



INTERNATIONAL JOURNAL OF RESEARCH SCIENCE & MANAGEMENT PROMOTING RELAXATION, EXERCISE AND BIODIVERSITY THROUGH THE URBAN STREAM CORRIDORS

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Abstract

Stream corridors are an important urban landscape unit that should be developed for recreation, exercise and biodiversity. However, Akure stream corridors are hardly used for these purposes. The absence of local riparian buffer ordinances further complicates the problem. This makes the benefits of urban stream corridors to be little appreciated in the city. This paper examines the pattern of usage of Akure urban stream corridors, and the constraints to their development for relaxation, exercise and biodiversity. Until now, research attention into Akure stream corridor benefits is lacking. A total of 317 structured questionnaires were administered across the city's built-up area. This was complemented with interviews and observations. Analysis of the data was executed in SPSS Version 22.0. The Bartlett's test indicated that the samples were adequate. The minimum Cronbach's alpha was 0.744. This met the criteria for validity and reliability. Rather than develop Akure stream corridors for relaxation, exercise and biodiversity, they are gradually depleted for residential and commercial uses. Combining the local riparian buffer ordinances with mass education, may instigate a commitment of the urban stream corridors towards relaxation, exercise and biodiversity by the planners, policy makers, and the residents.

Introduction

An urban stream corridor could be defined as the cross and longitudinal profiles or extent over which a river flows in its basin and its immediate surrounding area. This usually starts from the source of a river or stream, to the point where the river joins or discharges into a bigger one. Depending on their length, width, depth, and relative stability from anthropogenic interruptions, urban stream corridors facilitate biodiversity through the opportunity they afford for migration and dispersal of plant and animal species, and ensure the flow and transmission of gene-pools across landscapes[1, 2]. As a component of green infrastructure network, urban stream corridors are expected to enhance a city's natural support system, through the promotion of ecological functions that are vital to the sustenance of biodiversity[3]. Other advantages of the urban stream corridors include serving as a buffer and a shield against several incongruous city forms, as well as a transportation route for the movement of energy and matter across trophic levels. Therefore, rivers, streams, and their associated riparian areas are a vital part of our natural resources. Without clean water and healthy stream corridors, man and livestock cannot survive, as streams and riparian areas provide drinking water for humans and livestock, water for irrigation and industry, aquatic and terrestrial habitats, aesthetic values, and recreational areas[4]. The usage of urban streams and their corridors affects all citizens, hence the necessity for rivers and stream corridors to be effectively managed. The improper usage of most urban stream corridors in Nigeria has constituted a limitation to the availability and adequacy of recreational facilities and biodiversity. In Kansas, United States, projects associated with streams must be vetted and approved by either the Kansas Department of Wildlife and Parks (KDWP), or the Kansas Department of Health and Environment (KDHE), depending on the total hectares of land to be affected by such activities, before they are commenced [4]. As valuable as the urban stream corridors are, however, systematic evaluation of their potential for relaxation, exercise and promotion of biodiversity has not been adequately explored in Nigeria, and Akure, Ondo State in particular. Most urban stream corridors in Nigeria are either used for agricultural production, such as, urban gardening or dry farming, the raising of flowers or botanical gardens, or for car-wash businesses. Very little, if any, of the potential of the urban stream corridors, is utilised as an alternative transit corridor to relieve urban traffic congestion in the inner parts of big cities, or for recreation and exercise in them. The absence of local riparian buffer ordinances, which define the ownership status, management and usage pattern of urban stream corridors in Nigeria, constitute the greatest limitation. Added to this, is the limited conduct of academic research to adequately inform and guide



