Online ISSN: 2249-460X
Print ISSN: 0975-587X

Global Journal of Human Social Sciences : B

Geography & Environmental GeoSciences

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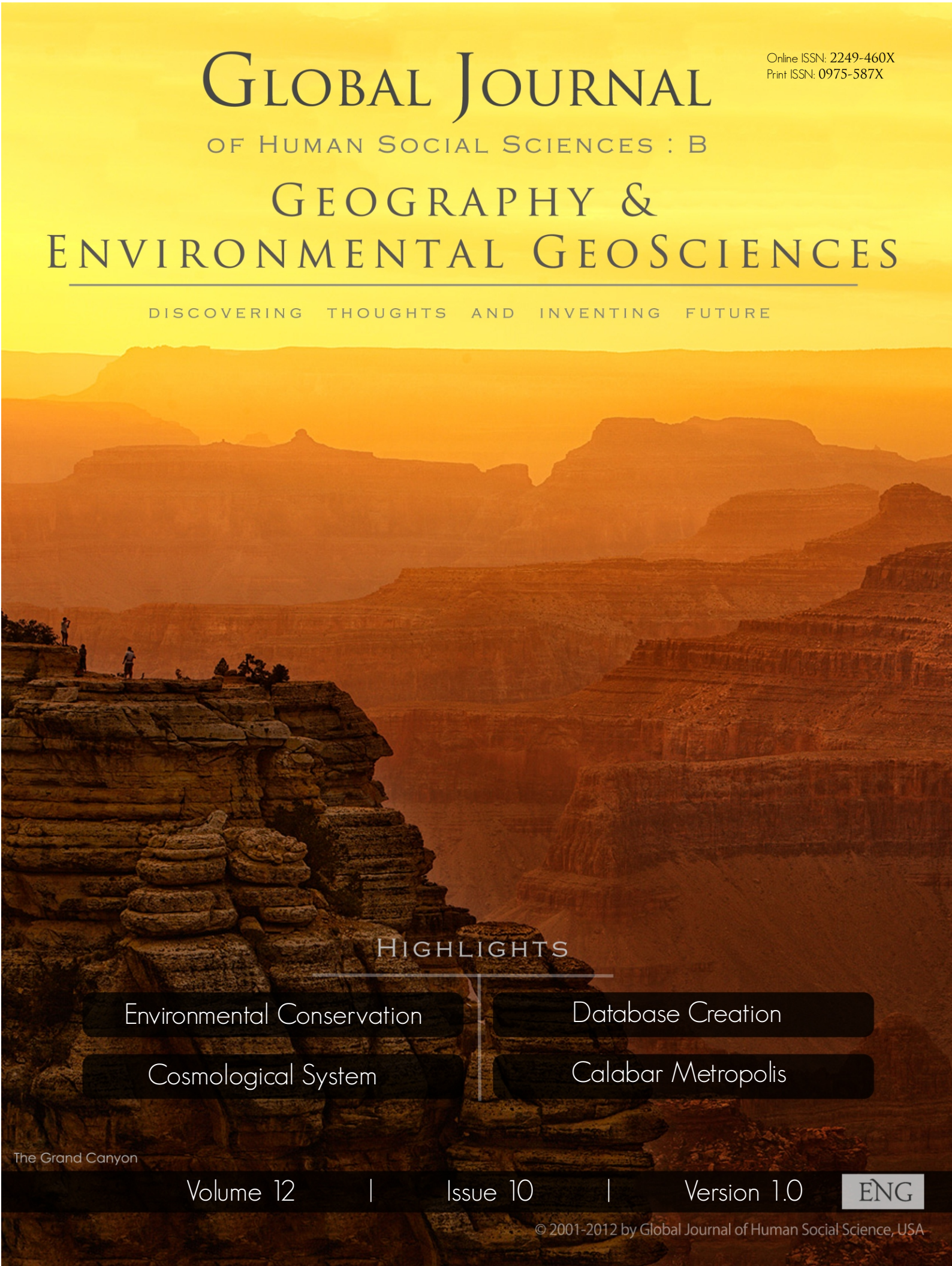

Highlights

- Environmental Conservation
- Database Creation
- Cosmological System
- Calabar Metropolis

The Grand Canyon

Volume 12 | Issue 10 | Version 1.0 ENG

Global Journal of Human Social Science : B
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Volume 12 Issue 10 (Ver. 1.0)

Open Association of Research Society

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

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USA Toll Free: +001-888-839-7392
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Offset Typesetting

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Contents of the Volume

Global Journal of human social science
Geography & Environmental GeoSciences
Volume 12 Issue 10 Version 1.0 Year 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

'Buried And Forgotten But Not Dead': Reflections on 'Ubuntu' in Environmental Conservation in Southeastern Zimbabwe

By Munyaradzi Mawere
University of Cape Town, South Africa

Abstract - The subject of ubuntu has taken a central stage in academic research on Africa in recent years. In Zimbabwe as in Africa in general, academics and researchers have tussled with various aspects of this subject, with most research emphasizing the contribution of ubuntu in business, education, healthy, philosophy and legal systems. Ramose (1999), Teffo (1995) and Shutte 2001, for example, explore the importance of ubuntu in African philosophy, especially in areas such as morality/ethics, epistemology, logic and metaphysics. Mbigi and Maree (1995), Goduka and Swadener (1999) and Prinsolo (1995) focus on the value of ubuntu in business, education and healthy fraternity respectively. Still other studies (Cornell ny; Sindane 1995) have exported the concept of ubuntu into legal systems and politics. Surprisingly, insignificant attention has been devoted to exploring the value of ubuntu in environmental conservation. This paper examines the extent to which since time immemorial, ubuntu helped to conserve the 'natural' environment and to save it from deterioration by human action. The piece marshals the concept of ubuntu and positions it against the southeastern Zimbabwe, in particular, Norumedzo and Mukanganwi landscapes. It argues for the revival and reinstitution of ubuntu to complement efforts by Science in biodiversity conservation. The argument finds its justification in ubuntu's profound respect for life (of both human and non-human beings) which makes it a potential drive for sustainable development and biodiversity conservation.

