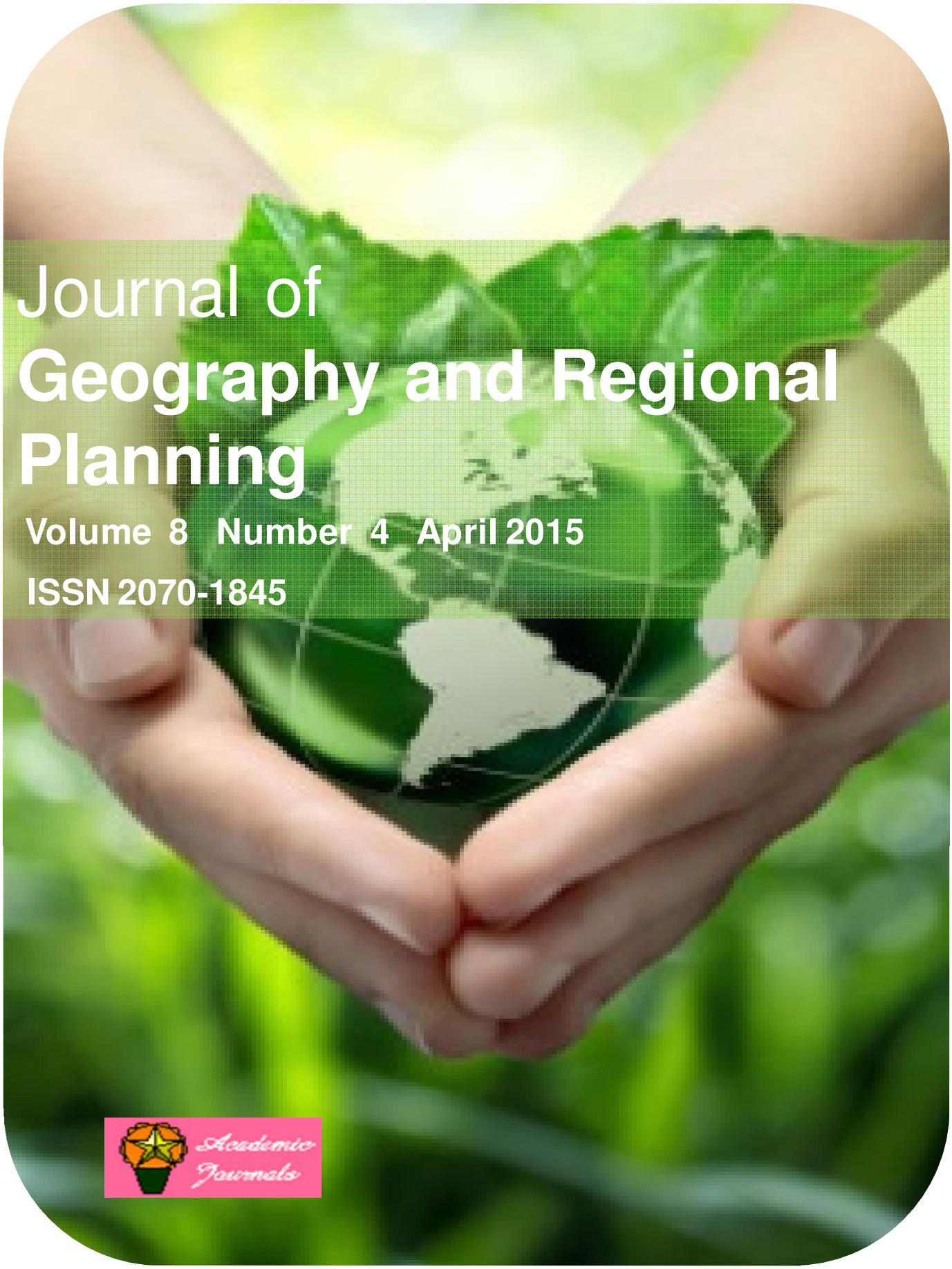


Journal of Geography and Regional Planning

Volume 8 Number 4 April 2015

ISSN 2070-1845

Academic Journals

ABOUT JGRP

Journal of Geography and Regional Planning (JGRP) is a peer reviewed open access journal. The journal is published monthly and covers all areas of the subject**.**

Journal of Geography and Regional Planning (JGRP) is an open access journal that publishes high-quality solicited and unsolicited articles, in all areas of Journal of Geography and Regional Planning such as Geomorphology, relationship between types of settlement and economic growth, Global Positioning System etc. All articles published in JGRP are peer-reviewed.

Contact Us

Editorial Office: jgrp@academicjournals.org

Help Desk: helpdesk@academicjournals.org

Website: http://www.academicjournals.org/journal/JGRP

Submit manuscript online http://ms.academicjournals.me/

Editorial Board

Journal of Geography and Regional Planning

Table of Contents: Volume 8 Number 4 April 2015

ARTICLES

Research

academicJournals

Vol. 8(4), pp. 84-98, April, 2015
DOI: 10.5897/JGRP2014.0454
Article Number: 887C30F52619
ISSN 2070-1845

http://www.academicjournals.org/JGRP

Journal of Geography and Regional Planning

Full Length Research Paper

The incidence of violent deaths in geographic perspective, Colombia, 2004-2013: An analysis based on the concept of spatial regimes

Óscar A. Alfonso R

Universidad Externado de Colombia.

Received 06 August, 2014: Accepted 22 April, 2015

Homicide, deaths in traffic accidents, other lethal accidents and suicide are, by incidence, the causes of violent deaths. Forensic medicine and auxiliary disciplines have made significant scientific contributions to formalize an epidemiology of these phenomena, ethnology being the commonly used methodological choice. This paper proposes two different approaches in order to contribute to this epidemiology, on the understanding that it is a phenomenon that has spread in the country for decades and has affected a considerable contingent of population size. The first is the basic geography of the incidence of violent deaths by town, describing their spatial regularities, while the second chooses the statistical analysis under the assumption that five spatial regimes identified with demographic and economic criteria exist and each one will verify the temporary continuities and certain hierarchy linked to trends in employment or unemployment of the Colombian territory.

Key words: Human Geography, spatial regimes, homicidal violence.

INTRODUCTION

The purpose of this paper is to contribute to the qualification of epidemiological studies on violent deaths in Colombia, a contribution that is confined to clarify the spatial and temporal regularities of the four modalities and formulate some hypotheses that connect their incidence with the ongoing spatial regimes in Colombia, the main one precisely being that there are substantial differences in the incidence of violent deaths, reflected by the rate per hundred thousand inhabitants among spatial regimes. With this purpose in mind, we start discussing the notion of spatial regimes as a prelude to their identification in the case of Colombia, and finally, the incidence of each of the four forms of violent death. The final thoughts are to suggest content policy for the systematic reduction of these incidences until their eventual eradication.

REGIONALIZATION AND THE CONCEPT OF SPATIAL REGIMES

The prominence of political-administrative division in the analysis of the territorial organization and its dynamics is for practical reasons and usually mediated by local

E-mail: oscar.alfonso@uexternado.edu.co

authorities to be the unit of analysis most commonly used for statistical production. Contiguity and jurisdictional boundaries, as well as coordination of the departments, are the criteria that are the bases of the municipal strategy of the political-administrative and fiscal decentralization, and the defense of the interests of the municipality is the constitutional rule that guides and upholds the local autonomy. Are these analyses the best representation of territorial dynamics? Are there significant features that discontinuous or distant municipalities share? And, if any such features exist what rules govern them?

The dynamics of certain markets beyond jurisdictional boundaries of territorial entities aside from certain eco-territorial units have been arbitrarily fragmented for the sake of creating municipalities required as a condition of local politics. The answer to the first question above refers to the value of an alternative analytical approach that, in most cases, requires the use of a unit of analysis of broader spatial scope, generally some kind of region *just to be consistent*, has failed to go beyond the current model of territorial state. Exercises of regionalization proliferate. The natural regions, as an example, are the introduction to the knowledge of the geography of the country but are insufficient to the extent that further regionalization with environmental criteria have revealed geographic and climatic determinism important for the understanding of territorial dynamics that in the era of climate variability have assumed greater significance.

The relevance of the second question which is the possibility of similarity amidst the distance lies, first, in the need for an alternative analysis to intraregional heterogeneity; and, secondly, arises from the need for reorientation of the territorial policies with differential approaches that promote sustained wealth creation and its better redistribution. Ultimately, it arises from the need to expose the incongruity of the territorial state model and, in a manner that is consistent, the need for its redesign. The criteria to identify these features are as varied as the interests and inclinations of the theoretical researchers; in fact, based on the preceding example, it can be observed that the feedback that the rainfall will acquire as crucial statistics to arrive at the understanding of the territorial dynamics in view of weather anomalies and, therefore, the resilience of local socio-ecological systems. For now, the urbanization of the population continues to be the phenomenon of *broader space* and, through the analysis of the hierarchical system of cities, spatial regimes are discernible.

The notion of spatial regimes forms the base of the different approaches of center-periphery.

With the purpose of understanding the organization of national spaces as a stage and, in turn, result of the evolution of the capitalist system, geographers have led the theoretical production on which, in turn, have gravitated many of the developments spatial economy. Corrêa (1997), for example, considers the German tradition as an anachronistic approximation of reality that goes far beyond the centrality of capitalism, as phenomena own network of cities of developing countries have different origins, as well internal linkages and external closely connected with social inequalities that characterize the Latin American continent. The city network is the social product where the spatialized social interactions (Corrêa, 1997: 93) occur and therefore, the explanation of the emergence of new territorialities is on the way minority groups in society conquer certain spaces.

Such groups are a characteristic feature of societies that have been built on huge disparities and persistent economic dependence (Azcárate et al., 2002), the urban macrocephaly the dominant form of economic spaces whose demo-economic dynamic contrasts with the rise of marginality.

In connection with the Latin American development, dependency theorists espouse the idea of succession dependency as a commonhistorical feature of the subcontinent. Meanwhile, theorists of imperialism argue that the transfer of the contradictions of capitalism from the dominant countries-central- to the dominated countries-periphery- is an inherent result of the dynamics of the system, spontaneity of a phenomenon of great complexity that is criticized by those who emphasize the different forms assumed by inter-regional imbalance and, especially, by those who believe that "urbanization is correlated with the development of the productive forces" (Singer, 1998.71) and therefore is associated with the overlapping of determinants of far reaching socio-territorial phenomena such as the rural-urban migration and demographic transition of each nation.

The theorists of the so called New Economic Geography in their interest in "showing with the greatest possible clarity and simplicity how interactions among the increasing returns at the enterprise level, transport costs and factor mobility can lead to the emergence and subsequent modification of a spatial economic structure"(Fujita et al., 2001, 68) proposed a model of the core-periphery type that "can provide good analytical results to every economist who *does it*" (Fujita et al., 2001, 68). To arrive at the formulation, acknowledge the gross simplifications ofreality with which one builds the assumptions that give the model *operability*, and emphasize transport costs as a regulatory element in the stability of inter-regional balance that in its interaction with the mobility of factors of production enjoy a high potential to produce economies of agglomeration.

At the national level, Durlauf and Johnson (1995) were the pioneers in the criticism of the models of convergence of the regional growth rates suggested by Barro and Sala-i-Martin (1991, 1992), to verify the existence of multiple steady states that, sorted each of the 96 economies considered according to the initial conditions and using literacy levels as a control variable, yield as a result that in the capitalist world four spatial regimes

coexisted. Dall'erba and Le Gallo (2005) explicitly employ the notion of spatial regimes, as a theoretical and analytical alternative approaches to the regional convergence arising from the same neoclassical models of economic growth posed fifteen years ago, *supposing* the equalization of per-capita income among regions as immanent result to market dynamics. The distinctive feature of the regional dynamics from the configuration of the Euro zone is the increase of the regional inequality within peripheral regions that hold lower levels of development than those in the center. To reach this conclusion, these two spatial regimes were established with statistical criteria such as the per-capita income calculated for a sub-regional spatial level from the cartography of Eurostat, "and can be interpreted as the convergence clubs according to the following rule: if the statistic for region i is positive, this region belongs to the group of 'rich' regions and if negative, this region belongs to the 'poor' regions" (Dall'erba and Le Gallo, 2005: 127).

Hasbaert (2014) discusses the regional geography, based on their disagreement with the results of the homogenizing globalization thesis checks because, in contrast, who attended a "permanent reconstruction of heterogeneity and fragmentation", regionalization and who seek to account for the spatial differentiations. Different approaches have in common regional geography reveal what specific or "differentiation of areas", the integration of human and natural dimensions, spatial continuity, regional stability and meso-scale analysis referred to the nation-state. The differences of degree and nature, which are the foundation of territorial diversity, are at the base of the increase in inequality promoted by a very selective as today capitalism, and rescue identity promoted by different social groups (Hasbaert, 2014).

This paper emphasizes a comprehensive look at the territory to identify and characterize the spatial regimes. This means that regardless of the starting point, the socio-economic and eco-climatic events must uphold spatial-temporal regularities to be differentiated in terms of intensity and probability of occurrence and, therefore, the possibility of *randomness* should be minimized. Therefore, territorial entities belonging to spatial regimes should have more than one feature in common and, in aggregate form, such schemes should substantially differ from each other. The statistical rule of *clusters*, i.e, the minimum variance within each regime and maximum variance among regimes, is useful in the comprehensive analysis of the various determinants of territorial dynamics proposed here.

The third question relates to the rules that govern the territorial regimes a crucial question that must be answered if you want to intervene accurately with the course of events; i.e. it is an unavoidable aspect of the diagnostic phase of any territorial public policy. The most successful efforts for formulating the law of population of each territorial regime must be made from the different currents of eco-ecology. On the basis of such schemes are situations such as the systematic population decline and simultaneously the highs and lows in food production, while at the top there are large human agglomerations whose absolute population growth is constant and *food demand is overly supplied by the fertile regions*, imports and*processed supply* amid *distributive* inequity that is polarized between the waste and malnutrition. Productivity approaches its limits due to the boom of the value-price in the markets of the agro-industrial goods, which is a powerful incentive to increase the materialproduct of the earth and, in a consistent manner, the ecological deterioration of the surface layers and aquifers. Amid the latent shortage, competition for wealth explodes violently when the territorial model of state and its institutions reveal their weaknesses to ensure respect for the life and property rights of the population. Migrations and Diasporas appear as the alternative for a new way of life in a different habitat located generally in another space regime.

THE HIERARCHY OF THE VIOLENT DEATHS IN COLOMBIA AND SOME EPIDEMIOLOGICAL FEATURES

This analysis refers to the four forms of violent death considered by the forensic medicine in Colombia: homicide, deaths in transit accidents, other lethal accidents and the suicide.

An approximation to the epidemiology of violent death in Colombia

Homicide

Homicide as the way to more frequent and violent death in Colombia is one of the most serious offenses as violating the fundamental human right of life, depriving everyone else (Franco, 2005). Generally, this type of death is staged public roads, followed by housing. The lack of tolerance, failures in the systems of education and lack of respect. in the family sphere trigger violent behavior among members of a society. According to De la Hoz (2003: 25), murder can be "instrumental, when exercised with specific purposes such as sociopolitical, territorial or economic scale control; random when it happens accidentally in actions against property and property of citizens (street robberies, burglaries, for example); or impulsive when it happens as a result of dysfunctional relationships exposed to factors of latent and manifest (e.g. quarrels, whose trigger is alcohol and drugs' risks).

Franco (2005) argues the spatial, temporal and relational generalization of violence; the complexity of the dynamics recognized the multiplicity of actors,

circumstances, origins and manifestations and, finally, the degradation of violence. Impunity encourages violent behaviors that lead to murder. The use of violence is endogenous to murder. Ricaurte (2011) may be intrapersonal violence revenge being the determining factor; sociopolitical violence originated in the ideological polarization; and finally, domestic violence that primarily affects women. Other embodiments are by Lozano (2012) analyzed, such as indigenous groups exerted on the geostrategic interest motivated by their territories from the armed outlaw, the drug trade, local elites and multinational groups. Similarly, various studies conducted by the National Institute of Legal Medicine and Forensic Sciences highlight the increase in juvenile violence associated with school violence, domestic violence, fights between gangs and criminal gangs and violence between bars sports teams, especially football.

Traffic accidents

The risk of occurrence of traffic accidents rise with the increase in the sinuous roads and inadequate design in terms of camber, by bad mechanical state of the vehicles and for breach of traffic rules for drivers. In 2003 figures, the cost of accidents was equivalent to the budget for education and health (López et al., 2003). Since 2007 the number of accidents has increased to the point that in 2012 the rate of fatalities highest traffic of the decade (Moreno, 2012) was recorded. The human factor is the main cause of most accidents. According to Hernández et al. (2004) drivers violate traffic rules in error and / or intentional conduct. It can also occur due to ignorance of the rules. Forero (2007) believes that "there are factors of sociological, psychological and biological order can influence human behavior and the assimilation of the norm." The pedestrian remains the first victim, but in recent years there has been an increase in accidents in which the most involved are cyclists and motorcyclists. As for cyclists, González (et. ál., 2005) argue that most of the victims are young adults, the main risk factors for breach of traffic rules, lack of traffic signals, obstacles in Via not wear a helmet, vest with reflectors or rear lights, speeding and climatic factors. As motorcyclists, Rodriguez (2010) states that, compared to high vehicular congestion of Colombian metropolis, the motorcycle has become the solution address the growing need for mobility. This means of transport to be small, inexpensive and easy operation, became a working environment, entrepreneurship and fun to decrease travel time for their owners; however, its great weakness is associated with the protection of the occupants.

In relation to the mechanical factors, López et al. (2003) suggest that in middle-income countries such as Colombia, the accident in transit increase due to the aging of the fleet. To corroborate this, Hurtado and Trujillo (2006) raised a mathematical and experimental model to identify some mechanical characteristics of the vehicles involved when the accident through the identification of traces of braking and the mechanical causes of the collision. As for the prevention and sanction both Forero and Valbuena (2009) as Forero (2008) agree on the need to restore the legitimacy of the state so that drivers are not motivated to break the law due to the inefficiency of the competent authorities.

Other accidents

Accidents do not happen by chance, but by the combination of human and environmental factors (Soriano, 2007) associated with the activities carried out by individuals (Garzón, 2010). The largest proportion, about 80% of people who die in an accident are men and most deaths tends to concentrate in the evening hours, especially on weekends (Gonzalez et al., 2006), but other patterns are not minor, such as the ratio of territories with high wealth river drowning (González et al., 2005), a phenomenon that particularly affects children.

The leading cause of accidental death has been the fall, being the most vulnerable older adults, due to the loss of some capabilities and basic and psychological functions such as change in vision and balance, among others (Gonzalez et al., 2006). Most accidents occur in the home because of neglect by family members or caregivers of vulnerable populations such as children and the elderly. Soriano (2008) states that most drownings occur in pools, which may reflect the relaxation of parental controls when children go to these places in their free time. Another phenomenon that affects the accident figures is the use of gunpowder. The use of gunpowder that although it is believed that its use is associated with the Christmas season occurs throughout the year due to the proliferation of fairs and festivals in the country (Perdomo, 2009). According to Moreno (2011), most of these events are preventable, since many cases are associated with system failures occupational safety, negligence of another and lack of prevention.

