Global Scientific JOURNALS

GSJ: Volume 9, Issue 7, July 2021, Online: ISSN 2320-9186
www.globalscientificjournal.com

INTENSITY ANALYSIS ON LANDUSE CHANGE IN YENAGOA METROPOLIS, BAYELSA STATE NIGERIA.

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ABSTRACT

LandSat Images of 1986/87, 2002 and 2018 obtained from the Archives of the United States Geological Survey were used to analysed urban landuse change in Yenagoa Metropolis, Bayelsa State, Nigeria. Images were supervised and classify into five classes, built- up area, agriculture/cleared land, bare-soil, forest and water using maximum likelihood classification algorithm. Land use change was determined by transition matrix, based on the transition matrix, gain, loss, persistence, total change, swap and absolute value of net change were computed. Intensity Analysis was used to determine the annual change of a particular location at a given point in time at three levels, interval, category and the transitional level of intensity. The results revealed that between 1986/87, 2002 and 2018, built-up area and agricultural/cleared land use increased and gained more persistence than other land use which showed a decline and loss in persistence due to rapid urban expansion in the study area. Intensity of urban land use at the interval level revealed that the annual land use change intensity was relatively fast during the first time interval 1986-2002. At the Category level the result revealed that built-up gain was active and experienced more intensity across the landscape, Transitional level revealed that Built-up areas expanded and targeted at the expense of other land use in the study area. The study therefore recommended that suitable landuse control measure should be put in place and urban dwellers be involved in land use planning process and implementation law and also development of plans for intensification of landuse rather than sprawl in the study area.

1 INTRODUCTION

The earth surface is significantly altered by man due to anthropogenic activities and his uses of land has had a profound effect upon the natural environment thus resulting into accelerated growth of landuse change and expansion (Zubair, 2008). All human activities takes place on the land, the land is the most significant element in development. Over the years urban landuse has been dynamics due to many factors such as economics, environmental, socio-political and cultural factors. Population increase and human activities intensity makes the quantum of developable land available to continue decrease daily.

Land use and land cover change is a general term for human modification and conversion of Earth's terrestrial surface.(Mmon, 2008) Though humans have been modifying and converting land resources to obtain food, fiber and other essentials for thousands of years; current rates, magnitude and intensities of land use and land cover changes are far greater than ever in history. (Zubair, 2006) .These, drive unprecedented changes in ecosystems and environmental processes at local, regional and global scales. These changes encompass the greatest environmental concerns of human populations today which including climate change, biodiversity loss and pollution of water, soil and air (Ellis, 2013). Analysing the consequences of landuse changes while sustaining the production of essential resources has therefore become a major priority of researchers and policymakers globally.

Land is vital to the survival of all life on earth and it is very important that we quantify and understand the various changes that has taken place on it. In recent times, Yenagoa City is characterized by remarkable growth in population, expansion and developmental activities which have resulted in increased land consumption and alteration of the earth surface (land).The increasing

concern for the management of natural resources in recent times has been necessitated by the increase in demographic pressure and its associated anthropogenic activities which have led to serious environmental stress and ecological instability. The outcome of the natural and socio-economic factors of landuse in Yenagoa calls for an accurate investigation in the causes, processes and rate of landuse and change in the metropolis Yenagoa metropolis has expanded in an exponential proportion and the rates of urban population growth are higher within the city as a

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locus of economic activities. The extent of this urbanization or its growth drives the changes in land use pattern within the city. Yenagoa Capital City, just like most Nigerian cities is growing at a very fast rate, both in population and spatial dimensions, thereby increasing the demand on its scarce land resource. Just like many other State Capitals in Nigeria the region has undergone severe environmental alteration since the oil boom era due to several anthropogenic activities directed at the exploring and exploiting the natural resources in the region. This study takes a subsequent step beyond mapping to quantify the dynamics of land change during two time intervals by using the Intensity Analysis framework (Aldwaik & Pontius 2012, 2013). This paper illustrates the proper application and interpretation of Intensity Analysis for urban city.

2. Methodology

2.1. Study area

The study area is Yenagoa City in Yenagoa LGA of Bayelsa State. The study area lies along latitudes between 4o 48′ 00′′ North and 5 o 24′ 10′′East; and longitudes between 6o 12′ 00′′E and 6o 39′ 30′′E (Figure 1). It is bounded by Rivers State on the North and East, Delta State on the North West and West, Ogbi a LGA on the South East and Southern Ijaw on the South west. Yenagoa LGA has a population of 352,285 by 1996 estimate (National Bureau of Statistics, 2006). The climate of Yenagoa LGA is an equatorial type of climate (Iyorakpo, 2015). Rainfall occurs generally every month of the year. The mean monthly temperature is 25 oC to 31 oC. The hottest months are December to April. The difference between the wet season and dry season on temperature is about 2 oC. Relative humidity is high throughout the year and decreases slightly during the dry season. The study area is located within the lower delta plain believed to have been formed during the Holocene of the quaternary period by the accumulation of sedimentary deposits. Generally, Yenagoa is situates on lowland with the elevation between 3m and 7m above mean sea level and characterized by flood plains. It is drained by Epie Creek, Orashi River

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and Ekole Creek. The major soil types in the state are young, shallow and poorly drained soils. There are, however, variations; some soils occupy extensive areas whereas, some are of limited extent. The soil texture ranges from medium to fine grains. Like any other area in the Niger Delta; the vegetation is composed mangrove forests, freshwater swamp and lowland rain forests. The main occupations include farming and fishing.

