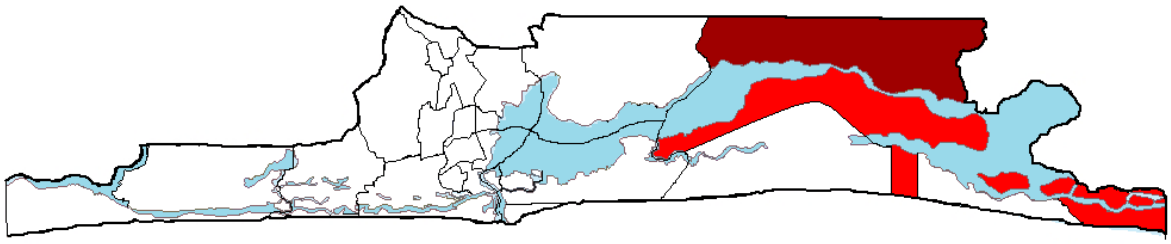

Figure 2. Epe within the context of Lagos State

Source: Lagos State Ministry of Physical Planning and Urban Development (2019)

3.2. Survey design and sampling

Survey research design was adopted for the Primary data collected from the respondents with the use of questionnaires. The total population of Epe as at the 2006 population census was 181,409; the population was projected to 2021 (296,521) with a growth rate of 3.34% (National Bureau of Statistics, 2011). The population from which the sample size was drawn is 296,521.

Following Krejcie and Morgan (1970) sample size determination table, 384 questionnaires is appropriate for a population of more than 100,000. Following this, 384 respondents were selected for this study. Systematic random sampling technique was adopted to administer the questionnaires to the respondents so as to ensure equal chance of

selection. Starting from the beginning of zone 1 road, the first respondent was randomly picked while others were selected at the interval of 15th until the number of respondents were exhausted. Using close ended questions, the socioeconomic characteristics of the respondents were sourced. Also, the benefits of greenbelts to the residents and the effects on the community were sourced from the respondents. Descriptive statistics of frequency, percentage and charts were used to describe the socioeconomic characteristics of the respondents and the benefits rendered by greenbelts. Inferential statistics of multiple regression analysis were employed to analyse the relationship between city resilience and benefits of greenbelts in the community.

4. RESULTS AND DISCUSSION

4.1. Socioeconomic Characteristics of Respondents

The gender of the respondents as shown in Table 1 indicates that males were in the majority of the respondents with 69.5% while females accounted for the remaining 30.5%. This result might not be unconnected with the tradition of patriarchal system as practiced in this part of the world where issues concerning home are generally handled by male members of the household. This may also have to do with the 2006 population census, which reported more males than females. On the age categorization of the respondents, the result shows that respondents within the age bracket of 46 to 64 were the majority with 49%, this is followed by 21.8% for age between 65 and above while 28-45years and 18-27years recorded 18% and 11.2% respectively. This result shows that the respondents in the age brackets of working class were dominant in the study area and by implication, it means they are well positioned to address the thrust of the study. Besides, the respondents in these categories are old enough to know much about goal of the study and respond appropriately to questions.

The educational qualification of the respondents as shown in the table reveals that those who had NCE/HND constituted 29.5%, BSC 28.6% while SSCE had 17.7%, no formal education 13.3% and higher degree 10.9%. It can be deducted from this result that the respondents were mostly educated to a reasonable level as only very few were without any formal education. This again places them in a better position to understand the study and may likely be reflected in their responses Concerning the occupation of the respondents, majority of them were farmers 47.7%, about one-quarter 25.5% were artisans by occupation, while civil servants had 12.8% and the remaining 14% were into other occupations. The deduction from this is that the study area is dominated by farmers. The monthly income of the respondents places the majority in the income bracket of between N31,000-N60,000 with 65.4%, 20.3% earned between N61,000 and N90,000 while 2.6% earned above N90,000 and the least earned monthly income was less than N30,000 and by 11.7% of the respondents. Majority of the respondents by implication were middle income earners, this may not be unconnected with their farming dominated occupation, and in the developing countries of the world, farmers are generally known for their subsistence farming practices which place them poor in terms of reward. This finding is in agreement with Antle and Ray (2020).

