



# Geomatic approach in assessing locational variation in compliance with building law according to educational status of developers, in Calabar Metropolis, Nigeria

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## Abstract

Education is key to Development and Sustainability as compliance with Building law depends significantly on the Educational level of Building Owners. This study aimed at evaluating the locational variation in level of compliance with building law according to the Building owners' educational status at the time of Building. The study was carried out in Metropolitan Calabar. Primary data were collected using direct field measurement of building characteristics pertaining to safety and health of the residence. A total of 749 questionnaires were administered to building owners according to the 13 sampled districts. Data collected from the field was subjected to statistical analysis using the Analysis of Variance (ANOVA) and geospatial analysis. The geospatial techniques adopted for the study was the Interpolation Analysis, which was further adopted to was buttress the variation of compliance with Building Law according to Education status. Result of the ANOVA, shows an f ratio of 18.32 at a degree of freedom of 805, hence giving the researcher the power of rejecting the null hypothesis whilst upholding the alternative hypothesis that there exist a significant difference in the level of compliance factored against Educational status and level of awareness of Building owners in Calabar Metropolis. Same result was obtained from the interpolation of the mean compliance level of Building owners in the Study Area. It was recommended that education of Building owners should be thoroughly improved. This can be achieved by government Budgeting and making funds available to subsidize, education or possible make primary and secondary education free as well as increase grants for further studies for especially, indigent students in the poorer performing compliant Districts. This will increase the stock of knowledgeable elites in the Study Area.

**Keywords:** Locational Variation; Educational Status; Compliance, Building Law; Interpolation; Inverse Distance Weighting (IDW)

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## **1. Introduction**

The need for sustainable, liveable and safe building cannot be disputed. In order to ensure the safety, liveability, functionality and sustainability of Buildings, there should be standards to which Building owners must comply. The need for this standardization in Building has manifested in series of regulations and policies adopted by Governments of various countries especially the Developing Countries (Vaibhav, 2014). In Nigeria, the Federal government had deemed it fit, to adopt environmental policies and regulations specifically those pertaining to Building standards and these have been encapsulated in the umbrella legislation known as Urban and Regional Planning (Decree No. 88 1992). Whilst, the government of Cross River State on its own part, enacted The Building Regulation of 1984, as amended in 1987 (Offiong, 2018), in order to ensure regulatory standards when it comes to Building constructions within the State. However, and regrettably too, irrespective of the Building Law formulated by the Cross River State Government there has still been persistent cases of spiteful violations of these laws notably, within Calabar , the Capital City. This has been so over the past 31 years since the Law was enacted, with studies showing that Education is key to knowledge and civility (Baiche, et'al 2013, Haury et'al 1998). The current issue of violation can only get worse with the present level of Education across Residential Districts in Calabar. This shows the extent at which the Government of Cross River State has failed in carrying out its Sustainability goals especially with the increasing fallen standard of Education in an already civil service oriented state with too few monies in the hands of the people to either seek further knowledge of the world around them or sponsor members of their families in furtherance of Higher Education. This has called for the need to examine the Education level of Building Owners and its relationship with level of compliance with Building Law across different locations in the Study Area. The study with the Resulting data analysed using the geomatic approach in assessing the pattern of spread of compliance with Law across the 13 Districts of the Study Area.

### **1.1. Literature review**

Building codes and regulations are relevant in ensuring the safety and sustainability of a residence, however, the rate of non-compliance with these codes and regulation is very alarming. Factors that lead to the increasing level of non- compliance are in multiples. However, the level of education attained by these Building Owners plays an important role in compliance with the Building regulations. In order to strengthen this fact, Baiche, Walliman and Ogden (2006) in their study on levels of compliance with Building Regulations and standards typically achieved in England and Wale, adopting a questionnaire survey of occupants of recently completed speculatively built houses, with a total of 200 questionnaires distributed in eight housing developments completed 9-15 months previously, discovered that the levels of compliance were not always sufficient, though there was no evidence of systematic and purposeful non-compliance with building regulations. Faults were largely due to lack of skills and knowledge of the required standards on the part of the operatives, and shortcomings in site management and toleration of sub-standard workmanship. The researchers emphasize need for more initial and continuing training of tradesmen, both in trade skills and knowledge of the provisions of building regulations, and more rigorous site management procedures adopted, particularly when pressure for completion is at its greatest.