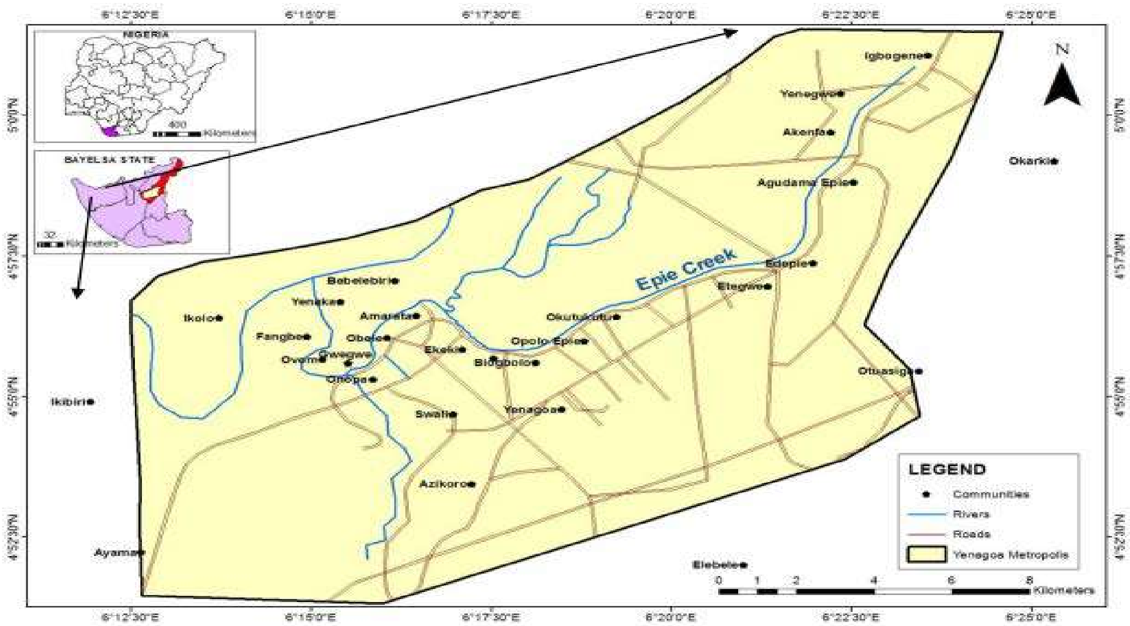

Figure 1. Yenagoa Metropolis

2.2 Methods of Data collection

Landsat images of 1986/1987, 2002, and 2018 15, 16 years intervals were obtained from the archives of the United States Geological Survey (USGS) for the study area. the satellite images were utilized with a spatial resolution of 30m, a major issue with remote sensing images of the study area is cloud cover, this is because many parts of the study area experience all-year-round rainfall this makes it difficult to obtain useful cloud-free image scenes (Kuenzer, Van baijma, Gessner, & Dech, 2014), in the spite of this difficulty dry season and cloud-free images were used to avoid the effect of seasonal variation (Belay, & Mengestu 2019) the dry season is mostly considered the best period for analysis, as the difference croplands and natural environment are the best marked. All the images acquired were within December, January, and February of 1986/1987, 2002, and 2018. This was to ensure that differences in the images were minimal. The satellite image was processed and analysed using ENVI 5.1. (Environmental for Visualising Images) software. To relate data to the true biophysical environment several sub-processes were undertaken which include mosaicking, geometrical correction, atmospheric correction, and image enhancement. All acquired satellite images were corrected before analyses and improve image quality also the satellite datasets were projected to the Universal Transverse Mercator map projection system and Datum of the world Geodetic system 84(WGS84) ensuring consistency between datasets during analysis.

A supervised image classification method was employed using the Maximum Likelihood method in classifying the images. The pixel-based supervised image classification algorithm was used to produce land use maps of the study area supervised image classification was recommended to yield good results.

Five land use categories were considered in the image classification, the land use categories are water body, bare soil, forest, agricultural/cleared land and built-up/ residential land use, a subset of data collected from the field survey was combined with existing maps and goggle earth image data to assess the accuracy of maps derived from analysis. Overall accuracy was performed to validate the classification using transition matrices.

2.3 Intensity Analysis

To determine the intensity of landuse in the study area intensity analysis was performed following the framework of Aldwaik and Pontius (2012). This method has been widely used by some scholars which include (Alo & Pontius, 2008; Enaruvbe &Atafo, 2019; Enaruvbe & Pontius, 2015; Huang, Li, &Pontius, Kiemas, & Hong, 2013; Huang, Pontius, & Zhang, 2012; Pontius, Shusas, &McEachern, 2004; Runfola & Pontius, 2013, Tutu Benefoh, Villamor, Van

Noordwilk, Borgemeister, Asante, Asabonteng, 2018; Minaei & Kainz, 2018; Braimoh, 2006; Mwangi, Lariu, Julich, Patel, Mcdonald,& Feger, 2017; Enaruvbe & Ige-Olumide, 2015).

CROSS-TAB Module in IDRISI SELVA Software was used to Over Lay two consecutive image pairs of 1986/1987- 2002, and 2002-2018 to gain a transition matrix of each period, (1986-2018 was chosen because it is necessary to study longer-term spatio-temporal land-use change considering the richness of regional land use data over the past century and help to understand long term human-environment interaction and the changes in the terrestrial ecosystem and make comparison over time). A transitional matrix is a cross-tabulation of Landsat image across two points in time giving categorical change, transitional matrix is an important process in image comparison because it caters for the land-use area by the categorical transition between two points in time (Manandhar, Odeh,& Pontius, 2010; Enaruvbe, Keculah, Atedhor,& Osewle, 2019).

Pontius, Susan, and Mceachern, (2004) shows the transition matrix by computing Swap and Net change, this help to gives a clear understanding of the characteristics of land-use change of an area, it was on this relationship we compute the gain, loss, total change, swap and absolute valve of net change using the intensity analysis method describe by Pontius and Malizia, (2004); Aldwaik and Pontius, (2012). The method was employed in this study to analysed urban land-use change. This method was applied to gain insight into the changes that vary across each time interval year, which land use have lost or gain or which land use is dormant or active over the past years, and the transition that varies across each category in the land use across the study area .this is important because although, there have been many attempts at analysing land use and urban development in this part of the world. However previous analysis of the change matrix is not sufficient to provide systematic and quantitative information on land use, some researchers have used the method of intensity analysis. This method determines the intensity of land-use change for one or more image pairs at three (3) level using the information contained in the

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transition matrix is the only data required for the computation of the intensity analysis this was computed using the intensity analysis program available at https://sites.google.com/site/ intensity analysis/free-computer-programs (Aldwaik & Pontius, 2012).