Keywords : *Ubuntu, natural environment, conservation, southeastern Zimbabwe, Africa.*

GJHSS-B Classification : *FOR Code: 160507, 160605*

Strictly as per the compliance and regulations of:

'Buried And Forgotten But Not Dead': Reflections on 'Ubuntu' in Environmental Conservation in Southeastern Zimbabwe

Munyaradzi Mawere

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I. Introduction

In Africa and beyond, especially in the turn of the new millennium, there has been concentrated debates [both oral and written] on the 'actual' causes of environmental problems we are facing today. Boggled by the same conundrum, Zimbabwean scientists/researchers like those of many other African countries have established over-population, deforestation, veld fires, farm invasions and other anthropogenic activities as the causes of environmental degradation and other environmentally related problems the country is suffering (Chaumba *etal* 2003). I admit this position has enjoyed many disciples and audiences for years now, and while to some extent it is true of Africa and Zimbabwe in particular, I argue that it misses a crucial point underlying all these problems: no wonder the problems persist (even) with magnified severity. To be more specific, the researchers disregard ubuntu's undeserving loss of value in environment conservation and development projects since the advent of colonialism through the present time, in African societies. The insignificant attention to the philosophy of ubuntu in conservation is observable in literature where most scholars and researchers have only applied the concept of ubuntu in areas such as healthy, education, judiciary systems, religion and politics. Ramose (1999), Teffo (1995) and Shutte 2001, for example, explore the importance of ubuntu in African philosophy especially in areas such as morality/ethics, epistemology, logic and metaphysics. Mbigi and Maree (1995), Goduka and Swadener (1999) and Prinsolo (1995) focus on the value of ubuntu in business, education and healthy fraternity respectively. Still other studies (Cornell n.y; Sindane 1995; Bhengu 1996) have exported the concept of ubuntu into legal systems and politics. Surprisingly, scholars have devoted insignificant attention to explore the underlying value of ubuntu in environmental conservation. One, therefore, wonders if in the past the philosophy of ubuntu did not occupy the front seat in biodiversity or 'nature' conservation projects.

Against this background, this paper traces and examines the position of ubuntu in nature conservation in the past through the present. In this attempt, the paper marshals the concept of ubuntu and positions it against the southeastern Zimbabwe, in particular, Norumedzo and Mukanganwi landscapes. The salient features in environment conservation projects in these two landscapes help to unravel the extent to which ubuntu, though been subverted over the years, captures and informs 'sustainable' conservation of the environment. The paper thus challenges the given causes (by many scientists/researchers in Zimbabwe and beyond) of environment degradation in Africa for the major reason that they fail to recognize what I shall call 'the cause of causes' which lies in the de-valorization and undermining of ubuntu's potential to help conserving the environment. It is worth noting that the philosophy of ubuntu is enshrined in taboos

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(zvierwa), avoidance rules (miko) and other such traditional systems as proverbial lores. Without necessarily dismissing to oblivion the 'secondary causes' of environmental degradation (those identified by most scientists/researchers i.e deforestation), the paper argues for the revival of ubuntu in environmental conservation projects; its full recognition, restoration and reinstitution along with science in national environmental conservation projects and policy planning.

II. Understanding Ubuntu

The concept of ubuntu though, has gained tremendous prominence in intellectual discourse over the years in Africa and beyond, is peculiarly difficult to define with precision. This is because the concept is elastic and pragmatic as it is employed to inform almost all spheres of the Bantu world-views; it is used in numerous contexts and situations. In linguistic terms, however, the concept is traceable to the so-called Nguni Bantu languages, particularly Ndebele and Zulu. In many other Bantu languages, the concept has equivalent terms. For example, in the Shona of Zimbabwe, ubuntu is equivalent to the concept 'hunhu'. Yet, the central question remains: 'What is it that is referred to as ubuntu?'

According to Ramose (1999), ubuntu is a multi-faceted philosophical system that involves logic, metaphysics, epistemology and ethics; it is a philosophy of life that is concerned with the reinforcement of unity, oneness and solidarity among the Bantu people – the so-called humanness. It is the distinctive elasticity and practical nature of ubuntu that makes it applicable in almost all facets of human life. As such, the concept has been wisely exported as an underlying philosophy or code of conduct into business, legal system, education, theology/religion, healthy and academic disciplines such as African philosophy and ethics.

Historically, the concept of ubuntu ('unhu' in Shona and 'humanness' in English) or rather the philosophy of ubuntu is intergenerational, that is, it has been spontaneously passed on from one generation to the other mainly through oral tradition and practices. This is aptly echoed by Ramose (1999) who notes that African philosophy based on 'Ubuntu' is a living philosophy, based on their recognition of the continuous oneness and wholeness of the living, the living-dead and the unborn. For Ramose, and rightly so, it is commonly believed that in pre-colonial African societies, the concept of ubuntu was instrumental in maintaining social cohesion, administering peace and order for the good life of everyone in the society and even strangers. This connotes that the social praxis of ubuntu has always been wholesome and all encompassing though insignificantly studied in relation to nature conservation in African societies.

III. Alleged Causes of Environment Degradation in Zimbabwe

While there is adequate evidence that, Zimbabwe, like many other countries in Africa, is experiencing environment conservation problems, there are disagreements on the 'real' causes of the problems. Some scholars (Moyo *etal* 1991; Masaka 2011) argue that environmental problems in Zimbabwe, like in some parts of Africa, have been aggravated by the twin projects of colonialism and science. Moyo *etal* (1991), for instance, argue that during pre-colonial times and the earlier part of the colonial period, land was neither a scarce resource, nor was it under threat of permanent environmental degradation, but with increasing colonial settlement and control, inequality of access to the natural resources was dictated. Moyo *etal* (ibid) give example of the Land Apportionment Act of 1930 that took away most of the fertile communal land from the majority and converted it into commercial farms for the minority. With an annual population growth rate in excess of 3.5% (IUCN, 1988) and a shrinking access to land, traditional conservation methods including fallow and extensive grazing became impractical in these communal areas, and land degradation set in. For Masaka (2011:331):

> *The colonization of Zimbabwe and the rest of the African continent was predicated on a treacherous basis of trying to improve the lives of the people of Africa when in fact it spelt doom to the personhood of Africans and the resource dispossession that impoverished people that had managed to survive within their means prior to the advent of colonialism.*

Masaka furthers to argue that colonialism in Zimbabwe was predicated on the myth that the locals were not able to sustainably use the natural resources at their disposal.

