ANALYSIS OF URBAN DECAY FROM LOW RESOLUTION SATELLITE REMOTE SENSING DATA: EXAMPLE FROM ORGANIC CITY IN NIGERIA

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Abstract

Urban decay reflects deleterious manifestation of urban environment neglect occasioned by poverty and low capacities of dwellers to effect meaningful repairs of aging housing stock. Though urban decay has social, economic and cultural dimensions, it is primarily a physical entity and can be observed comparatively across districts and cities. This paper analyzed the spatial and temporal pattern of urban decay in different parts of a traditional organic city through data extracted from satellite remote sensing images. It analyzed temporal differences in urban quality in the city using uniform parameter of urban blight measurement. It presented a classification scheme for mapping urban decay from remote sensing data using composite parameters including urban densities, urban accessibility, age and type of building materials and vegetation/impervious surface components. These indices were measured from remote sensing data and condensed into an urban decay index through geo-statistical analysis of extracted data layers of data. The average indices of each of the parameters were condensed into the city blight index for the entire city. The computed City Blight Index was 0.39 in 1975, 0.38 in 1995 and 0.48 in 2005. The paper discussed the factors responsible for the temporal changes in urban blight condition in Ibadan city

Keywords: Urban decay; remote sensing data; urban accessibility; urban density; urban building condition.

Introduction

The background of the study

Urban blight is a state of urban squalidness and over crowdedness, characterized by decrepit structures, poor sanitary conditions inadequate provision of amenities and general deterioration of urban environment (Okoye,1979; Abumere,1987; Fabiyi, 1999). Urban blight was given different appellation by authors including urban slum, urban decay and ghettos (Wirth,1938; Stokes 1962; Breger,1967;Mangin 1967). These appellations may have different colorations of description of physical deterioration of urban areas in their respective larger city context. Stokes (1962) asserted that slums are areas of the city in which housing and resulting social arrangement develop by processes so different from those by which the general growth of the city proceeds that they will destroy the city.

The concept of urban decay involves several fussy elements and often defies universal acceptability. Breger (1967) adopted urban blight to represent that physical condition of the city as opposed to the social and cultural aspect of the rundown neighborhoods in the city.

According to him ‗urban blight designates a critical stage in the functional or social depreciation of real property beyond which its existing condition or use is unacceptable to the community. From this context the urban decay can be defined in relation to the community's acceptable standards. The minimum acceptable standards in the community depend on the social values of the community and may vary greatly due to differences in the cultural orientation history and most significantly, the income of the communities. Consequently, the functional depreciation of properties and neighborhood lot cannot be measured and compared across different communities with different cultural values and housing stocks. This research attempts a classification scheme and methodological approach to compare different level of urban decay temporally and across different districts of the city.

The relevant research concerns of urban blight as considered by many authors are basically three which include the identification and delimitation of blighted areas; the process and factors of slum formation and ; the location of slum areas in a city.

- ***Identification and delimitation of slum*** (Klove, 1941; Meyer, 1967): Most definition of slum has been descriptive without providing the prescription and elements to identifying slum areas within the city. Meyer 1967 for instance stated that ‗the term slum housing in the adjective could be difficult to define, the slum at a minimum includes the idea that housing is low quality, needing major repairs, or dilapidated'. The definition and delimitation of slum must be capable of fitting a wide range of apparently analogous situations. The definition accounts for the community housing standards, the community evaluation of its housing requirements, as well as the community's techniques for handling and absorbing the poor and the stranger. The State of Illinois 's neighborhood Redevelopment Corporation law of July 1941 clearly presented some elements for delimiting slum in its definition of slum: ‗those urban districts in which the major portion of the housing is detrimental to the health, safety, morality or welfare of the occupants by reasons of age, dilapidation, overcrowding, faulty arrangement, lack of ventilation, light or sanitation facilities, or any combination of these factors' (Klove 1941). Three dimensions were clear as elements of measuring or delimiting urban slum from act which was recognized as early as 1941 including housing dimensions, neighborhood environmental dimensions and human/occupant dimensions. Particularly, Klove (1941) adopted a technique that identified blight on the basis of physical condition of urban neighborhoods. The term was used to describe a condition of advanced deterioration of properties. The techniques employed in delimiting the boundaries of different stage of blight in the city of Chicago was based on residential block distribution maps of various housing characteristics prepared from data collected by the Chicago Land Use survey. With the aid of predefined criteria Klove extracted the blighted areas based on the following characteristics:
  a. A majority of the residential structures were erected before 1895
  b. A majority of the dwelling units were classified as substandard in housing quality by the Land use survey
  c. Twenty percent or more of the residential structures were in need of major repairs or unfit for use

The city of Chicago was thus classified into slum or blighted area, near blighted areas. The result is similar to the classification of CJ stokes, where different categories of slum were identified.

It is noteworthy that though attempts have been made to discount blight using physical condition and appearance blight is basically a product of the inhabitant. It is possible to estimate the characteristics of inhabitants from the assessment of their dwellings and neighborhoods and vice- versa. Stoke (1962) have differentiated different levels of slum, based on the occupants and their positions in the socio-economic continuum.

- **Process of Slum Development** An ideal city is a slum less city, Slum is a cancer on the body of the city which must be removed through *surgical blades* of urban physician. Slum development is a result of infection on the typical ideal city. Authors in this line of research have identified urban decay as a stage in the cyclic process of urban growth. It was noted that the same factors that induce urban growth also contribute to urban decay. However the interjection of slum in urban growth cycle differs between developed and developing economies. The stage at which urban decay infractions set into typical urban growth cycle is different between cities and is caused by different factors.