Suicide

The highest number of deaths by suicide occurs among young adults and the elderly. For every woman who commits suicide, four men do too. Alejo et al. (2003) distinguish two phases of the phenomenon: when the individual who wants to harm attempts suicide, and when suicide is consummated. Montalbán (1998), cited by Bohórquez (et al., 2004) proposes a taxonomy of suicide: "a) those whose beliefs make them consider suicide as a transition to a better life; b) those who feel so alone than live as a release and represent an escape from an intolerable situation in real life; c) psychotic who commit suicide in response to hallucinations or delusions; and, d)

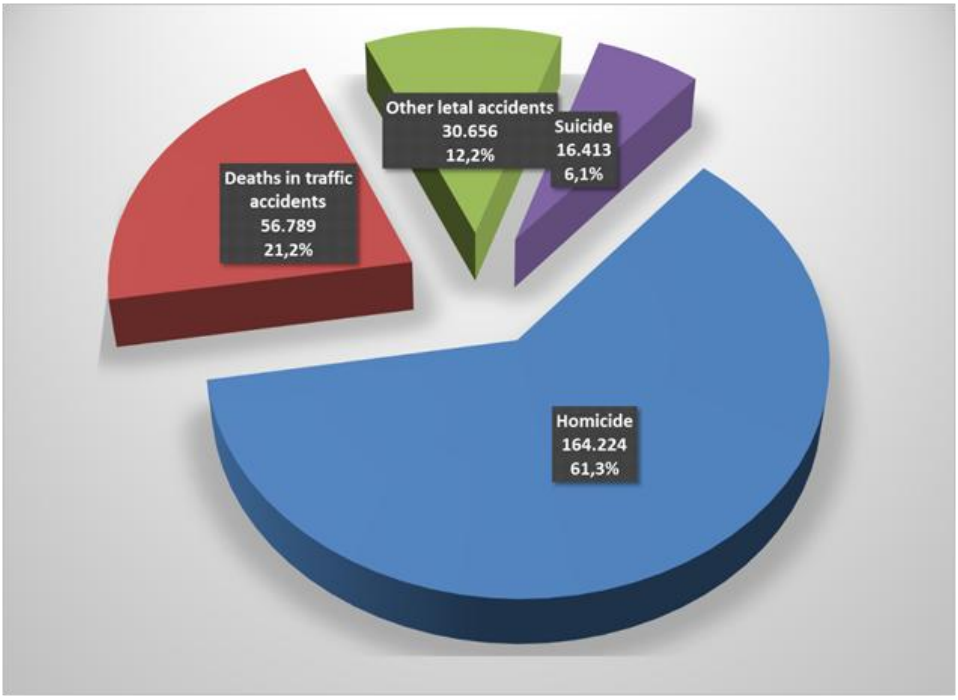


Figure 1. Distribution of the violent deaths by modality, Colombia 2004-2013. Source: Based on statistics of necropsies of the Colombian Institute of Legal Medicine and Forensic Sciences, published in *Forensis.*

those who commit suicide out of spite and the belief that people grieve and that they, somehow, will be there to see their affliction ".

Chica (2010) recognizes the importance of psychological reconstruction of the deceased helping you identify personality traits with difficult situations that may lead to understanding the causes that led him to believe that death was the only solution for all internal sufferings. Adolescence and old age are critical age where the individual becomes more susceptible against their own feelings and emotions. With aging some pictures of depression and loneliness, isolation and disease raise the odds of attempting suicide. In adolescence, some situations suggest to young there is no reason to continue living. This can be caused by psychological abuse, physical, sexual, academic failure, separation from home, lack of affection, domestic violence or bullying academic lead to demotivation feel young live. The type of homicide-suicide occurs as soon as a person kills himself 24 h after having made a homicide, depressive trait which, according to Castaño (2005), usually taken for lashing the act or fault, for fear of being judicialized, or as victim of the same act of murder.

Violent deaths in the last decade at the Colombian territory

From a territorial point of view, 4.1% of Colombian municipalities have not seen a homicide in the last decade; 10.4% have had no traffic accidents; 5.3% have had no other types of accidental deaths and 14.5% have not reported suicides. The whole intersection is an even smaller proportion- 1.6% of Colombian municipalities, where there have never been violent deaths in the last decade. The distribution of inflicted or self-inflicted, or by non biological causes such as diseases presents a persistent hierarchy that in aggregate terms for the period of the study is reflected in Figure 1, in which murder far exceeds the other remaining three modalities.

Gaitán (2006: 246-257) warned that Colombians are not culturally violent, and to this end, verified the existence of periods of peace with the subsequent substantial drop in the number of homicides. This is not the trend in recent decades, since the gradual reduction and the slowing of the rate of homicide nationwide is evidenced in Table 1, in contrast with the occurrence of the phenomenon in traditionally peaceful places, a phenomenon that had already been identified by National Reference Center on Violence at the end of the last century. The spatial escalation of homicide leading to the omnipresence in the Colombian territory, sum up certain regularities to provide a complex picture in which the masculinity of the victims-never less than 92% of cases, is linked with a high incidence among men between 18 and 45 years old, with the use of firearms as a lethal instrument preferred by the perpetrators of the act of

Table 1. Incidence of violent deaths, Colombia 2004-2013 (Rate for 100.000 population).

Cause	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Homicide	41.3	40.2	37.4	37.0	34.3	39.4	38.3	35.9	34.0	30.3
Deaths in traffic accidents	12.2	12.6	12.6	11.6	12.8	12.9	12.5	12.6	12.9	13.2
Deaths in other lethal accidents	6.6	7.3	7.1	7.3	7.2	6.4	7.5	7.3	6.4	5.6
Suicide	4.1	4.2	4.0	4.2	4.1	4.1	4.0	4.1	4.1	4.1
Total	64.2	64.3	61.1	60.1	58.4	62.8	62.3	59.8	57.4	53.2

Source: Based on statistics of necropsies of the Colombian Institute of Legal Medicine and Forensic Sciences, published in *Forensis*, and the census statistics and municipal population projections of DANE.

murder and the prevalence of urban public space as a preferred scenario to commit the act. But any epidemiology of homicide is pointless if the determinants and the mobility of the behaviors of the murderers are not known, and the territorial features that set them apart. The political violence mediated by ideological intolerance, the promotion by different segments of illegal drug trade, the targetingof smallholders and small landowners and ethnic groups which see *it* as ancestral values, the presence of death squads carrying out "social cleansing" in metropolitan public spaces, the biopolitical violence directed at the youth, who create images such as graffiti, and rap singers of *graphic phrase* are determinants that together with vengeance and defense of honor explain the largest proportion of homicides. In any case, the executors of the act of killing are people who are unaware of the ethical value of life or, if they are aware of it, it can easily be broken with monetary stimulus or the feeling of social recognition, among others, and therefore the lack of this awareness must be overcome, both within the family and in the classroom, preferably with a reform of the educational system explicitly aimed for this purpose.

The problems caused by the poor state of roads for motor vehicles, including inadequate signage, collapse of road base frames, landslides, abrupt dropsin roads and their sudden impassability because of climate variability, coupled with the poor technical and mechanical condition of vehicles and the ignorance and breach of traffic rules, the inherent abuse of speed by the drivers and their deficient psychomotor skills associated with the consumption of liquor, ingestion of hallucinogenic drugs and others that dull the senses and the speed of reaction, make up a bundle of determinants of deaths in traffic accidents. These are characterized by unpredictability and wrongful deaths associated with irresponsibility. The most vulnerable have been pedestrians and then motorcyclists and, again, the masculine gender of the victims is a dominant trait in at least 80% of the cases. The passengers and the channels of public vehicles and private transport form the third group of victims in order of importance, while the most vulnerable age groups are the elderly. The risk associated with the increased speed of interaction that promotes the global economy, the use of the motorcycle as work instrument in the era of labor flexibility, the increase in travel time and finally the territorial features where they occur are four unknown aspects until now in the epidemiology of deaths in traffic accidents.

The deaths caused by accidents occur mainly because of neglect and unpredictable events associated with the environment and climate variability. The lethality of these accidents, on average, revolves around 20% of cases. The incidence by age group increases with age, reflecting the effectiveness of the measures for the care of infants and the neglect of senior citizens. Around 80% of fatal accidents are male and a significant portion is unintentional self-inflicted injury and the other in the work environment, affecting specially farmers and workers. Falls from great heights are the main mechanism, followed by drowning, electrocution, suffocation and poisoning. In the epidemiology of fatal accidents, the differences due to territorial determinism have not been considered.

Suicide tends to be associated with the mental health of its practitioners or the abrupt decrease of lithium in the human body. But the main trigger of suicide is the economic crisis, which according to the perspective of the one who commits suicide prevents him from successfully solving his own needs and those of his dependents. This was noted by Durkheim (1965: 195) who disagreed with these conventional diagnosis when he said that "a live being cannot be happy, and may not even live, unless his needs are sufficiently proportionate to his means." If this is so, the almost unchanging rate of suicide indicates that in Colombia there is a layer of residents exposed constantly to a crisis of means of survival, i.e, some shortcomings of structural nature that are not captured by the ups and downs of economic growth. These shortcomings are the basis of triggering other phenomena such as the revenge of a person in love who does receive his partner's affection, or disenchantment with life in the manner of Andrés Caicedo, Colombian novelist who committed suicide was very young. For young people, it is common as a suicide trigger thehopelessness of their lives when families cling to old beliefs or strange codes such as the arranged marriage that led Jinju to commit suicide with her first-born in the womb, notwithstanding, that such practices are prohibited in modern China (Yan,

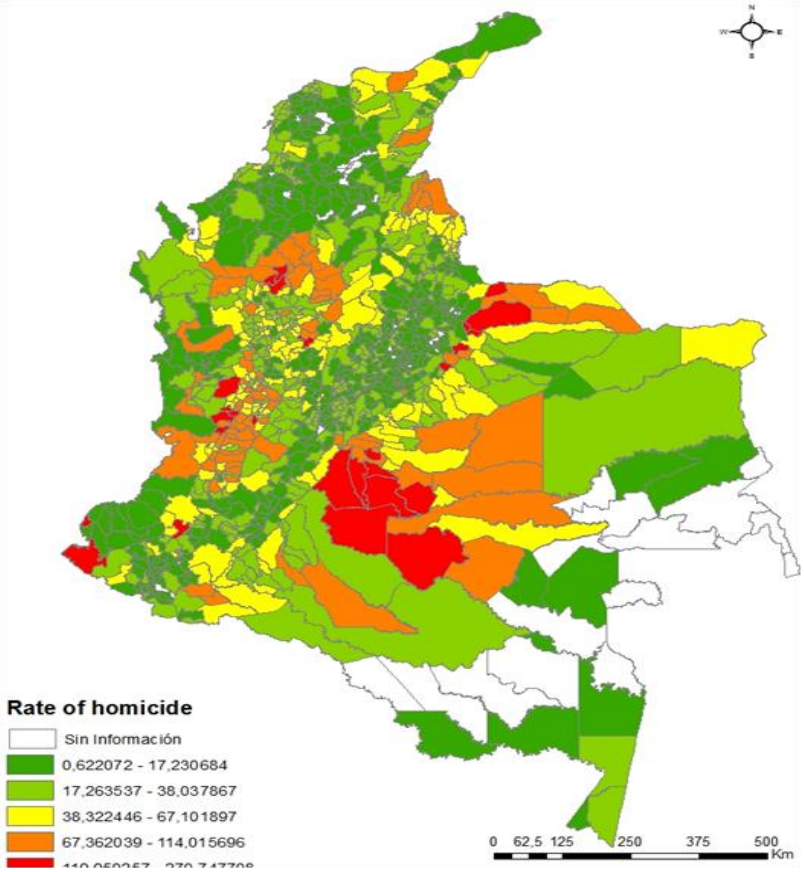


Figure 2. Incidence of homicide in Colombia 2004-2013 (Rate per 100,000 population). Source: Calculations based on statistics from autopsies of the Colombian Institute of Legal Medicine and Forensic Sciences published in Forensis, IGAC mapping and municipal census population statistics and projections DANE.

2013). Suicide rates are explained to a great extent by the masculinity of suicide and are higher in the groups of 18 to 30 and over 70. As the media crisis is widespread, its intensity does not present substantial differences between spatial regimes.

The calculations that are used later differ, although in an insignificant mannerwith the regular publications by *Forensis* insofar as they are the only cases attributable to a municipality and also employ the population projections adjusted by DANE. The tendency of the rate of homicides in the last decade is to its gradual decline, while that of the other forms of violent deaths has very few changes, almost constant in time. Therefore, all the fluctuations in the total rate are due almost exclusively to what happened to the murder rate that continues to triple from the deaths in traffic accidents, which is the second leading cause.

At the municipal level, the incidence represented by the rate per hundred thousand inhabitants has some outstanding features, such as the fact that the municipalities with the highest incidence are those of eastern Colombia and Piedemonte plains, recurring scenarios of the internal armed conflict such as Vistahermosa (270.7), Puerto Rico (218.6), Pajarito (198.0) and La Macarena (163.7) and El Dovio (171.6) and Briceño (167.9) in the west of the country. Traffic accidents that occurred on the way to the eastern plains in the stretch between Granada (148.9), Guayabetal (136.7) and Canyon Upía (119.4), as well as pathways San Luís (111.9) and Yotoco (100.7), have been the most prevalent in the last decade. Meanwhile, in Corrales (69.3) and California (59.3), very small municipalities in Boyacá and Santander, respectively, the incidence of fatal accidents has been the highest. Finally, in Villa de Leyva (39.3) the incidence of homicide is at the top due to an unusual increase of the phenomenon in 2004. Figures 2 to 6 show the incidence of the four types of violent causes of deaths and their aggregate in the Colombian geography.

Homicide is a phenomenon whose intensity is much higher in the Llanos foothills, in Antioquia and in the valleys of the west than in the rest of the country, while fatal traffic accidents are higher in the highways to Llano

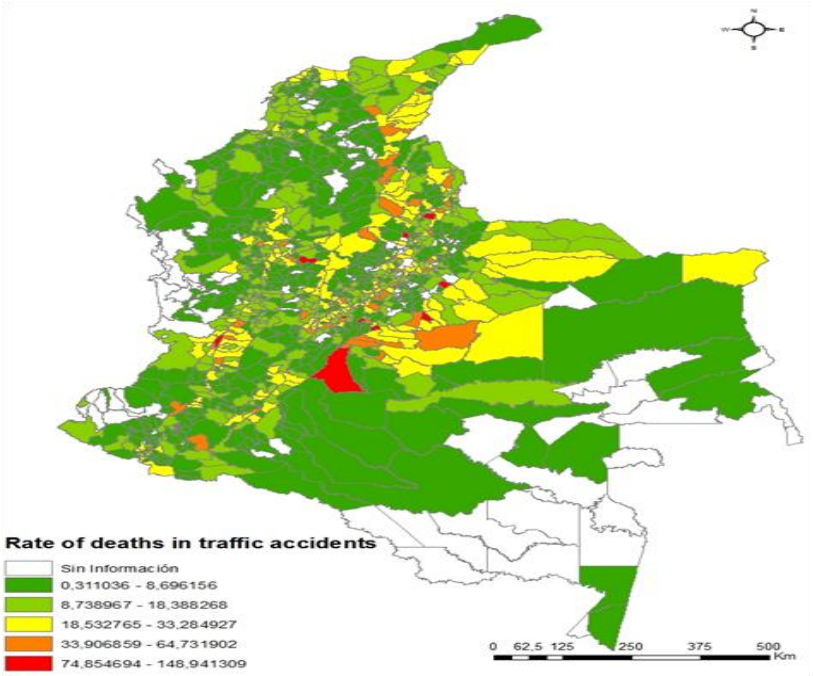


Figure 3. Incidence of deaths in traffic accidents in Colombia 2004-2013. (Rate per 100,000 population). Source: Calculations based on statistics from autopsies of the Colombian Institute of Legal Medicine and Forensic Sciences published in Forensis, IGAC mapping and municipal census population statistics and projections DANE.

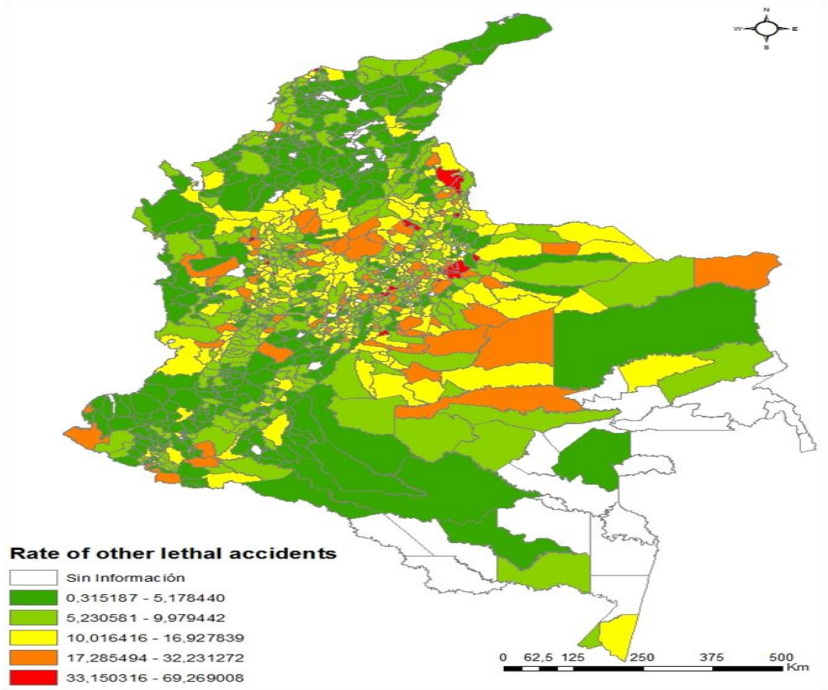


Figure 4. Incidence of deaths in other accidents in Colombia 2004-2013 (Rate per 100,000 population) Source: Calculations based on statistics from autopsies of the Colombian Institute of Legal Medicine and Forensic Sciences published in Forensis, IGAC mapping and municipal census population statistics and projections DANE.