Other scholars (Aylen 1941; Bowyer-Bower 1996) argue that overpopulation and indigenous practices triggered and fueled environmental degradation and other such environmental conservation problems in Zimbabwe and beyond. Aylen (1941), for example, claims that during pre-colonial times and the earlier part of the colonial period, there was little detrimental impact on the environment by human land use in Zimbabwe because of the extensive, nomadic and fallow land-use practices that provided well for the relatively low population densities, as well as the practice of indigenous soil conservation measures. For Bowyer-Bower (1996), the western awareness, through science, of the causes and effects of land degradation from inappropriate land use and management, and the need for and use of appropriate monitoring techniques and conservation measures, has been well established in Zimbabwe since the 20th century when land-use guidelines for environmental protection have long been

legislated. Also, a formal management infrastructure for their research, implementation, and support through extension services remains considerable.

Still other scholars (Chenje 2000; Goredema *etal* 2011) argue that the post-independence Zimbabwe government was responsible for the mounting environment conservation problems with its fast track agrarian reforms. Chenje (2000), for example, argues that, besides the dramatic decline in agricultural production, many 'natural' resources have suffered in the newly resettled areas due to lack of expertise on land use by the new farmers. For him, if there is no significant change in farmers' behavior towards the environment both greenhouse gases concentrations and global temperatures would constantly increase. The different activities undertaken by new farmers which have resulted in large tract of forests being indiscriminately cut or burnt, animals habitants being destroyed, scattered dwellings being left to collapse on their own has had varying effects on the environment with negative implications on the climate. These activities have reduced vegetation cover, impacted on the soil conditions, runoff processes and has triggered gully erosion. On the same stroke, Goredema *etal* (2011:147), argue that:

> *The Fast Track Land Reform Program saw the movement of a number of people into land that was formally occupied by commercial farmers. New areas were cleared to enable cultivation of crops and other associated activities such as hunting, gold panning,….and settlements. These activities certainly have had implications on environment management and climate change…For example, there was a great decline in crop between 2001 and 2002 and reports show that nearly one million Zimbabweans faced acute hunger. Maize came down from 800,000 tons to 80,000 tons, wheat from 225,000 tons to 100,000 tones, tobacco 230 mil kg to 70 mil kg.*

There is no doubt that when confronted with arguments surrounding environment conservation contestations in Zimbabwe, it is somehow difficult to identify the exact root cause responsible for the conservation crisis in the country. Yet, it is important to understand the 'root cause' of conservation crisis in Zimbabwe, before understanding what this research considers as secondary causes that many scholars in environment conservation have identified as the causes. Identifying the root cause is important in order to avoid secondary causes and to suggest possible solutions to the crisis. Trying to look for solutions to the secondary problems would miss the point as it is akin to attempting to cure a disease before understanding its real cause. In what follows, I give a general critique of arguments raised by those in conservation contestations before suggesting what I think is the root cause of the causes of environment conservation crisis in Zimbabwe.

IV. The Root Cause(s) for the Failure of Zimbabwe's Environment Conservation Project

As highlighted in the introduction of this paper, Zimbabwe, like many other countries in Africa and beyond, is experiencing an environmental crisis, in addition to economic and political turmoil the country is experiencing especially since the turn of the new millennium. In the present study, I am not concerned with the latter, but with the former, especially the question: "What is the real root cause of the failure in Zimbabwe's environmental conservation project?" This, though not an easy task, is the question I will grapple with in this section.

As has been seen in the previous section, contestations on environment conservation in Zimbabwe also reveal a trajectory of land contestations in the country since the colonial period through the present. They also put to light the tension between knowledge forms, particularly Science and Indigenous knowledge systems (IKSs). Though scholars sketched in the previous section might be correct in their own right in terms of what they think are the causes of environment conservation crisis in Zimbabwe, I do not buy their arguments. Instead, I proffer the argument that both the colonial and post-independence governments have failed the environment conservation project of Zimbabwe. I will not show where both the colonial government and post-independence deserve merit (as I have done this elsewhere) (see Mawere 2011b), except to point out how both governments have failed Zimbabwe's environment conservation project.

To start with the colonial government, the latter instead of seeking ways to merge the local people's ubuntu embedded in their IKSs with expert science in the national conservation project, it despised and castigated to the dustbin of oblivion all conservation practices that were considered traditional or 'indigenous'. By default or otherwise, it failed to realize that, ubuntu, as a philosophy of life of the local people-the Shona, was a rich system that the bearers had used successfully for centuries now in conserving their 'natural' environment. It is clear, therefore, that the colonialists and some anthropologists' description of Africa as a 'dark' and 'virgin land' that required civilization was a total failure to understand and interpret the locals' philosophy of life, in this case, their 'philosophy' of the environment. Seeing 'nature' in its beautiful state, they were made to believe that the locals were unable to exploit nature as they were not 'real' people like themselves, but part of nature: nature therefore cannot exploit itself. It was far from their conviction to think that the 'nature' was good looking simply because of the way the locals interacted with their environment and all biodiversity in it. As such, with the advent of colonialism along with science in Africa,

and Zimbabwe in particular, nature/culture dichotomies were created for the first time in Zimbabwe's conservation history. This disrupted the harmonious relations that were prevailing between the locals and their 'natural' environment. The ubuntu and other such indigenous knowledge systems (IKSs) that regulated the people's way of life and perpetuated the harmonious relationships of humans with all other entities (non-humans included) in the natural environment were pejoratively labeled speculations and unscientific. Because of this devalorization of the African knowledge systems and traditions, ubuntu could not flourish. In the 'new' set-up, the flourishment of ubuntu could only be possible under the provisions of Customary Law, for as long as it did not clash with Western Civil Law under the secular processes of modernization and commercialization, a framework of a policy of separate development that ultimately led to the destruction of the locals' ties with their natural environment. In fact, the locals were forced to abandon or leave ubuntu to lie dormant and learn the colonial's science and philosophy as the only reality and appropriate way to conserve the environment. This way, ubuntu as with other IKSs, was indeed 'buried' and forgotten; since then perhaps until recently, ubuntu has never been accorded any priority in the nature conservation agenda of Zimbabwe.