London (1980) and London and Palen (1984) gave demographic explanation as the primary background theory inducing changes in urban setting. Leushcke and Wegener (1987) noted that population changes is not adequate to explain the incidence of urban decay. The use of population growth as a measure of urban decay obscures the fact that urban area is in the first place a physical entity. The emphasis of the methods suggested by Leushcke and Wegener (1987) is that urban change should be measured on the basis of physical parameters or spatial entities rather than the casual factors and the associated urban elements.

Other authors have examined the process producing urban change through the filtering theory. The theory explains the process that enables some parts of the city to experience increase in quality while others filter down or deteriorate in quality. Filtering theory relate to urban decay. Alao (1976) described filtering as a change in quality of service provided by a unit. Down-filtering means reduction in the quality of service, while up-filtering means an increase in the quality of service rendered by a unit. The process of up-filtering is equivalent to gentrification phenomenon resulting in the upgrading of urban environment from the low quality status to high-grade urban environment. Down filtering augment the supply of slum and causes urban deterioration.

In the broadest sense, filtering is used to describe movement of housing units, specifically a model in which dwelling units are constructed for relatively high-income household and then gradually become available to lower income groups as the units depreciate in quality and therefore value. The process of filtering has been identified as the main theory around the formation of urban decay (slum).

Sule (1980) further amplified the concept of filtering with the pay ï off matrix which he referred to as prison dilemma as shown in figure 1 A and B denote two property owners, R denotes a decision to improve a dwelling unit and N represents a decision not to improve it. The entry in the first row, first column indicates that if A and B invest in improving their houses, the returns will be 3 percent per unit of investment. If B renews his property and A does not, the returns per unit of investment for B will be 1% while A will be 4 %. If both of them decided not to renew their property, their returns will be 1.5% each. Thus in the absence of co-operations, the interdependence and externality present in the property set-up ensures that individual decisions are in favor of neglect of property and results in misallocation of resources. David and Whinston (1961) argue that slum often results from property speculation of owners who may delay the renovation of existing structures in anticipation of the arrival of more intensive uses, which might bring capital gains. Abumere (1987), however observed that this is not usually the case in Nigerian slums. According to him, slum is based on poverty rather than a waiting game for more remuneration on housing. The processes producing slum in Nigerian cities are poorly understood, despite the considerable numbers of primate cities in Nigeria and the attendant slum conditions. Each of the primate cities in Nigeria has distinctive urban history, processes and actors in urban degradation.

- **L*ocation of slum and the inhabit*ants of different types of slum** Several authors have located slum in the down- town and the oldest parts of the city. Others have identified different parts of the city where low price land and housing could be found in the city, including undevelopable land, waterfront and abandoned mining sites. (Mabogunje, 1968; Goldrich *et al*,1967; Portes,1971; Hill,1986; Fadare,1997,Gotham 2001)

	R	**B**	**N**
R	(3,3)		(1,4)
A			
N	(4,1)		(1.5,1.5)

Figure 1. Pay-off matrix of urban blight development. (Adapted from Sule 1980)

From the foregoing, urban blight though have different dimensions including the social economic and the human/cultural aspect. It is essentially a physical entity and can be seen identified, measured and compared between regions and cities. It is also possible to estimate other socio, economic and cultural aspect of the blighted areas from the physical condition and appearances of urban settlements. The socio demographic characteristics of the people in the slum area are major ingredients producing the physical manifestations observed in the blighted areas of the city (Riis 1892; Stokes 1962; Portes 1971; Gotham 2001). Therefore the socio-demographic dimensions can be estimated from the physical parameters. It is however difficult to objectively identify the scale of deterioration in deferent districts of the city and measure urban decay spatially and temporally. Visual assessment and the use of windshield survey are subjective and are not practically repeatable, this study attempts a new approach with remote sensing data.

It is necessary therefore to identify parameters to classify urban decay in cities and to develop methodology approach for inter-urban, intra-urban and inter-temporal comparisons of physical deteriorations of districts and cities at a uniform sweep. Remote sensing approach comes in hand in this context. Though the process producing slum is different from one city to another involving historical, social and economic forces, the physical manifestations are uniform both spatially and temporally in cities. The study focuses on measurement of the physical manifestation of urban decay from satellite remote sensing data.

The objective of the study

The central objective of the study is to advance a methodology approach on physical measurement of urban blight condition and map spatio-temporal pattern of urban decay in Ibadan using multi-date remote sensing data with the view to understanding the process that gives rise to urban blight in the city. The specific objectives include:

- to develop a classification scheme for identifying urban decay from low resolution satellite images
- to examine the patterns of urban decay in the study area
- to attempt the evaluation of the process that account for the pattern observed in the study area

Methodology

The study area

The choice of the study area was based on the fact that the city has gone through a considerable process of temporal changes of urban decay cycle. The city also has components of high quality urban precincts and poor blighted areas. The city of Ibadan therefore possesses all the critical elements of urban quality measurement that were considered for measurement in this study.