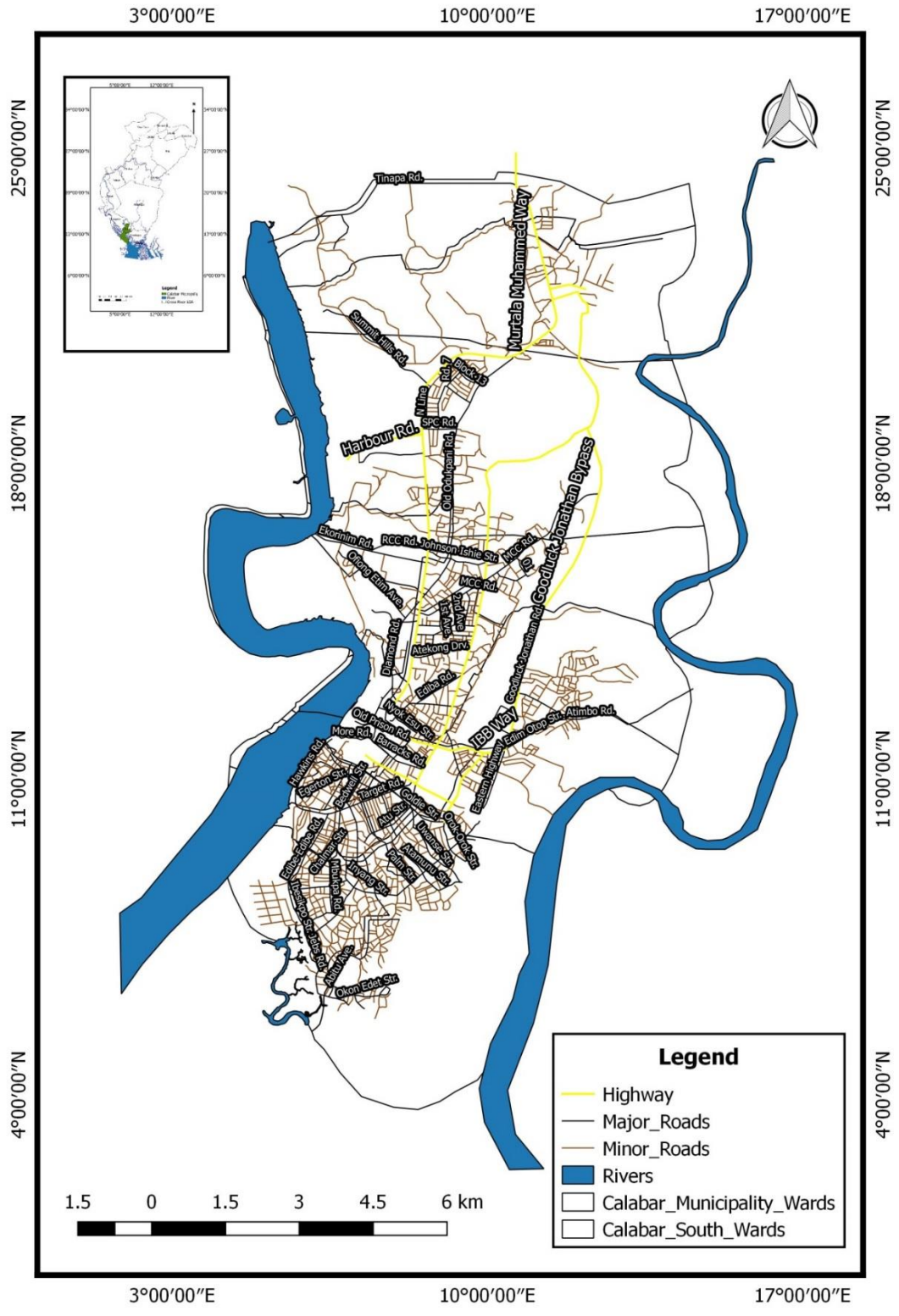
Offiong (2017) study on the spatial difference in the level of compliance with building Law across residential built up districts in Calabar Metropolis. Compliance with building regulations differs according to residence, where residence with Building owners with low level of education comply least and residence with building owner with high level of education complying most with the building regulations. The recommendation is that there should be improved compliance with building law across built up residential districts of Calabar Metropolis.