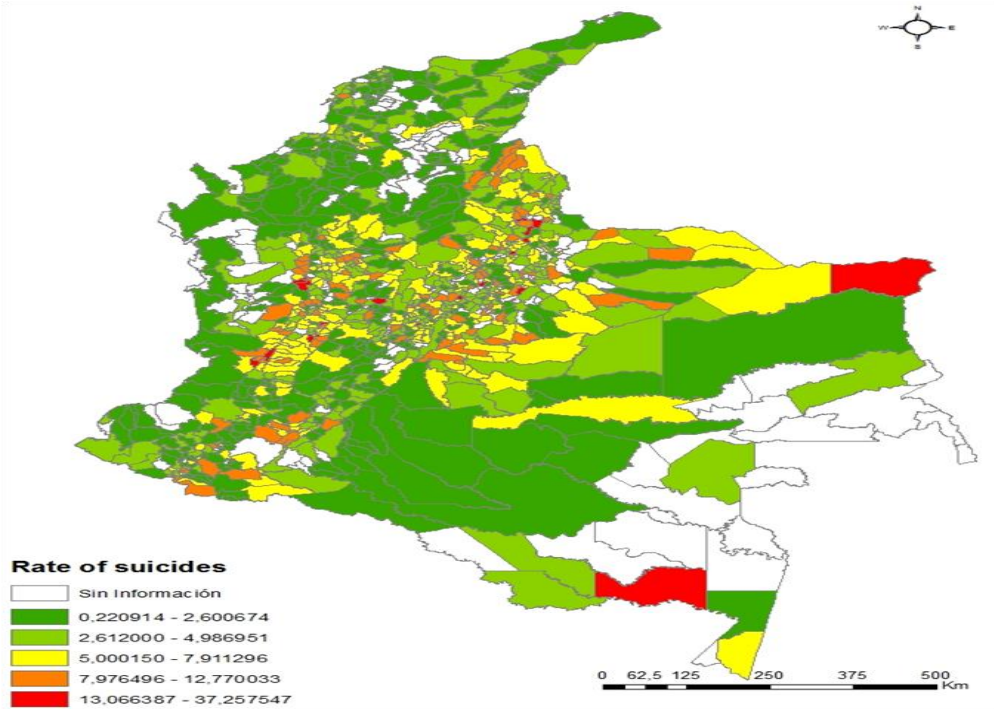


Figure 5. Incidence of suicides in Colombia 2004-2013. (Rate per 100,000 population) Source: Calculations based on statistics from autopsies of the Colombian Institute of Legal Medicine and Forensic Sciences published in Forensis, IGAC mapping and municipal census population statistics and projections DANE.

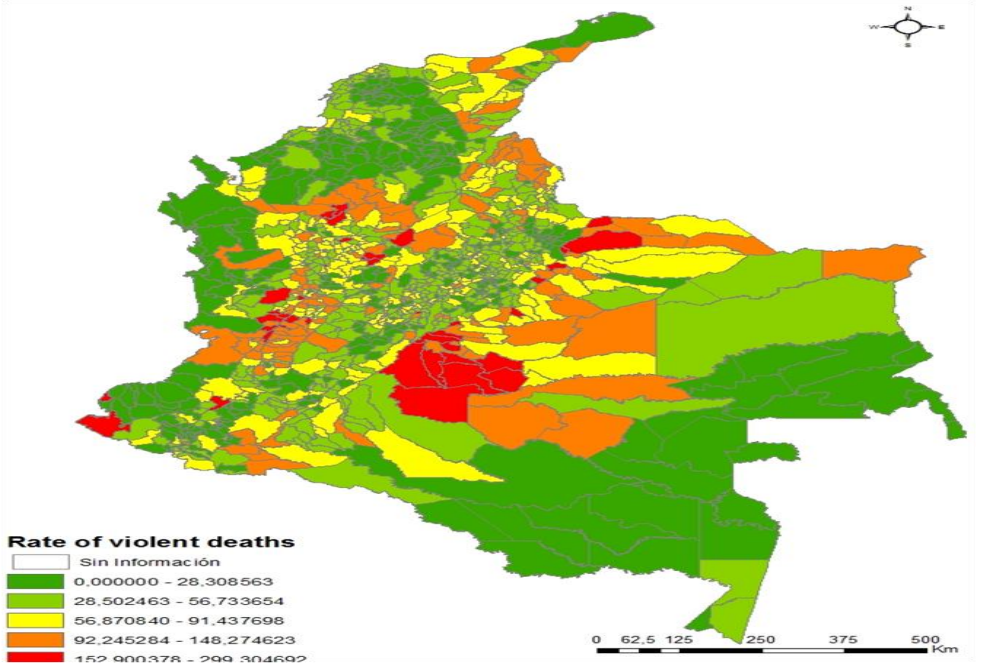


Figure 6. Incidence of violent deaths in Colombia 2004-2013 (Rate per 100,000 population). Source: Calculations based on statistics from autopsies of the Colombian Institute of Legal Medicine and Forensic Sciences published in Forensis, IGAC mapping and municipal census population statistics and projections DANE.

Table 2. The spatial regimes in Colombia.

Metropolitan areas	**Bogotá**	**Bojacá, Cajicá, Cota, Chía, El Rosal, Facatativá, Funza, Fusagasugá, Gachancipá, La Calera, Madrid, Mosquera, Sibaté, Soacha, Sopó, Subachoque, Tabio, Tenjo, Tocancipá y Zipaquirá**
	Medellín	Barbosa, Bello, Caldas, Copacabana, Envigado, Girardota, Itagüí, La Ceja, La Estrella, Marinilla, Rionegro y Sabaneta
	Barranquilla	Galapa, Malambo, Puerto Colombia y Soledad
	Cali	Candelaria, Jamundí, Palmira y Yumbo
	Bucaramanga	Floridablanca, Girón y Piedecuesta
	Cúcuta	El Zulia, Los Patios, San Cayetano y Villa del Rosario
	Pereira	Dosquebradas, La Virginia, Santa Rosa de Cabal y Cartago
	Manizales	Chinchiná, Neira y Villamaría
	Armenia	Calarcá y La Tebaida
Other departmental capitals	Leticia, Arauca, Cartagena, Tunja, Florencia, Yopal, Popayán, Valledupar, Quibdó, Montería, Inírida, San José del Guaviare, Neiva, Riohacha, Santa Marta, Villavicencio, Pasto, San Andrés, Sincelejo, Ibagué y Mitú.	
	Mocoa y Puerto Carreño.	
Rest of the country	278 with stable population growth	
	321 with moderate growth	
	433 with persistent decline	

Source: Alfonso (2014)

Road, in the roads to the sea and, to a lesser extent in the highways of Cali that lead to the south-west of the country. Meanwhile, the intensity of other types of fatal accidents has particularly affected the northern part of the foothills and from there in an easterly direction to the departments of Santander and North of Santander. In the case of suicide, its greatest intensity occurs in the Andean regions and, with as much or more intensity in Puerto Carreño on the border with Venezuela. Remarkable is the low intensity of this phenomenon in the Caribbean and the Pacific, a situation that is immediately associated with certain *less severe* cultural traitsthan the Andean but the power of family and supportive networks of friends in the event of crisis are less explored. Finally, the incidence of the four causes of violent deaths that is presented in Figure 6, reveals the relatively low intensity of the phenomenon in the eastern cordillera, the pacific and the middle part of the Caribbean, from the Gulf of Urabá to the vicinity Santa Marta, as in the Amazon and the bottom of the Altillanura.

INCIDENCE OF VIOLENT DEATHS SPACE SCHEME

Are there substantial differences in the rates of violent deaths in the spatial regimes of Colombia? If the answer to this question is yes, the usefulness of the results lies on the fact that this dimension of the phenomenon should be part of an epidemiology that based on spatial patterns assure its prevention effectively. The hypothesis of epidemiological polarization that is found at the base of the question will be verified through descriptive statistics and parametric exercises that, without a doubt, are exercises that have limitations in the face of the ethnographic approaches that social anthropology puts forward but the overall vision justifies the methods used here. Epidemiological polarization refers to the persistence in the last decade, and in some areas of Colombia, of high incidence of death from violent causes, compared to other areas in which it has remained at very low levels. This notion is derived from the differences of degree proposed by Haesbaert (2014) for territorial analysis.

The identification of spatial regimes that are presented in Table 2, and their characterizations (cf. Alfonso 2012a, 2012b), are the result of different demo-economic exercises in which the criteria of structural interaction population-changes of residence- and jurisdictional daily-cyclical movements- helped identify the nine metropolitan areas comprised of their core and 56 metropolized municipalities, while the criteria of population primacy and theirthree measures found that among department capitals there are two sub-regimes thus, in effect, 22 hold different levels of primacy and the remaining two are not even the most populous in their departments. Finally, the review of the absolute and relative population growth for the rest of municipalities in recent intercensal periods identified three regimes: municipalities with stable growth, moderate growth and persistent growth decline.

It is very likely that the future of territorial phenomena subsequent to 2005, especially those associated with climate variability and the intensification of internal armed conflict, has consolidated these regimes, so that metropolitan areas must have continued to host the largest share of population growth, while a significant proportion of municipalities with moderate growth must have migrated to the regime of municipalities with persistent decline.

But these phenomena can only be demonstrated with the results of the next census of population that the country is already in default to perform.

THE HOMICIDE

The homicide, despotic expression from the lack of ethical value of life, has geographical regularities among which is the metropolitan concentration that, for what happened in the last decade, highlights the reaffirmation of a territorial mode of operation of their executors, inherited from the degradation of democratic security. Homicide statistics that are used show both what happens but conceal what is forbidden to us. In the first case, the number of homicides recorded by Forensics is higher than that reported by the National Police. For what reason? Who is competent to perform the autopsies? Beyond these issues and in relation to what the statistics do not reveal, it is known that the mass graves abound where murderers bury traces of their crimes, so that if these bodies were properly accounted for population incidence of homicide would rise and the dimension of the already very serious state of helplessness of thousands of victims would worsen.

The origins of the homicidal violence in Colombia are associated with the anti-democratic development of agriculture. Without having solved the problem, the violence escalated because of the rigidity of the State in its position to advance the agrarian reform. Linked to these triggers, the main cause of the rise of homicidal violence today has been drug trafficking, a phenomenon that knows no right, left nor center and whose corrupting power has blurred both the inner state system and some ranks of the civil society. If the homicidal mark of drug trafficking during its heyday was indelibly etched in the Colombian territory, it has deepened during the periods of contraction of theharvested area from the coca leaf and the domestic price of coca paste. That is to say, that such deepening is largely due to the dispute of a smaller stock of illicit income by a contingent of greedy promoters and distributors that will not shrink but, on the contrary, tends to widen the "criminal batallions" being its most conspicuous expression. Therefore, the income of extortion and bribery has emerged as a complement to the contracted income from drug trafficking.

In related activities such as hired killings, it is common to find the executioners doing the sign of the cross before beginning the macabre operation that will end the life of their victim, knowing that it is violating the commandment "Thou shalt not kill." That routine illustrates, among other things, that stubborn inclination of Colombians to disregard the rules, however, as in the aforementioned case, the rules of divine origin. I imagine that the Church has an explanation for this that for now, I am not aware of. Such contempt, with regard to homicide, is essentially due to the absence of ethical value for life within the codes that guide the behavior of murderers. The content of such value should be taught in basic education, but has been neglected in favor of certain matters aimed at increasing competitiveness, a policy that has produced equivocal results. Therefore, the murderer cannot be treated as a madman or homicidal violence as a pandemic, but that, following Einstein's logic, “what is crazy is that the state pursues results that are different using the same guidelines that have led us to democratize insecurity and defenselessness, such as reduced sentences and release.

The confluence of the battalions of criminals in metropolitan areas is a phenomenon that overlaps with the emergence of new triggers of homicidal violence, interwoven, mainly, in the bloody reconfiguration being experienced the world of work. Without the *Fordism* having reached the promise of the universalization of social security in health or pensions, although if the strenuous increase of labor productivity, a multitude of producers of ideas, from knowledge and images which have been launched into cyberspace, to the classroom and onto the streets of the great human agglomerations to propose new social relations. Such proposals of immaterial production come into conflict with the Fordist legacy and take metropolitan public space where ideas of peace in the verses of rap music and images on the graffiti are disseminated, but their authors are gunned down in the streets of the North Eastern Commune in Medellín or in the prestigious Avenida Pepe Sierra bridge in Bogotá, as neither the teenage skater by inadvertently trespassing an "invisible border" in some corner of Siloam, managed to escape death.

But another determinant of homicidal violence that daily claims more victims is some form of political violence, triggered not because of ideological differences but because of the violent dispute from the spoils of fiscal decentralization and royalties that thicken municipal coffers. Decentralization was implemented in the municipalities of Colombia in the middle of a contingent of local politicians accustomed to settle their differences in blood and fire. With the increase in the fiscal situation, the participation of the municipalities in the nation’s current revenue and in the royalties from the exploitation of the subsoil, consolidated corruption and homicidal violence like a midwife to the distribution of local budgets. In the midst these archaisms, the "entrepreneurs of municipal procurement" have formed, devoid of academic profile or of business vision but endowed with political connections in the underworld who choose to bribe officials from third category to which decentralization has entrusted them the spoils of local public investment. In other cases as much or more aberrant, *the authorities* of the local public expenditures are for the politicians.

The metropolitan homicide incidence is significantly higher than in the rest of the country: 40.4 versus 37.5 in the country (Table 3). Except in 2006 and 2007 when the metropolitan and national rates were virtually identical, in the rest of the decade the metropolitan homicide has

Table 3. Rate of homicide per 100,000 habitants and spatial regimes, Colombia 2004-2013.

Spatial regimes	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Metropolitan Areas	47.2	41.4	37.0	37.1	36.7	45.0	44.4	40.1	35.3	32.3
Metropolitan Core	47.3	39.8	36.2	36.2	37.1	46.8	45.2	41.1	35.5	33.3
Metropolized municipalities	46.8	46.0	39.4	39.4	35.7	39.8	42.2	37.4	34.8	29.6
Other departmental capitals	40.8	33.9	33.2	34.8	32.1	33.7	32.7	30.4	32.1	29.1
Municipalities of the rest of the county	35.2	40.8	39.0	37.7	32.3	34.9	33.3	33.0	33.1	28.5
Stable growth	37.5	41.5	42.2	41.8	36.0	41.3	40.0	37.4	40.6	33.1
Moderate growth	30.6	37.6	37.2	35.7	26.8	28.4	26.4	27.0	24.4	21.6
Persistent decrease	34.8	42.0	34.6	31.5	29.9	27.8	25.9	29.1	25.5	24.8
Total country	41.3	40.2	37.4	37.0	34.3	39.4	38.3	35.9	34.0	30.3

Source: Calculations based on statistics of necropsies of the Colombian Institute of Legal Medicine and forensic sciences published in Forensis, and statistical census and DANE municipal population projections.

exceeded the national rate. The metropolitan areas, at the top of the hierarchy of the clusters of the country, are the places where homicide is concentrated and the most dynamic structures of their executioners are reproduced. National Police spokespersons have maintained before the public opinion that in the cities there are no criminal gangs. These spokespersonsare right if they mean that thegang leaders are probably elsewhere, but are not,if it is considered that what we face are contingent of battalions of criminals operating across the geography of the country and, as I have argued, its criminal logic leads them to vie for the market of the blackmailed victims that reside in Colombian metropolis. The recent announcement of the Episcopal Conference that four of these "battalions" are willing to negotiate the reintegration of their "5,000 troops" confirms the idea that it is not merely a few "bands" of criminals. Surely that many refined ethnographies of homicidal violence in Colombia are moving forward today, but the overall vision that is presented here succinctly suggests that there are demonstrations and geographical determinism to be considered to deal with the killers effectively but also that the future generations will charge us the precarious state of societal ethical value of life, *thoughwe count with more bilingual graduates with great math skills.*

The contrast of the phenomenon between spatial regimes is relatively clear: where more wealth is produced incidence of homicide is higher; or, in the same sense, the homicide rate decreases systematically among municipalities whose flow of population is contracted in a moderate or persistent manner. Additionally, such incidence is slightly higher in cities than in towns from its immediate area of influence so that murder is a diseconomy of agglomeration that increases the fear of victimization of the residents in this spatial regime in relation to the others.

FATAL TRAFFIC ACCIDENTS

In recent years, the Colombian cities have experienced an unprecedented outbreak of death in traffic accidents that have caused the general condemnation and in a customary manner, the tightening of penalties for drivers who in a drunken state incur culpable homicide. The golden rule of driving that is sobriety behind the wheel, has been transgressed for a long time to reach the level of a pandemic. The private vehicle in the hands of drunkards has crippled many lives, but also people drunk with narcissism and arrogance that try to impose their standard of "get away coz I'm here" about traffic rules, cause numerous fatalities daily. Several reasons encourage this phenomenon. On the one hand, it has been mentioned in recent years that the exosomatism is part of a lifestyle linked both to ostentation as to the satisfaction of universal needs. In the Colombian metropolis, there are upscale residences of at least ten private parking spaces, while motorcycles have become a way of life in a society that values less job stability but more the speed of business interactions. The incompetence of the drivers of public transport and a system that absurdly rewards their physical exertion until exhaustion, are another cause of a significant portion of these lost lives. Overall, the persistence and stability of this rate of deaths in traffic accidents at such a high level as presented in Table 4, reflect the hostility that is experienced in urban roads, metropolitan and national roads and that, in the near future, should lead to a rethinking of systems and regulations in that land passenger mobility is supported because, as we have seen, in the bad example of congressmen and senior officials of the governmentwho attempt to use their position to contain sanctions and, when they do, encourage other citizens to follow the same behavior.

The metropolized municipalities that are part of the first spatial regime have experienced the highest rate. Much of this is due to the absence of a metropolitan mobility policy and poor complementary regulations. When in a metropolitan core regulations such as the "carrot time" is adapted, for example, the regulated activity is relocated in the municipalities and within its immediate area of

Table 4. Rate of deaths in traffic accidents per 100,000 habitants and spatial regimes, Colombia 2004-2013.

Spatial regimes	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Metropolitan Areas	13.2	12.0	12.8	10.2	12.2	12.3	11.3	10.7	11.2	10.9
Metropolitan Core	12.6	11.0	11.7	8.2	11.1	11.2	10.2	9.7	10.0	9.7
Metropolized Municipalities	14.8	15.0	16.1	16.1	15.4	15.6	14.3	13.4	14.7	14.2
Other departmental capitals	14.7	14.3	14.9	15.2	13.8	14.6	14.2	14.3	15.5	15.7
Municipalities of the rest of the county	10.4	12.7	11.6	12.0	13.1	13.0	13.4	14.1	13.9	15.0
Stable growth	13.0	13.9	13.2	13.1	13.7	13.9	13.8	14.8	14.7	15.9
Moderate growth	9.5	12.4	11.9	13.5	13.6	14.6	15.3	15.4	14.8	15.6
Persistent decrease	6.5	10.7	8.6	8.8	11.4	9.9	11.0	11.8	11.5	12.5
Total country	12.2	12.6	12.6	11.6	12.8	12.9	12.5	12.6	12.9	13.2

Source: Calculations based on statistics of necropsies of the Colombian Institute of Legal Medicine and forensic sciences published in Forensis, and statistical census and DANE municipal population projections.

Table 5. Rate of deaths in other lethal accidents per 100,000 habitants and spatial regime, Colombia 2004-2013.

