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EFFECTS OF URBANIZATION ON ECOSYSTEM SERVICES IN BAMENDA III, NORTH WEST REGION- CAMEROON

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ABSTRACT

Urban growth and the concentration of people in urban areas are creating societal problems world-wide. In most towns and cities in Cameroon especially in Bamenda, Yaounde and Douala where urbanization have intensify within the last few years, the colonization of green areas, wetlands, grass lands, forest parks, and communal forest which constitute among other things the ecosystem in these areas have been alarming and calls for concern especially for the sustainability of the ecosystem services in the future. In this study, Bamenda III, which form part of the Bamenda City Council and a primate city par excellence has witnessed dramatic changes in its peri-urban zone. This study thus examines the effect of urbanization on ecosystem services in Bamenda III Municipality. The researcher examines the effect of population growth on urban ecosystem services in Bamenda III municipality. A hypothesis was set and tested at .05 significance level. Data for the study were obtained through primary and secondary sources using a mixed design method of inquiry which combines both quantitative methods and qualitative approaches to explore data on the urbanization trend variables such as population patterns from 2007 to 2018 in Bamenda III Municipality and its implications on the landscape linked to the key ecosystem services. Purposive and systematic sampling techniques were used to survey a sample population of 200, drawn using the Miller & Brewer Sample determination Method (2003). The data generated were analyzed using descriptive and inferential statistics. The results from the findings showed that urbanization have negatively affected ecosystem services in the municipality. The linear regression that was used to test the hypothesis at a .05 level of significance indicated a strong Pairwise Correlation at a calculated P-value .001, thus, the null hypothesis which stated that Population growth has no significant effect on ecosystem services destruction in Bamenda III was rejected in favor of the alternative which stated that Population growth have had significant effect on ecosystem services destruction in Bamenda III. Generally, the result have proven that urbanization have greatly influenced the land use changes in the municipality which have negatively affected ecosystem services. As one of the major recommendation, the city authorities especially the City Council Delegate, Urban Development planners, the Mayor of Bamena III, the Civil Society leaders should come together and take concrete decisions that can be sustainable to ensure protection of the urban environment of Bamenda III to meet the ecosystem service needs of future generations.

Key Words: Urbanization, Ecosystems, Ecosystem Services, Bamenda III.

I. INTRODUCTION

Urban growth and the concentration of people in urban areas are creating societal problems world-wide. Most towns and cities in the Sub-Saharan African region especially in Cameroon, Nigeria, and Ghana are already witnessing varying decrease of land cover on features such as urban green areas, wetlands, riparian mangrove forest and grassland ecosystems which are currently giving way for the construction of new roads, new residential and industrial layouts, recreation and amusement parks (Grimm et al, 2000; Scalenghe et al 2009; Groffman et al 2013; Handel et al 2013; Mulluer et al 2013).

FAO (2018) stated that Managing urbanization poses huge challenges, Cities can be hubs of socio-economic development, but the rapid pace of urban growth and the limited resources available to accommodate increasing demand for food and basic services can also present huge barriers for the equitability and sustainability of city development. In Cameroon for example, Douala, Bamenda, Kumba, Buea where the researcher have visited, urbanization has translated largely into unplanned urban expansion accompanied by unsustainable production and consumption patterns, leading in turn to the over exploitation of natural resources there by destroying the ecosystem biomes.

Several studies in recent years have projected global urban expansion and examined its potential impacts on biodiversity and ecosystem services. Burak et al. (2013) after their study of Chinese cities corroborated that the amount of urban land near protected areas (PAs) is expected to increase, on average, by more than three times between 2000 and 2030 around the world.