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policy makers towards alternative, sustainable use and management of the urban stream corridors beyond food production. However, the only Ondo State government's visible involvement in Akure urban stream corridors is centred on flood minimization and control, mostly along the Ala and Elegbin River corridors. On the other hands, urban stream corridors in the advanced economies of Europe, Canada, United States and Germany, provide complementary services such as journeys-to-work, walking for leisure or exercise, dog walking, and the promotion of biodiversity. On the contrary, urban stream corridors in most cities of Nigeria are viewed as, using[5] terminology, a no-man's land. This perception is responsible for the illegal conversion and occupation of most urban stream corridors across Nigerian cities. In Akure, Ondo State, the urge for economic survival by many unemployed residents, often results in series of undesirable, negative socio-economic and environmental adjustments that deplete the quantity of green spaces in the city[6]. The attitudinal factors mentioned here consist of those negative actions that urban residents put up in the city on daily basis that reduce the green spaces. These include the development of residential buildings on road, river and powerline setbacks, conversion of road, river and powerline setbacks to commercial activities, conversion of urban gardens to residential or commercial uses, lack of proper maintenance, and illegal felling of urban trees without replacement. The aim of the study is to promote relaxation, exercise and biodiversity in Akure through effective utilisation of the urban stream corridors. Consequently, the paper answers five research questions, which include: 1) where are Akure public open spaces located? 2) why would Akure urban stream corridors be ideal for the promotion of relaxation, exercise, and biodiversity? 3). How are Akure urban stream corridors currently used? 4) do the uses promote relaxation, exercise, and biodiversity? and 5). What measures should be taken to ensure that Akure urban stream corridors promote relaxation, exercise and biodiversity?

Theoretical Underpinnings

Two issues are addressed under this sub-heading. These are literature review and conceptual framework.

2.1 Literature Review

Extant literature abounds on the benefits of parks and open as destinations for recreation and exercise, which have been associated with human habitation for a very long time. From the Victorian to the present time, parks and open spaces have served as community gathering places and locales for human activity, designed to enhance relaxation, health and wellbeing[7]. Play grounds, athletic fields, swimming pools and gardens, are parks that provide tangible benefits to humans[8]. A park is a dedicated open area provided for recreational uses, usually owned and managed by local governments or municipalities. Parks and open spaces can be used for active and passive recreation. Nevertheless, both activities are geared towards the same goal. Parks and open spaces in urban areas provide strategic services in view of the vital contribution they make to improvements in the quality of life of residents in urbanised societies[9, 10, 11]. In addition, park and open spaces also constitute natural assets, which contribute to the quality of life, and urban health and wellbeing, and biodiversity, since they comprise of vegetation such as forests, wilderness, marshlands, greenbelts, mountains, or water bodies, within the urban milieu[12]. As natural elements, they serve as "natural tranquillizers" that sedate and reduce urban stresses, which have become a characteristic of today's urbanized living[13]. Parks also provide environmental and ecological services, such as air and filtration, water purification, noise sheltering, microclimate moderation, and the production of ecosystem services. Parks and open spaces also offer psychological restoration and emotional stability[14, 15], as well as foster social cohesion and community bonding [16, 17]. As important as parks and open spaces are, however, their planning and design has neither deeply incorporated the urban stream corridors as co-contributors to the city's recreational resources, nor identified as a key factor in the production and delivery of environmental and ecological services in most developing countries. In Nigeria, and Akure, Ondo State, the urban stream corridors have remained almost completely estranged from mainstream town planning practice, except only passing reference to their required setbacks in the course of physical development. One important fallout of such a neglect, is the absence of town planning provisions for urban riparian buffer ordinances, which ought to outline the ownership, administrative structure, and other general use-criteria, for all urban stream corridors in the country. Yet, urban stream corridors harbour substantial urban forest vegetation, and other biotic and abiotic elements, whose activities contribute to a city's health and wellbeing, and biodiversity. The contribution of urban stream corridors in the provision of conducive habitats for urban vegetation cannot, be over-emphasized. Corridors connect landscapes and thereby facilitate natural ecological functioning, which in turn increases niche diversity[18]. The urban green vegetation serves as



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habitats for different animal species, as well as a store for genetic diversity.[19],asserted that urban vegetation contributes to human wellbeing through the promotion of biodiversity. It is suggested that cities with large and mature vegetal ecosystems attract many birds, pollinating insects, and other animals [20]. The presence of a large number of pollinators in a city is a good indicator of the city's strong and sound biotic health. Urban parks in particular, have been noted to also provide safe havens for migratory birds[19]. The diversity of plants and animals in a city provides great opportunity for urban residents to encounter nature on daily basis [21]. A large bird population and diversity in an urban environment is a good index of how peaceful, green, and sustainable the city is[22]. In some western European countries, bird watching has developed from a passive recreation into a lucrative tourism industry[23]. However, these benefits represent part of the normative roles that urban vegetation plays in an ideal environment where vegetation is abundant and less disturbed. The structure and composition of urban vegetation in most developing countries, Nigeria inclusive, have been adversely affected by urbanization and human growths in them[24]. The impact of urbanization in cities has led to series of fragmented urban forest landscapes[24].This occurs mainly along urban stream corridors, streets, roads, powerline setbacks, cemeteries, derelict lands, wetlands and incidental open spaces, and in the hilly areas of cities. The increasing realization of the benefits of Akure urban corridors, calls for a closer study of their contribution to recreation, exercise and biodiversity. This provides a complimentary approach to sustainable recreational planning and living in the medium city. Section 2.2 discusses the conceptual framework of the research.