Spatial regimes	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Metropolitan Areas	6.4	6.3	5.6	6.0	6.1	5.1	5.7	6.2	4.6	4.2
Metropolitan Core	6.1	5.5	5.1	5.6	5.8	4.9	5.1	5.7	4.5	4.2
Metropolized municipalities	7.3	8.9	6.8	7.0	7.0	5.6	7.5	7.6	5.1	4.4
Other departmental capitals	9.3	8.1	8.1	9.1	8.6	7.5	8.1	7.1	7.5	6.7
Municipalities of the rest of the county	6.1	8.1	8.5	8.3	8.1	7.5	9.2	8.6	8.0	6.8
Stable growth	7.0	7.7	8.4	7.5	7.5	7.6	8.8	7.7	8.0	6.3
Moderate growth	4.8	9.2	9.3	8.4	8.6	8.0	10.5	10.2	7.6	7.2
Persistent decrease	5.3	7.9	8.0	9.8	8.7	7.0	8.8	9.1	8.3	7.4
Total country	6.6	7.3	7.1	7.3	7.2	6.4	7.5	7.3	6.4	5.6

Source: Calculations based on statistics of necropsies of the Colombian Institute of Legal Medicine and forensic sciences published in Forensis, and statistical census and DANE municipal population projections.

influence, extending motorway sections and thus, their inherent risks. The municipalities of stable and moderate growth located in the road to the Ocean towards the north of the country, mainly in the savanna Cesarense, and the ones previously mentioned, the Path to the Llanos Foothills near Llano, have experienced the most significant increase in the last decade in the incidence of deaths in traffic accidents on its population.

Other fatal accidents

The conviction of the randomness of the conventional neglect or chance as causes of the lethality of fatal accidents hinders any effective approach to an epidemiology. The formulation of new hypotheses is indispensable condition to overcome this state of ignorance. When the metropolis on account of the construction boom in height becomes vertical, the risk of detachment from the top also increases for both the construction workers and residents in the buildings. Similarly, the daily innovations in consumer lifestyle and the acceleration of everyday interactions demand to the human beings greater efforts so that their senses promptly capture the threats that loom over. Stress occurs because of the succession of all kinds of exaltations which occurred in an environment that is never the same, as some of these innovations have altered it, then overpowering the overconfidence as a result of misjudgment of environmental immutability. This rule applies to all cases, from the fall in height to the choking from food intake or drink.

Table 5 shows a statistical regularity,and is that as one moves down the hierarchy of spatial regimes, the incidence of deaths from this type of fatal accidents increases significantly. Such regularity associated to hypothesis of the innovations indicates that the senses of residents in the areas with greater agglomerations are keener to perceive and adapt to the environmental mutations that they cause.

Suicide

The multi-causation is a recurring argument in the different epidemiological studies that center on suicide. When the suicide is self-inflicted the death is because, in

Table 6. Rate of suicides per 100,000 habitants and spatial regimes, Colombia 2004-2013.

Spatial regimes	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Metropolitan Areas	4.5	4.3	4.1	4.1	4.5	4.3	4.1	4.2	4.0	3.9
Metropolitan Core	4.5	4.3	4.1	4.1	4.4	4.3	4.2	4.0	4.0	3.7
Metropolized Municipalities	4.5	4.4	4.2	3.9	4.5	4.3	4.0	4.5	4.1	4.5
Other departmental capitals	5.0	4.3	5.1	5.3	4.6	4.3	4.2	4.7	4.8	5.0
Municipalities of the rest of the county	3.5	3.9	3.6	3.9	3.7	3.8	3.9	3.8	4.0	3.4
Stable growth	4.4	3.9	3.7	4.0	3.4	3.5	3.7	3.7	4.1	3.2
Moderate growth	2.6	4.3	3.7	4.0	4.0	5.1	4.2	4.2	4.0	3.8
Persistent decrease	2.5	3.8	3.5	3.6	3.9	3.5	4.1	3.8	4.0	3.7
Total country	4.1	4.2	4.0	4.2	4.1	4.1	4.0	4.1	4.1	3.8

Source: Calculations based on statistics of necropsies of the Colombian Institute of Legal Medicine and forensic sciences published in Forensis, and statistical census and DANE municipal population projections.

one's judgment, one's personality is routinely bent by tight family regimes, academic or occupational that frequently, one is judged to be unable to address the present and future needs of himself and his dependents, or because one is overwhelmed by an unknown future life but is warned that it is extremely problematic.

These triggers of suicide do not know spatial regimes; the results are presented in Table 6. In other words, the crisis can occur anywhere and at any time, in the same way that the incompatibility between freedom required for the development of the personality and rigid family, academic or occupational schemes is a-spatial.

Final thoughts

Expectations about the advent of the long awaited peace among Colombians have increased the flow of initiatives for the development after achieving it. The post-conflict proposals are intertwined with those of peace, as it should be, because the world of the violent people and their victims covering the everyday behaviors of one or the other has overlapped. Violent deaths intensity differences in spatial regimes require different policies. The output of this Orwellian universe does not tolerate pointless debates. Every human relationship is, by our nature, conflictive. But the violent resolution of internal armed conflict should quickly result in a substantial reduction leading to the elimination of murder and, for this, the analytical contribution of this geography of homicide could well support a post-conflict strategy consistent with the intensity reached by the phenomenon. The lethality of traffic accidents would be reduced substantially with institutional changes that make viable initiatives of supra-jurisdictional coordination of everyday life, such as the assignment of local autonomy in the matter to a metropolitan-scale mobility authority. But both deaths in traffic accidents as those arising in the other accidents, only can be successfully faced with the substantial reduction of the flexibility of the labor contract, cause un-scrutinized from the acceleration of the pace of everyday life that arise from one or another type of deaths. When such flexibility is accompanied by some of the four causes of underemployment-by capacities, remuneration, working hours and labor-abuse, personal crisis ensues and that triggers suicide. Therefore, the substantial reduction and eventual elimination of violent deaths in Colombia are closely related to the cultural and political revival of the ethical value of life and with the renewal of the significance of the contribution of the work to the development.

Conflict of Interests

The author has not declared any conflict of interest.

REFERENCES

Alejo HJ, González O, Hernández W (2003). *Conducta suicida según ciclo vital*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Alfonso RÓ (2014). Los desequilibrios territoriales en Colombia: estudios sobre el sistema de ciudades y el polimetropolitanismo. Colección *Economía Institucional Urbana*, n.º 9. Bogotá, Universidad Externado de Colombia.

Azcárate LB, Azcárate MVL, Sánchez SJ (2002). Geografía de los grandes espacios mundiales. Notas del Grado en Historia del Arte. Disponible en https://gradohistoriaarteuned.wordpress.com/category/asignaturas-de-1o/asignaturas-2a/geografia-de-los-grandes-espacios-mundiales/. (20/4/2015).

Barro RJ, Sala-i-Martin X (1992). Convergence. Journal of Political Economy, vol. 100, n.º 2. Chicago, The University of Chicago Press (http://www.jstor.org/stable/2138606).

Barro RJ, Sala-i-Martin X (1991). Convergence across states and regions. En *Brookings Papers on Economic Activity*. 1.

Bohórquez VMJ, Espinosa GL, López LL, Pareja SA, Sánchez H, González O J (2004). *Suicidio y niñez: Factores relacionados con el suicidio en mujeres menores de 18 años en Bogotá durante el año 2003*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Castaño HB (2005). *Filicidio-suicidio. Un reto por estudiar*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Corrêa RL (1997). Trajetórias geográficas. Rio de Janeiro, Editora Bertrand Brasil.

Chica UH (2010). *La respuesta de muchos, la experiencia de la vida: el suicidio*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Dall'erba S, LeGallo J (2005). Dynamique du processus de convergence régionale en Europe. En *Région et Développement*, n.º 21. París, l'Harmattan. Tomado de http://region-developpement.univ-tln.fr/fr/pdf/R21/R21_dallerba_legallo.pdf el 21/11/2012.

De La Hoz BG (2003). *Variaciones conceptuales y lugares comunes en la explicación del homicidio en Colombia*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Durkheim E (1965). El suicidio. Buenos Aires, Editorial Schapire S. R. L.

Durlauf SN, Johnson PA (1995). Multiple Regimes and Cross-Country Growth Behavoir. En Journal of Applied Econometrics, vol. 10 n.º 4. Tomado de http://www.jstor.org/discover/10.2307/2285053?uid=3737808&uid=2&uid=4&sid=21103251453307 (10-01-2014).

Forero ML (2007). *Muertes y lesiones por accidentes de tránsito, Colombia, 2007*. (2007). En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Forero ML (2008). *Muerte y lesiones por accidente de tránsito, Colombia 2008*. (2008). En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Forero ML, Valbuena J (2009). *Eventos fatales y no fatales relacionado con el tránsito y su relación con las emociones. Colombia, 2009*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Franco AS (2005). *Una aproximación a los contextos explicativos de la violencia en Colombia*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Fujita, M, Krugman P, Venables AJ (2001). Economía Espacial: Las ciudades, las regiones y el comercio internacional. Barcelona, Ariel Economía.

Gaitán DF (2006). El crimen organizado en Colombia: una breve revisión. En *Violencia y crimen: ensayos en memoria de Fernando Gaitán Daza*. Bogotá, Universidad Externado de Colombia.

Garzón RN (2010). La*s lesiones no intencionales: un problema de salud pública*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

González OJ, Ramírez L, Carreño P (2005). *Accidentes fatales en el lugar de trabajo: Una consecuencia lógica*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Gónzalez OJ, Rengifo AO, Ramírez LL (2006). *Muerte accidental en el adulto mayor: negligencia o desantención*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

González OJ, Domínguez CM, López AC (2005). *Lesiones anatómicas y factores relacionados con muertes de ciclistas en accidentes de transporte. Bogotá, 2004*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Haesbaert R (2014). Viver no limite: territorio e multi/transteritorialidade em tempos de in-segurança e contenção. Rio de Janeiro, Editora Bertrand Brasil.

Hernández H, Perdomo M, García Ruiz M (2004). *Muertes y lesiones en accidentes de tránsito, Colombia 2004*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Hurtado GM, Trujillo M.(2006).*Huellas de frenado irregulares: Importancia en el análisis y resultados de un accidente vehicular*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

López DP, Guzmán B, Jiménez E (2003). *Los accidentes de tránsito se pueden prevenir*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Lozano MN (2012). *Hominidios de indígenas, 2003-2012: Instrumento de apropiación violenta de la tierra*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Moreno LS (2012). *Muertes y lesiones por accidentes de transporte. Colombia, 2012*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Moreno LS (2011). *Comportamiento de la accidentalidad, Colombia 2011*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Perdomo MM (2009). *Muertes y lesiones accidentales*. En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Ricaurte VA (2011). *Comportamiento del Homicido, Colombia 2011*. (2011). En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Rodríguez CG (2010). *Accidnetes de motociclistas: Hacia la indentificación de medidas efectivas*. (2010). En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Singer P (1998). Economia Política da Urbanização. São Paulo, Editora Contexto.

Soriano BM (2007). *Muertes y lesiones accidentales*. (2007). En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Soriano BM (2008). *Muertes y lesiones accidentales*.(2008). En *Revista Forensis*. Bogotá, Instituto Nacional de Medicina Legal y Ciencias Forenses. Disponible en http://www.medicinalegal.gov.co/forensis, (17/11/2014).

Yan M (2013). Las baladas del ajo. Madrid, Kalias Editorial.

academicJournals

Vol. 8(4), pp. 99-110, April, 2015
DOI: 10.5897/JGRP2015.0478
Article Number: BC54AF152621
ISSN 2070-1845

http://www.academicjournals.org/JGRP

Journal of Geography and Regional Planning

Full Length Research Paper

Climate change and erosion activities in Benin-Owena River Basin, S. W. Nigeria

C.I. Ikhile

Department of Geography/Regional Planning, University of Benin, Benin City, Edo State, Nigeria.

Received 15 January, 2015: Accepted 8 April, 2015

The impact of climate change on the incidence of soil erosion was examined in the Benin-Owena River Basin, Southwestern Nigeria. Climate change was indexed by rainfall and temperature. Information was obtained on these parameters from 1960-2010 for some selected stations in the basin. Similarly, data on erosion control measures were obtained in the basin from 1990-2010. The results obtained showed gradual increase in temperature, vis-à-vis a fluctuating trend in rainfall. Erosion control measures increased in the drainage basin due to the uncertainties observed in the climatic indices. Intensive sporadic rainfall and increasing temperatures occasioned intensified control measures adopted in the basin. It is concluded that climate change has impacted erosional activities in the basin. It is recommended that more structures should be developed to curb the menace of erosion in the basin.

Key words: Climate change, drainage basin, erosion, rainfall, temperature.

INTRODUCTION

Climate change has been defined as a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period typically decades or longer (IPCC, 2007). Recent evidence and predictions have indicated that climate changes are accelerating and will lead to wide-ranging shifts in climate variables. Specifically, in 2007, the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) effectively put to rest many of the debates surrounding the science of climate change, rendering -evidence solid enough to impel action. It found that warming of the climate system was 'unequivocal' and that a number of attendant effects were already observable (Pender, 2008). The range of effects has included a warming of sea water temperature that has given signs such as the collapse of ice shelves in Antarctica, propelling a dangerous sea level rise that now threatens many settlements along the coastal environments, along with pollution and other anthropogenic or human-related- drivers, the very existence of coral reef ecosystems around the world. These changes to our natural world gravely threaten the health and quality of life of many environments that inhabit our coastal zones. Global average temperature is projected to increase to as high as 1.4-5.8^{o}C in the next century compared with temperature levels in the 1990s (Sygna, 2005). The case of overflowing/increase in the volume of the River Niger and the consequent flooding with its attendant ecological disasters in the third week of September, 2012 is very fresh in mind. Various communities along the Niger River valley in Nigeria were

E-mail: ikhilek@yahoo.com

affected, with destruction of settlements, farmlands, communication networks, livestock, lives and properties. This has been described as extreme weather events occasioned by global warming.

Soil erosion is the gradual destruction of the earth through the action of water and other agencies that weaken the earth surface over a period of time. It has been referred to as the detachment and removal of the topsoil either partially or completely. Soil erosion is the physical process by which soil particles are detached and removed from the ground surface by water and wind (Segura et al., 2014). Soil erosion threatens soil fertility due to nutrient and organic matter loss while also decreasing water quality through increased turbidity (Brown and Froemke, 2012). There are two types of soil erosion: geological (occurring where there is flow of energy and matter on the earth surface), and accelerated (resulting from man's activities). Accelerated soil erosion often results in the physical loss of the soil constituents, leading to severe economic loss arising from reduced crop yield or total crop failure (Faniran and Ojo, 1980; Odemerho and Onokerhoraye, 1994). Also, accelerated soil erosion can lead to loss of land due to gullying, pollution of streams, seas, silting up of lakes and damage to canals and irrigation works. Gullying is the most serious type of accelerated erosion. It has been more recently compounded by the current sporadic rainfall due to global warming. Apart from other factors of the nature of soil and land surfaces, vegetation, agriculture, mining, construction works, climate has recently become a very potent force leading to global concern. In a related work, Nearing et al. (2004) observed that global warming is expected to lead to a more vigorous hydrological cycle including more total rainfall and more frequent high intensity rainfall events. Rainfall amounts and intensities increased on average in the United States during the 20th century and according to climate change models, they are expected to continue to increase in the 21st century. These rainfall changes, along with expected changes in temperature, solar radiation and atmospheric CO^2 concentrations will have significant impacts on soil erosion rates. According to them, rainfall erosivity levels may be on the rise across much of the United States when rainfall amounts increase, erosion and runoff will increase at an even greater rate: the ratio of erosion increase to annual rainfall increase is on the order of 1:7. Even in cases where annual rainfall would decrease, system feedbacks related to biomass production could lead to greater susceptibility of soil to erode. They hold that erosivity results calculated from the Canadian Centre for climate modeling and analysis model also showed an increase in erosivity across northern United States including New England and Southern Canada. The Canadian Centre model result also indicated a reduction in erosivity across much of southern plains, from Texas to Nebraska. Results of the computation using annual precipitation indicated changes in parts of southern United States tending towards lower erosivity. Soil erosion may be expected to change in response to changes in climate for a variety of reasons, the most direct of which is the change in erosive power of rainfall (Nearing, 2001; Pruski and Nearing, 2002a). According to Segura et al. (2014), rainfall runfall erosivity (R) is one key climate factor that controls water erosion. They identified the watersheds that are vulnerable to future climate change in terms of soil erosion potential. Their results show that mean decadal rainfall runoff erosivity (R) value would increase with time according to all nine climatic projections considered between 1970-2090. These trends vary widely spatially. In general, catchments in the northeastern and northwestern United States characterized by a strong increasing trends in R in midwestern and southwestern United States are either weak or inconsistent among the nine climatic projections. The northeastern and northwestern United States will likely experience a significant increase in annual variability in R in extreme events (that is increase).

According to Olaniran (2011), three types of actions have been suggested to address the problem of climate change: these include mitigation, adaptation, and resilience. Mitigation involves efforts to prevent climate change. Mitigation activities can be divided into two parts: conservation and development and deployment of alternative energy sources. Each of these has two principal components which are technology and behavior change. Adaptation deals with responses to climate-related disasters that are not prevented by mitigation efforts while resilience is the characteristic needed in individuals, communities, nations and the world, to prepare for disasters to reduce the suffering and loss they bring and to rebound in positive ways. Effective structural planning could be an important tool and potent mitigation and adaptation strategy to address the problem that may arise from the effects of climate change and erosion. The relationship of climate change and soil erosion is the focus of the current investigation.

Study area

The study area has been detailed in the works of Ikhile (2007a,b). It lies between Latitudes 6^{o}30' to 7^{o}35'N and Longitudes 4^{o}50' and 6^{o}00'E (Figure 1). This includes parts of Edo and Ondo States of Nigeria. The climate is the tropical continental type with alternating wet and dry seasons of varying duration. The seasons correspond to the periods of dominance of the wet tropical continental air masses. The seasonal distribution of rainfall follows the direction of the Inter-Tropical Divergence (ITD) and varies almost proportionally with distance from the coast. The wet season occurs within seven months from April to October while the dry season lasts from November to March.