As part of its promise to the long subjugated people, at independence, the Zimbabwean government vowed to commit itself to rectify all the problems that the colonial government created, that of relegating ubuntu included. The post-independence government pledged to reverse the ongoing land degradation and promote sustainable land management by publishing Zimbabwe's National Conservation Strategy through the Natural Resource Board, now the Environmental Management Agency (EMA) in 1980 as requested for all nations by the World Conservation Strategy report of (IUCN-UNEP-WWF, 1980). This was indeed a positive gesture towards sustainable conservation as it appeared to resuscitate both threatened species and those (species) that the colonial government did not consider important enough for inclusion in the national conservation project. Yet, the post-colonial government's national conservation project, like its predecessor's conservation model, was heading towards a dismal failure. The major reason for the failure was that the post- colonial Zimbabwean government, just like the colonial government, adopted formal science as its sole tool for environmental conservation. By so doing, Zimbabwe was perpetuating the colonial legacy of despising and relegating ubuntu and other environmentally related IKSs to the backseat of national conservation projects. As such, the strained relations between humans and nonhumans and the nature/culture, Science/IK dichotomies that the colonial government created remained unchallenged. Yet, this was the number one enemy of sustainable environment conservation. It resulted in some species such as forest insets whose value and rights were never pronounced in the colonial government's environmental conservation project to remain alienated. Zimbabwe's most recent National Environmental Policy and Strategies (ZNEPS) of 2009 clearly shows this perpetuation of the colonial government's conservation model with its silence on the moral value and rights of other fauna and flora species in the 'natural' environment. The policy is largely discriminatory and exclusionary of other entities in the 'natural' environment and scientifically informed. As a way of elucidating the point I make here, I cite the ZNEPS (2009: 7) which says:

> *At species level, the country supports an estimated 4,440 vascular plant species, 196 mammal species, 672 bird species, 156 reptile species, 57 species of amphibians, 132 fish species and uncounted numbers of species in other groups. The diversity of microorganisms in particular is extremely poorly known…..*

As can be seen in the quotation above, one can see that insect species and many other small species are not fully recognized in Zimbabwe's current environmental policy despite the contribution that most of these insects make to human livelihood and the ecosystem as a whole. We can only assume that insects, together with other small organisms are those being referred to as "uncounted species in other groups" (Ibid). The truth remains that Zimbabwe's current environment policy (2009) has no specific clause that provides for the protection of forest insects and many other small organisms. It is clear, therefore, that some fauna and flora species are made by the ZNEPS to be more equal than others. This is contrary to the philosophy of ubuntu, which seek peace and harmony with everyone in the society and with the 'natural' environment. Though might have its own flaws, ubuntu as embedded in environmentally related traditional knowledge systems, since time immemorial, acknowledged the moral value and rights of all entities in the 'natural' environment. Thus, while traditional management of the environment by the local Bantus was informed by ubuntu, the experience that Zimbabweans went through since the colonial period have led them to despise their own traditional knowledge systems. Thus, the post-independence Zimbabwe through its national environment policy is not an exception to the unsustainable conservation in the country.

V. Ubuntu in Environment Conservation in Southeastern Zimbabwe: What has Gone Wrong with Ubuntu over the Years in some Parts of Southeastern Zimbabwe?

There are no comprehensive and systematic researches on ubuntu in conservation in southeastern Zimbabwe. However, my preliminary ethnographic studies in this part of the country have shown that in some parts of southeastern Zimbabwe the philosophy of ubuntu is still used in small-scale environment conservation projects and with visible consequences to the environment. Where the philosophy of ubuntu still prevails, the consequences are positive and otherwise in those areas where the philosophy has lost its grip. In what follows I present two communal areas in southeastern Zimbabwe -Mukanganwi and Norumedzo - the latter of which is still using ubuntu in its environment conservation project.

Starting with the latter, Norumedzo is a mountainous communal area found in southeastern Zimbabwe, particularly the Bikita district in Masvingo province. It is about 100km from Masvingo urban. The area is occupied by various Bantu groups, mainly the VaDuma of *moyo* (heart) totem, who share the same culture generally referred to as the Shona. Though the traditional way of life of these people has been affected in a number of ways by the Western contacts, it is still largely regulated by their long lasting ubuntu philosophy. This philosophy is still visible in the way the VaNorumedzo conserve their 'natural' environment which is also their major source of livelihood.

