EFFECTS OF POLITICAL DISPENSATIONS ON THE PATTERN OF URBAN EXPANSION IN THE OSOGBO METROPOLIS, OSUN STATE, NIGERIA

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ABSTRACT

Most studies on urban growth have focused on measuring the extent and rate of urban growth, while some focused on the understanding of factors that initiate and sustain city growth at local and global scales. Only anecdotal studies exist on the effects of different political regimes on urban growth. Both military and democratic governments enacted and implemented various urban and related policies that might have impacted the urban expansion. This is because a regime's ideology (be it civilian or military) could be a crucial growth-determining factor. This study compares urban growth in Osogbo, Nigeria, during military and civilian regimes, using eight landscape metrics. Landsat images of the Osogbo metropolis for the years 1986, 1991, 1996, 1999, 2003, 2010 and 2014 were selected, based on the progression of political regimes in Nigeria. Where necessary, the images were gap-filed and co-registered to a common datum. Supervised classification was used in identifying built-up areas over-time, while change vector analysis was used in exploring growth pattern between the civilian and the military regimes. Landscape metrics were used to assess the process and impacts of urban expansion, while analysis of variance was used to assess variations in growth between the two dispensations. There has been considerable growth in Osogbo metropolis since its creation in 1991, and significant differences exist in urban growth rates between military and civilian regimes ($F=7.920$, $P \leq 0.05$). However, the effect of urban growth on distance to central business district, available open space, urban sprawl, and shape of built-up areas, are not significantly different between the military and the civilian regimes. Urban expansion occurred primarily through expansion of existing urban areas rather than spontaneous and detached development. Therefore, one of the most difficult conclusions from this study is that urban benefits derived through city growth do not necessarily have anything to do with the type of city administrations in place.

INTRODUCTION

Globally, urban growth has been attributed to population growth owing to natural increase or migration. Migration into urban areas has often been influenced by pull factors, such as availability and accessibility to better infrastructure and social amenities including roads, schools, health care facilities, economic opportunities, energy, food security, social networking and higher life expectancy

(Thapa and Murayama, 2010; Zhang et al., 2013; Shu et al., 2014). As the urban population grows, needs for land and housing resources increase. This results in urban expansion and the associated conversion of farmland and natural vegetation into residential use. Rising from such growth is the encroachment into farmland and ecologically sensitive land adjoining the cities, and the emergence of urban slums and sprawls (Zhang et al., 2013; Shu et al., 2014).

Factors influencing urban growth vary in their importance at local and national scales (Shu et al., 2014). However, the political landscape is an important determinant of the pattern of urban growth. The various policies of different political dispensations shape the way cities grow, and patterns of land-use conversion. The policies that are enacted and implemented provide the framework for programmes that engender planned urban growth and development or create enabling environment for growth and consequent expansion or contraction.

Improved macro-economic indicators, such as gross domestic product (GDP), foreign direct investment (FDI), and transportation, have been identified as major drivers of urban growth in most developing countries, including Nigeria (Zhang et al., 2014). However, harnessing the dividends of the urban demographic structure, managing the fertility intentions and migration in relation to the availability of quality infrastructure and sustainable economic development, assuring a guided urban growth, including land conversion, depends largely on the prevailing political ideologies as well as commitment to informed policies and programmes of the government.

Despite the myriads of factors influencing urban growth, studies on the variations in urban expansion across different political regimes are limited. Specifically, comparative analyses of urban expansion during civilian and military regimes have not been addressed in the literature. Earlier research on the effects of governance on urban expansion have focused basically on housing construction and have emerged from the Western world, where governments exact considerable influence on land-use (Zhang and Tao, 2011; Sole-Olle et al., 2013). Limited literature exists on the role of political dispensations and administrative regimes on urban development in emerging cities, where land is predominantly in the hand of individuals and where democratic ethics are not fully entrenched. This study becomes important in view of the occasional military intervention in political processes, coupled with the non-participatory governance approach they adopt.