2.2 Conceptual Framework

The study adopts a morphological spatial systems planning (MSPA) and the Green Infrastructure (GI) approach to highlight the potentials of the urban stream corridor of Akure as an ecological planning unit as shown in Figure 1. The MSPA and the GI approach was adopted by [25], for the planning of the Loggang District of China. It could be deduced from his framework that, it is not only the connectivity and connectedness of the three basic landscape units - the patch, the corridor, and matrix [1] that are important, but also other elements attached to, and influence, the performance or productivity of the three landscape units, which function as a system to enhance the sustainability of all biotic and abiotic elements within the system's catchment area. The MSPA and GI approach emphasizes the interconnectivity of the urban stream corridors with other urban green space elements in the city, such as the recreational open spaces, the forests and wilderness, and the people that use them. The MSPA believes that urban green spaces could constitute the life-support system of a city, if systematically planned, developed, and maintained, and that green spaces could provide various ecosystem services in a sustainable way[25]. By integrating the morphological spatial pattern analysis (MSPA) and the green infrastructure (GI) network in a GIS-based environment, the study provided an urban green space planning method, which guided the sustainable land use planning and urban development decisions for the Longgang District, Shenzhen, China. In this study, connectivity is used to refer to the invisible environmental interactions that take place among the patch, the corridor, and the matrix landscapes, while connectedness refers to their closeness or contiguity, and the extent of perforations. Connectivity is a vital element in landscape structure, because of its importance in species-landscape interactions[26].Performance or productivity, as used here, refers to the quantity or amount of ecosystem services that are generated and released by the three landscape units acting in unison. Adopting this approach provides the avenue for seeing the functional interconnectivity of the urban stream corridors with other urban green space elements in the city, particularly with other recreational resources such as the urban forests, the wilderness, marshlands, as well the buildings, and the people who inhabit them. This stresses the necessity for understanding these inter-relationships, and helps to further strengthen them towards the development of the key ecological zones of the city that contribute to its sustainability. The urban stream corridors represent one of these zones. Figure 1 clearly describes the interconnectivity of the MSPA and the GI approach.

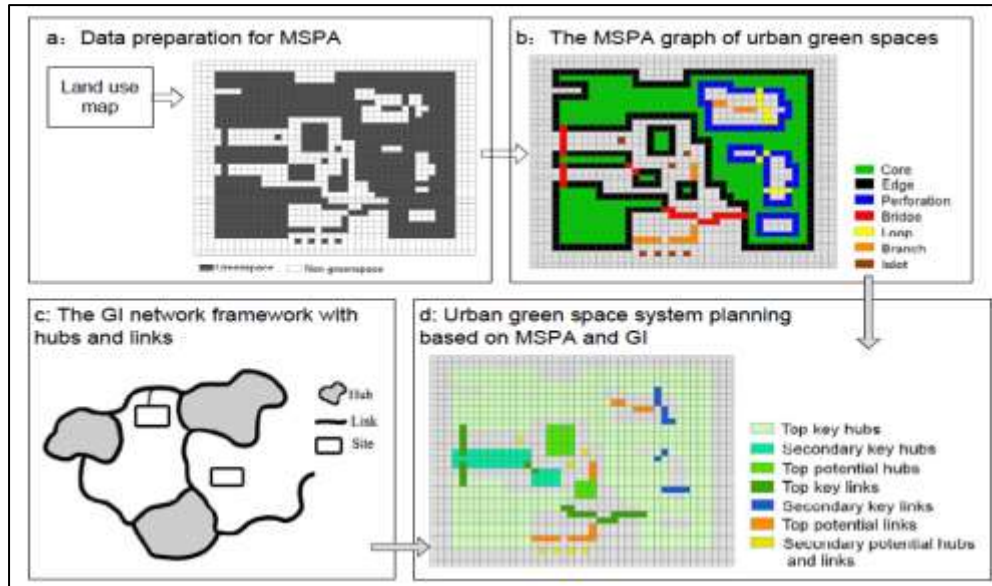


Figure 1: Morphological spatial pattern analysis (MSPA) and the green infrastructure (GI)

The Study Area

The study area is Akure, Ondo-State. Akure is a medium-sized settlement, with a population of 353,211 [27]. It was formerly a provincial headquarter until the state-creation exercise of 3rd February 1976 further gave it an additional status as the new Ondo State capital.