Ibadan is located in the Southwestern part of Nigeria. It lies within latitude 7° 19Nj08Nj and 7° 29Nj25Nj of the equator and longitude 3° 47Nj50Nj and 4° 0Nj22NjIt is the capital of Oyo State. Ibadan comprises of 11 local government areas, often classified as Ibadan region. The inner city is referred to as Ibadan metropolis comprising of 5 radial local government areas which form the boundary of the study area, as shown in figure 2. Ibadan is an ancient city dating as far back as 1800s. The city has had rapid growth; in fact it was regarded as one of the pre-colonial urban centers in Nigeria (Mabogunje 1968). Developed land increased from only 100ha in 1830 to 12sqkm in 1931, 30sqkm in 1963, 112sqkm in 1973, 136sqkm in 1981,and 214sqkm in 1988. Similarly, in 1856, the population was estimated at 60,000; by 1890, it had increased to about 200,000; in 1963, it was 600,000; and today, it is almost 3million (NPC 2006). Ibadan, is a large sprawling city with no discernable pattern of growth or development and this has earned the city such epithets as ñthe worldôs largest indigenous city,ò ñthe black metropolisò or ñthe largest urban village in Africaò.

Ibadan today has grown to absorb many rural hinterlands including OOjo, Moniya, Akobo in the northern end, Alakia-Isebo, Adegbayi, Adeogun in western end, Owode, New garage in the southern end and Apata,, Apete in the western end of the city.

Figure 2: The Study area

The study area is limited to the metropolitan Ibadan, comprising five local government areas and a total of 75 wards or rating zones which were subsequently divided into 24 zones. The 75 rating wards were collapsed into 24 study zones since most of the rating wards don't have physical boundaries that could be identified on the low resolution images. The criteria for grouping include the sizes of the wards and the presence of notable boundaries such as streams or major roads. The division into study wards was basically for convenience for field work. See figure 3

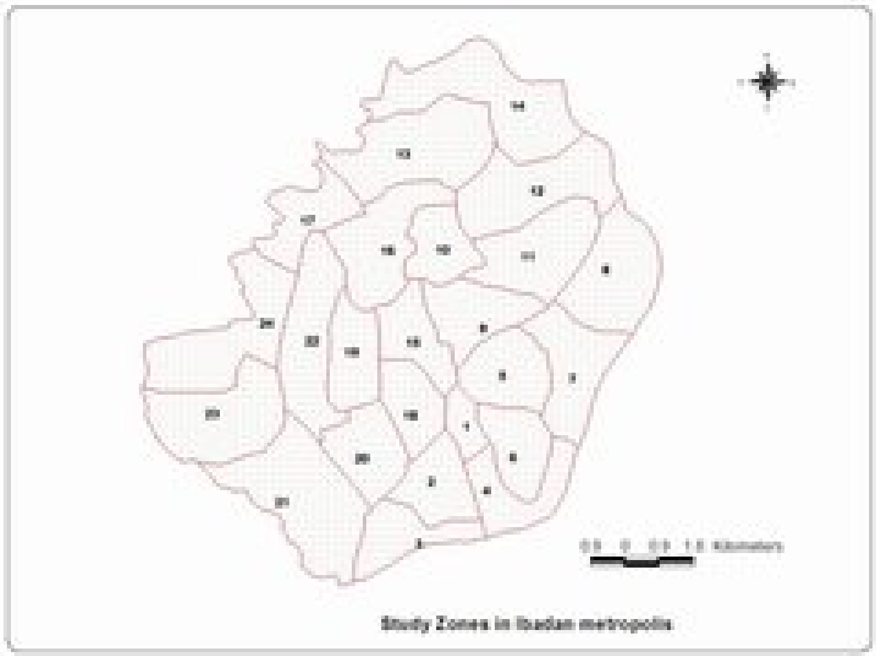
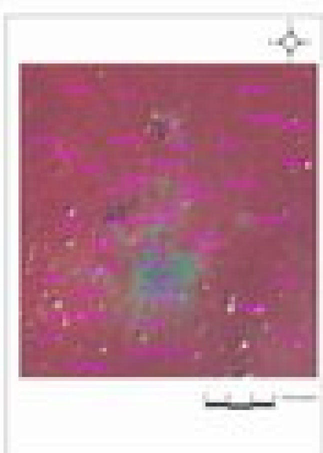


Fig.3: The study zones

Data Sources

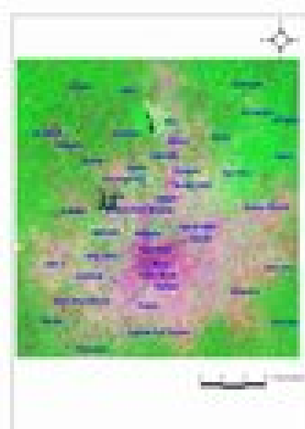
Image data sources

Three dates LandSat satellite images were used for the analysis. The data were acquired in 1975, 1995 and 2005. The low resolution images from Thematic MapperÊ and Enhance Thematic Mapper (ETM) obtained from LandSat were supplemented by IKONOS 1meter satellite images (acquired in Dec 2006) for second level detail analysis of urban blight condition. The second level analysis of high resolution images significantly improved the interpretative properties of the low resolution Landsat satellites images. See fig 4(a -c)



LandSat 1975

LandSat TM. 1995



Landsat ETM 2005

Fig4(a-c) LandSat Images of the study area

Survey data: Data were also obtained through questionnaire from randomly selected respondents in each study zone. In all, an average of 50 copies of questionnaire was administered in each zone making a total of 1200 questionnaire. The respondents were asked to choose in the city the district they considered as ideal residential quality and to identify attribute, that make such areas attractive and reasons they considered such places as standard environment.