It is against this backdrop that this study examined the effects of military and democratic political dispensations on urban expansion in the Osogbo metropolis, Osun State, Nigeria. The study assessed the relationship between the urban expansion and selected spatial metrics, with a view to addressing the following: (a) the historical trend in urban growth in the metropolis; (b) identification of landscape metrics that best describe urban expansion; (c) identification of the predominant urban expansion processes; and (d) significant differences in urban expansion during the military and civilian regimes.

STUDY AREA

The study was conducted in Osogbo, the capital city of Osun State, with a reported population of 280,000 during the 2006 census (NPC, 2006). The metropolis is made up of two local government areas (LGA) namely Olorunda and Osogbo. The Osogbo metropolis is one of the ancient cities in the southwestern region of Nigeria and it is inhabited predominantly by Yoruba-speaking people. The city is located within latitude $7^0$57'30"N, longitude $4^0$32'30"E and $7^0$43’0”N and $4^0$37'30"E. Major economic activities in the city include handmade, traditionally woven cloth *"Aso Oke"* and batiks,

cloth dyeing, embroidery, pottery, and goldsmith work. Industrial corporations include Nigeria Machine Tools, the Osogbo Steel Rolling Company, and the Industrial Development Centre. Wire and nails industry, printing press, garment industry, and agro-allied producing companies are also located in the city. Several academic institutions include the state owned university and Ladoke Akintola Teaching Hospital.

Osun state has been governed under different political dispensations since its creation from the old Oyo State in 1991. Between 1991 and 1999, the state was governed by military administrators; since 1999 to date, it has been governed by democratically elected governments under different political parties/ideologies. Both the military and the democratic governments (the various political parties) enacted and implemented various urban and related policies. While access to the previous administrator's political agendas was impossible, it is pertinent to note that among the seven-point agenda unfolded at the inception of the current administration in 2010, is modern town planning and urban development (*Thisday*, 2010). Others include free and qualitative education, restoration of the basic health system, and war against poverty, hunger and unemployment. This agenda represents one of the conscious attempts at factoring urban development into the political campaign in Osun State.

METHODOLOGY

The analysis of the temporal pattern of urban expansion in Osogbo was conducted using Landsat retrievals. The image selection was based on the years that different political dispensation prevailed in the state. Cloud-free Landsat images of 1984, 1991, 2003, 2010, and 2014 were downloaded from the website of the National Agency for Space Administration (NASA). The boundaries of the two urban LGAs were used to delineate the study area. All satellite images were clipped to the boundary of the study area. Image bands 4, 3, and 2 were used to differentiate built-up areas from non-built-up areas, given that the urban areas appeared bluish-grey to steel-grey (Gupta and Prakash, 1998; Huang et al., 2007). Landsat ETM+ bands of 2003, 2010 and 2014 were corrected for the Scan Line Correction (SLC-off) error by using previous year's image to correct the selected year's image using the Landsat Gap Fill function in ENVI® (Ramachandra et al., 2012).

Unsupervised classification using maximum likelihood classification algorithm was used in characterising the retrievals into three distinct categories, based on a 95% likelihood for each land-use type. A majority filter analysis was used to dissolve spurious pixels within large classes. Image classification was accomplished using Environment for Visualisation software (ENVI® 5.2). Urban areas in this study refer to the built-up areas as indicated in the satellite images. Green areas and water were not classified as part of the built-up areas (Huang et al., 2007). The classified images were subsequently converted to their corresponding vector equivalent for further analysis. Built-up areas were separated from other land-use types, and areal extents were quantified with the help of ArcGIS software. Subsequently, the proportion of the delineated land area occupied by built-up land use was calculated and the trends analysed.