The intensity analysis is an accounting method used to determine the rate of change of a particular location at a given point in time (Aldwaik & Pontius, 2012). This quantitative method analyse maps of land categories at three-level;

a. The interval level
b. The category level and
c. The transitional level.

The interval level analyses, the total change in each time interval to examine how sizes and the annual rate of change varies across each time interval. At this level, the observed annual change intensity is been compared to a uniform annual change intensity that would exist if the annual changes were distributed uniformly across the entire time extent. The interval level of intensity analysis answers the question, at what time intervals are the annual rate of overall change relatively slow or fast for any particular time interval. If the annual change intensity is Greater than the annual uniform change intensity then the changes in that area at that particular time is relatively ‘’fast’ ’for that time interval, but if annual change intensity is less than the annual uniform change intensity then the changes in that area were relatively ‘’slow ’’ for that time interval.

The category level analyses each category to measure how the size and intensity of both gross losses and gross gain varies across each land use category over the period, the intensity of gross losses and gross gain for each category is calculated and compared to the observed intensity of the annual change that exists if the change within each interval were distributed uniformly during the entire spatial period. This level examines the land use categories that are relatively dormant versus active over the years, at the category level of intensity analysis, if the annual change

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intensity is Greater than the annual uniform change intensity then the changes in that area at that particular time is relatively ''Active 'for that time interval, but if annual change intensity is less than the annual uniform change intensity then the changes in that area were relatively ''Dormant '' for that time interval.

The transitional level analysis assesses a particular transition to see how the size and intensity of the transition change among categories useable for that transition when a category loses or gain its intensity, this level of analysis shows which categories are intensively avoided or targeted for that given transition level by comparing the observed intensity of each transition. This level

Summary of the intensity analysis equation

$$S_1 = \frac{area\ of\ change\ during\ interval\left|Y_t, Y_{t+1}\right| / are\ of\ study\ region}{duration\ of\ Interval\ \left|Y_t, Y_{t+1}\right|} x100\%$$

$$= \frac{\left\{\sum_{i=1}^{J}\ \left[\ \left(\sum_{i=1}^{J}\ Ctjj\right) - C_{tjj}\ \right]\right\}\ /\ \left[\sum_{j-1}^{1}\ \left(\sum_{i=1}^{1} C_{tjj}\right)\right]}{Y_{t+1} - Y_t} x\,100\% \qquad \text{(eq. 1)}$$

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$$U = \frac{area\ of\ change\ during\ all\ interval / area\ of\ study\ region}{duration\ of\ all\ aIntervals} x100\%$$

$$\left[= \frac{\sum_{t=1}^{T-1}\ \left\{\sum_{j=1}^{J}\right.}{}\right.$$

$$G_{tj} = \frac{\text{area of gross gain of catgory j during } \left|Y_t, Y_{t+1}\right| / \text{duration of } \left|Y_t, Y_{t+1}\right|}{\text{area of category j at time } Y_{t+1}} \qquad \text{(eq. 2)}$$

$$x100\% = \frac{\left[\left(\sum_{i=1}^{J} C_{tij}\right) - C_{tjj}\right] / (Y_{t+1} - Y_t)}{\sum_{i=1}^{J} C_{tij}} x100\% \qquad \text{(eq. 3)}$$

$$L_{ti} = \frac{area\ of\ gross\ loss\ of\ catgory\ i\ during\ \left|Y_t, Y_{t+1}\right| / duration\ of\ \left|Y_t, Y_{t+1}\right|}{area\ of\ category\ i\ at\ time\ Y_t}$$

$$x100\% = \frac{\left[\left(\sum_{j=1}^{J} C_{tij}\right) - C_{tii}\right] / (Y_{t+1} - Y_{t})}{\sum_{j=1}^{J} C_{tij}} x100\% \quad \text{(eq. 4)}$$

$$wtn = \frac{area\ of\ gross\ gain\ of\ catgory\ n\ during\ \left|Y_t, Y_{t+1}\right| / duration\ of\ \left|Y_t, Y_{t+1}\right|}{area\ that\ is\ not\ category\ n\ at\ time\ Y_t}$$

$$x100\% = \frac{\left[\left(\sum_{i=1}^{J} C_{tin}\right) - C_{tnn}\right] / (Y_{t+1} - Y_{t})}{\sum_{j=1}^{J}\left[\left(\sum_{in1}^{J} C_{tmj}\right) - C_{tnj}\right]} x100\%$$

$$Vtm = \frac{area\ of\ gross\ loss\ of\ catgory\ m\ during\ \left|Y_t, Y_{t+1}\right| / duration\ of\ \left|Y_t, Y_{t+1}\right|}{area\ that\ is\ not\ category\ m\ at\ time\ Y_{t+1}} \quad \text{(eq. 5)}$$

$$x100\% = \frac{\left[\left(\sum_{j=1}^{J} C_{tmj}\right) = C_{tmm}\right] / (Y_{t+1} - Y_{t})}{\sum_{i=1}^{J}\left[\left(\sum_{j=1}^{J} C_{tij}\right) - C_{tin}\right]} x100\% \quad \text{(eq. 6)}$$

Mathematical notation for intensity analysis.

J number of categories;

I index for a category at the initial time point for a particular time interval;

J index for a category at the final time point for a particular time interval;

m index for the losing category in the transition of interest;

n index for the gaining category in the transition of interest;

T number of time points; t index for the initial time point of the interval [Y_t, Y_{t+1}], where t ranges from 1 to T−1; Y_t year at time point t;

C_{tij} number of pixels that transition from category i at time Y_t to category j at timeY_{t+1};

S_t annual intensity of change for time interval [Y_t, Y_{t+1}];

U value of uniform line for time-intensity analysis;

U value of uniform line for time-intensity analysis

G_{tj} annual intensity of gross gain of category j for time interval [Y_t,Y_{t+1}];

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L_{ti} annual intensity of the gross loss of category i for time interval $[Y_t,Y_{t+1}]$;

R_{tin} annual intensity of transition from category i to category n during time interval $[Y_t, Y_{t+1}]$ where $i \neq n$;

W_{tn} value of the uniform intensity of transition to category n from all non-n categories at time Y_t during the time interval $[Y_t, Y_{t+1}]$;

Q_{tmj} annual intensity of transition from category m to category j during time interval $[Y_t, Y_{t+1}]$ where $j \neq m$;

V_{tm} value of the uniform intensity of transition from category m to all non-m categories at time Y_{t+1} during the time interval $[Y_t, Y_{t+1}]$.