Image data analysis; Ground checks and ground control correction

The images were appropriately geometrically corrected with through the selection of ground control points. The ground control points and GPS were used to achieve about 10 meters positional accuracy. The images were classified based on predefined criteria (as discussed in the next section) into different quality zones with a relative rank values. In places where the buildings are so clustered to enable interpretation on the LandSat images we used 1 meter resolution IKONOS image to assist classification. In order to classify a place into urban decay of good environment, we rely on visual interpretation especially to extract information from the IKONOS images using the interpretative elements such as shapes, tone and texture. The study zones layer in vector data format was overlaid on the images for analysis as shown in fig 5.

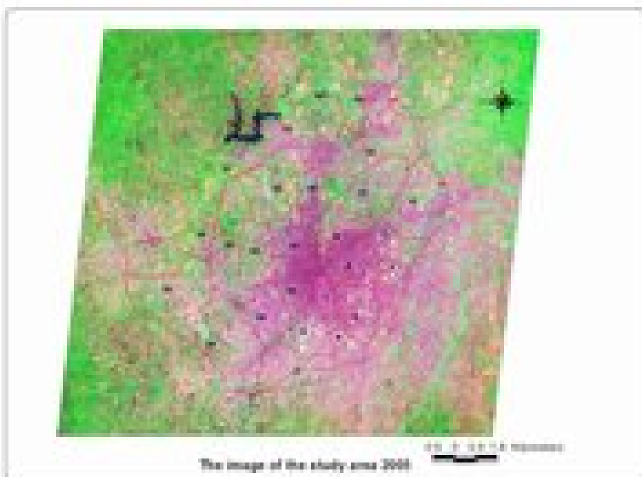


Fig5: The study zones in the LandSat Images of 2005

Urban decay classification schemes and indexing

We used a hybrid of urban indicators as indentified by international expert group meeting on urban indicators in Nairobi January 1994. The city programme addressed the following components as basic for inter comparison of urban settlements. These include:
Socio-economic background, Housing conditions, Health condition, Natural conditions, Natural environment, Land use, Urban transport, Energy use, Air pollution, Water and sanitation, Solid and Hazardous wastes.

Most of these elements are not measurable physically nor are they discriminated from the visual assessment of urban condition. These make them subjective and thus difficult to use as basis for inter comparison of physical quality of urban area. More 1970 however utilized the principal component analysis to extract the components that can be discriminated from remote sensing images and can be used as elements of urban quality or housing quality measurement. We collapsed the responses of the people about the attributes of a standard good environment in the city and the places they would like to live if their income improves into six major subheads including: Spacious environment; secured environment, good housing stocks; good road condition and functional urban utilities//facilities such as water, electricity and sanitation.

From the perspectives of UNDP report (UNDP 1996) and the perceived standard of the inhabitant we extracted the visible parameters that can be measured from remote sensing data as surrogate measure of urban quality. The following parameters were eventually used to measure urban decay in Ibadan city:

(a) ***Urban accessibility***: Accessibility relate to ease or difficulty to move around different components of urban area. This is largely a function of urban highway corridors and connectivity levels and the road conditions.

(b) ***Urban density and congestion***: This relates to the level of clustering of building and urban land uses in the city. This relates to the number of buildings per unit area.

(c) ***Building materials quality***: The roof quality was used as a means of measuring urban building quality based on the age differentials of the buildings in the city

(d) ***Vegetal – impervious surface dichotomy***. The level of greenness in urban neighborhood indicates some forms of planning and organized space which is used as a measure of urban quality.

Urban decay delimitations

The following parameters were used in the interpretation and classification of the remote sensing data into different urban qualities score. Each of these parameters was given a threshold score through which all the zones were classified into good urban neighborhood and blighted neighborhoods. The threshold serves as a value through which the city is measured on a *monothetic* boolean scale of good (1) and bad (0).

The parameters above were used in the interpretation and classification of the remote sensing data into urban decay and good areas. A grid of cells with dimension 40 X 40 meters was placed on the scenes. When the value of a grid cell falls below the city threshold; such area is classified as **0** while a score of 1 is assigned to areas that score above the city standard threshold. The total number of cells in each zones that score 0 and 1 were enumerated to find the percentage 0 score in each zone to measure percentage decay areas in the zone.

When the percentage of **0** scores is higher than **50** in a zone**,** the zone is classified as urban decay, in the case that percentage score **0** is less than **50** we classify the area as good urban environment i.e ***not poor***

The total number of zones classified as urban decay using a particular parameter is used to compute percentage urban decay on the basis of that parameter. For instance

UA = percentage urban decay by urban accessibility is computed as:

$$\mathbf{Ua} = \sum_{i=1}^{n} Ua_i \times \frac{100}{n} \quad \text{.................................eq1}$$

a

UD = percentage urban decay by urban density is computed as:

$$\mathbf{Ud} = \sum_{i=1}^{n} Ud_i \times \frac{100}{n} \quad \text{................................. eq.2}$$

UB = percentage urban decay by building materials is computed as

$$\mathbf{Ub} = \sum_{i=1}^{n} Ub_i \times \frac{100}{n} \quad \text{.................................eq.3}$$