Eight landscape metrics describing the spatial and temporal patterns of urban expansion were computed with a view to identifying common patterns in the shape, size, and growth patterns across different political regimes (Huang et al., 2007). These metrics are series of quantitative indices representing urban shape, complexity, compactness, patchiness, linearity, squareness and size of urban area (Riiters et al., 1995). They provide a quantitative method of assessing and comparing

urban forms during the different political regimes. The metrics used include: (a) absolute and relative patch size, (b) edge density, (c) compactness, (d) complexity, (e) density, (f) porosity and (g) centrality (Huang et al., 2007). Absolute size was described by total urban area and number of urban patches, while relative size was described by the mean patch size. The mean patch size is a function of the number of patches and the size of each area. The number of patches is a measure of fragmentation extent. Decreasing values of mean patch size show that urban growth occurs more as a process of new and multiple urban nuclei formation than of envelopment or annexation (Seto et al., 2007). Edge density measures the total edge of urban areas relative to the total landscape and should increase with new urban nuclei, but may decline as urban areas fuse together and boundaries dissolve.

Complexity and Area Weighted Mean Patch Fractal Dimension (AWMPFD) was used to assess the irregularities in built-up area shape. The higher the value of AWMPFD, the more irregular the shapes are; its value approaches 1 for simple shapes, while it approaches 2 when built-up boundary shapes are more complex. AWMPFD is likely to increase during the early periods of urban land-use change when new urban nuclei and expansion of the existing urban space create irregularly shaped landscape patterns, but will likely decrease as urban form becomes more regular (Seto et al., 2007; Ramachandra et al., 2012). Centrality is the degree to which a built-up area is close to the central business district (CBD) and it measures the average distance of built-up patches to the largest built-up patch (Huang et al., 2007). The more elongated the city shape is, the bigger the centrality index. The Compactness Index (CI) describes the overall built-up landscape and the more regular the patch shape and number, the bigger the CI value (Li and Yeh, 2004; Huang et al., 2007). Porosity Index, measures the ratio of open space compared to the total built-up area. Areas occupied by vegetation and water bodies which appeared as blank polygon in the urban landscape amount to "holes" of open space within the urban area. Porosity, thus, refers to some other non-urban landscape enmeshed within the built-up land-use. It can be used to characterise urban sprawl (infilling) in cities.

RESULTS

Trend in Land-use Dynamics in the Osogbo Metropolis between 1984 and 2014

The analysis of the population size of the city showed increases from 245,836 in 1986 to 250,951 in 1991, and to 341,120 in 2002. Between 2003 and 2011, the population increased further from 350,774, to 438,516 in 2011 (NPC, 2006). Between 1991, when the state was created, and 2014, the areal extent of the city grew by 92% as the metropolis expanded from 54.8 to 105.4 km^2 at 2.20 km^2 average annual growth (Table 1). In the period 1984 to 1991, before the creation of Osun State, a period dominated by military rule, the size of the built-up area increased from 54.8 to 67.6 km^2. Following the creation of Osun State from the old Oyo State, governed by a democratically elected government (1991 to 2000), the built-up area increased by 21.5% (14.6 km^2) at an average annual growth rate of 1.62 km^2/a. The rate of growth slowed down considerably between 2000 and 2003, as the metropolis only expanded by 3.9% (3.2Km^2). The period between 2003 and 2009 was characterised by another civilian administration in the state. During this period, the areal extent of Osogbo metropolis grew by 13.1% (11.2 km^2 square kilometres) at an average annual growth rate of 1.6 km^2/a. Furthermore, between 2010 and 2014, the metropolis increased to 8.9 km^2, reflecting a 9.2% increase at an average annual growth rate of 2.2 km^2/a.

The area occupied by vegetation decreased from 93.2 to 39.5 km^2 at an average annual rate of 1.63 km2/a. The percentage reduction in vegetation was 57.7% within the period. The average area extent of water bodies was 3.4 km^2.