As land is urbanized, the effects of the conversion on the remaining ecosystems are becoming more apparent. By increasing local temperatures and altering hydrologic and nutrient cycling, land conversion and increasing impervious surface cover has been found to affect forest health which form greater part of world's ecosystem and forest resilience to other stressors (Gavier-Pizarro et al. 2010, Kaye et al. 2005, Matlack 1993, McDonnell et al. 1997). Still, these remnant patches of natural forest are critical to improving air quality, reducing flooding, tempering the urban heat island effect and providing other ecosystem services that are important to both human societies and nature as a whole (Xiao et al. 1998, Nowak et al. 2006).

In Cameroon, Oscar (2015), stated that the natural environment is the foundation for human existence, and obviously very valuable to human. This is old knowledge, and most people feel it intuitively. However, it is only recently that valuing the services of ecosystems has become an object of scientific study and a pressing political subject. The need for these studies has also become more pressing as the speed and scale of the effects of human behaviour on nature have become more evident. Kimengsi et al. (2017), studying urban land use dynamics and development implications in Bamenda III concluded that there has been increase in the area for settlements from 1389ha to 2943ha in the municipality. Most studies on this subject matter have focused on ecosystem services and their importance to the society, proving that the natural environment is the foundation for human existence, and obviously very valuable to us. The effects of urbanization on ecosystem services in Bamenda III have received less attention.

In view of the above, it is clear that there is need to examine the effects of urbanization on ecosystem services in Bamenda III, North West Region-Cameroon. The pertinent questions to be asked include the following: - what explains the rapid degradation of intra-urban and peri-urban natural spaces in Bamenda III at the time when policies on urban greening and sustainable towns are highly solicited? -What could become of the urban ecosystem services in Bamenda III given the anarchy of urbanization?

The null hypothesis tested in this study states:

"That Population growth has made no significant contribution to ecosystem services destruction in Bamenda III

2. Location of Study Area

The study is undertaken in Bamenda III council area North West Region of Cameroon. Located between latitude 5° 58' 30'' and 6° 4' North of the Equator and longitude 10°10' and 10°18' East of the prime meridian, Bamenda III is one of the Council areas that make up Bamenda City in Mezam Division. The council area was created by presidential decree No 2007/1171 of 24 April 2007 alongside the Bamenda I and II Sub-Divisional Council. The sub- divisional council is within the territorial limits of the Nkwen and Dzah villages. The council area is bounded by Bamenda II Sub-divisional Council to the West,

Bafut Sub-division to the North, Tubah Sub-division to East and Bamenda I sub-divisional council to the South.

Bamenda III has a total surface area of 69.6 km² with a population density of 1, 584/km² as of 2005. According to projection in the Minimum Urban Local Development Scheme (SMAUL) February 2018, Bamenda III council has an estimated population of 193110 Inhabitants. In addition to its sub-divisional status, Bamenda III is also the seat of a few economic strengths of the North West Region. At the moment, Bamenda III is the gateway in and out of Bamenda City from Bui, Donga and Mantung, Ngohketunja and Boyo divisions and through the West Region to other parts of Cameroon.

FIG. 1- Location of Bamenda III in Mezam Division of the North West Region

Source: adapted from Bamenda council map

2. Method

This study adopts a mixed method design of inquiry which combines both quantitative methods and qualitative approaches to explore data on the urbanization trend variables such as population patterns from 2007 to 2018 in Bamenda III Municipality and its implications on the landscape linked to the key ecosystem services. Landsat images were taken from Google Earth to compare the land changes and uses from 2007 to 2018 in the municipality. Data for the study was derived through both primary and secondary sources and the target population for the study included inhabitants of Bamenda III. A sample of 200 was drawn from a target population of 193110. The purposive and systematic sampling techniques were adopted for the collection of primary data.

Data collected from the field was analysed using descriptive and inferential statistics, frequency tables and percentages. The hypothesis was tested using multiple linear regressions at 0.05 levels of significance.