VGS = percentage urban decay by vegetation/impervious surface computed as:

$$\mathbf{VGS} = \sum_{i=1}^{n} VGS_i \times \frac{100}{n} \quad \text{................................. eq.4}$$

The percentage of zones in the city with value 0 for each parameter was extracted for the city to compute the percentage urban blight by accessibility (UA), percentage urban blight by urban density (UD), percentage urban blight by building roof condition. (UB). and the percentage vegetation and impervious surface mix (VGS). These are expressed in percentages and are used in computing the district index for urban blight as shown in equation 1 to equation 4. **n** represents the number of zones or districts or wards in the city in this case 24. The composite index for the city-wide city blight index is represented as CBI which can be computed as follows:

$$\text{CBI} = \frac{\sum_{i=1}^{m}(UA+UD+UB+VGS)}{M*100} \quad \text{é é é é é é é eq.5}$$

CBI represents composite city blight index of the entire study area which is a summation of all the percentage blight using all the parameters (M). **M** represents the total number of variables or parameters used to measure the level of urban decay in the city. In our case M is equal to 4. The parameters were expressed in percentages, therefore M* 100 is meant to cancel the percentages so that the value can be expressed as index rather than in percentages. If the value of CBI is greater than 0.5 the city is classified as highly blighted that is mostly slum, when the value is lower than 0.5 the city is non-decay area that is urban decay is localized and less significant. A value of CBI = 1 represents complete slum city, while CBI = 0 represents slumless city.

This approach was used to classify and measure urban decay in Ibadan city both spatially and temporally over a period of thirty years between 1975 and 2005.

Results and Discussion

The indices of the classifications scheme developed to capture urban blight conditions of organic city were found tos be effectively measurable from the LandSat ETM data supplemented by high resolution images in the areas of extremely high densities. The methodology adopted in this study attempts to simplify the technicalities of satellite image interpretations in urban applications so that other urban gate keepers such as urban planners , developers and urban analyst could apply the tool for measuring urban decay development in real time and temporal analysis.

The observed changes in slum development and general urban quality differential over time in Ibadan city over a period of 30 years (1975-2005) are discussed in the following sections

Spatio-Temporal Pattern of Urban Decay in the City (1975-2005)

High densities areas

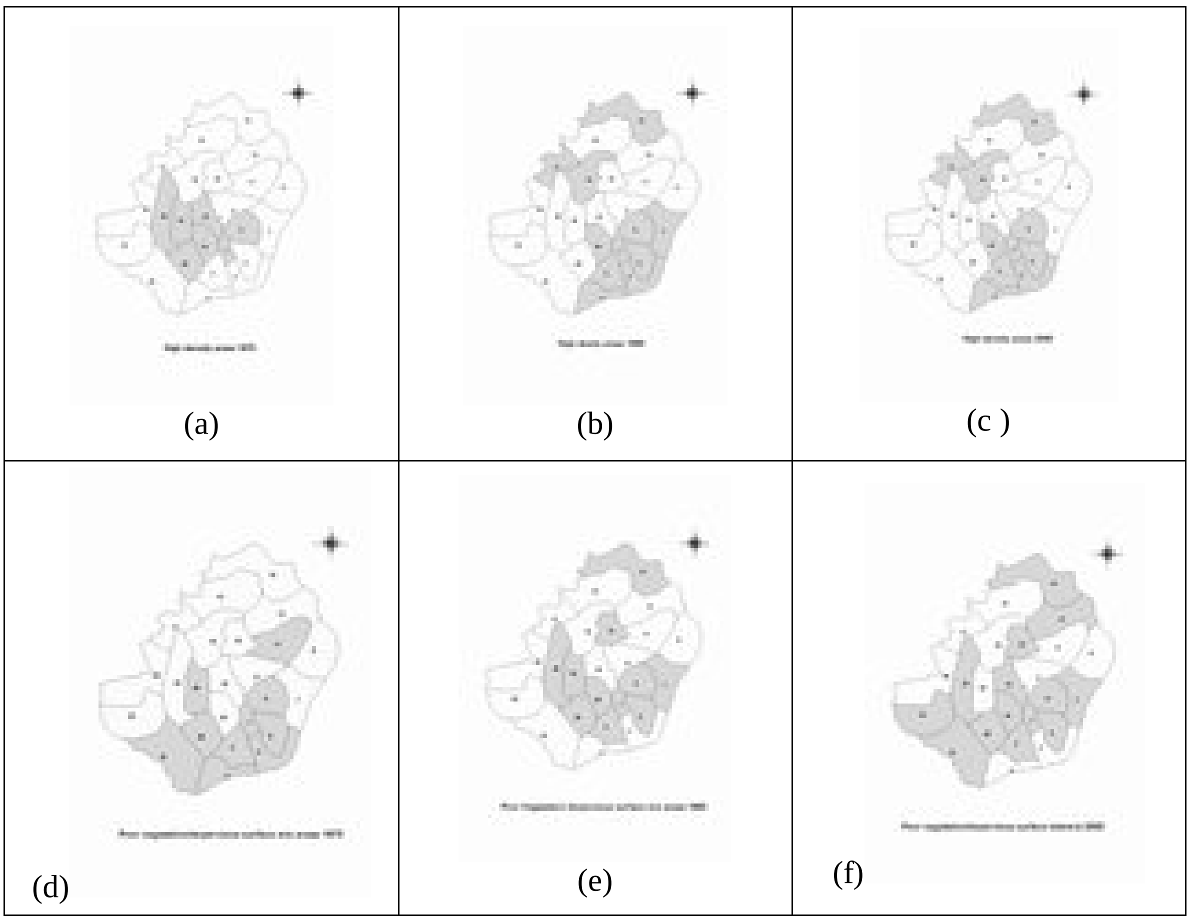
The city boundary Ibadan was rather small in 1975, most of the zones were largely farmlands and scattered buildings, yet about six core area zones were identified as urban decay including zones 1,5,15,18,19,20 and 22 as shown in the Table 1. These zones were in the traditional and the commercial core areas of the city. They were the oldest parts of the city dating as far back as pre-colonial days (Mabogunje 1968). Urban high density zones steadily increased from the core to the periphery especially in the south eastern part of the city as shown in Fig 6(a-c). The southern part of the city benefited from urban growth that is associated with the economic boom of the mid seventies in Nigeria which largely increased the opportunities of the informal sector and the emergence of middle class in Nigeria as dominant players in urban housing. Unfortunately however, the informal housing development in this period later turned to urban slum. The increase in oil related income of urban dwellers during this period encouraged rural-urban migration which prompted rapid growth in urban housing to provide accommodation for the new arrivals. Three zones in the northern parts of the city also increased in densities during the period of oil boom years. They were initially minor settlements including Ojoo, and Eleyele/Apete where existing villages were sub-summed by the expanding city. The core of these settlements retained poor high density conditions, while the new developments are also substandard due to the activities of informal private actors in housing delivery coupled with the limited ability of individual to raise sufficient fund for high quality housing. The corporate housing market in Nigeria and especially in Ibadan had been all time very low (Fabiyi, 2007).