## 2. Material and method

### 2.1. Study area

Calabar Metropolis lies between Longitude 8°18'00" E to 8°24'00" E and Latitude 4°54'00" N to 5°04'00" N. The Metropolis is divided into Calabar South and Calabar Municipality. It is bounded by the Calabar River to the West and the Great Qua River by the East, Odukpani Local Government Area to the North and Akpabuyo Local Government Area to the South. The area covers 137.039 sqkm with Calabar Municipality having a land coverage area of 103.491sqkm and Calabar South having a land coverage area of 33.548sqkm. The Metropolis is 93km away from Uyo, 107km away from Aba, 147 km away from Port Harcourt and 570km away from Lagos (Njoku, 2012).

Calabar Metropolis had a population of 328, 878 in 1991, according to the National Population Commission (NPC). The 2006 population census didn't show a significant change in population with Calabar Municipality having a population of 183,681 persons and Calabar South having a total of 191,515 persons, amounting to a total of 375,196. In 2015, Calabar Population stood at 466,800. This was 0.256% of total Nigeria's population. It was predicted that if population growth rate would be same as in period 2006-2015 (+0.89%/year), Calabar population in 2018 would be: 479 329 (<http://population.city>, 2017). The number of buildings in Calabar Metropolis in 2016 had grown to 15,894 according to Nigeria's population and Housing census drawn from the thirteen (13) metropolis residential areas being studied (Offiong, 2018). Ebong (1983), observed that housing in Calabar has become the thorniest problem facing its inhabitants (Offiong, 2018). Due to the increasing population of resident in the study area, houses were erected with no compliance with the law.. It can be easily observed that more than 50% of districts already designated as residential locations are yet to be fully built up. These include settlements and suburbs such as Ikot Ekpa, Ikot Effiom, Eyamba,Obot Okoho, Bacoco, Awkada,Adebyo Ikot Omin, Ekaobo, Ikot Nkebre, Ikot Enobong, Ikot Omin, Ine Udo, Ndito Okobo, Ine Akpan Ufana, Ine Udo, all surrounding the completely built up area but hindered by a near absence of access roads (Offiong, 2018). .Due to the economic condition of the state and the fact that the state is among the educationally disadvantaged State in Nigeria (BENTENBLOG, 2018), compliance in the State is unimpressive and leaves much to be desired.



**Figure1.** Map of Calabar Metropolis (Source: <http://www.geospatiallinks.com.ng>)

## 2.2. Types of data

In order to achieve the objective of this study, both Primary data and Secondary data were employed. The primary data used in the study were based on questions on the education status of respondents (owners of buildings), asked in the questionnaire. The secondary data used included data on existing literatures and journals as well as Legal Documents on Building standards.

## 2.3. Sources of data

Both primary and secondary data were adopted in this stud. The primary data source include questionnaires administered to respondents, and direct field measurement of building characteristic. While secondary data used were data from the Cross River State building regulations, existing literatures and articles

## 2.4. Data collection procedure

Data pertaining to this study was collected using a questionnaire survey, were 749 questionnaires were administered (Adopted from Offiong, 2018).. To assess the Education status of Building owners, Education level was ranked from Highest (3) to Lowest (1) as shown in table 3. The ranking was used to measure the level of Education attained by Building Owners, which was then compared with the compliance with Building Law, so lower cases as to show if Education, actually affect compliance with Building Law.

**Table 1.** Ranking of Educational Status of owners of building Prior to the Building Construction

Educational Status		Ranking
Low Level	Primary and below	1
Middle Level	Secondary	2
High Level	Tertiary and post-graduate NCE, College of Technology	3

*SOURCE: Cross River State Building Regulations 1984 as amended in 1987as adapted from Offiong, 2018*

In measuring the compliance level of Building Owners a set of rankings was applied to estimate how well Building Owner comply with Building Law. The ranking begins from 1 (poorer) and terminates in 4 (Good or full compliance). Table 2 shows the ranking of the compliance standard adopted in the study.