There is usually a break in rainfall in August. Specifically,

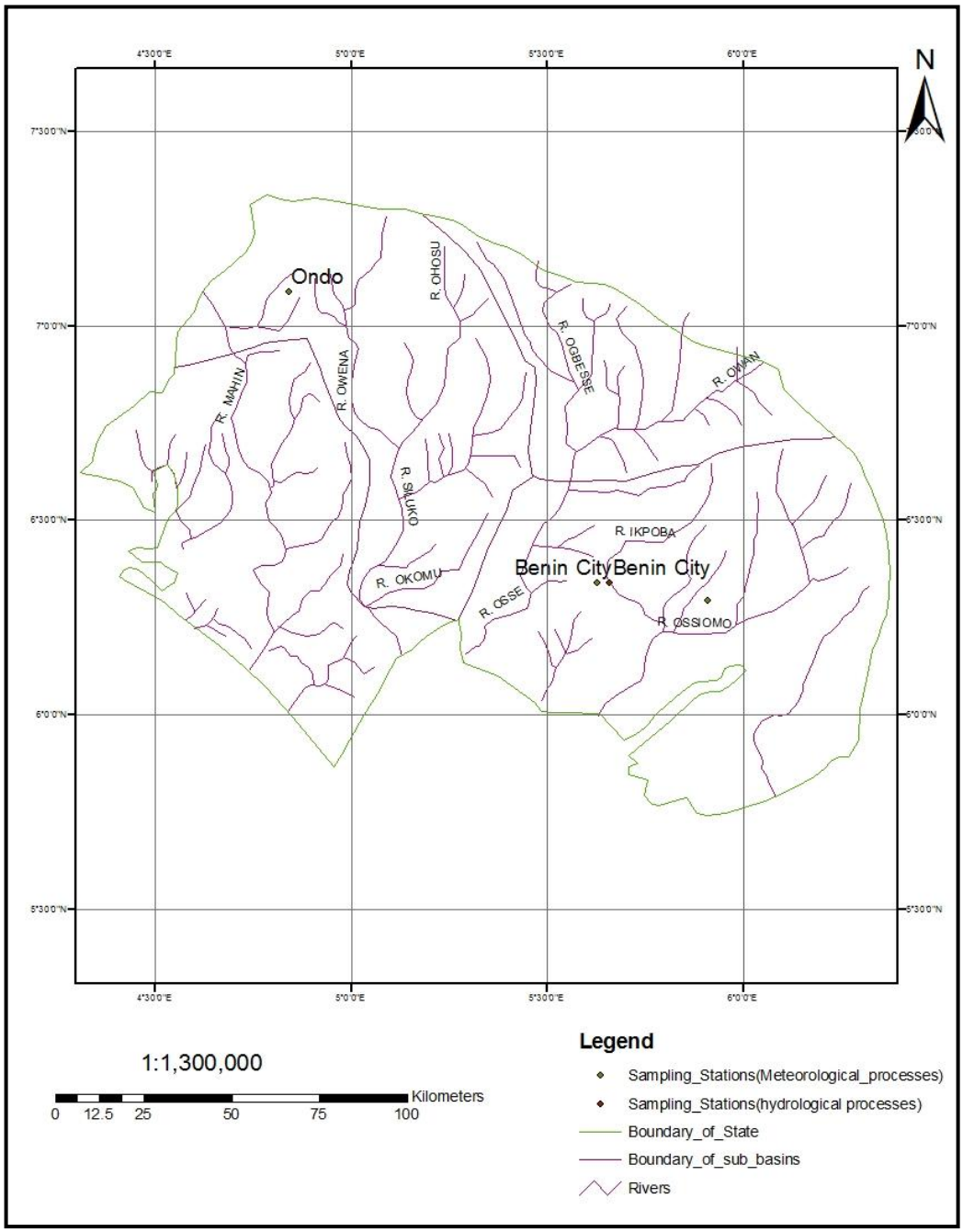


Figure 1. Map of a segment of the Benin-Owena River Basin.

the study area has annual mean rainfall ranging from 500 to 2,780 mm. About 90% of the rain falls in six to seven months of April to October. Mean annual temperature ranges between 24^{o}C-33^{o}C.

The mean number of hours of sunshine is 5-7 depending on the season. The rate of evaporation is high being the continental interior. The relative humidity is between 60-80% per annum depending on the season of the year (dry or rainy). The mean atmospheric pressure is about 1013 mb.

METHODS

The rainfall data used for this study were obtained from the Federal Ministry of Aviation, Meteorological Services (FMAMS) Oshodi, Lagos, and the Benin City Synoptic Station in Edo State. The rainfall data covered a period of forty years from 1961 to 2010. The rainfall was measured with a Stevenson's automated rain gauge installed at the Lagos and Benin City Synoptic Stations. Rainfall for the period was recorded on monthly charts. Monthly, annual and decadal totals were used. The data were subjected to transformation using mean averages via regression analysis and GIS models. The results are presented in decadal and monthly means and

Table 1. Decadal Rainfall (mm) Distribution in the Basin (1961-2010).

Decade	Ondo	Benin	Akure	Ado-Ekiti	Basin Mean
1961-1970	1664	2477	N.A	1444	1862
1971-1980	1603	2234	N.A	1417	1751
1981-1990	1541	2355	1445	1387	1682
1991-2000	1627	2493	1486	1391	1749
2001-2010	1686	2374	1633	1722	1853
1961-2010	1624	2300	1562	1439	1727

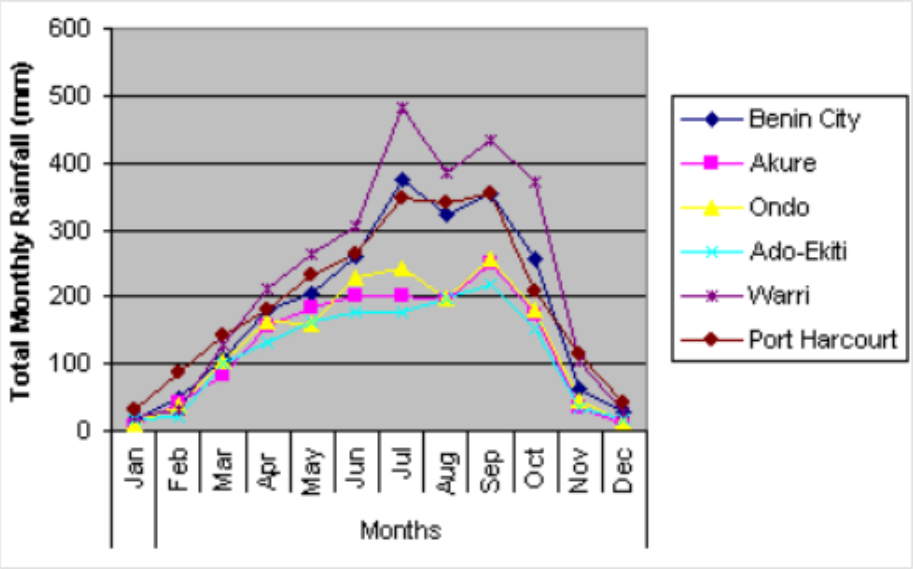


Figure 2. Decadal Mean Monthly Rainfall (mm) for Benin-Owena River Basin Area (1961-2000).

displayed using charts, graphs and tables. Benin City was used to show the general variation in the climatic elements.

Statistical Analysis

The relationship among the different studied meteorological variables was assigned by computing the multiple regression coefficients (r). This model indicated the degree of relationships among rainfall, temperature and was used to predict the rate erosion in the river basin to climate change.

RESULTS AND DISCUSSION

Rainfall distribution for Benin City

Rainfall for the basin as a whole exhibited distinct patterns in the decades 1961–2000 as shown in Figure 2. The annual total for Benin during the decade 1961–1970 ranged from 1985 to 3049 mm for the years 1964 and 1965, respectively. The decadal total was 247,691mm (Table 1). January was particularly dry in 1964, 1967 and 1969, with zero values of mean monthly rainfall, while it was only 1970 that had no rainfall in the month of December (Figure 2). The decade 1971–1980 showed a different pattern. The total annual rainfall ranged from 1702 (1972) to 2585 mm (1980). In this decade, most January and December months were very dry (Figure 3) with zero rainfall values for up to five years (1973–1976, 1979). This decade was drier than the previous one. The decadal total was 20,050.51mm. The total annual rainfall for the third decade (1981–1990), ranged from 1227 to 2461 mm in 1986 and 1990, respectively. Between 1985 and 1989, Decembers were completely dry with zero rainfall values and January was also dry for many years. This decade was apparently the driest of the record. A similar observation was made by Olaniran and Sumner (1991). December 1990 recorded an unusually high mean monthly total of 168 mm, and this was the highest ever-recorded rainfall in December between 1961–2000. The decadal total was 235,493mm.

The total annual rainfall for 1991–2000 ranged from 1860 to 2776 mm in 1993 and 1992 respectively. December and January were not as dry as previously experienced (Ojo, 1987). The rains tended to fall in all

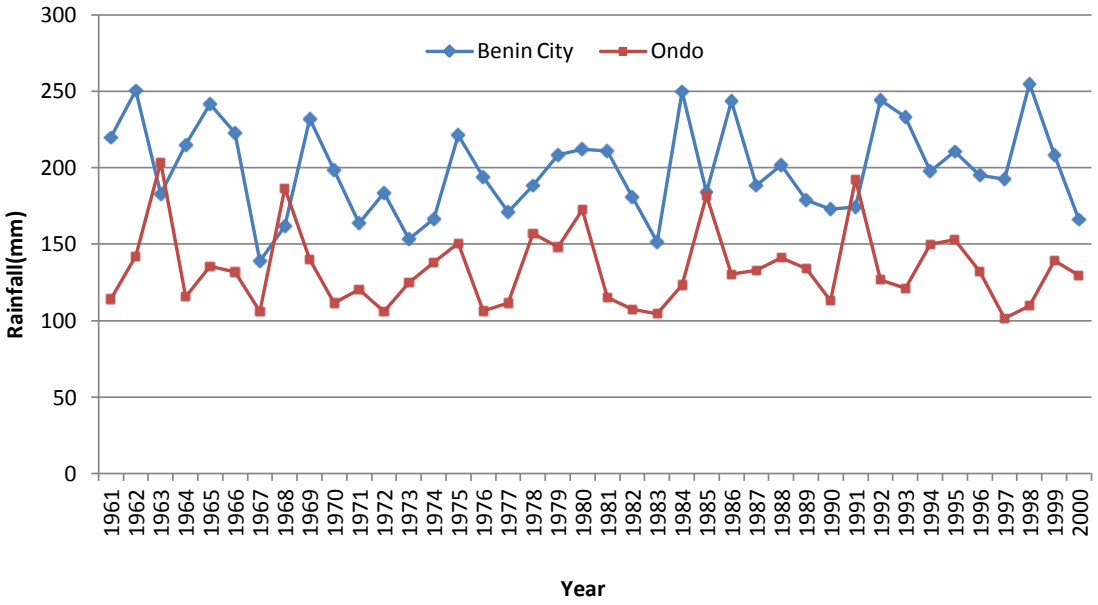


Figure 3. Decadal Mean Monthly Rainfall (mm) for Benin-Owena River Basin Area (1961-2000).

months of the year, with the exception of 1992 and 1994 when the Decembers were dry. The decadal total was 24,932.23mm.

Generally, the first three decades showed double maxima of rainfall with an August break. In the fourth decade (1991–2000), the August break was absent with the August months recording generally higher rainfall values than all the other decades. This means that the normal pattern was reversed in this decade. Even the December months were very wet. January was generally the driest month with a total of 682 mm of rain from 1960–2000. July was the wettest month with a total of 14 975 mm of rainfall from 1961–2010.

Rainfall distribution in the drainage Basin

In Akure, the rainfall distribution in the decade 1981-1990 was fairly even (Table 1, Figures 2 and 3). The decade 1991-2000 recorded a higher decadal total rainfall and a more varied mean monthly rainfall distribution. The rainfall distribution of Ondo during the period of study (1961-2000) showed wide variability (Babatolu, 2002). The highest rainfall figure in the decade was recorded in 1963 (2,440.94mm) and the lowest was recorded in 1997 (1,217.10 mm). The rains decreased generally in the last decade (1991-2000).

The distribution of rainfall in Ado-Ekiti was rather erratic. The 1991-2000 decade seemed to have the highest wetness, and with more even distribution. All the months recorded rainfall with the exception of 1991-1993. The decadal rainfall totals however were lower compared with the other decades. The highest recorded annual total rainfall was in 1973 (2,734.4 mm) and the lowest was in 1964 (899.7mm). Annual rainfall totals tended to exhibit a reduced trend after every ten years (decade) in Ado-Ekiti (e.g. 1964-1974, 1983-1993).

Temperature distribution in Benin City

The temperature condition for Benin City is presented in Table 2. The annual mean temperatures increased steadily from 1961 to 2000. During the 1961–1970 decade, it was 25.8°C to 27.0°C (decadal range: 1.2°C). During the 1971–1980 decade, it was 26.3°C to 27.5°C (decadal range: 1°.2C). During the 1981–1990 decade, it was 27.1°C to 27.6°C (decadal range: 0.5°C).

In this decade, the climate of Nigeria was described as playing a climatic drama (Ojo, 1987). The climate fluctuations were larger and the weather became more unpredictable. The last decade, 1991–2000, has been the warmest with annual mean temperature ranging from 27.2°C to 28.2°C (decadal range: 1.0°C). The air temperature appears to exhibit a persistent increasing tendency in Benin City coupled with decreasing rainfall. This may be an indication of global warming and climate change. There is a statistically significant relationship between mean annual rainfall and air temperatures in the study period at a 0.01 confidence level.

The temperature distribution for the period 1961–2000 showed a wide variation and a gradual warming of the environment. For the decade 1961–1970, the annual minimum ranged from 19°C to 24°C (January 1967 and February 1970) and the minima slightly increased over the following decades. The 1981–1990 decade showed the greatest extremes of temperature, recording the lowest and highest annual minimum temperatures for the

Table 2. Temperature condition of Benin City (1961 – 2010) (°C) (Ranges) Source: Ikhile (2007). N.A= Not Available (Station Records begin in 1980)

Decade	Annual Minimum	Mean annual Minimum	Annual Maximum	Mean annual Maximum	Annual Mean	Decadal range
1961 – 1970	19.2 – 24.2	21.9 – 22.8	27.2 – 36.7	31.1 -31.3	25.8 – 27.0	1.2
1971 – 1980	21.0 – 24.9	22.4 – 23.3	27.0 – 34.7	30.2 – 31.7	26.3 – 27.5	1.2
1981 – 1990	18.4 – 26.3	22.2 – 23.8	27.6 – 36.0	31.3 – 32.1	27.1 – 27.6	0.5
1991 – 2000	21.0 – 25.5	23.3 – 23.9	27.4 – 37.0	31.2 – 31.8	27.2 – 28.2	1.0
2001 – 2010	22.73-25.93	24.65-25.88	27.47 - 28.8	27.24-28.77	27.42-28.69	1.27

Source: FMAMS (2010).

Table 3. Mean Monthly Minimum Temperature (°C) of the Study Area (1961-2010).

	Months											
Stations	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Benin City	22.3	23.7	23.9	23.6	23.2	22.7	22.3	22.2	22.4	22.6	23.2	22.3
Akure	19.2	21.4	22.6	22.7	22.2	21.6	21.1	21.2	22	21.9	21.7	19.5
Ondo	21.4	22.9	22.9	22.7	22.4	21.8	21.6	21.4	21.8	21.8	22.4	21.8

Source: FMAMS (2010).

Table 4. Mean Monthly Maximum Temperature (°C) of the Study Area (1961-2010).

	Months											
Stations	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Benin City	32.6	37.1	33.7	32.7	31.9	30.4	28.4	28.2	29.2	30.6	32.3	32.4
Akure	32.8	37.5	33.9	32.7	31.3	29.6	28	28	28.4	29.9	32.3	32.4
Ondo	32	33.6	33	31.6	30.8	29.3	27.6	27.1	28.3	29.8	30.8	31.6

Table 5. Mean Annual Temperature (°C) of the Study Area (1961-2010).

	Months											
Stations	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Benin City	27.5	28.9	28.7	28.2	27.6	26.5	25.4	25.2	25.8	26.6	27.9	27.3
Akure	26	28	28.4	27.8	25.7	25.7	24.6	24.6	24.2	26	27	26.1
Ondo	26.7	28.3	28	27.2	25.6	25.6	24.6	24.3	25	25.8	26.6	26.7

Source: FMAMS (2010).

whole period of study. The mean annual minimum followed a similar pattern. The annual maximum for 1961–1970 ranged from 27 to 36°C (July 1961 and March 1962) and remained approximately constant over the following decades. The year 1998 recorded the highest temperature of 37.0°C during the 40-year period. This is in line with Odjugo (2000). The annual mean maximum followed a similar trend

Temperature condition in the Drainage Basin

The mean annual temperature distribution of Ondo follows the same trend as for the maximum temperature distribution (Tables 3, 4 and 5, Figures 4, 5 and 6). The temperature has been on the increase rising steadily from 1961-2000. The distribution in the first decade was rather more uniform, though the decade ended with increasing temperatures. The second decade witnessed much extremes and variations, beginning and ending with lower temperatures. In the third decade, there was still more fluctuations and oscillations starting and ending with high temperatures. The fourth decade was most erratic and dramatic (Ojo, 1987).

The distribution of temperature in Akure for 1981-2000

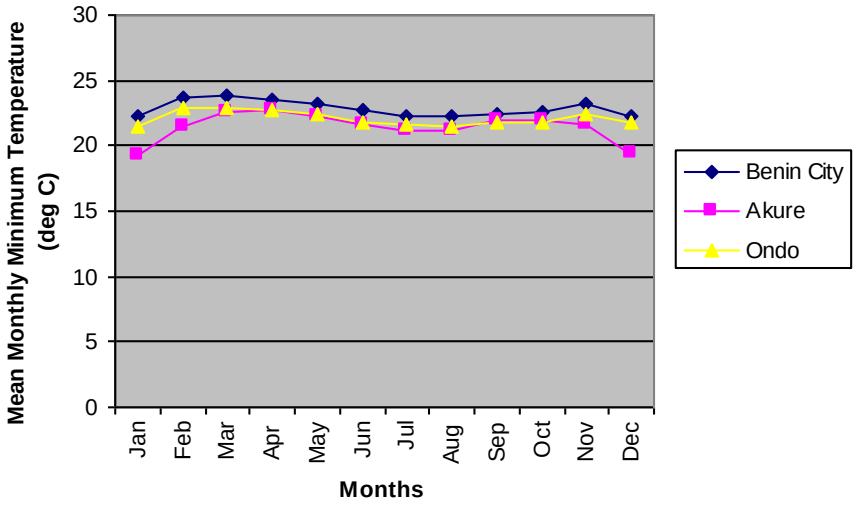


Figure 4. Mean Monthly Minimum Temperature (°C) of the Study Area (1961-2010). Source: FMAMS (2010).

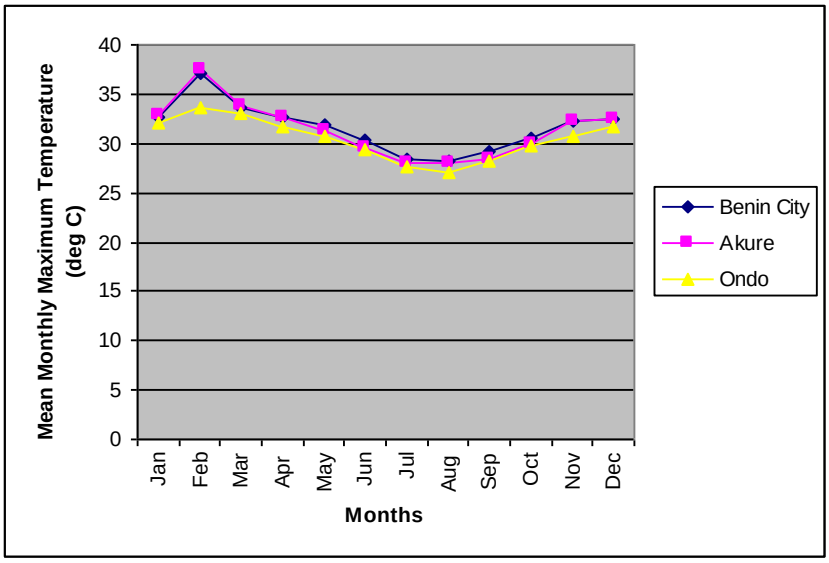


Figure 5. Mean Monthly Maximum Temperature (°C) of the Study Area (1961-2010). Source: FMAMS (2010).

was quite varied and a similar warming of the environment was observed. All the measures of temperature ranging from minimum to mean annual showed increasing trend.