Norumedzo communal area comprises 24 villages and is ruled by Chief Norumedzo. The area is rich in edible stinkbugs (*encosternum delegorguei* Spinola) locally named *harurwa* [in Shona language] and loquats (*mazhanje*) which exist in the thicket forest/grove (*jiri)* that was set aside for its natural resources - *harurwa* and *mazhanje* - to flourish. The *jiri,* which is about some hundred square kilometers, is the 'natural' environment being sustainably conserved by the locals, and is believed to be sacred. Both the locals and strangers are constantly advised by the chief through headmen and village 'policemen' not to tamper with it as tampering with the *jiri* is believed to anger ancestors who in return might cause *harurwa's* extinction and the *mizhanje* trees not to produce fruit. It is during the exploitation of resources from the *jiri* that the exploiters should demonstrate their highest level of ubuntu to the environment, locally known as '*hunhu'* (humanness). As such, to ensure sustainable exploitation of resources from the *jiri*, anyone who wants to exploit resources from the *jiri* would have to first of all seek permission from the village authorities. Villains (those who tamper with the *jiri*) are tried and convicted by Chief Norumedzo's traditional court.Norumedzo communal area comprises 24 villages and is ruled by Chief Norumedzo. The area is rich in edible stinkbugs (*encosternum delegorguei* Spinola) locally named *harurwa* [in Shona language] and loquats (*mazhanje*) which exist in the thicket forest/grove (*jiri)* that was set aside for its natural resources - *harurwa* and *mazhanje* - to flourish. The *jiri,* which is about some hundred square kilometers, is the 'natural' environment being sustainably conserved by the locals, and is believed to be sacred. Both the locals and strangers are constantly advised by the chief through headmen and village 'policemen' not to tamper with it as tampering with the *jiri* is believed to anger ancestors who in return might cause *harurwa's* extinction and the *mizhanje* trees not to produce fruit. It is during the exploitation of resources from the *jiri* that the exploiters should demonstrate their highest level of ubuntu to the environment, locally known as '*hunhu'* (humanness). As such, to ensure sustainable exploitation of resources from the *jiri*, anyone who wants to exploit resources from the *jiri* would have to first of all seek permission from the village authorities. Villains (those who tamper with the *jiri*) are tried and convicted by Chief Norumedzo's traditional court.

To ensure that beliefs associated with the *jiri* are not put to test, the Chief has organized the villages in such a way that they take turns to safeguard the *jiri* from overexploitation, especially during the season of *harurwa* and *mazhanje*. The Chief is well connected to the surrounding Chiefs and the District Police Chief (Member-In-Charge) who, in a way, help him fostering and perpetuating the philosophy of ubuntu in the *jiri*. Once the season for *harurwa* and *mazhanje* comes, the Chief pays tribute to both the Police Chief and the surrounding Chiefs. This way of doing is possibly drawn on the deep-seated philosophy of ubuntu which through the Shona (like other traditional Bantu groups) philosophy of neighborhood (*chigarisano*) and friendship (*usahwira*) emphasizes practices of respect, sharing and mutuality. The philosophy bridges the divides and tensions amongst the people as it encourages neighbors to help each other and share the resources they have in their respective communities. As the philosophy of ubuntu is wisely applied to foster social cohesion, sharing with outsiders is not only an expression of love, but discourages potential thieves and invaders from stealing the neighbors' belongings. Through ubuntu, even outsiders are made to feel that the neighbor's property is also theirs. Thus, using the philosophy of ubuntu embedded in all the above explained mechanisms, chief Norumedzo and his people are managing to conserve the 'natural' environment while at the same time maintain good relations with those outside their community. And, given that the *jiri* is a source of livelihood for the Norumedzo and outside communities, the philosophy of natural

conservation-ubuntu- they are using have managed to survive for centuries now. Even the 2008 Zimbabwean politico-economical crises have left the philosophy intact and the *jiri* flourishing (Mawere *forthcoming*).

Contrary to the Norumedzo scenario is the mountainous Mukanganwi communal area, also in the southeastern Zimbabwe. It is about 85km from Masvingo urban and about 20km before Norumedzo. My contact with the locals in Mukanganwi during my preliminary ethnographic studies revealed that, in this area, *harurwa* and *mazhanje* used to exist in abundance as in Norumedzo today. This was indeed evident from the look of *mizhanje* trees I observed in the area most of which had been debarked and others at the verge of falling. I was curious to know the possible cause of the increasing deterioration of *mazhanje* and *harurwa* harvests in the area. I was told by one of the old headman, Gore, that the cause was nothing, but abandonment of ubuntu. This was echoed by another headman, Mushinyi. It was from this response that I became curious and sought to examine the influence of ubuntu in environment conservation.

On examining why ubuntu was fast losing its grip in Mukanganwi, unlike in Norumedzo, I was informed that Chief Mukanganwi rules from a distant as he is a full time lecturer at the University of Zimbabwe. And because the Chief is away most of the time and is believed to have been seriously affected by Western tradition, the philosophy of ubuntu has been badly eroded in his chiefdom, and with negative consequences. It was further revealed by headman Gore that traditional practices such as the philosophy of ubuntu function well when the chief is always available to support his headmen in upholding it by punishing perpetrators. In the next section, I examine the negative consequences of abandoning ubuntu in environment conservation projects in Mukanganwi communal area.

VI. Consequences of Abandoning Ubuntu in Environmental Conservation

As previously highlighted, the abandonment of ubuntu in conservation projects in Mukanganwi communal area has its negative consequences on the locals' livelihood. The consequences are many and lacking the space to explore them all in depth, I will simply focus on those that the locals revealed during the present research.

First, *harurwa* and *mazhanje* which used to exist in abundance during the old days have drastically diminished. Many people now travel to Norumedzo, about 20km away for *harurwa* and *mazhanje*-once ubiquitous resources. This means suffering to the Mukanganwi people as they now travel longer distance in order obtain resources that used to be ubiquitous in their area. More so, their livelihood has been greatly compromised as it was from *harurwa* and *mazhanje* that they sustained their families and now that the resource is further from their locality there are inconveniences in obtaining the resources.