The multiple linear regression is expressed as:

$y = a+b_1x_1+b_2x_2+b_3x_3+b_4 x_4 + b_5 x_5e$ ---------- i

Taken the case of the Hypothesis

Letting Y = the dependent variable (Population growth between 2007 and 2018),

X_1 = Independent variable (Increased in road infrastructure)

X_2 = Independent variable (Increased in built-up area)

X_3 = Independent variable (Increased in Educational facilities) and

X_4 = Independent variable (Increased in health Structures)

a = constant (The intercept (*a*) that minimize the squared deviations between the expected and observed values of *Y*.

b = Regression coefficient

b_1 = The estimated slope of a regression of *Y* on X_1

e = the error, random or variables not considered

3. Results

3.1 Effect of population growth on urban ecosystem services in Bamenda III

The Bamenda III council area has since its creation in 2007 witnessed an increase and concentration of its population. This population is concentrated around the urban space and gradually decreases towards the periphery. Many people migrate into Bamenda III council

area. As such, it is very common to find Nigerians, Bamileke's, the Bui's, Ngemba's, and Wimbum people amongst others. These migrants are attracted on the one hand by the trade and agricultural potentials of the council area and on the other hand pushed into the area by the on-going socio-political crises. This explains why in 2018 the area witnessed an unprecedented population increase, totalling 193110 inhabitants as presented on table 1.

Table 1. The evolution of the population Of Bamenda III (2007 to 2018)

Year	Total Population	Population Increase
2007	91436	5486
2008	97272	5836
2009	103481	6209
2010	110086	6605
2011	117113	7027
2012	124588	7475
2013	132540	7952
2014	141000	8460
2015	150000	9000
2018	193110	43110

Source: Council Development Plan (2012); Bamenda III Population statistic department, 2019

As indicated on table1, by the year 2007, the population had reached 91436 and within a space of two years increased to 103481 inhabitants. It is observed from the table that the population had witnessed a constant increased, and by 2018 the population was estimated at 193110 indicating a cumulative increase of 107160 inhabitants. This increase in population has greatly influenced the land use pattern of Bamenda III. The urbanization and development of Bamenda III Sub-divisional Council has had a significant impact on the natural ecosystem and the living environment of the area. The present state of the environment is characterized by unplanned urban sprawling and clearance of communal forest for low housing construction which has a negative impact on ecosystem services.

3.2 Population/Land use cover and it effect on ecosystem services in Bamenda III

The encroachment of various land uses into the peri-urban areas of Bamenda III becomes very much visible and the destruction of the natural ecosystems is evident with the increase in population. To determine the land use changes in the municipality, satellite maps were developed using Landsat images of 1987 and 2018 which were further supported by field work. This assisted the researcher to identify the various land uses ranging from development of road network, dimension of built-up areas in the council area, educational and health facilities as well, which acted as a pull factor for the population. As further illustrated on table 2 below, the dimension of roads both tarred and earth roads in Bamenda III were altogether 9054 meters, in 2010, the number of roads increased covering a total distance of 14735 meters which is estimated to be 14.735 km distance. In the same year, the built-up area was estimated to be 20.1 Sq.km as against 18.1 Sq.km in 2007. Between the years 2015 to 2018, the total roads increased from 19314 to 22626 meters, with a total built-up area from 28.8 Sq.km to 32.3 Sq.km respectively. Educational and health facilities also witnessed an unprecedented increased during these periods. Educational infrastructures increased from 29 to 37 in 2010, 46 in 2015 and to 51 by 2018. Health infrastructures also increased from 3 in 2007 to 9 by 2018.

Table 2. Population and land use cover in Bamenda III (2007-2018)

Year	Population	Road infrastructure (m)	Built-up area (Sq.km)	Educational facilities	Health facilities
2007	91436	9054	18.1	29	3
2010	114815	14735	20.1	37	4
2015	18208	19314	28.8	46	8
2018	193110	22626	32.3	51	9

Source: Bamenda III Population statistic department, 2019

Author's computation, Google Earth, 2019

The author observed during field work that the Bamenda III sub-divisional council upon it creation till today have greatly transformed from a purely peri-urban area of the then Bamenda Urban Council to a semi urban zone with the agrarian land scape facing traits of losing it ecosystem services as new activities keeps on emerging such as commercial structures, banking institution, new lay-out buildings, health and educational services and communication lines.