Poor access areas in Ibadan city

Most of the core parts of the city have poor accessibility including Molete, Felele, Oje Inalende, Ekotedo in 1975. These parts of the city have lanes rather than streets and are characterized by roof to roof building development. Building developments in this area give little consideration to vehicular accessibility. Vehicles are parked on main roads while owners navigate to their dwellings through footpaths and lanes. These zones are the residences of the poorest people in the city; it is associated with the indigenous population as well as the aged and illiterates. Newer development in the southeastern parts and parts of the north including zone 14 and 19 grew with poor accessibility, though, the widths of roads are adequate in some areas the condition of roads are appalling, poor drainage condition and impassable earth roads servicing residential areas. These areas do not observe building codes as most building are built on the edge of the main road. The rate of degeneration of road networks in the new area is also very fast as a result of poor drainages.

Decayed roof materials in the city

The roof condition was used as a measure of condition of building and ages of building. Most of the buildings in the study areas have corrugated iron sheets as the roof top materials. The study showed that most parts of the city are covered by brown roof, a visible sign of decay in 1975. In 1995 however newer buildings were built within the city as could be observed from the images as brighter tones. This was recorded as growth by fission, these newer building reduced the percentage of building with poor roof condition in 1995, while increasing the density in the city as shown earlier. The finding confirmed the observation of past studies on Ibadan (Areola 1982; Mabogunje 1968) which recorded that previous compound in the core were partitioned to allow new buildings by successful children of landlords in the traditional parts of the city. The percentage poor roof condition increased further in the year 2005, as shown in figure 6 (g,h,i)