Fig 2:Map of Akure and its geographical context

This resulted in massive expansion of the city size, arising from its socioeconomic development of the city in such areas as road construction, construction of office complexes and residential areas, and the establishment of schools and recreational centres. The city is located within Ondo State in the South Western part of Nigeria. Figure 2 is the geographical and contextual location of the city of Akure Ondo State, Nigeria. Ondo state is one



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of the 36 states that make up Nigeria. It lies approximately on latitude 7° 15' North of the Equator and longitude 5° 15' East of the Greenwich Meridian.

Data Design and Methods

A total of 317 structured questionnaires were administered on nine major housing areas of the city. The housing areas include Gaga (40), New Town (55), NEPA (31), Ijapo Estate (32), FUTA (30), Ondo Road (48), Akure Central Area (40), Shagari Village (42), and Oshinle (32). The questionnaires were administered across the nine popular residential housing areas of the study area on systematic basis. Every fifteenth building after the first one, was sampled along each street. After the first street, sampling was conducted on the fifth street across the housing area. The systematic sampling method was adopted because it aligned with the linear arrangement of streets and buildings in the study area. Information on the socio-economic status of respondents such as age, income, education, and gender were obtained through the survey. Respondents were requested to assess the adequacy of urban vegetation and recreational facilities around their homes. They were asked to indicate the factors responsible for the falling urban vegetation and open spaces in the city. In addition, respondents also disclosed the effect of reduction in urban vegetation and open spaces on them. The assessment also covered the urban stream corridors. The SPSS Version 22.0 was used for data analysis. The data were screened for outliers, while the KMO/Bartlett's test for sample adequacy showed that the data were adequate. The high Cronbach's Alpha of the seven constructs, with none less than 0.744, showed that the results of the study are reliable and valid. Structural Equation Modelling (SEM/AMOS) was used to isolate the dominant from the weak factors depleting urban green spaces in the city. The Relative Importance Index (RII) was employed to rank the factors. Remote sensing analysis was combined with the GIS imagery to depict the decennial changes in urban green spaces, including the urban stream corridors in the city. The normalised difference vegetation index (NDVI) was also used to assess the city's vegetation health. Interview and observation also provided additional data for the analysis. The use of multi-method approaches helped to reveal not only the status of urban green spaces in the city, but its liveability as well. In view of the limited scope of the paper, only a few results relevant to this work are presented and discussed here.

Results and Discussion

The results of the analysis are presented and discussed sequentially as shown in Section 5.0 (i-v).

i) Location of Akure Public Recreational Open Spaces: The researchers identified and mapped the location of twenty recreational open spaces in the city, out of which three are private, while seventeen are publicly-owned. Some of the publicly-owned include Alagbaka Botanical Garden, Ilula Caring Heart Neighbourhood Recreation Centre, and the Ondo State Woodlot. The privately-owned recreational centre includes the De Rock Amusement Park and Recreation Centre, and the Professor Afolayan Wildlife Park. In spite of the higher proportion of public parks and open spaces over the private, some have been converted to other uses, such as the former Ministry of Works open space now converted to the Ministry's Engineering complex, and the Akure Recreation Centre, revealed to have been sold to a commercial bank. Consequently, Figure 3 displays the location of the parks and open spaces, whether or not some have been converted or sold. The justification is to be able to come up with a descriptive pattern of the location of open spaces in the city that will guide planners towards further locational decisions in the city