Equations 1 and 2 define the annual percentage of change in the land use for each time interval. The interval level analysis compares the observed annual change intensity, S_t, Equation 1 to a hypothetical uniform annual change, U a change that would be if the annual change rates for each interval were spread uniformly over the entire period of study. (Equation 2) The annual change rate is regarded as fast if $S_t < U$ and slow if $S_t > U$.

Equations (3) and (4) show the categories of land use that are relatively dormant versus active in a given time interval, it measures the spatial pattern of size and intensity of overall (gross) gains, G_{tj}, and gross losses L_{ti} for a given land use category. The intensities of gross gains (Equation 3) and gross losses (Equation 4) are calculated and compared with a hypothetical uniform intensity that would be if the change within each interval were uniformly spread across the entire study area, which is equal to S_t. Categories that have greater change intensity than S_t are regarded as active while those whose change intensity is lower than S_t are regarded as dormant.

Equations (5) and (6), are used to calculate the observed intensity R_{tin} of annual transition from category *i* to category *n* for a given time interval relative to the size of category *i* at the beginning of the interval. The observed intensity R_{tin} is compared with uniform intensity W_{tn} calculated using Equation 6 which takes that category *n* gains uniformly across the landscape. For example, if $R_{tin} > W_{tn}$, then gain of *n* is target *i* but if the reverse is the case, a gain of *n* is seen to avoid *i*.

Equations (7) and (8) are used to measure the transition from a particular losing category *m* to a different category *j*. The observed intensity Q_{mtj} is calculated using Equation 3.7 while the hypothetical uniform intensity V_{tm} will occur if category *m* were to lose at the same annual intensity to all non-*m* categories is calculated using Equation 8.

If $Q_{mtj} > V_{tm}$ then category *j* is regarded as to target loss of category *m* whereas if $Q_{mtj} < V_{tm}$ the category *j* is said to avoid loss of category *m*. Therefore, with this analysis, it is conceivable to say, for example, which land use categories are targeted (or avoided) by rapid urban development. It can also tell if a forest loses, which other land use categories would benefit (targeted) from that loss.

This analysis analyse the rate of annual change of land use that is relatively slow and relatively fast, which land use categories are relatively dormant versus active in the land use patterns, and finally, the transition patterns that were intensively avoided or targeted by a given land category in the study area between 1986-2018.

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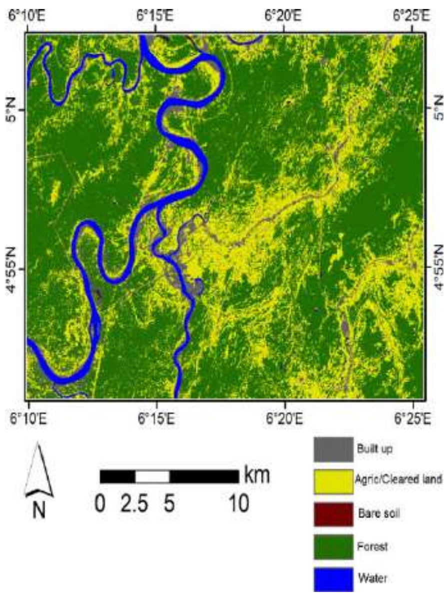
3 Results and Discussion

3.1 Landuse change in Yenagoa .

landuse change, was dtermined by computing the total area gain and loss persistence , the total change, swap change and absolute value of net change for each time interval. (1986/1987, 2002, and 2002, 2018) using the cross-tabulation of the land use map of the study area following the method describe by Pontius et al. (2014, 2012). Figures 2, 3, 4 shows the spatial pattern of landuse change and figures 5, 6, 7, 8 shows the spatial pattern of landuse gain and loss for 1986-2018. Table (3) is a summary of the landuse change %in the study area,



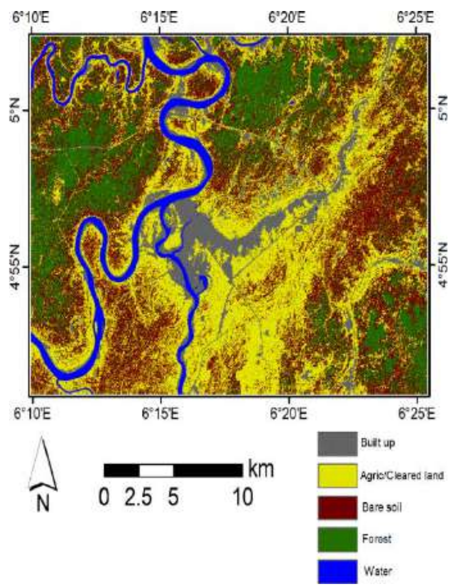


Fig 2: Land use pattern of Yenagoa 1987

Fig 3: Land use pattern of Yenagoa 2002.

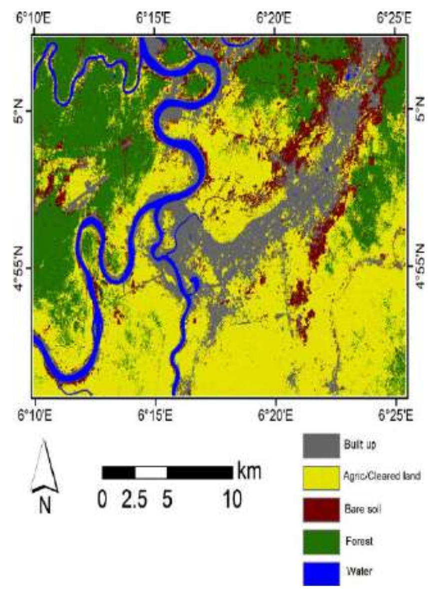


Fig4: Land use pattern of Yenagoa 2018.