Soil erosion

Due to excessive rain in the past decade, most towns in the drainage basin have been seasonally afflicted with flooding and erosion (BORBDA, 2001). The effect of the menace has left some roads impassable and some buildings on the verge of collapse. In addition, many public utilities such as electric poles and water pipelines have been damaged due to the extensive soil erosion.

The most troublesome of all the erosion types is gully erosion (Figures 7, 8 and 9). This has necessitated the setting up of numerous soil erosion and flood control projects all over the drainage basin. The funds for the project run into millions of Naira and are usually released from the Nigerian Ecological Funds Office in the Presidency. The current projects include,

a) Ondo State
(i) Okitipupa (ii) Oke-Igbo (iii) Oka-Akoko

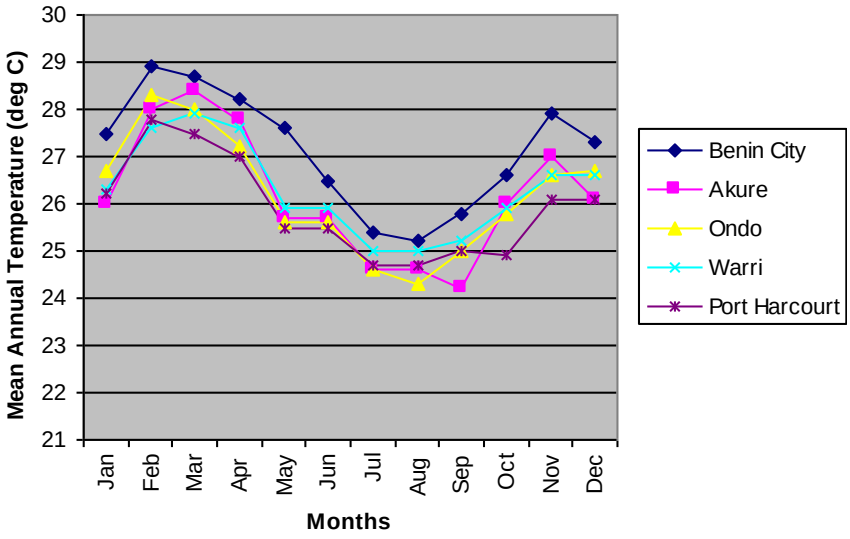


Figure 6. Mean Annual Temperature (°C) of the Study Area (1961-2010).
Source: FMAMS (2010).

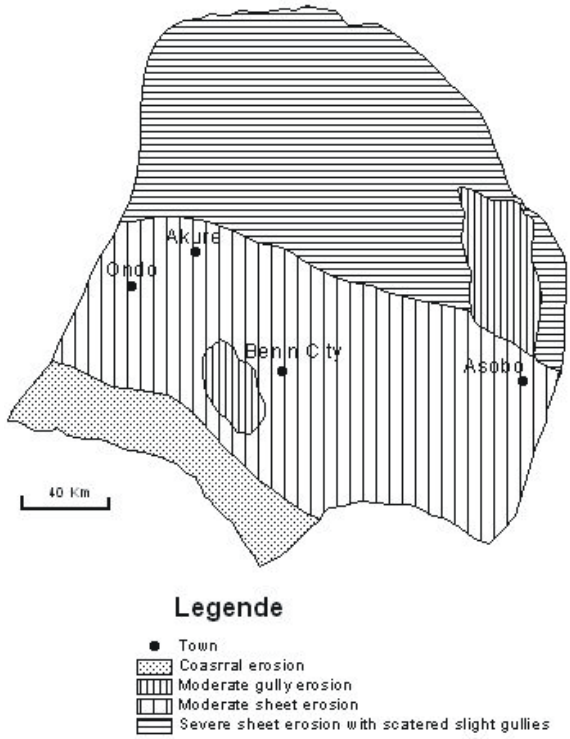


Figure 7. Distribution of erosion sites in Benin-Owena.
Source: Sanyu and Sumiko (1994).

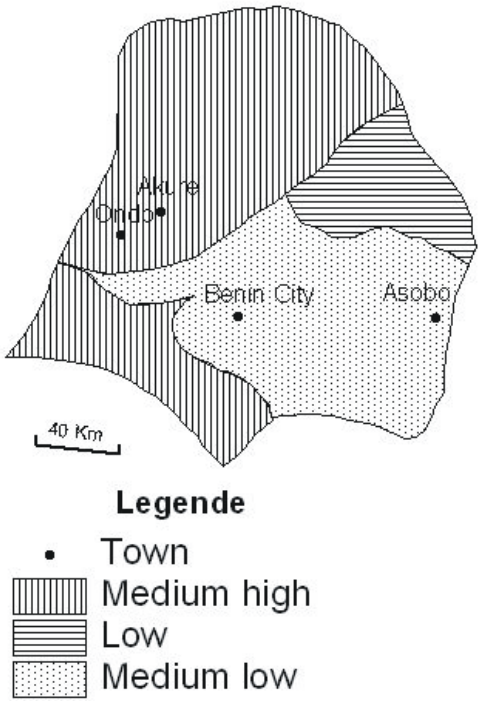


Figure 8. Map of gully erosion hazard in Benin Owena River Basin.

b) Ekiti State
(i) Ado-Ekiti (ii) Efon-Alaaye (iii) Orin (iv) Usi (v) Ilupeju
c) Edo State
(i) Auchi (ii) Uromi (iii) Ibore (iv) Queen Ede (iv) College Road, Benin City
d) Delta State
(i) Agbor (ii) Umutu (iii) Ubulu-Uku (iv) Issele-Uku

A few of these projects are discussed to illustrate the magnitude of the problem within the Benin-Owena River Basin.

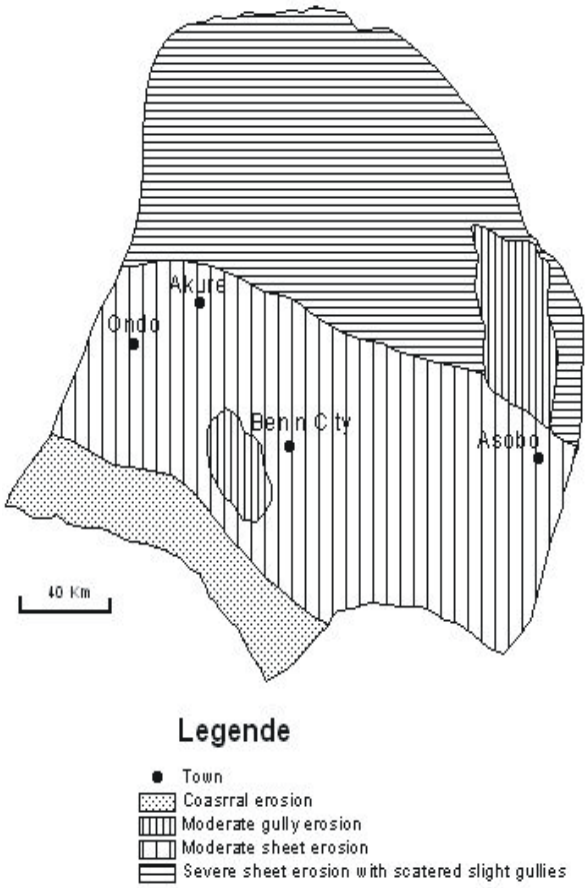


Figure 9. Distribution of erosion sites in Benin-Owena River Basin.

Auchi Erosion Control Project

Auchi is a growing urban settlement in Etsako West LGA of Edo State. The town has been seasonally afflicted with flooding and erosion over the years and the environment left in pitiable condition. The degradation caused by the soil has undermined the foundation of many buildings and rendered many roads in the town impassable. This has resulted in abandonment and ultimate collapse of many buildings. In addition, many public utilities such as water pipelines and electric poles have been damaged as a result of this extensive soil erosion. BORBDA, in 1986 made an attempt at correcting this serious land degradation by commissioning a design firm to study and design erosion control works

The following streets/areas have been greatly devastated: (a) Magistrate Court, Igbe Road site. (b) Igbe Road, Jattu Road site (c) Warrake I site (d) Warrake II site (e) Polytechnic Gorge site (f) Iyekhei Gully site (g) Oshiobugie Gully site. The design in 1986 allowed for 77,000m^3 of earthworks, 6,027km of drains to gulp about 4,836m^3 of concrete. The project was executed at a cost of over sixty million Naira. This was funded by the Ecological Funds Office of the Presidency.

Benefits of the Erosion Control Project,

1. Construction of a ground total of 2.5km of concrete channel for the discharge of surface runoff, while gullies with a total volume of 150,000m^3 have 30,000m^2 of the reclaimed land surface grassed for slope protection.
2. Restoration of traffic flow after re-construction of the collapsed bridges, culverts and drainage channels.
3. Land enhancement resulting from river training and drainage channel works.
4. Improved aesthetics to the environment.
5. Improvement of health.
6. Substantial reduction to the state of anxiety of those living near the river, gullies or bottom of hills under whose building spring water used to ooze out.
7. Stopping for all times makeshift drainage channels constructed by individuals for diverting flood from their houses.

When these benefits were weighed against the cost, it was obvious that the project was economically feasible.

Uromi Erosion Control Project

Uromi is a growing urban settlement in the Esan South East Local Government Area of Edo State. The town has been seasonally afflicted with flooding and erosion over many years and the environment left in pitiable conditions. The degradation caused by soil erosion had rendered many roads in the town impassable. This had led to the abandonment and ultimate collapse of many of these buildings. The study carried out revealed that the following factors were responsible for the perennial flooding and erosion:

Rainfall: Uromi is in the forest zone. The rainfall here is moderately high, giving rise to high volume of runoff.

Vegetation Cover: The vegetation is sparsely distributed due to human activities to give way to physical development. The absence of thick vegetative cover gives room for scouring and denudation.

Inadequacy of existing drainage structures: The existing drainage structures were grossly inadequate for the type of rainfall intensity experienced in Uromi. Some streets had no defined drains to discharge the runoff. This led to the flooding of the streets and in the process getting eroded to the extent that they developed into gullies. By the time the study and design were completed, the following nine streets/areas were identified to have been devastated: 1. Oyomon Street, 2. Oyomon Lane, 3. Eguare Road, 4. Uje-Oro Road, 5. Eidonjie Street, 6. Awo-Uzia Road, 7. Ukoni/Uwalor Road, 8. Ojomon/Efadion Road, and 9. Mission Road.

To check the menace of flooding and erosion in these areas, the study and design proffered some preventive

Table 6. Descriptive statistics.

	Mean	Std. Deviation	N
Monthly Rainfall	184.667	130.2578	12
Monthly Temperature	27.133	1.2390	12

Table 7. Correlations.

		Monthly rainfall	Monthly temperature
Pearson Correlation	Monthly Rainfall	1.000	-.812
	Monthly Temperature	-.812	1.000
Sig. (1-tailed)	Monthly Rainfall	.	.001
	Monthly Temperature	.001	.
N	Monthly Rainfall	12	12
	Monthly Temperature	12	12

Table 8. Variables entered/removed[b].

Model	Variables entered	Variables removed	Method
1	Monthly Temperature[a]	.	Enter

a. All requested variables entered. b. Dependent Variable: Monthly Rainfall.

and remedial measures. The measures include the following: (i) Provision of adequately sized reinforced concrete drainage channel (ii) Backfilling of the area involved compacting the fill to a minimum of 100% B.S compaction (iv) Upgrading existing drains to adequately size, scouring-resistant reinforced concrete lined drains (v) Replacing all undersized drainage structures (such as culverts) with adequate sizes.

The project was estimated at a total cost of over fifty million Naira for its completion in the year 2000. The Ecological Funds Office of the Presidency equally funded it. The design in 1990 allowed for 16,000m^3 of earthworks, 12.47km of drains that gulped about 4.471m^3 of concrete. There is a total of 1.0km of concrete drain for the discharge of surface runoff. Gullies with a total volume of 10,038.6m^3 have been filled with good quality laterite and compacted. Erosion continues to be dynamic in this area. Visits to these areas reveal degradation of the highest order, suffering, fear, anxiety and helplessness experienced by the people affected in all the communities in the Benin-Owena River Basin.

The project was estimated at a total cost of over fifty million Naira for its completion in the year 2000. The Ecological Funds Office of the Presidency equally funded it. The design in 1990 allowed for 16,000m^3 of earthworks, 12.47km of drains that gulped about 4.471m^3 of concrete. There is a total of 1.0km of concrete drain for the discharge of surface runoff. Gullies with a total volume of 10,038.6m3 have been filled with good quality laterite and compacted. Erosion continues to be dynamic in this area.

Visits to these areas reveal degradation of the highest order, suffering, fear, anxiety and helplessness experienced by the people affected in all the communities in the Benin-Owena River Basin. The degree of severity of gully erosion in the drainage basin is shown on Figures 6a, b and c.

Interpretation of statistical analysis

Regression

This is presented in Tables 6-11. The parameter estimate table shows that monthly temperature negatively and significantly predicts the changes in monthly rainfall. The Beta value depicted by “B” in the table for temperature is -85.382 which indicates that during temperature decrease,

Table 9. Model summary

Model	R	R Square	Adjusted R square	Std. error of the estimate
1	.812[a]	.660	.626	79.7075

a. Predictors: (Constant), Monthly Temperature. The R-statistic shows a strong relationship of 0.812. This means that there is strong relationship between monthly rainfall and monthly temperature in the area. This is supported by the R-Square value which returned 0.660 indicating that over 60 percent variation in the dependent variable (monthly rainfall) is explained by the predictor (monthly temperature) for Benin City.

Table 10. ANOVAb.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	123105.130	1	123105.130	19.377	.001[a]
	Residual	63532.816	10	6353.282		
	Total	186637.947	11			

a. Predictors: (Constant), Monthly Temperature; a. Dependent Variable: Monthly Rainfall. The ANOVA table shows that the model is significant at 0.05 level of confidence, As shown in the table, the F-statistic of 19.377 with a P-value of 0.001.

Table 11. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2501.364	526.799		4.748	.001
	Monthly Temperature	-85.382	19.397	-.812	-4.402	.001

a. Dependent Variable: Monthly Rainfall for Ondo.

rainfall increases in Ondo.

Conclusion

Climate change has impacted on erosion activities in Benin-Owena River Basin of southwestern Nigeria. While the temperature is on the increase, rainfall remains sporadic and of high intensity. In Benin City, rainfall in the decade 1961-2000 exhibited distinct variations. Generally, the first decades showed double maxima of rainfall with an August break. In the fourth decade (1991–2000), the August break was absent with the August months recording generally higher rainfall values than all the other decades. This means that the normal trend was reversed in this decade. Even the December months were very wet. January was generally the driest month with a total of 682 mm of rain between 1960–2000. July was the wettest month with a total of 14 975 mm of rainfall between 1961–2000.

The annual mean temperature of Benin City increased steadily from 1961-2000. During the 1981-1990 decade, the climate of Nigeria was described as playing a climatic drama (Ojo, 1987). The climatic fluctuations were larger and the weather became more unpredictable. The last decade, 1991–2000, has been the warmest with annual mean temperature ranging from 27°C to 28°C (decadal range: 1.0°C). The air temperature appears to exhibit a persistent increasing tendency in Benin City coupled with fluctuating rainfall. This may be an indication of global warming and climate change. There is a statistically significant relationship between mean annual rainfall and air temperatures in the study period at a 0.01 confidence level. The temperature distribution for the period 1961–2000 showed a wide variation and a gradual warming of the environment.

RECOMMENDATION

The various organs of government must continue to take drastic steps to combat the menace of soil erosion resulting from continuous climate change impacts. This is because climate change is still very much with us today.

Conflict of Interests

The author has not declared any conflict of interests.

REFERENCES

BORBDA (2001). Benin-Owena River Basin Development Authority – Briefs on Erosion and Irrigation Projects.

Brown TC, Froemke (2012). Nationwide assessment of nonpoint source threats water quality: Biosciences. 62(2): 136-146.

Faniran AO, Ojo O (1980). Man's Physical Environment, London: Heinemann.

Ikhile CI (2007a). Impacts of Climate Variability and change on the Hydrology and Water Resources of the Benin-Owena River Basin, Ph.D. Thesis, University of Benin, Benin City, Nigeria.

Ikhile CI (2007b). Application of GIS in land-use studies in the Osse-Ossiomo River basin, Nigeria IAHS Publ, 316, pp 245-251, Oxfordshire, U.K.

IPCC (2007). Climate Change : Impacts, Adaptation and Vulnerability Working Group II Contribution to the Intergovernmental Panel on Climate Change, Summary for Policy makers, IPCC Secretariat, Geneva, Switzerland.

Nearing AM (2001). Potential Changes in Rainfall Erosivity in the U.S.with Climate Change during the 21st century. J. Soil Conserv. Water, 56(3): 229-232.

Nearing MA, Pruski FF, O'Neal MR (2004). Expected Climate Change impacts on Soil Erosion rates: A Review. J. Soil Conserv. Water, 59: 1.

Odemerho FO, Onokerhoraye AG (1994). Physical Geography, A Handbook for the Tropics, BJSSA, Benin City.

Odjugo PAO (2000). The impacts of past and present trends in global warming on extreme weather conditions: global and local evidence. Asia Pacific J. Environ. Dev. 7: 53-69.

Ojo O (1987).The Climate Drama, University of Lagos Press. Inaugural Lecture Series, pp 53.

Olaniran OJ, Sumner GN (1991) Climate change in Nigeria: variation in rainfall receipt per rain day. Geo J. 22(1):242–249.

Olaniran HD (2011). Climate Change and Urbanization: A challenge to Urban Planning and Urban Sustainability in Nigeria.A Paper presented to the 52nd Annual Conference the Nigerian Assoc of Geographers, UDUS, Sokoto.

Pender JS (2008). What is Climate Change? And how it will affect Bangladesh. Briefing Paper (Final Draft) Dhaka Bangladesh.Church of Bangladesh Social Programme.

Pruski FF, Nearing MA (2002a). Climate-indused Changes in Erosion during the 21st century for 8 U.S. locations , Water Resources Research: 38(12):1298.

Segura C, Sun G, McNulty S, Zhana Y (2014). Potential impacts of climate change on soil erosion vulnerability across the conterminous United States, J. Soil Water Conservation : 69(2):171-181.

Sygna I (2005). Climate Variability in Cuba: The Social Networks. CICERO pp 2005 : 01.

academicJournals

Vol. 8(4), pp. 111-119, April, 2015
DOI: 10.5897/JGRP2015.0482
Article Number: DF50BAE52623
ISSN 2070-1845

http://www.academicjournals.org/JGRP

Journal of Geography and Regional Planning

Full Length Research Paper

Urban development and land use changes around the Ekiti State University (EKSU), Ado-Ekiti Nigeria

Owoeye, J.O.[1]* and Ogunleye, O.S.[2]

[1]Department of Urban and Regional Planning, School of Environmental Technology, Federal University of Technology, P.M.B 704 Akure, Ondo State, Nigeria.
[2]Department of Geography and Planning Science, Faculty of the Social Sciences, Ekiti State University, Ado-Ekiti, Nigeria.