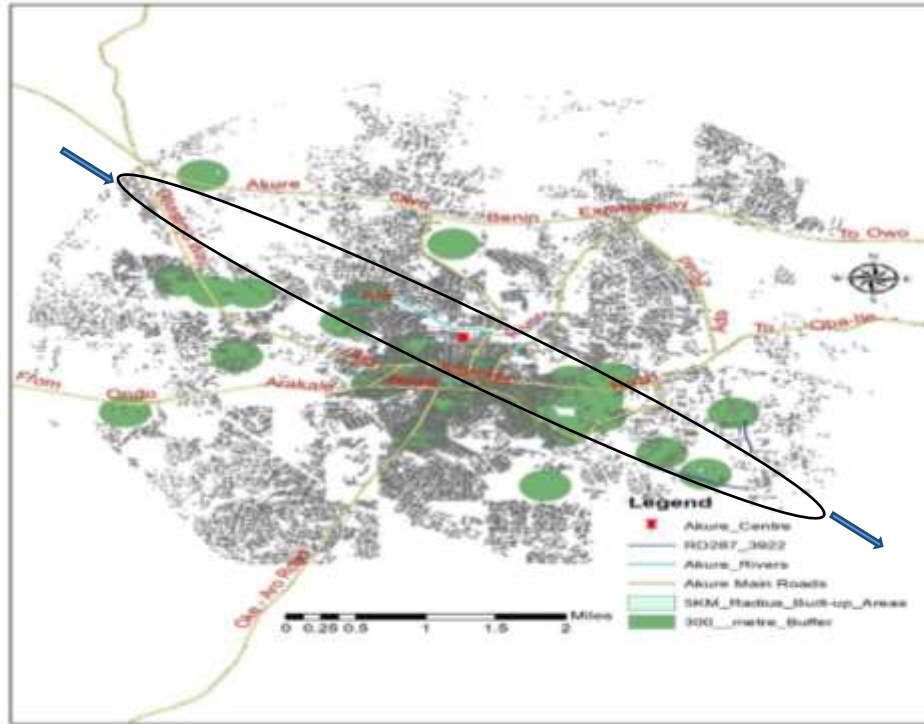


Figure 3. Location of Akure Public Recreational Open Spaces

Besides, another problem that threatens the availability of open spaces in the city is the differences in the level of accessibility of residents to them.

Table 1. Urban vegetation in Akure

S/N	Availability of Urban Vegetation	Frequency	Percent
1	Park	21	6.6
2	Agricultural Garden	57	17.98
3	Urban Forest	25	7.89
4	Vegetation along River Corridor	102	32.18
5	Vegetation along High-Tension Power Line	17	5.34
6	Street Trees along Road setback	56	17.67
7	Vegetation on incidental opens paces	29	9.19
8	Others	10	3.15
	Total	317	100.0



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Although some of the public open spaces were meant to be publicly-accessible, the limitation of access to them, such as having definite opening and closing hours and payment of user charges, makes the development of the urban stream corridors an attractive alternative. The residents' perception of the city's poor urban green space availability is as shown in Table 1.

The implication of the dominance is that government had, for far too long, abdicated its statutory responsibility for conscious urban greenery in the city. This has made the urban stream corridor vegetation to overshadow government's urban greening initiatives.

ii. Why would Akure urban stream corridors be ideal places for the promotion of relaxation, exercise, and biodiversity?

The spatial continuity of most urban stream channels provides accessible corridors for relaxation and exercise, especially where these are well-designed and landscaped to provide free and unimpeded routes for walking for exercise, journey-to-work, cycling, sitting, and reflection. Equally, well-planned and landscaped urban stream corridors, with mature trees, provide safe havens for the presence of pollinating insects, squirrels and birds. Studies reported by [23] CBI Product Factsheet (2015), revealed that bird and squirrel watching, and a closeness to nature, have contributed to the growth of a viable tourism industry in many European cities. On the other hand, free, unpolluted and unimpeded flow of urban streams in their channels, enhance the transport of materials and energy required as inputs for the growth and development of biotic lives at the lower courses. Such places add to the beauty of the cities where they are located, and provide opportunities for picnics and holidays. Figure 4 depicts a spatially-extensive view of a location along the Ala River corridor, on the left hand side of the Olusegun Obasanjo Way, Akure, which constitutes a potential for picnics, but is now used by itinerant cattle rearers. On the other hand, Figure 4 shows pristine, dense vegetation along the Ala urban stream corridor, which could preserve the city's biodiversity. One conclusion from this observation is that, biodiversity and specie richness are greatly enhanced where anthropogenic disturbances are severely limited. The flooded, cloggy, and relatively impenetrable nature of the urban stream corridors, present such opportunities. The implication of the above finding is that, the urban stream corridors could be used for relaxation and exercise, where conditions allow, or where other areas could be preserved in their natural forms for the enhancement of biodiversity.

iii How are Akure urban stream corridors currently used?