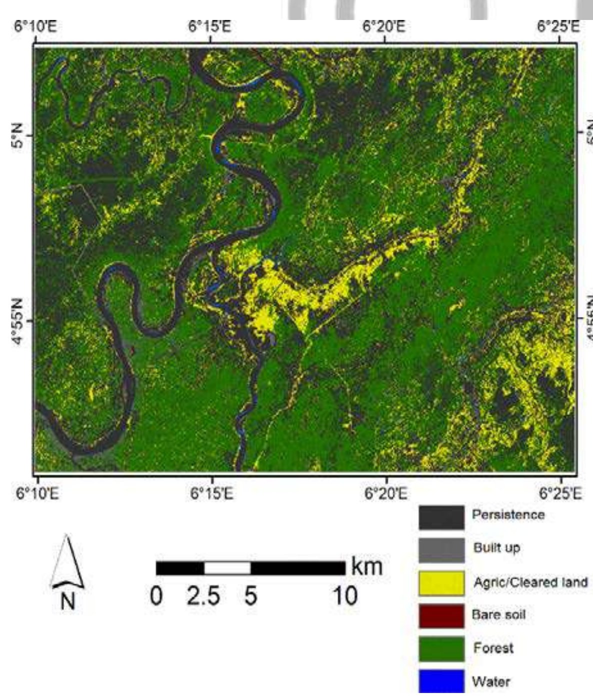


Fig 5: Yenagoa loss persistence 1987 and 2002

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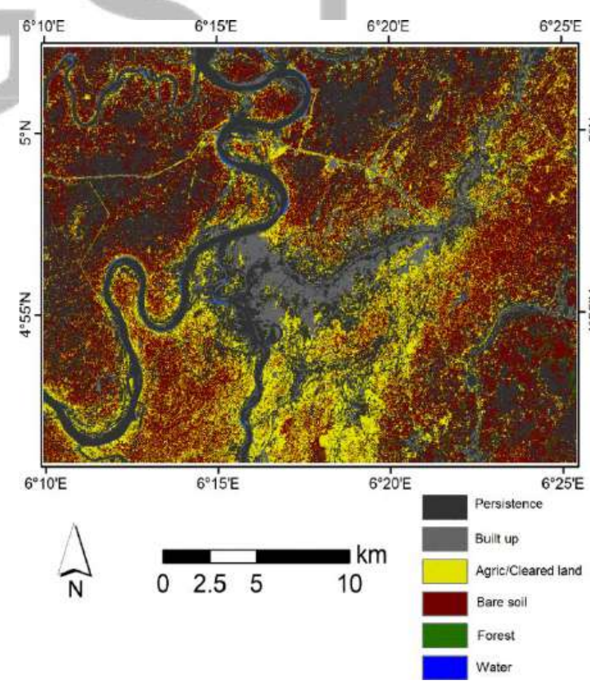

Fig 6: Yenagoa gain- persistence 1987 and 2002

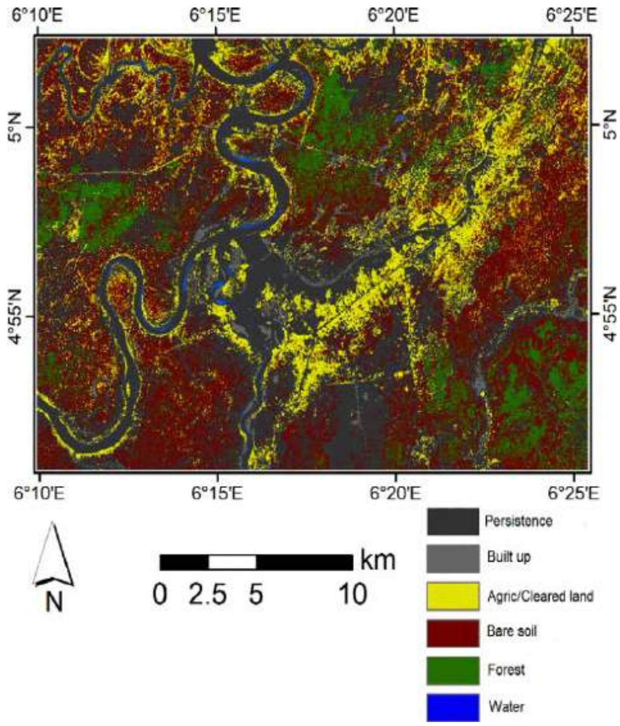

Fig 7: Yenagoa loss- persistence 2002 and 2018

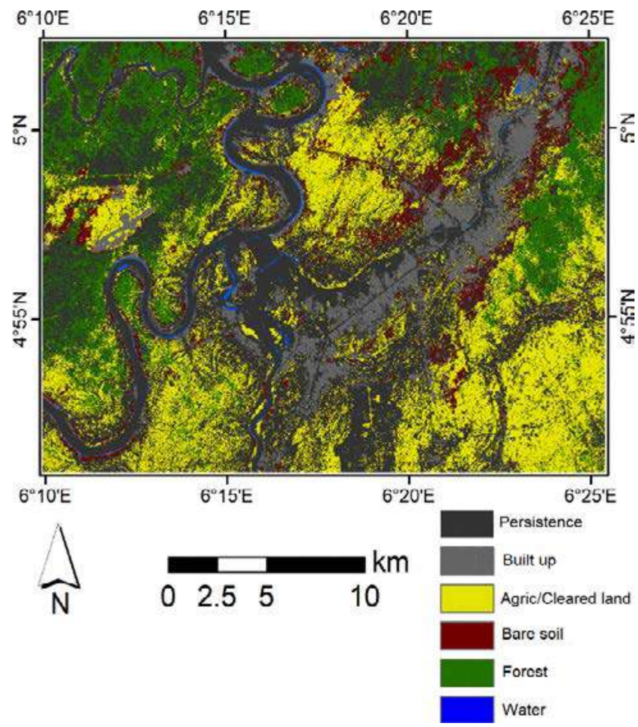

Fig 8: Yenagoa gain- persistence 2002 and 2018

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Table 1. Land use pattern of Yenegoa 1987 and 2002