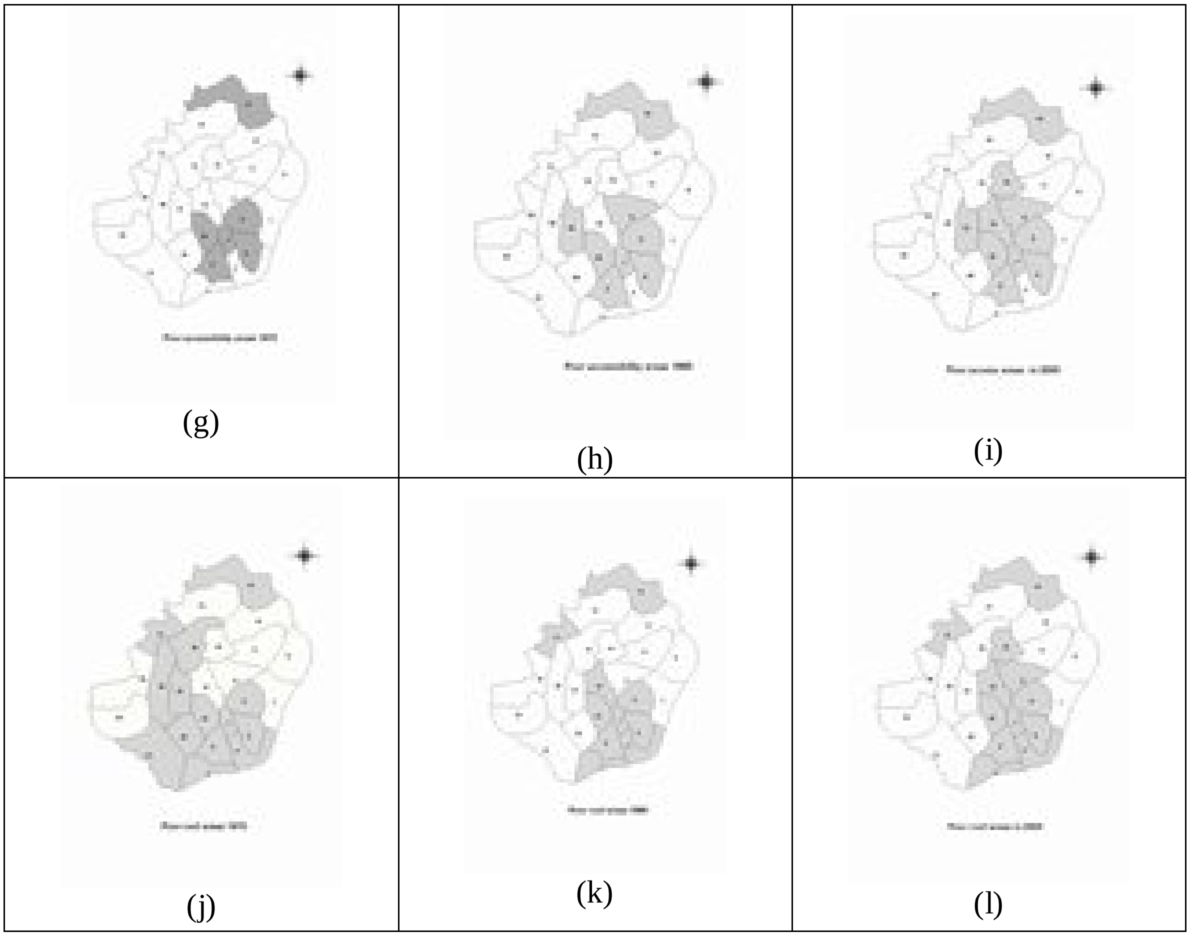


Figure 6(a-l) Urban blight in Ibadan metropolis between 1975 and 2005S

Poor Vegetation/Impervious Surface Mixture

These elements of urban decay clearly showed the effect of urban growth on the quality condition of the city. While only few zones have poor impervious surface/ vegetation mixture in the year 1975, including zones1,2,5,6,14 and 18, the areas in this category steadily increased with urban growth and haphazard development without clear-cut plan for open space and improved vegetal quality of the cityscape. Ibadan city has been allowed to grow over time without a proper master plan; most schemes available were developed by private developers who are largely individual and families and attempted to maximize the available area with block and mortal. There are however few government initiated planning schemes where considerable attention was given to aesthetic, functionality and urban quality of life. These few government initiated housing scheme retained the vegetation/impervious surface mixture through out the period observed. Institutional areas including University of Ibadan, University College Hospital (UCH) State government secretariat, Ibadan Polytechnic, Agodi GRA, Iyaganku GRA among other government premises, all retain good vegetation/impervious surface mixture throughout the thirty years considered (See Fig 6,j-k, and table 1)

Table 1:Trends in Urban decay between 1975 and 2005

1. Tends in Urban decay based on densities 1975-2005		
High density 1975	High density 1995	High density 2005
1,5,15,18,19,20,22	1,2,5,6,7,10,18,19	1,2,4,6,5,3,18,14,17,16
2. Trends in urban decay by vegetation –impervious surface (VIS) 1975-2005		
Poor pervious/impervious surface mix 1975	Poor pervious/impervious surface mix 1995	Poor pervious/impervious surface mix 2005
1,2,4,5,6,11,22,20,21,19	1,2,5,7,6,10,18,20,19,22,14,	1,2,5,7,6,10,12,15,18,20,22,14,23,21,
3. Trends in urban decay by roof quality 1975-2005		
Perc poor quality roof tops 1975(Rusty roofs)	Perc. poor quality roof tops 1995(Rusty roofs)	
1,2,3,4,5,6,18,19,20,21,22,16,17,14	1,2,3,4,5,6,15, 18,17 14	1,2,3,4,5,6,9,10, 18,15, 17 14
4. Trends In Accessibility Quality 1975-2005		
Poor Accessibility zones in 1975	***Poor Accessibility zone in 1995***	
1,2,5,6,18, and 14	1,2,5,6,9,18,19,14	1,2,5,6,9,10,15,18,19,14

Percentage change in urban decay in the city

The four parameters used to extract urban quality information from the images were developed to the urban Blight (decay) composite index and used to measure percentage change in quality over time The percentage poor density areas rose from 29.16% in 1975, to 33.3% in 1995 and 41.6% in 2005. It shows an increase of 4.17% between 1975 and 1995, while an increase of 8.27% was recorded between 1995 and 2005. See Table 2.

Table 2: Percentage Urban Decay in the Study Area

SN	Parameter	% decay 1975	%decay in 1995	%decay in 2005
1	Urban Density and congestion	29.16	33.33	41.6
2	Poor vegetation/impervious surface intex-mix	41.66	45.83	62.5
3	Decaying urban roof materials	58.33	41.6	50.0
4	Urban accessibility	25.0	33.33	41.6
	City Blight Index (CBI)	0.39	0.38	0.48

The growth in poor urban densities is closely related to urban growth by fission and lateral expansion. The same trend is observed in the analysis of pervious and impervious surface intermix during the thirty-(30) year periods. In 1975, 41.66% of the city has poor intermix of vegetation and impervious surface. Vegetation- impervious surface intermix is also a surrogate data to measure over-crowdedness in cities. In 1995 the area with poor intermix of vegetation and urban development increased to 45.83% in 2005. This increased to 62.5% in 2005. The analysis showed a steady increase in the level of congestion. The percentage decaying urban roof condition shows a decrease in 1995(41.6%) as opposed to 58.33% in 1975, but in 2005 it increased to 50%. This shows that there is high rate of urban growth in the pre-1995 but these buildings steadily degenerated to poor conditions before the year 2005.