Table 1. Socioeconomic characteristics of the respondents

Gender	Frequency	Percentage (%)
Male	267	69.5
Female	117	30.5
Total	**384**	**100**
Age	Frequency	Percentage (%)
18-27	43	11.2
28-45	69	18
46-64	188	49
65 and above	84	21.8
Total	**384**	**100**
Educational Qualifications	Frequency	Percentage (%)
No formal	51	13.3
SSCE	68	17.7
NCE/HND	113	29.5
BSC	110	28.6
Higher Degrees	42	10.9
Total	**384**	**100**
Occupation	Frequency	Percentage (%)
Farming	183	47.7
Artisan	98	25.5
Civil service	49	12.8
Others	54	14
Total	**384**	**100**
Monthly Income	Frequency	Percentage (%)
Less than N30,000	45	11.7
N31,000-N60,000	251	65.4
N61,000-N90,000	78	20.3
N91,000 and above	10	2.6
Total	**384**	**100**

4.2. Benefits of greenbelts to the respondents

Various benefits were said to be derived from the greenbelt of Epe according to the results of the study. As indicated in Table 2, the highest general benefit derived from the greenbelt were classified as commercial benefit 66.4%, this may be due to the various products fetched from the area in terms of both fauna and flora components which serve as means of livelihood. The next is air purification of the environment 29.9% and serene environment constituting 3.6%. This result agrees with Basit et al. (2022) which studied greenbelt conservation as a component of ecosystem, ecological benefits and management services in Peshawar city.

Table 2. Major benefit derived from greenbelt

Benefit	**Frequency**	**%**
Air Purification	115	29.9
Serene Environment	14	3.6
Commercial Activities	255	66.4
Total	384	100

The cost of farm produce in the study area was investigated and as shown in Table 3. 96.4% of the respondents agreed that the farm products in the study area were inexpensive, while the very few remaining others were of the opinion that the products were expensive. The admittance of cheap farm products may be connected to the availability of

cheap, fresh, natural farm products and other forest resources. Additionally, food acquired from the area requires less preservation, upkeep, and travel time to reach consumers.

Table 3. Cost of farm produce

Cost	Frequency	%
Cheap	370	96.4
Expensive	14	3.6
Total	384	100

Figure 3 presents respondents' perceptions of the impact of the greenbelt on social interaction. The results show that 86.7% of the respondents agreed that the greenbelt in the study area positively influenced social interaction, while 13.3% disagreed. This suggests that the greenbelt functions not only as an ecological resource but also as a social space that encourages interaction among residents. The availability of green space may promote recreational and physical activities, informal gatherings, and community engagement, thereby strengthening social cohesion. Therefore, the high level of positive response indicates that the greenbelt contributes to the social dimension of urban resilience in Epe.

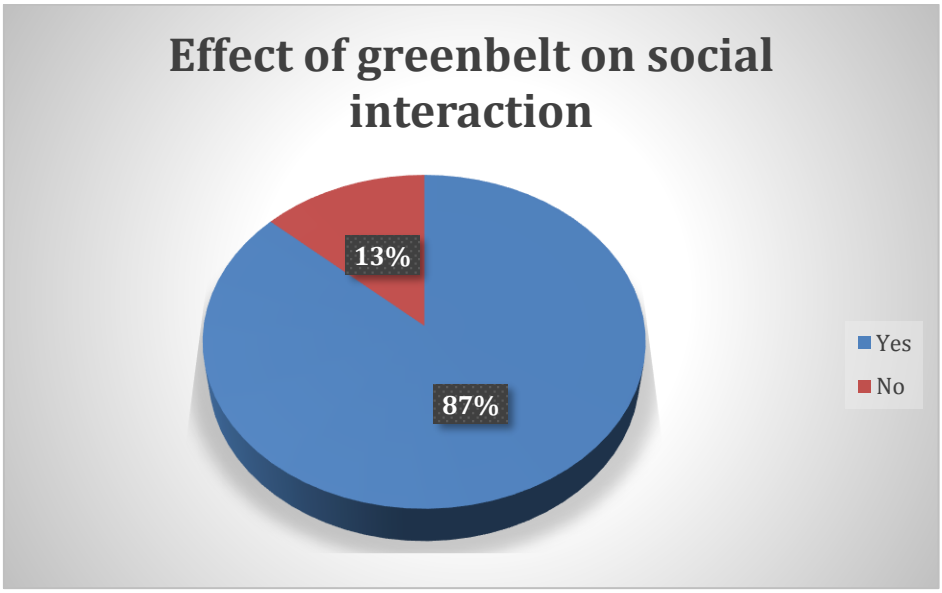

Figure 3. Impact of greenbelt on the respondents' social interaction

Further, the study as indicated in Table 4 found that 86.4% of respondents believed the greenbelt helps to control temperature, while 13.6% disagreed. According to the majority of the respondents, the greenbelts were often used by them during the dry season to serve as shade against the scorching sun while the micro climate within the area also extended the cool breeze to the surrounding environment. This may be due to the vegetation natural mechanisms for preserving moisture and inhibiting heat.