**Table 2.** Compliance Classification Standard

Compliance		
Mean grouping	Ranking	Classification
1 – 59.4	1	Poorer
59.5 – 79.4	2	Poor
79.5 – 95.4	3	Fair
95.5 – 100	4	Good (Full compliance)

Source: Researcher's Field Work 2017 adapted from Offiong (2018)

## 2.5. The sample

The study sample was made up of 794 residential buildings selected from the 13 residential districts of the study area. The 13 residential districts captured the metropolis residential areas contiguous to the completely built up area in Calabar metropolis. The 794 buildings selected represent five per cent of total number of buildings on separate stand.

Measurement of buildings was done considering 5percent of buildings on separate stand selected using systematic random sampling technique in each of the 13 metropolis residential districts that made up the study area. Copies of the questionnaire were distributed to owners of the buildings measured. From Table 3.1, out of 794 buildings measured, 742 copies of the questionnaire representing 93percent were successfully retrieved. This number was considered representative enough for the study.

## 2.6. Sampling technique

The multi-stage sampling technique was adopted for this study due to the objective of the study. The multi-stage sampling or multi-stage cluster sampling is a complex clustering technique that involves 2 or more clustering techniques. This technique clusters large population size into smaller clusters for easy examination (Research Methodology, 2018)

In the first stage, a purposive sampling was done to select all residential districts that satisfy the researchers' objective that is to study only buildings within the metropolis residential districts which are contiguous to the completely built up area in the Calabar Municipality. The districts so captured include Akim Qua Town, Ediba Qua Town, Essien Town, Ishie Town, Ikot Ansa, University Satelite Town, Ikot Efa, Esuk Utan, Ekorinin, Nyangasang and Edim Otop (adapted from Offiong, 2018).

The second stage of the multi-criteria technique was to capture only buildings on separate stand/yard. This housing type, apart from forming the highest percentage (57.2 percent) of dwellings for regular households in Calabar municipality, as adapted from Offiong (2018) it also guaranteed the probability of measuring all the ten building variables used for the study. Other types of housing unit include; informal

improvised dwelling (0.6 percent), semi-detached (7.3 percent), flat in block of flats (10.4 percent), Traditional Hut structure (9.5 percent), others (0.4 percent). , The second stage adopted a systematic sampling to select the next cluster. In other to carry out the systematic random technique, a sample frame was defined for each street at the interval of 20 buildings according to the number of buildings on separate stand/yard with a target of not less than 5percent in mind.

The third stage involved repeated systematic sampling in districts where the minimum 5percent was not met at first time due to repeated absence or outright refusal to allow measurement or supply needed information by owners of buildings within the frame.

**Table 3.** Number of Building Measured According to Residential Districts

S/N	Residential Districts	No. of Buildings	No. of buildings measured/ questionnaire administered.	Questionnaires Retrieved.	Percentage retrieved
1.	Akim Qua Town	2020	101	99	98
2.	Ediba Qua Town	1837	92	82	90
3.	Big Qua Town	2361	118	117	99
4.	Essien Town	1942	97	97	100
5.	Ishie Town	2627	131	112	85
6.	Ikot Ansa	1722	86	73	84
7.	University Satellite Town	750	38	38	100
8.	Ikot Efa	414	21	18	85
9.	Esuk Utan	204	10	10	100
10.	Ekorinim	441	22	22	100
11.	Esuk Atu	240	12	12	100
12.	Nyangasang	720	36	36	100
13	Edim Otop	616	30	25	83
	<b>Total</b>	<b>15, 894</b>	<b>794</b>	<b>742</b>	<b>93</b>

*Source: 2006 Population and Housing Population Data Bank, Nigerian's National Population Commission as adapted from Offiong, 2018*

**Table 4.** Requirement of the Cross River State Building Regulation of 1984 adopted for the study

S/N	Sections	Long Title
1.	S.2(A) (4)	Building Plan: Building must be with approved building plan
2.	S.5	Building line: At least 12 meters from road centre.
3.	S.13 (6)	Ceiling height: Minimum dimensions shall be 2.88meters
4.	S.6(3)	Set Back: Minimum permissible distance between a bungalow and other building not less than 4.5 meters.
5.	S.7	Building size restrictions: Not more than 50percent of land size should be built up.
6.	S. 13(b)	Size of living room: Shall be 12.96 square meters with width not less than 3.00 meters
7.	S. 16(3)	Height of ground floor: Shall not be less than 0.15 meters above the level of adjacent ground.
8.	S.19(1) (2)	Ventilation: Buildings shall have adequate cross ventilation with windows size not less than $\frac{1}{8}$ of the flow area of the room.
9.	S. 6 (1)	Space around buildings: A minimum distance of 1.5 meters shall be allowed from the property boundaries not facing any road.
10.	S.13 (d)	Corridor dimension: The minimum width shall be 1 meter.