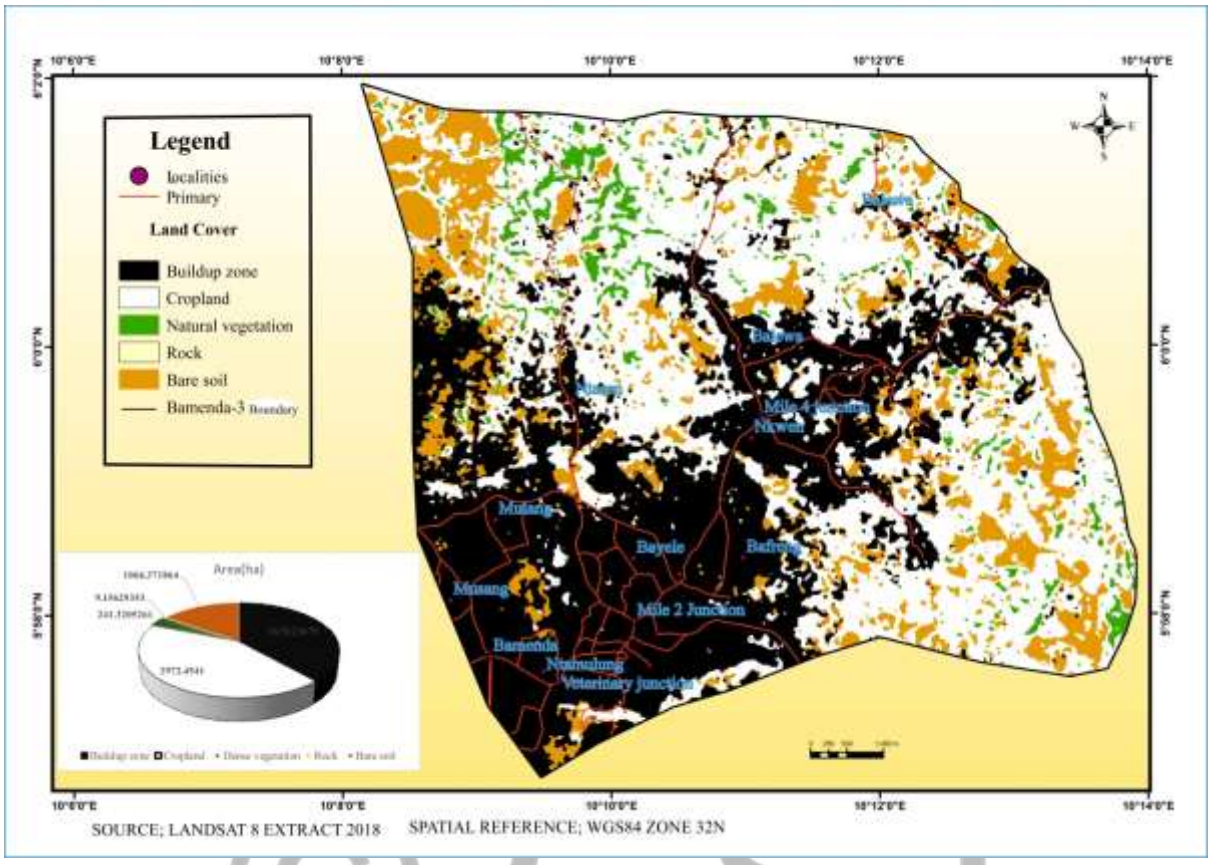

Fig.2- Existing pattern of land use changes in Bamenda III

Source: LANDSAT 8 extract 2018

With Population growth and the urbanization of Bamenda III, most of the lands have been cleared for construction works. These unprecedented increase in population couple with the fact that the existing pattern of land ownership in the municipality is not well documented and controlled by the Delegation of Urban Development Planning or the City Council, poses a serious problem on the ecosystem survival in the area.