Table 4. Heat regulation of greenbelt

Heat Regulation	Frequency	%
Yes	332	86.4
No	52	13.6
Total	384	100

As shown in Table 5, a substantial proportion of respondents, representing 98.2%, obtained food either directly or indirectly from the greenbelt. This indicates that the greenbelt serves an important food-support function for residents, particularly through the cultivation and availability of food and cash crops. Field observations further confirmed the presence of various agricultural produce within the study area, including cassava, vegetables, plantain, and banana. These findings suggest that the greenbelt contributes to local food availability and livelihood support, thereby strengthening the socio-economic dimension of urban resilience. Plate 1 illustrates one of the cash crops observed within the study area.

Table 5. Greenbelt as a source of food

Food	Frequency	%
Yes	377	98.2
No	7	1.8
Total	384	100

Plate 1. Cash crop (coconut fibre) within the study area

In addition to food-related benefits, Table 6 shows that 75% of the respondents obtained medicinal herbs from the greenbelt within their neighbourhood. This finding indicates that the greenbelt serves as an important source of ethnobotanical resources for local residents. The availability of diverse plant species in the area supports the use of medicinal plants for traditional health-related purposes. For example, velvet bean (*Mucuna pruriens*), locally known as Werepe or Yerepe in Yoruba, was observed in the study area, as shown in Plate 2. Other plant species identified include earleaf acacia (*Acacia auriculiformis*), pawpaw (*Carica papaya*), garlic (*Allium sativum*), and several coastal plant species, including water hyacinth, as shown in Plate 3. These findings suggest that the greenbelt contributes to community well-being by providing access to medicinal and other useful plant resources.

Table 6. Medicinal value of Greenbelt

Herbs	Frequency	Percentage
Yes	288	75
No	96	25
Total	384	100

Plate 2. Velvet bean (*Mucuna pruriens*) in the study area

Plate 3. Coastal flora (water hyacinth) within the study area

4.3. Relationship between city resilience and greenbelt benefits.

This section examines the relationship between greenbelt benefits and urban resilience in the study area. To determine the extent to which greenbelt benefits influence city resilience, multiple regression analysis was conducted. City resilience was treated as the dependent variable, while six greenbelt-related benefits were used as independent variables: job opportunities, biodiversity preservation, food provision, medicinal resources, cultural value and aesthetics, and recreational and educational benefits. The results of the multiple regression analysis are presented in Tables 7, 8 and 9.

Table 7. Regression model summary

Model	R	R Square	Adjusted R square	Std. Error of the Estimate
1	.482[a]	.240	.117	.11111

a. Predictors. (Constant), job opportunities, diversity preservation, food, medicine, cultural value and aesthetics, recreation and educational purpose

Table 8. Test of statistical significance

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	.111	.6	.024	2.759	.013[a]
residual	.284	22	.013		
Total	.507	37			

a. Predictors. (Constant), job opportunities, diversity preservation, food, medicine, cultural value and aesthetics, recreation and educational purpose
b. Dependent variable: City Resilience

Table 9. Regression coefficients

Model	Unstandardized Coefficients		Standardzed coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	.711	.465		1.210	.199
Job opportunities	-.012	.069	-.023	-.147	.055
Diversity preservation,	.321	.158	.209	1.788	.024
Food	.087	.071	.202	1.187	.043
Medicine	.118	.071	.218	1.334	.012
Cultural value and aesthetics	.106	.110	.119	.765	.046
Recreation and educational purpose	-.073	.130	-.081	-.442	.038

a. Dependent variable: City Resilience

As shown in Table 7, the multiple regression results indicate a statistically significant relationship between greenbelt benefits and urban resilience, with an F-value of 2.759 and a p-value of 0.013. This suggests that the greenbelt benefits examined in the model collectively contribute significantly to explaining urban resilience in the study area. The correlation coefficient, R = 0.482, indicates a moderate positive relationship between greenbelt benefits and urban resilience. Meanwhile, the coefficient of determination, R^2 = 0.240, shows that 24% of the variation in urban resilience is explained by the identified greenbelt benefits. The remaining 76% may be attributed to other factors not included in the model, such as infrastructure provision, governance, socio-economic conditions, disaster preparedness, and other environmental variables. These findings suggest that although greenbelt benefits are important contributors to urban resilience in Epe, they represent only one component of a broader resilience framework.