Table 1. Urban Growth in the Osogbo Metropolis between 1984 and 2014 (area in km^2)

Year	Built-up	Vegetation	Area of Water
1984	54.8	93.2	0.0
1991	67.6	76.7	3.7
2000	82.1	62.7	3.3
2003	85.3	59.4	3.3
2010	96.5	48.0	3.5
2014	105.4	39.5	3.2

Trends in Urban Growth Matrices in the Osogbo Metropolis between 1984 and 2014

The number of patches decreased from 1984 through 2000, increased between 2000 and 2003, and again declined steadily until 2014 (Table 2). The 56% increase in patches between 2000 and 2003 indicated rapid urban growth, characterised by new and multiple urban nuclei forming during this period. Thus, there was the enlargement of smaller urban-nuclei at the expense of the large built-up area. After 2003, the metropolis experienced a process of rapid envelopment or annexation, as the largest urban built-up fabric engulfed these smaller nuclei at an average rate of 6% per annum.

Table 2. Temporal trends in urban growth metrics

Years	NP	%CNP	MPS	ED	AWMPFD	%LPI	Centrality	Compactness	ROS
1984	102		53.7	73.0	1.47	86.3	1.99	0.004	5.57
1991	99	-2.9	68.2	76.6	1.40	89.1	1.52	0.004	16.84
2000	93	-6.1	88.3	66.1	1.43	78.3	1.80	0.005	10.69
2003	145	+55.9	45.0	78.1	1.4	82.4	1.79	0.002	14.28
2010	105	-27.6	91.9	48.9	1.4	91.5	1.85	0.005	10.58
2014	78	-25.7	135.1	30.9	1.3	94.5	1.91	0.01	11.29

Note NP = Number of patches in the built up area. %CNP = Percentage change in the number of patches. MPS = Mean Patch Size. ED= Edge Density. AWMPFD = Area Weighted Mean Patch Fractal Dimension. %LPI = Percentage of the Largest Patch Index. ROS = Ratio of Open Space.

The Mean Patch Size (MPS) increased from 1984 to 2000 and again between 2010 and 2014 but declined in the interval 2000 to 2003 when the number of new nuclei proliferated by 56%. The period between 1984 and 2000 witnessed the process of envelopment or annexation as the largest urban built-up fabric continued to annex the new and multiple urban nuclei to become comparatively larger. There was formation of new and multiple urban nuclei between 2000 and 2003 as indicated by the reduction in the MPS by about 49% (Li and Yeh, 2004; Huang et al., 2007). Thus, the rate of annexation of patches was greater in the new urban nuclei compared to that of the largest patch. The process of envelopment, however, continued at a greater momentum from 2003 to 2014.

Generally, the shape of the metropolis is complex although it is becoming gradually simpler as indicated by the *Area Weighted Mean Patch Fractal Dimension* (AWMPFD) in Table 2. The highest

AWMPFD figure was recorded in 1991; it declined to 1.3 by 2014. It should also be pointed out that, while the AWMPFD was almost constant between 2000 and 2003, the highest reduction in the AWMPFD was witnessed between 2010 and 2014 when it dropped by about 0.05 (3.68%). With the increasing development of the metropolis, the degree of urban shape irregularity is declining.

Generally, urban *Edge Density* (ED) displayed an oscillating trend as it increased between 1984 and 1991, declined in 2000 and began to increase in 2003 but again declined from 2010 to 2014 (Table 2). The highest ED was recorded in 2003, while the lowest occurred in 2014. New urban nuclei were added between 1984 and 1991 as indicated by an increase of 4.8% in edge density, while its reduction (13.6%) between 1991 and 2000 resulted from the annexation of smaller urban nuclei by the existing built-up fabric. Furthermore, new urban nuclei were again added between 2000 and 2003, as indicated by an increase (18.2%) in edge density, while the process of enveloping that started in 2003 continued till 2014, as indicated by the reduction in the urban edge density metrics.