Received 21 January, 2015: Accepted 22 April, 2015

Urban ecological systems are characterized by complex interactions among institutional, socio-economic and environmental variables. These interactions often generate complex human-dominated landscapes, which significantly influence effective functioning of local and global earth ecosystems and the services they provide to humans and other life on earth. Changes in ecological conditions that result from human actions in urban areas ultimately affect physical morphology and structural outlook as in the case of the study area. Using Survey Research Design (SRD) via questionnaire administration, observation and personal interview and photo-snaps for data collection, authors investigate the impact of urban growth on the environment as occasioned by the existence of a university; essentially, the effects that the growth has on the ecological system of the community. Findings in the study revealed that urban development affects the spatial heterogeneity of the landscape; especially the patterns of variation in land cover and changes in land use over time. The authors propose that effective monitoring agent to guide the direction and coherence of development in the study area is needed to forestall the haphazard pattern of development that is rampart in the area. Also, a comprehensive master plan is needed for the area coupled with provision of essential services like power supply to facilitate adequate and regular electricity supply in the area.

Key words: Urban growth, land-use changes, EKSU.

INTRODUCTION

Change of use as a concept tiptoed into development control arena by the fact that it is now regarded as development following an official endorsement or approval of the relevant development control department for any land development (Hald, 2009). But the cogent question still remains: 'what constitutes change of use?' From broad perspective the construction of a new building can be said to be a change in use of the land

*Corresponding author. E-mail: rantilinks@gmail.com, Tel: +2348039179250, +2348150943278.

because the building is for a purpose which is different from the purpose for which the land was last used. Land use changes are common phenomenon in city development process, which can happen within and or outside the city. Most often, residential areas are susceptible to land use changes due to characteristic of the neighborhoods, accessibility, renting/business factors and government policy (Yuri, 2009).

Change in economy and spatial distribution of population can occur through conversion from one land use to another. For instance, converting farm lands into residential, industrial, commercial or recreational use or vice versa. The land owners play key role in whatever will take place on his land and, therefore, their decisions identify the direction and quantity of changes (Ettema et al., 2010). Consequently, different land owners decide in different ways according to land types and parameters. The owners have to supply the financial investment of land change; thus, their awareness of the economic situation controls the speed of the changes and the final decision to be taken. In other words, the landowner may decide to leave the land at its current circumstances, develop the land by changing the land usage and exploit it, develop the land by changing the land usage and sell it or dispose it. The options vary with the preferences of different land owners. For instance, a farmer is not able to develop his land into a residential area if he does not have the required investment power and skills.

Ettema et al. (2010) differentiate between three different types of land owners according to their preferences. For example, farmers' preference is to exploit, sell or buy lands. Government's interest, on its own, is to maintain and sell or to develop and maintain while developers preference is to develop and sell or redevelop and exploit or sell. The eventual decision will depend on the expected value of each option to the owner. In case of commercial owners, utility will match with profitability; action will be taken on whichever delivers the highest profit. In case of government, social benefits might play a significant role whereas to the farmers, personal and emotional interest may influence their decision. The market price is a valuable index in deciding whether or not to sell a land with or without developing it (Ettema et al., 2010; Koomen et al., 2010).

The tendency of any change in land use begins as penetration process of commercial activities, which then continues to increase and dominate within an area. The occurrence of land use changes bring out questions on how the change took place and what are strong factors that cause them to happen. To answer the questions, it is important to analyze the structure and pattern of the changes and the causative factors. In this study, however, there is one special characteristic of the changes where most of the actors are academicians of who majority are students tenants with few staffs of the institution living among the host community. This seems to be a motivating factor that speeds up the rate of development and changing land use pattern around the university community. The thrust of this paper is unguided rapid development around the Ekiti State University (EKSU), Ado-Ekiti with a view to examine planning implication on the environment.

Universities can be valuable contributors to city's economy. They are immobile institutions fairly resistant to business cycle fluctuations. They tend to attract revenue from outside the immediate quarter through tuition, endowment income or state tax allocations which attract significant human capital, both students and employees from national market that contribute to the development in area of economic growth. The increase in population of student admitted every year since inception of the university up till date keeps increasing as well as the demands in various ways. There are great needs of accommodation hostels and business centres where to photocopy reading materials and print assignments, market where to buy food stuffs, beverages, banks for money transactions etc. All these are essential needs to be met in the university environment and the services require spaces for all their activities. The trust of this study, therefore, is to investigate the implication of land use changes occasioned by the establishment of the university and the expansion of Ado-Ekiti on the livelihood of residents around the study area.

CONCEPTUAL ISSUES AND LITERATURE APPRAISAL

Urbanization is an inevitable process that goes along with economic development and rapid population growth. The expansion of residential and commercial land uses into rural areas at the periphery of metropolitan areas is considered to be a sign of regional economic liveliness whose benefits are increasingly unbiased against eco-system impacts (Rimal, 2011). This includes degradation of air and water quality, loss of farmlands and forests, social fragmentation and infrastructure outlay (Squires, 2002; Yuan et al., 2005; Rimal, 2005, 2011; Oduwaye, 2015). It is generally believed that urbanization has both direct and indirect impacts on land use transformation such as urban sprawl and urban degradation. Urban areas and their urban-rural linkages are characterized by high dynamics of human influence and the associated land use patterns. In order to effectively address the issue of land use change process, a well-founded knowledge of underlying causes and driving factors is needed (Rimal, 2011; Oduwaye, 2015). Spatially explicit land use modeling techniques have successfully been applied to

sculpt the present and likely future land use patterns of urban areas (Lakes and Lautenbach, 2008; Bhalli and Ghaffar, 2015; Hegazy and Kaloop, 2015). The 2009 revision of World Urbanization Prospect reported in UN (2010) showed that Northern America, Latin America and the Caribbean, Europe and Oceania are highly urbanized with proportion urban ranging from 70.0% in Oceania to 82.0% in Northern America. The level of urbanization is expected to continue rising to about 84.0% in all these areas by 2050. In contrast, Africa and Asia remain mostly rural, with just 40.0 and 42.0% of their respective population living in urban settlements in 2010; and even by 2050, they are expected to be significantly less urbanized than the other major areas, reaching a proportion urban of 62.0% in Africa and 65.0% in Asia (United Nations, 2010).

Land Use Concept, according to Environmental Literacy Council (2002), is used to describe the various ways in which land and its resources are been utilized by different people, such as farming, mining, building, and grazing. Choices of how land is being used (or is to be used) are made by those who own or control the land. But the choices are limited by the physical and biological characteristics of the land, which include climate, soil and topography as well as institutional and economic factors. Urban land uses are classified into different parts such as residential, commercial, industrial, institutional, public, open space, infrastructural, and mixed land uses. *Land Cover,* on the other hand, refers to the physical and biological cover over the surface of land which includes water, vegetation, bare soil, and/or artificial structures.

Land use is a more complicated term which is defined by the natural scientists in terms of syndromes of human activities such as agriculture, forestry and building construction that alter land surface processes including biogeochemistry, hydrology and biodiversity (Adebayo, 2010; Ellis, 2010). Changes in land use and land cover date to pre-historical milieu have both direct and indirect consequences of human actions to secure essential resources. This may first have occurred with the burning of areas to enhance the availability of wild game and accelerated dramatically with the birth of agriculture, resulting in the extensive clearing (deforestation) and management of earth's terrestrial surface that continues till date. More recently, industrialization has encouraged the concentration of human populations within urban areas (urbanization) and the depopulation of rural areas accompanied by the intensification of agriculture in the most productive lands and the abandonment of marginal lands. According to Ellis (2012), all of these causes and their consequences are observable simultaneously around the world with its attendant consequences in form of biodiversity loss, climate change and population growth.

Rapid growth of cities in most African countries is traceable to rural-urban migration. It appears that large number of migrants to cities originates from smaller urban centres, and particularly from rural areas, leading to urban expansion. Consequently, Oyinloye (2010), Ellis (2012) and Owoeye (2013) observed some factors that encourage physical expansion of urban centres to include natural population increase, job-creating investment, industrial development, infrastructural development, housing provision and quality as well as level of commercial activities in cities. The effect of these factors is profound on rural lands changing into urban land uses.

MATERIALS AND METHODS

Research site

Ekiti State University, Ado-Ekiti is located within the neighborhoods of Iworoko Ekiti. It is about 15 kilometers away from Ado-Ekiti metropolis but less than a kilometer to Iworoko Ekiti thereby making it the closest community. Iworoko is strategically located and very accessible to other neighboring towns within the axis. For instance; Are and Afao are located to the east, Iyin and Igede to the west, Ifaki to the north and Ado metropolis (the state capital) is about 15 kilometers to the south. The land area is relatively flat with lush grassy vegetation and sparse forested area. While heading towards Afao and Ifaki, the land is thickly forested and mountainous which wall up the community on both sides. The residence of Iworoko can be classified into four categories - the artisans, farmers, civil servants and students (essentially the students of the university). Before the inception of the university, the people in the community were mainly farmers and into other related jobs. As the community continues to witness growth in terms of infrastructure and socio-economic development, their daily jobs become diversified. Lots of commercial activities, small scale industries, transport ventures and several government establishments begin to spring up with ample job opportunities for the residents, both skilled and unskilled.

The university was founded in 1980 but did not commence academic activities until 1982. It was initially named Obafemi Awolowo University, Ado-Ekiti. Since then, it has gone through a lot of transformations and changes in terms of the naming, students' population, incorporation of new disciplines and establishment of skill acquisition centres. Different governments at certain period of time have influenced the university since its inception till date. Figures 1-3 show the study site in both the national and local settings.

In physical structure, the university has made tremendous impact on the environment through her various contributions, particularly in the area of population increase. It serves as growth centre which attracts influx of people from different part of the state as well as other parts of the country. The institution has also influenced the daily activities of the host community, i.e. Iworoko Ekiti, from a mono (agrarian) activity to more diversified activities. Of course, it has metamorphosed the community from 'village' to a status of 'Town' due to its tremendous population growth and infrastructural improvement. Nonetheless, the developments come with penalties both on the host community and the university itself. For instance, the effects on the host community include irregular urban structures; derelict or substandard dwellings, houses and structures that were put up in haste to serve the pressing demands of students;

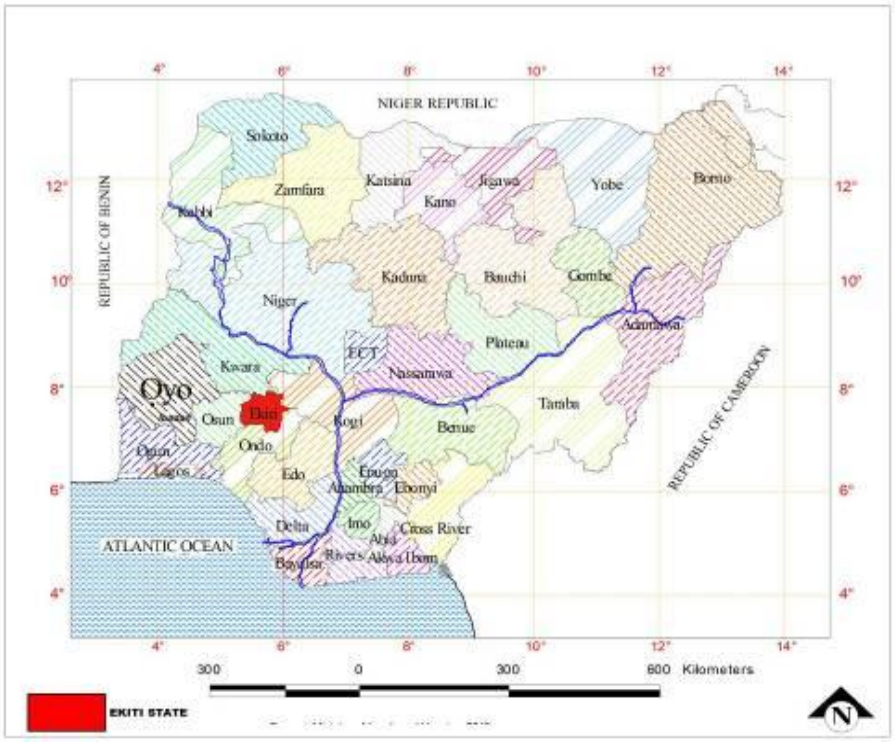


Figure 1. EKITI State in its National Settings. Source: Ekiti State Ministry of Lands and Physical Planning, 2014.

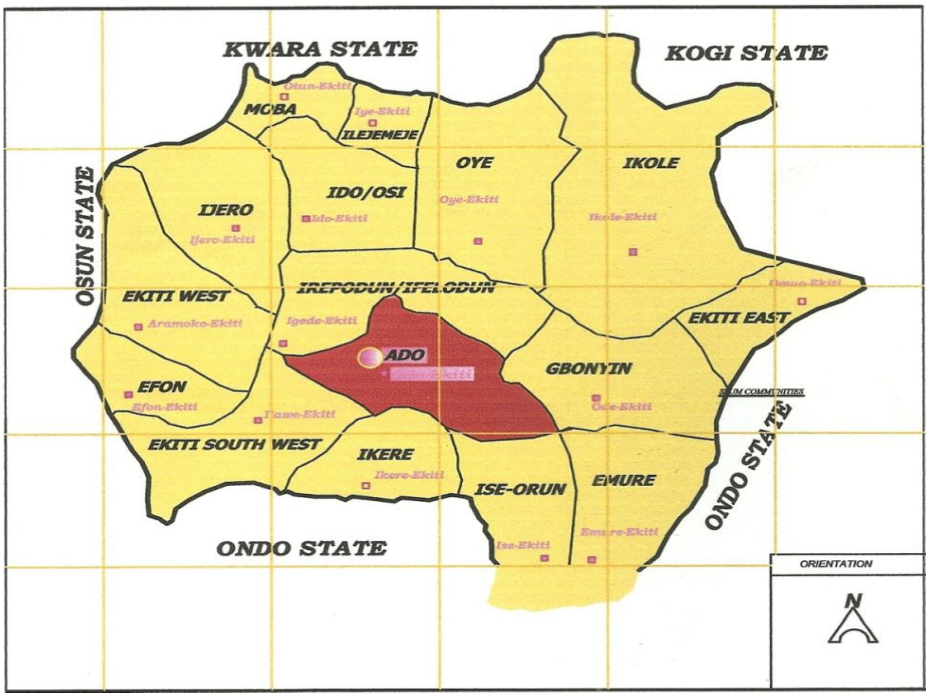


Figure 2. EKITI State showing its 16 Local Govt. Areas. Source: Ekiti State Ministry of Lands and Physical Planning, 2014.

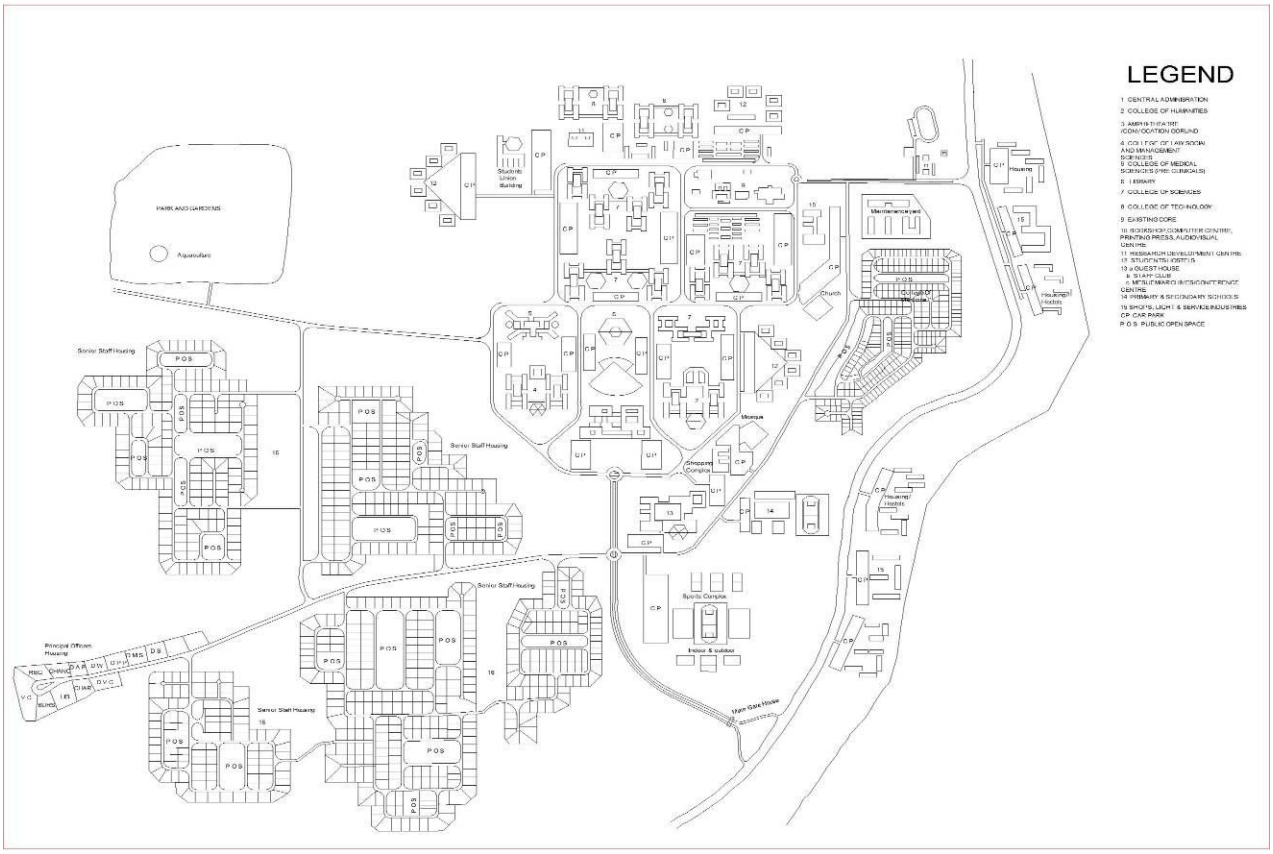


Figure 3. The Location of the Study Area (EKSU Master Plan). Source: The Physical Planning Unit; Ekiti State University, Ado-Ekiti.

agricultural lands being converted to residential and commercial land uses thereby forcing farmers, labourers and people in the community to hunt for white collar jobs as well as limiting lands for farming activities. On the other hand, however, the development has paved ways for people to encroach into the university's acquired lands leading to several alterations on her proposed master plan. This change in land uses brought about by the location of the university, no doubt, requires in-depth understanding and prompt intervention to ameliorate the possible negative impacts of the perceived irregularities in the urban structural arrangement of the community with a view to achieve harmonious and sustainable environmental management.