*Source: Cross River State Building Regulations, 1984 as adopted from Offiong, 2018*

## 2.7. Procedures for data analysis

To assess the variation in compliance with Building Law according to Education status of Building owners an inferential statistical test was adopted in the study. The type of test used is the Analysis of Variance test (ANOVA), where the education status of the building owners represents the Independent variable while compliance with Building regulations represents the Dependent variable.



Furthermore, an Interpolation algorithm called the Inverse Distance Weighting (IDW) was applied in further buttressing the locational variation in compliance level with Building Law across the 13 districts in the study area and also shows the spread of compliance. In carrying out the IDW interpolation the X (Longitude), Y (Latitude) Z (Mean Compliance Level) variables of each districts were acquired from satellite imagery, measurement of physical variables and questionnaires issued to Building Owners.

### 3. Result and discussion

Table 5 shows the level of compliance with building regulation and the education level of Building owners. From the table, the lower the education status of the building owners the lower the compliance level with the building regulations. Based on the findings, Building owners with low education level, have the lowest compliance level. While Building owners with high education level have the highest level of compliance with the building regulation.

**Table 5.** Level of compliance with building regulations factored by Education Level of Respondent Prior to the Building Construction in the Study Area

Educational Status	Ranking	Mean Compliance Level	N	Std. Dev	Compliance classification
Low Level (primary and below)	1	71.47	154	18.64	Poor
Middle Level (secondary)	2	74.18	169	21.99	Fair
High Level (tertiary and post-graduate)	3	80.48	458	16.39	Good
Total		77.34	781	18.56	Poor

*Source: Researcher's fieldwork, 2017*

#### 3.1. Test of hypothesis

$H_0$ : The level of compliance does not varies according to education status of building owners across the 13 residential districts

$H_1$ : The level of compliance varies according to education status of building owners across the 13 residential districts.

**Table 6.** Result of Regression Model for Level of Compliance with Building Regulations in the Study Area

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.452	0.205	0.198	0.645

*Predictors: Education Level,*

*Dependent Variable: Compliance Level*

*Researcher's fieldwork, 2017 as adopted from Offiong, 2018*

Regression models and the regression co-efficient were adopted for the analysis of the data in Tables 6. The summary of regression model is presented in table 5. From table 6 the result shows that there appears to be a strong relationship between level of compliance with building regulations and education of the respondents. From Table 4.5, the coefficient of linear determination is  $R^2 = 0.205$  or 21 per cent. This implies that the model was significant at  $<0.001$  level with an f-ratio of 31.787.

The regression model for level of compliance to Building regulations in the study area was derived from the unstandardized coefficients, (Table 7).

It is given by:

$$Y = 1.20 + 0.014x_1$$

Where :

Y = level of compliance with building regulations

$X_1$  = Respondents education

**Table 7.** Coefficients of Regression Model

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardize	t	Sig.
		B	Std. Error	d Coefficients Beta		
1	(Constant)	64.715	2.084		31.052	.000
	Education Status	4.851	.835	.201	5.808	.000

a. **Dependent Variable:** Level of Compliance

The respondents' education level is a good predictor in the relationship determining the level of compliance with building regulations in the study area as shown in table 7 above,  $|t| > 2$  for both cases. From the result of regression coefficients in Table 7, given a unit increase in education, level of compliance will increase by 4.851 units.

ANOVA for the Variation of the Level of Compliance with Building Law Across the 13 Residential Districts According to the Education Status of Property Owners as at the Time the Building was Erected in the Study Area.