The *Largest Patch Index* (LPI) decreased by about 12% between 1991 and 2000, and increased in the remaining years. This reduction may be associated with the various development activities. As of 2014, the largest patch accounts for as much as 94% of the total built-up area of the metropolis.

Generally, the built-up area is becoming increasingly compact, with less fragmentation noticed in the landscape (Li and Yeh, 2004). However, compactness index decreased in 2003, but increased from 2010 onward. The centrality index also increased from 1991 to 2014 although with a slight decrease in 2003. The results of the compact index and centrality index are similar. Thus, the average distance of the dispersed patches to the metropolis is also increasing because the city is becoming increasingly elongated (Li and Yeh, 2004; Huang et al., 2007).

Areas categorised as open space increased by 11.3% between 1984 and 1991 and declined by 6.2% between 1991 and 2000. The increase in open space is an indication of increasing sprawling, while its reduction indicates a move towards a more compact metropolis with reduction in urban sprawl. There has been a general decline in the area occupied by open space. In addition, the period of increased open space is typically followed by a period of reduced open space, perhaps owing to competition for land adjacent to built-up patches for residential and other purposes.

Relationship between Urban Growth and Selected Landscape Metrics

The analysis of the relationship between urban growth and spatial metrics provides an insight into critical metrics influenced by the growth. We observed a strong, positive and significant relationship between size of the built-up area and *Mean Patch Size* (MPS) (0.740, $P<0.05$). However, the association between built-up size and edge density (-0.793 $P<0.05$) and AWMPFD (-0.778, $P<0.05$) was strong and negatively significant. All other metrics did not show any relationship with the size of built-up area. In addition, the ROS exhibited a negative but significant relationship with the index of centrality, while compactness index showed a negatively significant relationship with the number of patches (-0.815, $P<0.05$), edge density (-0.888, $P<0.05$), and AWMPFD (-0.831, $P<0.05$), while it showed a significantly positive relationship with MPS (0.944, $P<0.05$). Thus, the more compact the metropolis becomes, the lower the number of fragmented patches, and the smoother the built-up edges. In addition, the higher the distance to the Central Business District (CBD) is, the lower the ratio of available open space in the metropolis is.

Comparative Analysis of Urban Growth between Military and Democratic Regimes

A comparative analysis of the various metrics between the periods of military and democratic regimes was conducted to identify whether there were significant differences in the metrics results between the two regimes. Generally, the military era tended to have relatively smaller values compared to the civilian regimes. However, the variations were not too obvious in some of the urban growth metrics adopted. Some of the calculated metrics were higher during the military regime, and others were higher during the civilian regime (Table 3). Built-up area, compactness index, largest patch index, mean patch size, number of patches and ratio of open space were much higher during the civilian regime than the military regimes. The AWMPFD showed that the shape of the metropolis was much more complex during military regimes compared to during the civilian regimes. Thus, irregular urban shape characterised the metropolis between 1984 and early 2000, while the shape is gradually becoming simpler, since 2000 to date. Thus, land appeared to have been developed in a more coordinated manner compared to what obtained during the military era.

The centrality index also showed that the metropolis was relatively circular under the military regime compared to what obtained under the civilian regime. Thus, the distance to the CBD was fairly longer during the civilian regime than during the military regime. Greater tendency toward a compact city was noticed during the civilian regimes than during the military regime. Higher edge density was an indicator of the existence of many new urban nuclei during the military regime. Under the civilian regime the metropolis witnessed rapid fusing together (annexation) of built-up areas resulting from the dissolution of individual isolated urban patched boundaries. The LPI further alluded to the increasing process of annexation during the civilian regime, unlike the military regime, as the LPI was higher during the civilian than during the civilian regime.