The study revealed the spate of illegal occupation and development along major urban stream corridors in



Figure 4: Spatially-extensive views along the Ala River corridor and groove along the Ala urban stream corridor



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Akure. This constitutes an impediment to the biodiversity and livability of the city. Physical enumeration of the intensity of illegal developments along three major flood-prone areas of Iloro-Idanre Road axis, Wema Bank-Toyin Bookshop axis, and the Odi-Olowo axis, revealed the structure of land uses depicted in Table 2. These areas represent the major receptacles for flash floods in the city, in view of their lower terrain and the blockage of their channels with garbage and different land uses. According to a former state director of physical planning, the river corridors ought to have been well managed and planned to serve as transit corridors to relieve traffic congestion during peak hours in Akure. He further remarked that the corridors also, ought to serve to encourage cycling and walking to and from work, if well planned.

Table 2: Illegal land uses along some selected stream corridors in Akure

S/N	Land uses	OdiOlowo	Iloro Area	Wema Bank	Total	Percentage
1	Residential buildings	48	153	108	309	70.39
2	Temporary workshop	4	7	4	15	3.42
3	Shops	19	13	10	42	9.57
4	Churches	9	13	11	33	7.52
5	Mosques	-	1	-	1	0.23
6	Schools	2	6	1	9	2.05
7	Sawmills	2	6	-	8	1.82
8	Factories	1	1	1	3	0.68
9	Petrol Station	2	2	1	5	1.39
10	Banks	-	1	1	2	0.46
11	Markets	-	1	1	2	0.46
12	Communication company	-	1	1	6	1.37
13	Beer Relaxation point	4	4	-	4	0.83
14	Shopping Complex	1	-	-	-	-
Total		91	209	139	439	100.0

As revealed in Table 2, residential land use forms the major perpetrator in terms of encroachments on the urban stream corridors. This is followed by shops and churches in that order. Findings revealed that the greater proportion of contraventions recorded for residential land use was due to the shortage of land, and the low financial capacity of many home owners in the area to acquire land at other locations. As observed from the distribution of land uses in the table, it could be inferred that almost all land use types were involved in the violation of the basic town planning setback standard. This raises a fundamental question on the efficiency of the town planning office on stoppage of illegal conversion of the green corridors for developmental purposes.



Figure 5: *Illegal residential developments along the Elegbin urban stream corridor*

In addition, physical obsolescence and uninhabitable conditions of residential buildings erected directly on the Elegbin River corridor, constitute another nuisance to the integrity of the corridors. The presence of these buildings constitutes a danger to law-abiding citizens from the activities of hoodlums. It also breaks the continuity and biodiversity of the river corridor. Residents' assessment of the usage of the corridors revealed that the usage was poor (with 86%), while only 14% believed that the usage was good. Studies conducted on Akure urban flooding and other environmental hazards by [28], and [29], resonate with this finding.

iv. Does the current usage pattern promote relaxation, exercise, and biodiversity?

It was revealed that the current usage of the urban stream corridors did not in any part of the city enhance recreation, exercise, and biodiversity. The analysis of forty years remote sensing imageries for the city between 1987 and 2016, Figure 6, revealed that the quantity of urban vegetation fell at about twice the proportion of urban development within these periods.