**Table 8.** ANOVA Summary

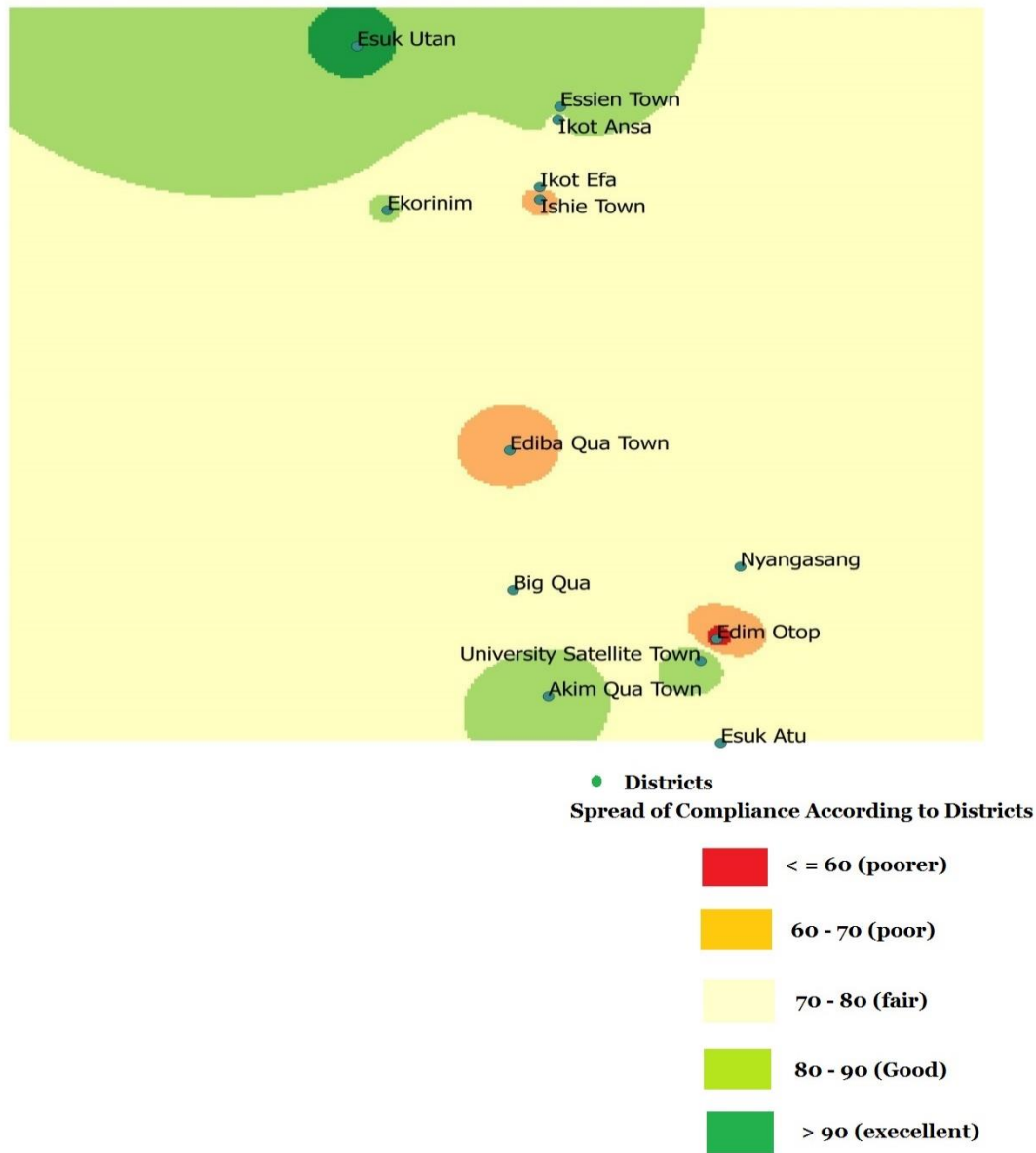
ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	79179.428	13	6090.725	18.316	.000
Within Groups	263366.048	792	332.533		
Total	342545.475	805			