Second, the rainfall pattern in Mukanganwi area has dramatically changed in the recent past. Unfortunately, there are no systematic researches, prior to the present research, carried out so far in this area to establish the real cause of the diminishing amounts of rainfall in this mountainous area. The present research, however, noted that while natural phenomena is partly blamed for the erratic rainfall in Mukanganwi over the past few decades, human causes like deforestation and veld fires seem to be significantly contributing to the climatic changes in the area. In fact, it can be inferred using the logic of comparison (with Norumedzo *jiri*) that reluctance on the deployment of ubuntu in people's relations with the 'natural' environment has compromised the rainfall pattern over the years. This is quite visible in Mukanganwi communal area which is now characterized by loss of forests that is going on annually. This indiscriminate cutting down of trees, for settlements, extension of farmlands and during *harurwa* and *mazhanje* harvesting, is a good reason to explain why rainfall is now erratic in the area. So are diminished harvests of *mazhanje* and *harurwa*. This is because forest clearance poses the greatest threat to insect diversity and negatively influences climate change. As echoed by FAO (2001), loss of tropical forests is the greatest threat to insect diversity globally, as tropical forests harbor the majority of all insect species and the destruction of tropical forests continues at the high annual rate of 0.5–1%. In line with climate change, UNFCCC (2006) and Bambaige (2008) noted that the main sectors likely to be impacted by climate change include: Agriculture and food security, water resources, costal resources, biodiversity, human health and infrastructure, loss of life, erosion, land degradation, sea level rise, natural disasters, salt intrusion, crops, ecosystems, property, human and animal habitats, outbreaks of pests and diseases, displacement of people, and destruction of infrastructure (communication network, schools, hospitals and houses). And, as reported by locals in the area, the impact of drought which was a rare phenomenon in Mukanganwi, badly ravaged the area in the recent years, especially in 2001/2002; 2005/2006 and 2008/2009 seasons.

Third, veld fires have become more frequent in the past few decades, especially during the absence of the chief. As previously highlighted, one of the functions of a chief is to enforce and promote the use of traditional practices and to administer peace among his people and their relations with the 'natural' environment. Veld fires are "blazes that get out of control and devastate extensive tracts of forest, grassland, wildlife and other natural resources as well as injure and kill people and destroy their properties" (Natural Resources, Agricultural

Development and Food Security, 2009; Mawere, 2010:92). When I asked headman Mushinyi whether veld fires were common in the past, he conceded, but emphasized that people had to seek permission first from village authorities. It was not a 'willy-nilly' exercise as nowadays. He added that perpetrators were tried and convicted by the headmen or chief's court and the fine varied depending on the size of land or kind of species destroyed. This confirms Mkwanazi's (2007) observation that human beings are responsible for 95% of forest and veld fires, as natural fires (not influenced directly by human beings) have become rare. Mukanganwi like many other Zimbabwe's communal areas is suffering constant veld fires. While in Mukanganwi, this has aggravated in the recent times due to constant absence of the chief, in many other parts of the country, land degradation has been enormously worsened by the chaotic Fast Track Agrarian Reform since the turn of the new millennium. The Agrarian Reform has had serious negative impact on the physical environment - both fauna and flora - as most of the new farmers in the newly resettled areas lack implements and so resort to fires as means to clear their land. This is echoed by Mawere (2011a: 880) who argues:

> *Veld fires contribute to a significant proportion of land degradation and the release of green house gases to the atmosphere and destroy property and resources needed for immediate use over the dry season, crops, firewood, biological diversity, water sources and grazing land.*

Finally, I consider deforestation. Deforestation in Mukanganwi communal area has dramatically increased over the years. In passing through a small path down the Hozvi Mountain in Mukanganwi's chiefdom, I was perplexed when I suddenly entered a vast cleared area down slope. It was in June and the trunks of the cleared trees were still lying on land. Down slope is where the homestead of my aunt, Mrs Gambe is found. It was here where it was confirmed that people in Mukanganwi no longer respect the 'natural' environment as they did in the past when the philosophy of ubuntu still flourished in that chiefdom. When I suggested that perhaps the cause was increase in the number of people who are now in need of firewood and land for farming, she strongly objected. Like headmen Gore and Mushinyi, she cited the abandonment of ubuntu philosophy as the root cause for the deforestation they are suffering today. In her words:

> *'Pose paunoona pangova makoronga apa raiva sango remizhanje nemimwewo michero yesango yaingoberekana pamadiro. Hapana chawaishaiwa kwete. Asi nhasi ndirori rangova gwenga nepamusaka pekurasa tsika nehunhu hwavakuru vedu. Vakuru vedu vairemekedza chose chaiwanikwa mumasango sekuremekedza kwavaiita vanhu' (All this land you see now full of dongas was a grove of wild loquats and other fruit trees which grew naturally. It was a land of plenty where everything existed in abundance. But, today the same land has been turned into a desert due to disregard of our forefathers' traditions and ubuntu. Our ancestors respected all biodiversity in much the same way they did to fellow humans).*

She indeed longed for the old 'golden' days when people used to cut down only branches of trees they would use, and when fruit trees like mizhanje received the same respect as that accorded to elderly people.

VII. Righting the Wrong: the Way Forward

In light of the foregoing, it is clear that if we are to go by the two models explained above-Norumedzo and Mukanganwi- we easily agree that the philosophy of ubuntu is a worthwhile traditional strategy that has proven beyond doubt its utility in some societies. It is one of the IKSs that if reinstituted has the potential to complement science in national environment conservation projects. Yet there are asymmetrical relations between Science and traditional practices like ubuntu and other such IKSs and, between humans and other entities in the 'natural' environment. The problem, however, remains: 'How can we move beyond these asymmetrical relations? Or does breaking the boundaries and dichotomies between nature/culture, Science/IKS entails reframing debates in environment conservation?' Such critical questions are akin to those that Mignolo (n.y) raises around modernity when he asks: "how can 'critical theory' be subsumed into the project of modernity/coloniality and decolonization? Or would this assumption perhaps suggest the need to abandon the twentieth century formulations of a critical theory project? Or, would it suggest the exhaustion of the project of modernity?"

In view of the preceding questions, I submit that debates in conservation require careful reframing. Yet, the problem on how the debates should be reframed persists as reframing necessitates a deconstruction process and possibly a reconstruction one. This is because that reframing implies a thoroughgoing reevaluation of the existing approaches in environment conservation and challenging them (where necessary) by suggesting new ones to respond to the problems in conservation. I have already argued for the revival of some traditional practices such as ubuntu in areas where the philosophy has lost its grip in conservation. But to do so would require a 'holistic' comprehensive approach-an approach that reconciles understandings of contending approaches in the Science/IK, Scientist/traditionalist debate (Mawere, *forthcoming*). This is to say that in this paper a post-humanities approach is suggested as a possibility to constructively

address and reconcile the asymmetrical relations in conservations and anthropology of knowledge in general.