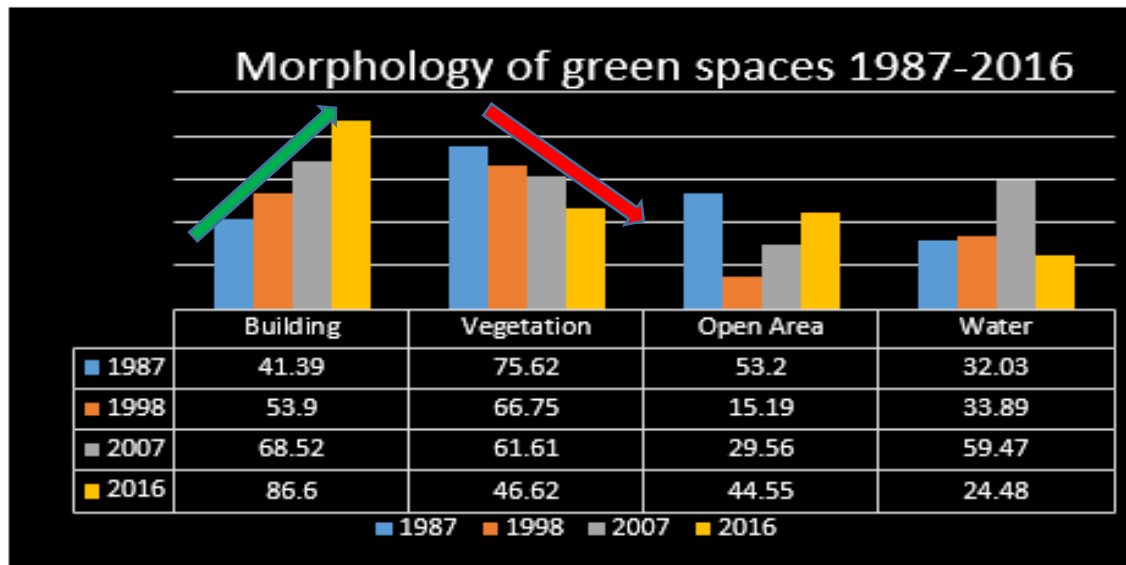


Figure 6: Decrease in Vegetation as urban development increases

The increasing trend of urban development is indicated by the green arrow, while the red indicates a continuous decline in urban vegetation, the urban river corridors inclusive. This implies a limited availability of urban vegetation for open air relaxation, social contacts, and community bonding [16, 17]. The continuous private acquisition and occupation of the corridors implies a permanent loss of a vital public good to the private domain. The fluctuating fortunes of open spaces between 1987 and 2016, as reflected in Figure 6, implies that open space availability and usage will continue to be dependent on government’s political will. The percentage of open space fell from 53.20 per cent in 1987, to 15.19 per cent in 1998. Between 1998 and 2016, open spaces rise steadily from 15.19 per cent in 1998, to 29.56 per cent in 2007 and, finally, 44.55 per cent in 2016, all due to increased government commitment to provide more open spaces by creating many open parks and markets in the city. This could further increase as government continues to show more commitment to open space development in the city. However, the quantity of water continues to decrease as seen in the figure. Water increased steadily from 32.03 per cent in 1987, to 33.89 per cent in 1998 and then, again, increased to 59.47 per cent in 2007. Nevertheless, water decreased from 59.47 per cent in 2007 to 24.48 per cent. A sustained reduction in the quantity of water in subsequent years implies a future threat to the propagation and availability of urban vegetation, as well as a threat to the sustainability of man and livestock.

v. What measures should be taken to ensure Akure urban stream corridors ultimately promote relaxation, exercise and biodiversity?

A lot of policies measures need to be taken to ensure Akure urban stream corridors promote relaxation, exercise, and biodiversity. The Akure municipal council should urgently enact and enforce the urban stream corridor riparian ordinance. The ordinance will not only define the ownership of river corridors and other riparian areas of the city, but will also propose specific use or development criteria that will guide human interaction within the corridors. Effective monitoring and enforcement of the open space masterplan, and the riparian corridors ordinance, will ensure that illegal developments on the open spaces and the urban stream corridors are drastically reduced. Government should enlighten and sensitize the citizens and residents on the importance of urban stream corridors. This should educate them on their commitments towards the maintenance of the urban stream corridors. When and where discovered, violators of the urban riparian ordinance must be sanctioned in order to prevent the committal of environmental abuses against the corridors.



Conclusion

Urban stream corridors provide substantial benefits for recreation, exercise, and biodiversity. However, urban stream corridors in Nigeria and Akure, Ondo State, are poorly utilised. This arises from lack of integration of the urban stream corridors into conventional recreational planning in the country. Besides, the failure of the government to enact any riparian ordinance to guide the ownership, planning and management of riparian areas, has contributed to the misuse of the urban stream corridors in the country. Consequently, government should urgently enact the riparian corridor ordinance, and educate and sensitise the citizens towards sustainable use of all riparian areas in the medium and big cities of Nigeria. It is also of necessity for the government to consider the acquisition and development of all river corridors in the city for proper planning towards the promotion of urban aesthetics, recreation, exercise, and for walking for leisure and journeys-to-work.

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