Table 3. Comparison of urban growth metrics between the military and civilian regimes

Metrics	**Military**	**Civilian**
Built-up Area (km^2)	68. 2	95.7
Area Weighted Mean Patched Fractal Density	1.4	1.4
Centrality	1.8	1.9
Compactness	0.004	0.006
Edge Density	71.9	52.6
Largest Patch Index	84.6	89.5
Mean Patch Size	70. 1	90.7
Number of Patches	98	109
Ratio of Open Space	11.0	12.1

The variance analysis showed that the observed variations in the metrics were not statistically significant. Nevertheless, there was a significant difference between the built-up area extent during the military and civilian regimes ($F= 7.920$, $P<0.05$). However, all other metrics were not significant.

DISCUSSION

Our study of Osogbo metropolis showed increased population size over time. The impact of natural increase on the population size is expected but notable is the increased migration, and economic opportunities as the metropolis became the seat of government in 1991. Also, the metropolis expanded between 1984 and 2014. The increase was significant ($F= 7.920$, $P<0.05$) during

the democratic government. State creation and decentralization of administrative units of governance is often accompanied by redeployment of civil servants from the parent state, establishment of the presence of federal ministries, allocation of funds from the federal to the new state, and construction of office complexes and infrastructure. These constitute a pull factor and foster the growth of supporting services, such as education, health care and waste management as well as of the informal sector. The growth of economic activities increases the socioeconomic status of the residents, liveability of the metropolis and expansion.

A process of annexation and enveloping characterised urban growth in the Osogbo metropolis. The process involved the enveloping of smaller urban nuclei by the larger patches. Two waves of annexation and enveloping in the metropolitan expansion were identified. The first wave commenced in 1984 or even prior, and continued until 2000. The year 1984 was the beginning of military intervention after the Second Republic, while the year 1999 marked the end. The second wave of annexation and enveloping commenced in 2000 and continued until 2014. This coincided with the beginning of civilian administration. The study showed that the union of the smaller isolated patches progressed rather slowly compared to the rate at which largest patch encroached on the smaller patches. Despite this process of annexation, the few surviving urban nuclei also continued to grow and expand. The continued enlargement of these urban nuclei increased the chance of being enveloped by the largest patch. Therefore, as the small urban nuclei increased, they became harnessed by the larger urban patch. This explains why the largest built-up patch accounted for about 94% of the built-up area. The process of envelopment, therefore, helped in reducing urban sprawl as indicated by the increased percentage of the largest patch. Hence, urban sprawl was reduced during the democratic dispensation compared to the military dispensation, and the percentage of open space also increased. The open space comprised mainly riparian vegetation and recreational grounds within the metropolis.

Despite the increased compactness of the city, the percentage of open space increased. The increase could be attributed to the need to protect and preserve ecologically sensitive landscapes including river courses, and the forest reserve used as tourist centres within the metropolis. In addition, the rising interest in sport and recreational activities have led to the opening of many neighbourhood recreational facilities in the metropolis.

CONCLUSION

The use of remote sensing and landscape metrics provide opportunity to quantitatively investigate urban expansion and estimate the impact of such expansion. The use of remotely sensed data, not only provides opportunity to compare urban growth over time, but also growth across different political dispensations and thus provides a basis for evaluating the contribution of different political regimes to urban growth. The metrics used can help to accessing the contributions of each regime type to urban development in terms of sprawl minimization, minimization of distance to the central business district, and understanding of the dominant urbanization process that characterised the regime.

Although, there is a significant difference in urban growth between the military and the civilian regimes, the effects of urban growth on distance to central business district, available open space, urban sprawl, and shape of built-up areas, were not significantly different between the two regimes. In addition, for most of the periods under consideration, urban expansion occurred primarily through

expansion of existing urban areas rather than spontaneous and detached development (Seto et al., 2007). Beyond policies aimed at urban growth, there is need to initiate programmes and policies that will ensure that the citizenry enjoy the benefits associated with such growth. Therefore, one of the most significant conclusions from this study is that urban benefits derived through city growth do not necessarily have anything to do with the type of city administrators in place.

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