However, one among the most complex concepts to define with precision in the humanities today concerns post-humanities. The complexity of the concept derives from its different interpretations by different scholars. It is worth noting, however, that what most scholars do not dispute about post-humanities is that:

> *It situates itself at a crossroads: the intersection of the disciplinary formation we call 'the humanities' in its current configuration, and the challenges posed to it by work (much of it interdisciplinary) in a range of fields that is associated with the emergent orientation known as 'post-humanism,' work that in some fundamental sense challenges the humanities as we now know it to move beyond its current parameters and practices. (http://www.cary wolfe.com/online.html).*

From this understanding and for purposes of this work, the post-humanities approach I advocate herein seeks to move beyond Science/IK and nature/culture dualisms: to establish forms and methods of interdisciplinary knowledge by way of rethinking 'productively' how changes in societies challenge scholars to reconsider their understanding of 'reality' and relations between different entities in the society. My post-humanities approach is therefore one that:

1. Seeks to promote a 'sustainable' dialogue between Science and other knowledge forms (such as IKS) that are involved in environment conservation practices and projects. Such an approach is worth considering as there are some traditional conservation strategies that have proven beyond doubt that they are efficient in conserving the 'natural' environment. The strategies being deployed by the Norumedzo people of southeastern Zimbabwe are among the list. Another case in point is that of Kissidougou and Ziama in Guinea cited by Fairhead and Leach. According to Fairhead and Leach's (1995: 1028), ethnographic study "there has been a broadly positive relationship between the peopling of Kissidougou and Ziama and their forest cover. As settlements are associated with the formation of forest islands, more villages mean more forest cover". From their research, the duo argue that "recent approaches by state agencies [and foreign organizations], which focus on decentralizing resource control by establishing village-level organization and environmental management plans, actually risk undermining the existing flexible, diverse constellation of resource management relations" (Fairhead and Leach: *ibid*). Fairhead and Leach thus argue for a 'sustainable' dialogue between Science (and the state) and IK in designing and implementing national environment conservation projects.
2. Seeks to reconsider and revive some traditional practices of environment conservation that at one point or another were despised and relegated to the periphery as speculations and unscientific as long as these have proven their utility or social praxis. The reconsideration of ubuntu and other forms of knowledge as complements to science could be cases in points. This is what Lien and Law (2010: 5) allude to when they argue that "through attention to practices and performativity, we may contribute to an anthropology which is more sensitive to relations between humans and other living beings than is possible in a more anthropocentric approach".
3. Is practically responsive of humans' changing understanding of themselves and the world in terms of their relations with other entities in the 'natural' environment. Such an approach is critical as it moves beyond dualisms by considering humans, non-humans and the state as a collective and as interdependent members of the universe they share. The creation of dichotomies/dualisms is undesirable as "this anthropocentric approach emphasizes particular qualities of the human-animal phenomena on the basis of relations of asymmetry marked by animal subordination. In other words, it separates 'culture' (human) and 'nature' (non-human) on the basis of unequal distribution of agency" (Lien and Law 2010:10).

VIII. Conclusion

This study has shown that some parts of Zimbabwe are facing mounting environment conservation mismanagement related phenomena and others which result from climate change. The paper has argued that while it is partially true that the natural phenomena and secondary causes cited by some researchers on Zimbabwe are worth blaming for environmental degradation in the country, research on Mukanganwi and Norumedzo communal areas revealed that causes such as veld fires and deforestation are only among the secondary causes. They have their own root cause (s) -underlying cause- which researchers on Zimbabwe and beyond, by default or otherwise, leave undocumented. I have argued that this cause is the subversion and relegation of the philosophy of 'ubuntu' (which is at the core of African thought and practice) in environment conservation projects. Thus due to the effects of colonialism and modernity's preoccupation with scientism, 'ubuntu' and other such IKSs that were used to conserve the environment have suffered relegation as speculations and unscientific (Mawere 2011b) to the extent that they were buried and forgotten, but indeed not dead.

More importantly, the paper has argued that the problems and challenges encountered in Mukanganwi communal area are not new or unique to the area, but are resonant of those encountered in other projects elsewhere, in Zimbabwe and beyond. Yet to overcome such environment conservation there is need for a post-humanities approach that encourages scholars to rethink conservation projects, particularly the possibility of moving beyond the nature/culture, Science/IK dualisms and considering the revival of 'buried' philosophies such as 'ubuntu' and other such knowledge forms as IKSs. This is what scholars such as Abrams (1996) protested for when he argued that in community-based projects the community should control the project and make important decisions, although professionals such as engineers may provide expertise and financial support provided by external financial sources. In this sense, I have argued for 'productive' rethinking of conservation projects at all levels - from grassroots to national level.

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Global Journal of human social science
Geography & Environmental GeoSciences
Volume 12 Issue 10 Version 1.0 Year 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Health Care Facilities Mapping and Database Creation Using GIS in Chikun Local Government, Kaduna State, Nigeria

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Abstract - The study investigated the spatial distribution of health care centres in Chikun local government area of Kaduna state, Nigeria with a view to use Geographic Information Systems (GIS) technique in health care management planning. The study used the administrative map of the study area collected from the local government as the base map. Information on the number and addresses of the health care centres in the study area were collected from the local government while the coordinates of the health care centres were obtained in the field using Global Positioning System (GPS). These data were incorporated into GIS environment and analysed using Arc Map 9.2 software.

The study reveals that there were 41 health care centres in the study area with 23 **(56.1%)** been private health care centres and 18 **(43.9%)** been public health care centres. The study also reveals the pattern of distribution of the heath care centres within the study area. The study also used World Health Organisation criteria for the location of health care centres in developing countries to propose 9 new sites for the location of new health care centres to adequately cover the health needs of the people of the study area.