Land Use categories	Total area covered in 1987 km^2	Percentage of total area covered in 1987	Total area covered in 2002 km^2	Percentage of total area covered in 2002	Percentage of total area Gain	Percentage of total area Loss	Total change of the area (Gain + Loss) (%)	Absolute value of net change (Gain – Lose) (%)	Swap (total change – absolute valve of net change) (%)
Built up	37.9758	6.23	58.9572	9.76	6.32	2.79	9.11	3.53	5.58
Agriculture/cleared	172.3725	28.53	219.7359	36.36	19.04	11.21	30.25	7.83	22.42
Bare soil	59.85	0.10	182.0529	30.14	30.13	0.09	30.22	30.04	0.18
Forest	366.9858	60.75	115.362	19.09	1.19	42.85	44.04	41.66	2.38
Water	26.5959	4.40	28.1205	4.66	0.68	0.42	1.10	0.26	0.84
Total	604.2285	100.0	604.2285	100.0	57.36	57.36	57.36	83.32	31.40

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Table 2. Land use pattern of Yenegoa 2002 and 2018

Land Use categories	Total area covered in 2002 km^2	Percentage of total area covered in 2002	Total area covered in 2018 km^2	Percentage of total area covered in 2018	Percentage of total area Gain	Percentage of total area Loss	Total change of the area (Gain + Loss) (%)	Absolute value of net change (Gain – Lose) (%)	Swap (total change – absolute valve of net change) (%)
Built up	58.9572	9.76	101.4507	16.79	9.84	2.81	12.65	7.03	5.62
Agriculture/cleared	219.7359	36.36	281.0448	46.51	24.11	13.97	38.08	10.14	27.94
Bare soil	182.0529	30.14	49.2282	8.16	5.13	27.10	32.23	21.97	10.26
Forest	115.362	19.09	143.271	23.72	13.60	8.97	22.57	4.63	17.94
Water	28.1205	4.66	29.2338	4.83	0.53	0.36	0.89	0.17	0.72
Total	604.2285	100.0	604.2285	100.0	53.21	53.21	53.21	43.94	62.48

Table 1 and 2 shows the land use distribution pattern of Yenagoa, the total percentage of built up area for 1987, 2002 and 2018 are 6.23%, 9.76% and 16.79% respectively. From 1987 to 2002, built up land use gained 6.32% persistence and lost 2.79%, with a total change of 9.11%, an absolute net change of 3.53% and a swap change of 5.58%. Between 2002 and 2018, built up gained 9.84% persistence and lost 2.81% with a total change of 12.65%, absolute net change 7.03% and a swap change of 5.62%.

Agriculture/cleared land use covered a total area in percentage of 28.53%, 26.36% and 46.51% in 1987, 2002 and 2018. From 1987 to 2002, agriculture/cleared land gained 19.04% persistence and lost 11.21%, with a total change of 30.25%, absolute net change of 7.83% and a swap change 22.42%. Between 2002 and 2018, agriculture gained persistence of 24.11% and lost 13.97% with a total change of 38.08%. The absolute net change of 10.14% while swap change of 27.94% was recorded.

Bare soil covered a total area in percentage of 0.10%, 30.14% and 8.16% in 1987, 2002 and 2018. From 1967 to 2002, bare soil gained 1.19% persistence and lost 42.85%, with a total change of 44.04%, absolute net change 41.66% and a swap change 2.38%. Between 2002 and 2018, bare soil gained 5.13% persistence and lost 27.10%, with a total change 32.23, an absolute net change 21.97% and a swap change of 10.26%.

Forest land use covered a total area in percentage of 60.75%, 19.09% and 23.72% in 1987, 2002 and 2018. From 1987 to 2002, forest gained 1.19% persistence and lost 42.85%, with a total change of 44.04%. The absolute net change of 41.66% and a swap change 2.38% was recorded. Between 2002 and 2018, Forest gained 13.60% and lost 8.97%, with a total change of 22.57%, absolute net change of 4.63% and a swap change of 17.94%.

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Water bodies covered a total area in percentage of 4.40%, 4.66% and 4.83% in 1987, 2002 and 2018. From 1987 to 2002, water bodies gained 0.68% persistence and lost 0.42%, with a total change of 1.10%, absolute net change of 0.26% and a swap change 0.84%. Between 2002 and 2018, water bodies gained 0.53% and lost 0.36%, with a total change of 0.89%, absolute net change of 0.17% and a swap change of 0.72% was recorded.

The result indicates Built up area and Agricultural/cleared land use experience increase and gained persistence in 1986/7 and 2018. With a slight increase in water body, bare soil, forest recorded decreased and loss during this period. The increase in buildup and cleared agriculture is due to urban expansion, construction and development is taking places opening of new lands. The slight increase in water body was due to heavy rain fall and the swamp nature of the study area.

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3.2 Intensity Analysis Results