*Predictor = District in the study area*

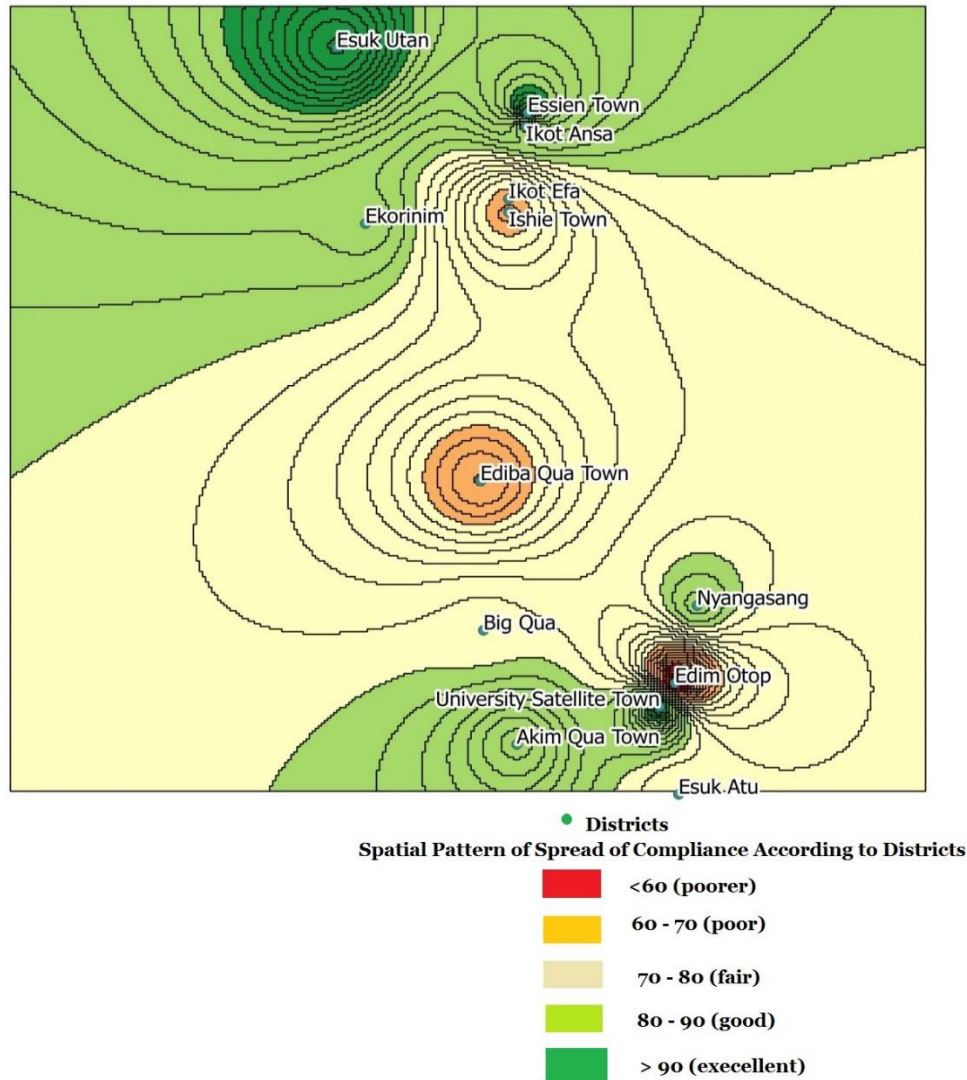
*Dependent= Level of Compliance*

From the ANOVA result in table 8, the f-ratio of 18.32 is derived with a degree of freedom of 805. This f-ratios at 805 degrees of freedom is significant at  $<0.001$ . Since,  $P < 0.001$  is lower than the 0.05 confidence limit set for the study, the null hypothesis is rejected in favour of the alternative hypothesis, which states that the level of compliance with building regulations varies across the 13 according to the education status of owners of buildings prior to the building construction varies significantly in the study area. Hence, the level of compliance with the building regulation varies across all 13 districts according to the education status of the building owners prior to the time the building was constructed.

However, to analyse the pattern of variation a Geometry approach using the Inverse Distance Weighting Interpolation was applied based on the Four (4) classification standard as shown on Table 2. Curiously, the interpolation analysis re-classified the researcher's classification standard into Five (5) to include the excellent ( $> 90$ ), the good (80-90), fair (70-80), poor (60-70), poorer ( $<60$ ).