According to informant interview with the Mayor of Bamenda III, the indigenous population of Bamenda III owned extensive parcels of customary land which is spontaneously subdivided and transferred to private land owners who build haphazard settlements without any concern to town planning norms. Land conversion to urban sprawl was also considered as a visible indicator of the council expansion, but the manner of sprawling into the peri-urban fringe is not planned as rampant forest is cleared, swampy areas converted to habitats thus destroying the natural vegetation and ecosystem services.

Also, the occupation of risky and vulnerable sites in the process of urban development is alarming in Bamenda III, risky and vulnerable sites such as steep slopes in Sisia quarter, along the Bamenda escarpment and watercourses have been invaded and built upon. This has contributed to the destruction of the natural environment distorting the normal functioning of ecosystem services in the area and poses serious risk to the inhabitants of these areas. Most vegetated watercourses in Bamenda III are destroyed leading to fast flow of runoff water which results in increasing the potentials of floods and the reduction of water bio-diversity.

3.3 Testing of the hypothesis

The hypothesis generated here was that population growth has no significant effect on ecosystem services destruction in Bamenda III. The hypothesis was tested with linear regression at a statistical significance of 0.05. The data on table 2 above were utilized in testing the hypothesis and the pairwise correlation coefficient result is shown. The result indicates a perfect correlation as the variables perfectly correlates within it. As can be observed on table 3 below, expansion of population in the study area correlate very high with increased in the number of constructed roads with a coefficient of .980* and a *P*-value of .001. There is also a perfect correlation between built-up area and population expansion indicated by a coefficient of .996* with a calculated *P*-value of .001. It should be noted here that as the population expanse on the landscape, the independent variables increased in their number, consequently the natural ecosystems in the municipality is destroyed as the landscape is transformed into numerous urban activities.

It is important to note here that correlation, whether simple or multiple ranges from +1 or 1 to -1, therefore, 1,00 in correlation means 100%. Thus, .978, .995 etc. can also be interpreted as 99% proof of the finding result to be true. It is only in the case of inverse correlation a negative sign of -1 is noticed.

Table 3 also indicates strong correlation between population expansion and educational facilities and health facilities as well. This is shown by the coefficient of .991 and .995 respectively. Both calculated *P*-values are shown on the table at .00* respectively indicating that the *P*-value .001 was not up to the target significance level of .05 that was initially targeted.

	Table 4.3 The Pairwise Correlations of the dependent and independents variables of population expansion effect on ecosystem services					
		Y	X_1	X_2	X_3	X_4
Pearson Corrélation	Y	1.000	.980*	.996*	.991	.995
	X_1	.980	1.000	.958	.998	.959
	X_2	.996	.958	1.000	.975	.999
	X_3	.991	.998	.975	1.000	.976
	X_4	.995	.959	.999	.976	1.000
Sig. (2-tailed)	Y	.00*	,010	.002	.005	.003
	X_1	.010	.00*	.021	.001	.020
	X_2	,002	,021	.00*	,013	,001
	X_3	,005	,001	,013	.00*	,012
	X_4	,003	,020	,001	,012	.00*
N	Y	4	4	4	4	4
	X_1	4	4	4	4	4
	X_2	4	4	4	4	4
	X_3	4	4	4	4	4
	X_4	4	4	4	4	4

Source: Researchers field work computation, 2019

The analysis of the hypothesis on the summary model on table 4, also reveals that the coefficient of R was 1,000[a] given an R-Square of 1,000 meaning that 100% of the dependent variable (Y) greatly affected independent variables (X_1, X_2, X_3...). The adjusted R-Square was just perfect and gave a better measure of goodness of fit.