The last row in table 2 shows the computed composite index of city blight or urban decay, during the three periods of consideration. It shows that the metropolis urban decay score in 1975 was **0.39**, it rose to **0.38** in 1995 and **0.48** in 2005. Ibadan metropolis is allowed to slide into virtual slum in the year 2005. Though the city has expanded beyond the limit of the metropolis yet blighted areas were detected, even newer areas present a picture of increasing slum development in the different parts of the city over time. The value of urban decay in the city is all time high growing to 0.48 in 2005. The metropolis is fast becoming the older part of the city, therefore there is tendency that the metropolis will soon become large scale slum in the future.

Urban Decay Index and Processes Inducing Change in Urban Quality

The temporal spread of blighted areas in Ibadan city could be associated with the unplanned growth of the city and the low participation of corporate private sector and government agencies in housing development. Most neighborhoods have different historical background and origin which account for most of the problems associated with the incidence and entrenchment of blighted conditions in almost all neighboruhoods in the city. These factors are succinctly identified in the following sections.

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Migration induced urban decay

Since independence, rural dwellers have continued to move to the city in Nigeria in order to benefit from the city prosperous economy. The migrants who usually are young school levers found residences with their relatives in the city and squat as temporary location, but often the residence become permanent. They may move out of their relativesô apartment to secure accommodation within the neighborhoods only to receive more migrants from the rural areas before they adjust to city lifestyle. In the final analysis such neighborhood may be occupied by people from the same area thus becoming ethnic or clan neighborhoods.

Due to congestion and the increased responsibilities to take care of unemployable rural-urban migrant, the inhabitants of such neighborhoods are hardly able to afford rent nor able to improve on their housing condition. Poverty further entrenches run down housing and poor sanitary conditions of such neighborhoods. Areas with migration induced urban decay are found in Sabo, Mokola, Oojo, Ekotedo where the Hausas, Nupes ,Idomas and Ijebus respectively live and created slum and deteriorated housing condition.

Land price induced urban decay

The price mechanism may group some people to a certain part of the city based on their economic / financial ability to pay for housing in such area. Poor areas attract poverty housing and adjacent lands often become available to the poor who can afford land rent. In Ibadan there are few government layouts, and infrastructural provisions in new development are often done by individuals. Areas without any form of infrastructure are characterized by low land price and are often attractive to the poor class. Waterlogged areas and family allotments in the core areas are usually available for the poor people to live. The core area land are still in the family holdings and are usually available for interested family members to partition and rebuild, usually, the buildings used to replace them are sub-standard housing.

Socio-temporal class changes inducing urban decay

Due to city expansion different parts of the city develop at different times. The residential mobility is associated with the income mobility of urban residents. When people of equal economic class migrate to a part of the city based on the facility available and the ability to pay for the service, such area may filter down in quality as occupants become older as well as the properties. Advancing age, coupled with reduced economic capacities as previously economically active households retire and the children move out of the neighborhoods, the area becomes residential enclaves of retirees and old people. The retirees often have limited capacities to maintain high quality housing environment. Housing market in Nigeria is very low while most people in good neighborhoods live on owner occupier basis. There can also be succession of residential neighborhoods when a given social class is partly or completely replaced by another social class who are stronger economically and buy over the properties thus displacing the existing class who have hitherto moved down economic ladder. Examples of these can be found in Old Bodija, GRA where residents were the rich class of the 1960s and 1970s. Most of the residents in these areas are old retirees and sometimes new arrivals who bought over property and develop commercial centers within initially residential areas.

Conclusion

The study presented four major indices to measure urban blight from space remote sensing data, advanced the methodological approach to calssify urban decay in a typical traditional city spatially and temporally. The use of multidate satellite images provided opportunities for a change process analysis of the urban decay condition in Ibadan over a thirty (30) year period.

Urban decay measurement classification scheme was developed which comprises of four major indicators including high urban densities, poor accessibility, ageing and poor building materials, and impervious / pervious surface intermix in cities. These parameters were found to adequately measure and identify urban decay in the city. The parameters were also found to be observable from remote sensing images. The spatial and temporal pattern of urban decay in the study area were identified and mapped from multidate remote sensing data.

The classification scheme adopted in the study to map urban decay is useful and adaptable in different cities of the developing countries with an organic city like Ibadan. The approach excludes subjective parameters like income and demographic characteristics of inhabitants to measure urban slum. It presented a simple and objective estimates of urban qualities.

The study identified urban decay in different parts of the city at different periods. Slum in Ibadan is not only an old or ageing neighborhood experience alone, it was found even in the younger neighborhoods which are characterized by run down housing with little or no access and poor intermix of impervious-pervious surface intermix. Urban decay in Ibadan could be found in the traditional core, the commercial core, the transitional zone and even in the urban fringe of the metropolis. The good areas and the poor areas often stand side by side in a characteristic unusual manner.

The growth in urban decay is associated with economic growth often linked with the oil ïboom years of late seventies. This period resulted in increased housing supply to accommodate the new arrivals from the rural areas as well as from other cities. However quality was sacrificed for quantity in the supply of housing, when poor informal private investors actively participated in housing delivery, thus providing substandard housing developments. Slum development is closely associated with the economic development and the enforcement of rules in housing developments in urban areas.

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