Determining the portion of each of the benefits, their regression coefficients as shown in Table 9 is used. Using the standardized beta coefficients, the constant "a" would disappear and the regression equation is of the form:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6$$

Based on the standardized beta coefficients presented in Table 9, the regression equation can be expressed as follows:

$$Y = -0.023x_1 + 0.209x_2 + 0.202x_3 + 0.218x_4 + 0.119x_5 - 0.081x_6$$

where Y represents urban resilience, x_1 represents job opportunities, x_2 represents biodiversity preservation, x_3

represents food provision, x_4 represents medicinal resources, x_5 represents cultural value and aesthetics, and x_6 represents recreational and educational benefits. The standardized coefficients indicate the relative contribution of each greenbelt benefit to urban resilience. Among the predictors, medicinal resources recorded the highest positive beta coefficient, $\beta = 0.218$, followed by biodiversity preservation, $\beta = 0.209$, food provision, $\beta = 0.202$, and cultural value and aesthetics, $\beta = 0.119$. This suggests that these benefits positively contribute to urban resilience in the study area. In contrast, job opportunities, $\beta = -0.023$, and recreational and educational benefits, $\beta = -0.081$, showed negative coefficients, indicating a weaker or inverse relationship with urban resilience within the model.

The p-values for the six predictors were 0.055, 0.024, 0.043, 0.012, 0.046, and 0.038, respectively. At the 5% significance level, biodiversity preservation, food provision, medicinal resources, cultural value and aesthetics, and recreational and educational benefits were statistically significant predictors of urban resilience. However, job opportunities were not statistically significant, as the p-value of 0.055 was slightly above 0.05. Overall, the findings suggest that most greenbelt benefits examined in the model significantly contribute to urban resilience in Epe, although their level and direction of contribution vary.

CONCLUSIONS

This study examined the contribution of greenbelt development to urban resilience in Epe, Lagos State, Nigeria. The findings show that the greenbelt provides several ecological, social, and economic benefits to residents and the surrounding environment. These benefits include livelihood opportunities, heat regulation, air purification, food provision, medicinal resources, biodiversity preservation, and recreational and cultural values. The regression results further indicate that greenbelt benefits contribute significantly to urban resilience in the study area, although other factors beyond the scope of this study may also influence the overall resilience of Epe. Based on these findings, the study concludes that the greenbelt in Epe is an important urban resilience asset that should be protected, sustainably managed, and integrated into local development planning. Since increasing dependence on greenbelt resources may lead to overexploitation, appropriate conservation and management strategies are necessary to ensure that the benefits are sustained for present and future generations. The study therefore recommends the following:

i. The Lagos State Government, in collaboration with the Epe Local Government Council, should enact and enforce appropriate legislation to protect the greenbelt from unsustainable exploitation, encroachment, and uncontrolled land-use conversion.

ii. Given the dependence of many residents on the greenbelt for livelihood support, the local community and Epe Local Government Council should adopt a community-based conservation approach. This would promote sustainable resource use while ensuring that residents continue to benefit from the greenbelt without degrading its ecological functions.

iii. Due to its biodiversity value, the Epe greenbelt should be further developed as a biodiversity conservation area or biodiversity bank. This could support environmental education, cultural activities, eco-recreation, and community-based revenue generation for both the government and host communities.

iv. To strengthen food security, the government should develop an empowerment programme in partnership with local residents to support sustainable cultivation within suitable arable portions of the greenbelt. This may include the provision of start-up capital, farm inputs, technical support, and other assistance for year-round farming. Such an initiative could improve local food availability, enhance livelihoods, and contribute to the broader socio-economic resilience of Epe and Lagos State.

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AUTHOR CONTRIBUTIONS

Both authors contributed to the study's conception and design. Rasheed Oreoluwa Dorcas handled data collection, preparation and analysis. Raheem Wasiu Mayowa wrote the first draft of the manuscript, and both authors worked out the previous versions.

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DECLARATION OF GENERATIVE AI IN THE WRITING PROCESS

During the preparation of this manuscript, the author(s) used ChatGPT (OpenAI) to assist with language editing, including grammar and clarity improvement. The author(s) carefully reviewed and revised the content as necessary and take full responsibility for the final version of the publication.

DATA AVAILABILITY

The authors declare that all data and materials, as well as the software application, support their published claims and comply with field standards. The data used was obtained directly from the field.

COMPETING INTEREST

The authors declare that there are no competing interests.

COMPLIANCE WITH ETHICAL STANDARDS

Ethical issues were given due consideration, regarding the purpose of the study, the contents of the research instrument, the acceptance of respondents' right to privacy, and the confidentiality of the data. The informed consent and willingness of the respondents to answer questions were also obtained.

SUPPLEMENTARY MATERIAL

No supplementary material is associated with this article.

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