Sources and methods of data collection

Data collection for this study was essentially through *Survey Research Design (SRD)* with the aid of personal interviews, structured questionnaires, photo-snaps and observation. Other sources include government ministries and establishments, journals, textbooks and internet facilities. For the purpose of this study, a percentage representation method was adopted to obtain a quota sample of residents around the university environment. The residents were categorized into three zones following the developmental levels in the study area. This involves the *core,* the *peripheral* area of Iworoko community towards the university site and the *immediate surroundings* of the university area. Thus, the residents of houses in these three zones become the target population for the study. In all, there are 1,354 buildings out of which 15.0% (amounting to 203 of the buildings) were randomly selected for questionnaire administration using systematic random sampling technique at every 5th buildings on household basis. Owing to invalidation of 3 out of the total questionnaires administered due to observed inconsistencies, 200 (representing 98.50% of the 203 questionnaires administered) were analyzed using both descriptive and inferential statistics.

RESEARCH FINDINGS AND DISCUSSION

Socio-economic characteristics of respondents

As shown in Table 1, majority (40.0%) of the sampled respondents were within the age bracket of 18–35 years out of which 22.5% were students of the university, followed by those within 26-35 years (25.5%). Respondents above these ages (i.e. 36 years and above) who are either staff members of the university, landlords or other residents of houses in the study area, altogether were about 34.5% of the sampled respondents.

Table 1. Socio-economic characteristics of respondents.

Variables	Frequency	Percentage
Age Distribution		
18 - 35 years	80	40.0
26 - 35 years	51	25.5
36 – 45 years	21	10.5
46 – 55 years	5	2.5
Above 56 years	43	21.5
Total	200	100.0
Gender Distribution		
Male	112	56.0
Female	88	44.0
Total	200	100.0
Period of Residency		
Less than 5 years	105	52.5
5 - 10 years	27	13.5
11 – 15 years	38	19.0
16 – 20 years	14	7.0
21 – 25 years	7	3.5
Above 25 years	9	4.5
Total	200	100.0
Occupational Distribution		
Artisan	52	26.0
Trading	41	20.5
Professional	44	22.0
Students	45	22.5
Public Servants	18	9.0
Total	200	100.0

Source: Authors' Field Survey, 2014.

Table 2. Building characteristics and neighborhood infrastructure.

Variables	Frequency	Percentage
Building Types		
Brazilian Style	104	52.0
Blocks of Flats	66	33.0
Bungalows	21	10.5
Storey building	9	4.5
Total	200	100.00
Age of Buildings		
Less than 10 years	102	51.0
10 – 20 years	17	8.5
21 – 30 years	15	7.5
31 – 40 years	21	10.5
Above 40 years	45	22.5
Total	200	100.00
Uses of Buildings		
Residential	131	65.5
Commercial	35	17.5
Religious	16	8.5
Mixed-use	18	9.0
Total	200	100.00
Sources of Power Generation		
PHCN	133	66.5
Power Generating Set	55	27.5
Inverter	12	6.0
Total	200	100.00
Adequacy of Power Supply		
Very Good	2	1.0
Good	61	30.5
Fair	48	24.0
Poor	48	24.0
Very Poor	41	20.5
Total	200	100.00

Source: Authors' Field Survey, 2014.

The period of residency in the area was investigated to ascertain relevance and genuineness of information given by the respondents. Majority (52.5%) live in the area in less than 5 years who were mainly students of the university while those with higher period of tenancy were mainly native of the community. This information gives a fair representation of the target population for the study.

Building characteristics and neighborhood infrastructure

Table 2 shows the characteristics of buildings in the study area and the condition of neighborhood infrastructures. As shown in the table, majority of the buildings are Brazilian types. This accounts for about 52.0% of the buildings in the area which are very common in the core of the community. Blocks of flats and bungalows are building types that are common around the university which are mostly occupied by the students and some staff of the university. Larger percentage of these buildings is newly built which are in good conditions. Over 50% were built in less than 10 years, usually within the vicinity of the university. Only about 22.5% were built above 40 years which are buildings at the core area, some of which are in bad conditions. Considering the uses of buildings, over 60% are used for residential purpose followed by commercial uses (17.5%), mixed uses (9.0%) and religious uses (8.5%). As usual, about 66.5% of these buildings are connected with Power Holding Company of Nigeria (PHCN) for source of power generation. The level of adequacy and regularity of PHCN source of power supply was investigated. Over

Figure 4. Farmlands being cleared and prepared for building construction around the study area. Source: Authors' Field Survey, 2014.

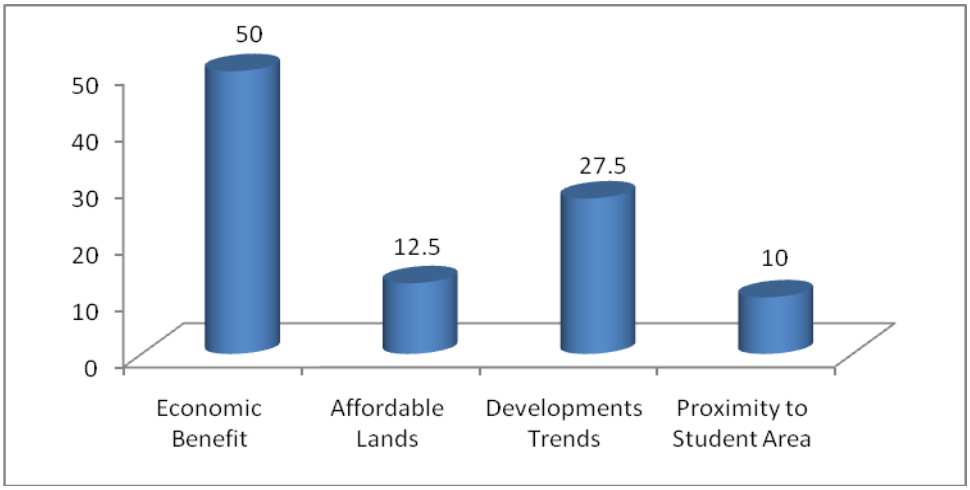


Figure 5. Reasons for land use changes in the study area.Source: Authors' Field Survey 2014.

60% are of the opinion that the power supply through PHCN is fair, poor or very poor which shows the level of problem the residents (including students) faced regarding electricity supply in the area. This is the reason why 27.5 and 6.0% make use of generating set and inverter as supplement respectively.

Pattern of land use changes and level of development

Land use change is the alteration in the initial use to which a piece of land is subjected to; one of the end results of urban development. Figure 4 depicts the common occurrence in newly open up sites of the community, portraying the evasive characteristics of residential land use in the university environment, as the demands for housing units by individuals and cooperate bodies increases. This infringes on farm lands and consequently has effects on the evolvement and pattern of land use in the area.

Investigating into major reasons for the changes in land uses in the study area; about 50.0% was of the opinion that the latter uses, which are either residential or commercial use, have high economic benefit to the owners and the community at large than the initial uses like agriculture. About 27.5% agreed that the change in land use in the area is resultant effects of development trend emanated from the location of the university while 12.5% are of the opinion that it is as a result of availability of affordable lands in the area. The remaining 10% posit the proximity to student area. This result is illustrated in Figure 5. The general observation made on urban development trends in the area focuses on high demands for

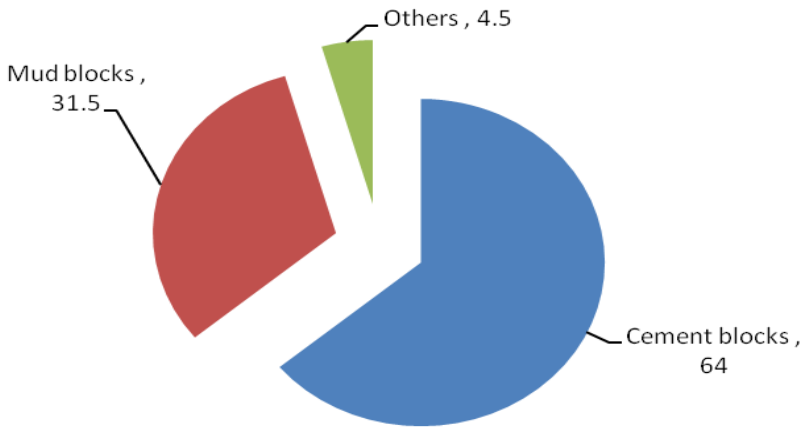


Figure 6. Material used for building construction in the study area. Source: Authors' Field Survey, 2014.

Figure 7. Building types at Ebira Community and at the periphery of Iworoko Town respectively. Source: Authors' Field Work, 2014.

land and increase in development of residential buildings, leading to congestion in the university environment. Hence, the need for adequate measure to mitigate the trend to forestall any environmental degradation and its attendant consequences in the area become pertinent.

The level of development regarding building materials used for construction was examined. Figure 6 shows major materials used. Arising from the investigation, larger percentage (64.0%) make use of cement blocks; essentially for modern buildings around the university environment whose occupants are mostly the university's students.

The 31.5% of the sampled buildings constructed with mud blocks are those at the core of the community and probably nearby huts at the peripheries occupied by the 'Ebiras' (people from Kogi State who mostly specialized in farm work). Typical examples of such buildings are shown in Figure 7. About 4.5% are those constructed with planks and bamboo which are mostly used as temporary sheds for road workers. Buildings found in these areas are generally substandard for human habitation.

RECOMMENDATIONS AND POLICY IMPLICATION

This study provides insight into urban development and land use changes as determined by individual property owners at certain time or the other depending on the trend of socio-economic development around a university community. This, without any doubt, influences the pattern and direction of the development in the area. One of the major findings was that the immediate environment of the university campus is the most developed area, living the rest of the study area (i.e. Iworoko community) with a minimal but yet tangible effects of the presence of

the university. Secondly, there are lots of higher order services still not available at the community despite the presence of the university. For instance, the facilities available in the two medical centres in the community are owned by the state government (i.e. Iworoko community health centre and Egulusi medical centre). Looking at the level of these facilities, they cannot handle major medical cases. Thus, patients are forced to go to either the Ekiti State University Teaching Hospital (EKSUTH), Ado-Ekiti or visits the Federal Medical Centre, Ido-Ekiti; a far distance town from the study area. Besides, another very important finding is the erratic nature of power supply in the area which needs government attention due to high population of students.

Based on these findings in the study, the following measures are recommended as policy guidelines toward a sustainable urban land use management in the study area. There should be in place a monitoring agent to guide the direction and coherence of development in the study area. This will forestall the haphazard pattern of development that is rampart in the area. Aside, there should be tremendous investment to provide adequate funds in building of resourceful environment focusing on standard housing units to enhance productivity of residents. Higher order services should be made available in the community to check incessant trips made to the state capital by all the residents of the community. The medical facilities in the environment should be upgraded to handle emergent medical cases rather than sending all to EKSUTH. Besides, essential services like power supply in the area need urgent attention. Government should provide transformer to facilitate adequate electricity supply that will curb erratic nature of power supply in the area. This will boost the level of socio-economic activities in the area.

Conflict of Interests

The author has not declared any conflict of interests.

REFERENCES

Adebayo MA (2010). Impact of Urban Land Use Changes on Property Values in Metropolitan Lagos. The Soc. Sc., Medwell Publishing; 4(1):111-117

Bairoch Paul (1991). *Cities and Economic Development: From the Dawn of History to the Present. Chicago;* University of Chicago Press

Bhalli MN, Ghaffar A (2015). Use of Geospatial Techniques in Monitoring Urban Expansion and Land Use Change Analysis: A Case of Lahore, Pakistan. Int. J. Basic Appl. Sci. 11:265-273

Ellis E (2010). Land-use and land-cover change. In *Cutler J. Cleveland (Eds.) Encyclopaedia of Earth;* Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment. (Retrieved on August 30, 2012 at: http://www.eoearth.org/article/Land-use_and_land-cover_change)

Ellis E (2012). Land-use and land-cover change. In Cutler J. Cleveland (Eds.): *Encyclopaedia of Earth*; Environmental Information Coalition, National Council for Science and the Environment. Washington, D.C. (Retrieved on August 30, 2014 at http://www.eoearth.org/article/Land-use_and_land-cover_change).

Ettema, J, van den Broeke MR, Van Meijgaard, E, van de Berg WJ (2010). Climate of the Greenland ice sheet using a high resolution climate model – Part 2: Near-surface climate and energy balance, The Cryosphere, 4:529–544.

Hald M (2009). *The Chinese Eco-City Concepts, Strategies, Policies and Assessments;* Bureau of Rural Sciences, Canberra.

Hegazy IR, Kaloop MR (2015). Monitoring Urban Growth and Land Use Change Detection with GIS and Remote Sensing Techniques in Daqahlia governorate Egypt. Int. J. Sust. Built Envir., Elsevier (in press); http://dx.doi.org/10.1016/j.ijsbe.2015.02.005

Koomen GJ, Den Blaauwen T, Hellingwerf KJ, Ungaro R, Mobashery S (2010). Fighting microbial resistance through development of new antimicrobial agents, directed against new specific targets. IUPAC Project 030-1-300.

Lakes T, Lautenbach S (2008). Modeling urban land use systems under transition - from socialist to post-socialist dynamics in urban areas, Wichmann, Digital Earth Summit on Geo-informatics 2008: Tools for Global Change Research, 212-217, Potsdam, Germany.

Oduwaye L (2015). Urban Land Use Planning and Reconciliation; *Inaugural Lecture Series 2015*, University of Lagos, Nigeria

Owoeye JO (2013). A Study on Environmental Habitability of Core Residential Neighbourhood in Akure, Nigeria; American J. of Res. Comm.; 1(2): 140-153. (Available at: www.usa-journal.com).

Oyinloye. MA (2010). Spatial Analysis of Urban Growth in Akure, Nigeria; Unpublished PhD Thesis, Federal University of Technology, Akure

Rimal B (2005). Application of Remote Sensing and GIS, Land use/land cover change in Kathmandu Metropolitan city, Nepal. J. Theor. Appl. Info. Tech.; 3(4):80-86 (www.jatit.org)

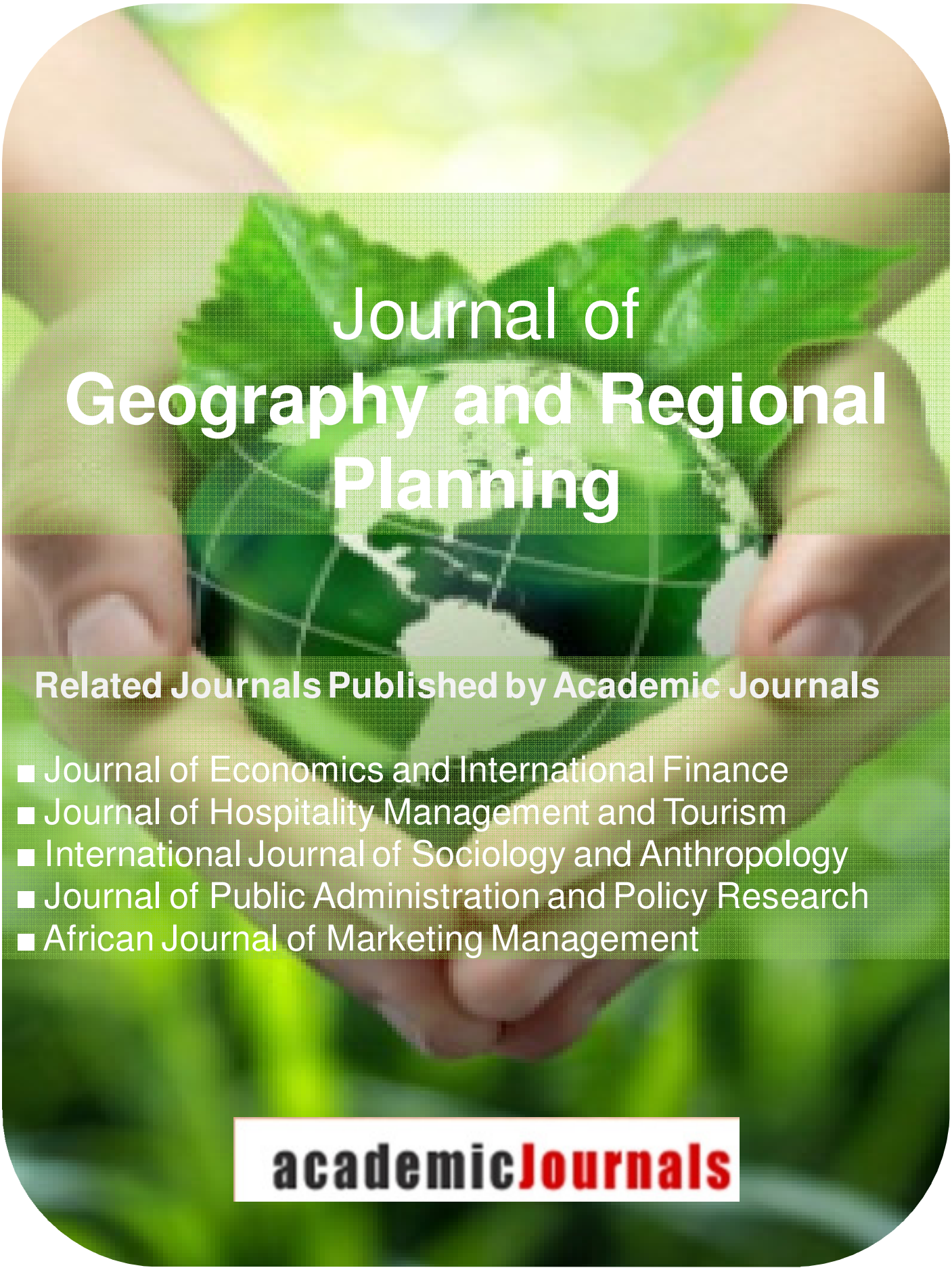
Rimal B (2011). Application of Remote Sensing and GIS, Land Use/Land Cover Change in Kathmandu Metropolitan City, Nepal. J. Theor. Appl. Info. Tech.; 23(2): 80-86.

Squires GD (2002). Urban sprawl and the uneven development of metropolitan America; In Squires G.D (edited): Urban Sprawl - Causes, Consequences, and Policy Responses; Urban Institute Press, Washington, DC: 1–22.

United Nations (2010). World Urbanization Prospects (The 2009 Revision); Department of Economic and Social Affairs Population Division, New York.

Yuan F, Sawaya KE, Leoffelholz BC, Bauer ME (2005). Land Cover Classification and change analysis of the Twins cities by Multi-temporal Land-sat RS. (Retrieved April 13, 2012 at: http://rsl.gis.umn.edu/Document/TCMA.change-detection-RSE.paper-3.pdf).

Yuri F (2009). Effects of land use change and urban development on biodiversity and traditional ecological knowledge in a Maya community in Yucatan. J. Sust. Urban Dev. Human Ecol., Italy; 2(5): 53-69.



Journal of Geography and Regional Planning

Related Journals Published by Academic Journals

- Journal of Economics and International Finance
- Journal of Hospitality Management and Tourism
- International Journal of Sociology and Anthropology
- Journal of Public Administration and Policy Research
- African Journal of Marketing Management

academicJournals