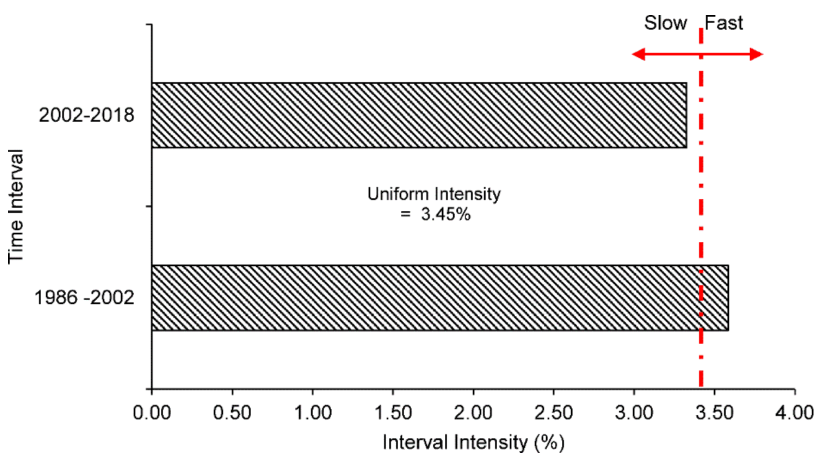

Fig 9: Interval Intensity of Yenagoa 1987-2018

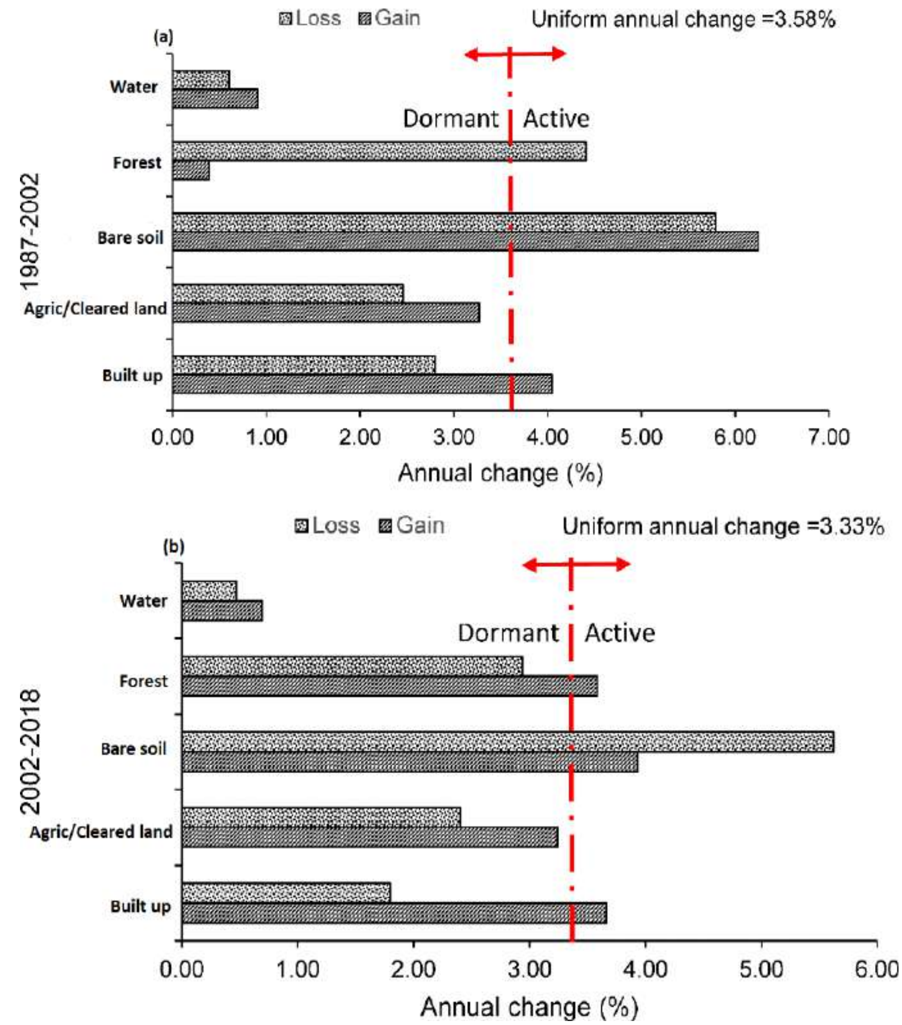

Fig 10: Category Intensity of Yenagoa (a) 1987-2002 and (b) 2002-2018

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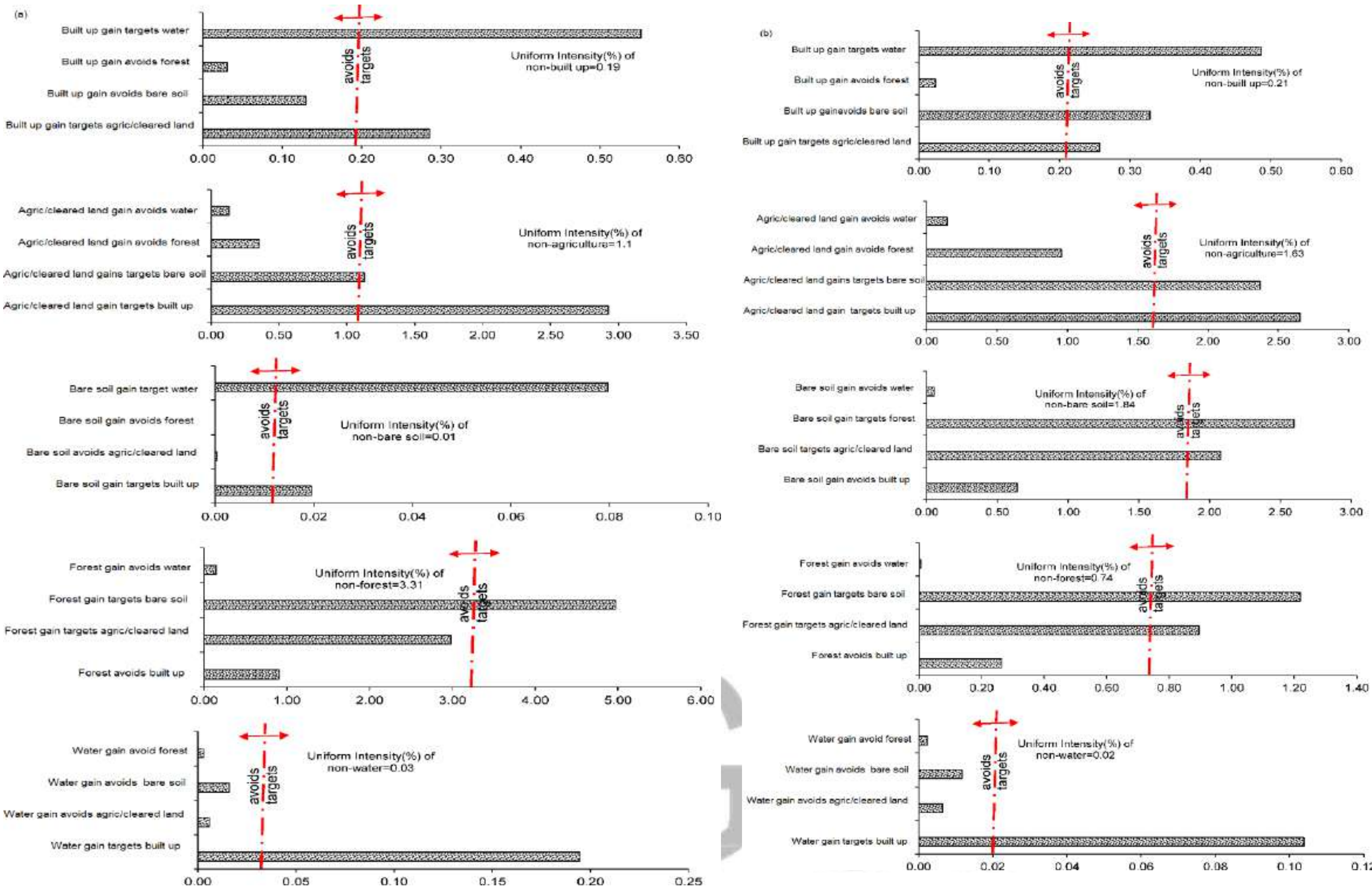