Based on the result, it implies that there was a significant effect of population expansion from 2007-2018 on natural environments and consequently destruction of ecosystem services in Bamenda III as indicated by increases in built-up areas, construction of more roads, increase educational and health facilities. On that note, we therefore rejected the null hypothesis (H_o) which stated that population growth has no significant effect on ecosystem services in Bamenda III and uphold the alternative hypothesis (H_1) which stated that there has been significant effect of population expansion on ecosystem destruction which effected ecosystem services in Bamenda III.

Table 4. Summary of the Model

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error	R Square Change	F Change	df1	df2	Sig. F Change
1	1,000[a]	1,000	.	.00*	1,000	.	1	0	.000

a. Predictors: (Constant), Construction of roads, Built-up area, Educational facilities, Health Facilities,

b. Dependent Variable: Population.

Source: Author's computation, 2019

3.4 Discussion of findings

The study has observed that, population expansion and land use changes have exerted some negative impacts on the ecosystem services in Bamenda III municipality. This objective was followed by a statement of hypothesis. The hypothesis stated that, population growth has no significant effect on ecosystem services destruction in Bamenda III. The hypothesis was tested with multiple linear regressions at .05 levels of significance. The analysis revealed that population growth has significantly impacted the ecosystem services in the study area negatively through haphazard building construction, land reclamation, deforestation and anarchical urban sprawling.

The finding of this hypothesis is in line with a number of empirical studies' found in the body of literature. The finding is in total agreement with Kimengsi et al (2017), who carried out similar research work in the municipality on peri-urban land use dynamics and development implications in the Bamenda III municipality. Kimengsi noted that the consequence of rapid and uncontrolled urbanization in Bamenda III is the growth of peri-urban environment. Adding that, peri-urban zone of Bamenda III has witnessed dramatic changes, and that settlements have expanded to the detriment of wetlands. For the present study, these are exactly the indicators that have contributed to ecosystem services lost in Bamenda III.

Another observation from research findings similar to that of this research is the one carried out by Grimm et al. (2000), Groffman et al. (2013), Handel et al. (2013), and Muller et al. (2013). Their studies stated that urbanization is transforming the urban landscape, thus distorting the ecology of urban zones (Groffman et al; 2003), loss of native biodiversity (Muller et al; 2013), the abiotic stresses such as fragmentation and suppression of natural disturbances which hampers the regeneration of the ecosystems through early succession stages (Handel et al; 2013, or increased surface runoff due to soil sealing (Scalenghe et al; 2009). This research work therefore is in conformity with the one carried out by these authors, because as noted above, the ecosystem services in Bamenda III are deteriorating due to population expansion and human activities on the landscape. The communal forest, wetlands, grassland ecosystems have disappear as the population continue to expand around the peri-urban fringes of Bamenda III.

3.5 Conclusion

Urbanization and urban sprawling is evident with a consistent increase in land use change pattern which continues to decrease the existing ecosystems and its services in the Municipality of Bameda III. Over the years, the population of Bamenda III is in constant increase and there are fears that if measures are not put in place to control the population expansion, the ecosystem services will be completely destroyed. This, therefore, calls for proactive measures by the authorities of Bamenda City, the town planners, the urban ecologist to put in place measures in building the local communities' resilience to adapt to measures introduced.

The roles and responsibilities of various parties involved in urban planning of Bamenda III municipality are largely unclear, overlapping and conflicting. It is not clear who does what, when and where especially between the City Council, the Delegation of Urban Development Planning and the Bamenda III sub-divisional council. In as much as land must develop with humans, we need to put forward the idea of smart growth to avoid some negative consequences. To reduce these problems, one thing will be to create desirable locations within town. Government and stakeholders should put boundaries around specific urban ecosystems such as wetlands, forest, so that the people should not encroach to such areas. These will help support effective and sustainable ecosystem management and ensure urban well-being.

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