**Figure 2.** Spread of Compliance with Building Law Across 13 Districts



**Figure 3.** Pattern of the Spread of Compliance with Building Law

Figure 4 is the map of spatial of compliance across the 13 Districts of the study Area. Figure 5 shows the pattern of spread of compliance with building Law across the 13 selected Districts of the study area. Based on the analysis, Districts with dark green colour have a compliance level  $\geq 90\%$ , making them excellent compliers with the law. Districts with lighter green color have compliance level from 80-90 making them good compliers, areas with Light yellow color, have spatial compliance from 70-80 making them fair compliers with the law, Districts with orange and red color have compliance level of 60-70 and 0-60 respectively. These are people with poor and poorer compliance level, respectively.

The analysis showed that there exists a significant variation in the level of compliance across the 13 Districts in the study Area. From the analysis output, Esuk Utan located at  $8^{\circ}21'19.40''E$ ,  $4^{\circ}57'7.40''N$ , E with a compliance level of 92.62, University Satellite Town located at  $8^{\circ}21'12.70''E$ ,  $4^{\circ}57'39.99''N$ , with a

compliance level of 90.66 and Essien Town, located at 8°20'26.03"E, 5° 1'20.70"N, with a compliance level of 90.62, comprises of the Elites Class and well educated citizens of the State understandably, making them excellent compliers of the Building law. The areas within the good class are Akim Qua located at 8°20'22.11"E, 4°57'25.97"N and Ekorinim located at 8°19'28.50"E, 5° 0'39.45"N. Also, areas within the poor class are, Big Qua located at 8°20'10.32"E, 4°58'8.36"N, Nyangasang located at 8°21'25.96"E, 4°58'17.58"N and Esuk Atu and areas within the poorer class are Ediba located at 8°20'9.24"E, 4°59'3.87"N, Ikot Efa located at 8°20'19.19"E, 5° 0'48.65"N and Ishie Town located at 8°20'19.25"E, 5° 0'43.68"N. Finally area in the poorest class is Edim Otop located at 8°21'18.10"E, 4°57'48.69"N. Figure 5 also shows that the compliance level of the excellent class, Good class and poor class decrease as it spreads outwards from the centre, while the spread of compliance for areas within the poorest zone increases outward from the centre. This accounts for the reason areas like Ikot Ansa and Ekorinim, are within the good class because the compliance level decreased from Esuk Utan to the nearby districts. Also from the map drawn from the Geomatic analysis, compliance level at Ediba town, Ikot Efa and Ishie town decreases as compliance spread farther to Big Qua and other towns. However, at Edim Otop, due to the nature of the district as a village, and most of the residents in this area are typically low income and middle income earners, with low education status, Building owners in this District naturally comply least with Building Law. And the level of compliance increases outwards as it spread to Nyangasang the University Satellite Town and Akim Qua Districts.

#### 4. Conclusion and recommendation

The analysis of data based on the target objective represents the Education Para-meter of compliance problem in the study area. Educational status of life of citizens and would be developers and ensure the professional competence of supervisors of buildings will be imperative. This will be necessary in order to improve the present level of compliance with Building Law in Calabar, occasioned by the present level of educational status involved in building construction work on the other hand.

Although level of educational attainment is a function of individual choice, but availability of funding is important, given the present low level of income identified in the study area. It is recommended that government should encourage residents to aspire to higher educational status and put in place measures such as would improve the income of citizens. An improved integrated approach to education as is being done in Akwa Ibom State, where education up to the secondary level is free, can be adopted for cross River State. This will give every family an opportunity not only to have their children in school, but also to build up capital for either business or savings which can improve their chances of providing further education for their children. In addition to free primary and secondary education, the improved integrated educational approach will involve providing incentives such as grants and educational aids and sponsorships. Government can shop for donor agencies in support of its educational funding programmes targeted at improving the educational status generally.

Also, The Town Planning Authority should adopt an integrated approach to education about building requirements and planning programmes. This should go beyond mere information about the existence of

minimum building standards to include information on the importance of the programmes from the formulation to implementation stages. This is important because people will more readily obey laws which they participated in formulating or for which they were consulted in the process of formulation. This is so because they would be more willing to comply with prohibitions which they collectively see as their own.

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