Fig 11: Transition Level of Land use Yenagoa (a) 1987-2002 and (b) 2002-2018

At the interval level of intensity, a uniform intensity of 3.45% is expected for urban land use/cover for Yenagoa. The comparison of the observed with the expected in Figure 9 shows that between 1987-2002 the intensity is (> 3.45%) the uniform intensity which indicate a pick pace for urban development while the period of 2002-2018 the annual intensity (< 3.45%). This indicated that for all the land use /cover the earlier period 1987-2002 witnessed a fast intensity of change than the second period and the changes were not perfectly stationary when compare across each time interval. At the category intensity level of Yenagoa Figure 10, from the first time interval 1987-2002 (Figures 10a) showed loss and gain in bare soil, loss in forest gain in built up exceeded the uniform annual change intensity of 3.58% and were relatively active and experience more intensity gain during this period. While loss and gain in water, agriculture/clear land gain in built up loss were dormant when compare to the uniform intensity of 3.58%. This gave an indication that bare soil, loss in forest and built up gain are the most active during this period. For the second time interval (Figures 10b). Showed loss and gain in bare soil, loss in forest gain in built up exceeded the uniform annual change intensity of 3.58% and were relatively active and experience more intensity gain during this period. While loss and gain in water, agriculture/clear land gain in built up loss were dormant when compare to the uniform intensity of 3.33%. This gave an indication that bare soil, loss in forest and built up gain are the most active during this period. When compare across the two period from the first and second time interval at the category level change intensity Water body, Bare soil, Agriculture, and Built up area were stable across the landscape in Yenagoa.

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From the transitional intensity of Yenagoa (Figure 11) , the first time interval 1987-2002 (Figure 11a) the result showed that a gain in built up area is most at the expense of loss water and agriculture/ cleared land . Gain in agriculture/cleared land targets bare soil and built up. Bare soil targets water and built up. Forest gain targets bare soil. Water targets built up.

The second time interval 2002-2018 (Figure 11b) the result showed that a gain in built up area is most at the expense of loss water, bare soil and agriculture/ cleared land. . Gain in agriculture/cleared land targets bar soil and built up .Bare soil gain targets forest and agriculture/cleared land. Forest gain targets bare soil and agriculture/cleared land. Water targets built up.

the results showed that intensity of landuse change in the study area is generally increasing, the increase in the intensity of landuse change could be attributed to sustained built-up gain in the study area during the period of this study (Fig. 11).Intensity of built-up area gain were active in 1986-2002 and 2002-2018. However this suggests a large-scale forced migration of people into the state capital of Yenagoa during the period. This is evident in Fig. 8 where built-up area gained a large area and a simultaneous increased the implications of rapid increased in built-up area and forest loss in the study area include threat to habitat in a globally important biodiversity hotspot, increasing pressure on available agricultural land because of increasing population, and pollution . The results of this study have provided better insight into land use change patterns in Yenagoa which could also apply in other biodiversity-rich region

4. Conclusions and Recommendations

Urban land use change is an unavoidable natural process. However rapid urban land use change caused by anthropogenic activities has led to several negative consequences. Monitoring and analysing the annual land use change in Yenagoa metropolis, Bayelsa State, Nigeria is an important component of urban planning and management. The study area has undergone major landuse alteration between 1986-2018, the study area has experience a decline in forest, bare soil, water bodies during this period and also gain substantial increase in gain and persistence in built up area and agriculture/cleared land use, forest land, bare soil and water land use will likely continue to decrease due to population growth, and human settlement in the study area. This result has shown that the decline forest land and increase in agriculture land will lead to forest degradation and deforestation with implications on people livelihoods biodiversity and ecosystem services.

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The intensities of urban land use shows that urban annual land use change intensities was relatively fast for Yenagoa in the first time interval 1986/87-2002, and the change were not stable when compare across the two period of time for the interval level of intensity. The category level of intensity bare soil was stable and experiences more intensity gain and loss across the study area. Transitional level reveal that built up area target at the expense of other land use and the changes were not stable when compare across the two period of time this indicating that significant changes occurred in the region that consequently affected the ecosystem and human life . The increase of surface area covered by built up area and agriculture land use as well as decrease in the area covered by forest bare soil, water could increase the likeliness or probability of different types of natural hazards especially urban flooding which is predominant in the region. These changes in landuse is a reflection of the influence of local and national polices and human impacts on the study area which has resulted in the increased in built up and agricultural land use. Majority of the land are being converted to build up area to increase infrastructure development the major changes observed in this study requires urgent intervention from forest managers, environmentalist, decision makers and stakeholder to address.

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