Keywords : *Health care, Centres, GIS, Mapping, Database.*

GJHSS-B Classification : *FOR Code: 111708, 111709*

Strictly as per the compliance and regulations of:

Health Care Facilities Mapping and Database Creation Using GIS in Chikun Local Government, Kaduna State, Nigeria

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I. Introduction

The provision of health care centres in Nigeria is a concurrent responsibility of the three tiers of government in the country. However, because Nigeria operates a mixed economy, private providers of medical health care have a visible role to play in health care delivery. The federal government's role is mostly limited to coordinating the affairs of the universityteaching hospitals, federal medical centres (tertiary health care) while the state government manages the various general hospitals (secondary health care) and the local government focuses on dispensaries (primary health care) which are regulated by the federal government. The total expenditure on health care is 4.6% of GDP, while the percentage of federal government expenditure on health care is about 1.5%(Wikipedia, 2009).

GIS (Geographic Information System) is a valuable tool to assist health research planning, monitoring and evaluating health systems. GIS can be defined as the science and technology related to the gathering, storage, manipulation, analysis and visualization of geo-referenced data (Burrough, 2001).

GIS has been be used by several scholars to combine different data and generate information required for decision making in health management. In 1854; John Snow demonstrated the utility of mapping disease outbreaks to gain insights as to their cause. Snow, an anaesthesiologist, mapped the highest density of cases that occurred in households, which used the public pump on Broad Street as their water source (Law et al., 1998). Benachi and Yasui (1999) identified that there was a positive correlation between deprivation of health centres and mortality rate. In their analysis of 2,200 small areas of Spain, they obtained two indices of deprivation and they concluded that, there was excess mortality in deprived areas estimated at 35,000 deaths. Thus, they called for government intervention in the deprived small areas of the country. They also found that there are inequalities in other aspects related to health care, such as, waiting list times, or the access to preventive health services. Olajuyin et al., (1997) investigated the effect of location on the utilization of healthcare centres in Irewole local government area of Osun State, Nigeria. Data used in this research included population data, list of health centres and their locations, and distance of the settlements to each health centre. They found that health centres were unevenly distributed among the settlements and that the distance was a paramount factor.

Okafor et al., (1977) analyzed the spatial distribution and efficiency of health centres in the old Bendel (now Edo and Delta) State. He created a data base of all the health centres in Benin and found that there were discrepancies between the population distribution and the distribution of health centres.Adejuyigbe (1973) used GIS technique to demonstrate the relationship between distance and patronage of health centres in Ife. He noted that attendance at each health centre in Ife region is a function of both type of service available there and the distance from other centre providing similar services. Dzikwi and Abbas (2012) also used GIS to map the spatial distribution of rabies in Kaduna State, Nigeria. They used GIS to analyze record data obtained from the

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state ministry of agriculture and the archived map of the state to track the spread and management of the disease in the state.

The World Health Organization (2004), describes GIS as "an excellent means of analyzing epidemiological data, revealing trends, dependencies and interrelationships that would be more difficult to discover using traditional tabular approach".

Site selection and distribution of health care centres are important components of an overall health system which has a direct impact on the burden of diseases that affect many countries in the developing world. The creation of health care centres database and mapping helps in showing the spatial distribution and information about location and their physical relations to each other. The purpose of using GIS in site selection and distribution of health care centres is that maps provides an added dimension to data analysis, which helps in visualizing the complex patterns and relationships. The use of GIS for measurement of physical distribution is well established and has been applied in many areas including retail site analysis, transport, emergency services and health care services (Wilkinson et al., 1998).

WHO (1997) specified criteria for health care planning for third world countries and indicated that each service area should cover a 4km catchment area with a population of 60,000.00 for primary health care in order to have adequate and equity of access to health centres.

In line with WHO (1997), this study therefore aimed to map the spatial distribution of health care centres as well as propose sites for new health centres in Chikun LGA of Kaduna state using GIS technique. This aim was achieved by identifying, mapping and creating a GIS database for public and private health centres in the study area. Sites were also proposed for new health centres to take adequate care of the population.

The study area is Chikun local government area of Kaduna state, Nigeria. The local government covers an area of about 445,659km2 with a population of 368,250 people as at 2006 (NPC, 2006). Chikun local government area lies within latitude 1000'0"N to 10050'0"N and within longitudes 6040'0"E to 7040'0"E.The study area covers Kujama, Kakau, Chikun, Nasarawa, Gwagwada, Sabon Tasha, Kasaya, Kamazou, Buruku and Sabon Gaya districts. Chikun LGA has experienced rapid urban growth, between the early 90s and 2004. The population had increased from an estimate of a hundred and fifty thousand (150,000) in 1994 to an estimate of three hundred and fifty thousand (350,000) in 2003 due to several reasons such which include the immigrationof people into the area as a result of religious crisis in Kaduna north and Kaduna central (National Population Commission, 2004). Thepopulation of Chikun LGA is said to have risen from three hundred and sixty eight thousand, two hundred and fifty (368,250) in 2006 to an estimated four hundred and twenty six thousand, nine hundred and two (426,902) in 2011 (FRN, 2007).

II. Materials and Method

The study used data containing the list of health care centres and their addresses in Chikun LGA. Administrative map of Chikun LGA was also sourced from the local government to serve as the base map. GPS was used to collect coordinate points of the health centres in the local government.

a) Procedure of data analysis

The administrative map of Chikun LGA was scanned and geo-referenced using Arc MAP 9.2. On-screen digitization was done with features such as roads, river, and rail-track in the study area digitized as line features. Districts and health care centers were digitized as polygon features. These spatial data were organized in layers.

b) Data base Creation

The following data were collected and used in the development of the database.

i. The study area map
ii. List showing health centre names and addresses as shown in table 1.1
iii. Health care centres coordinates.

All the necessary information for each health centre was entered into its layer's/theme's attribute table. This was done by adding required number of fields (columns) to the table and entering the data for all the health centers in their corresponding records (rows).

The coordinates of the health care centres were copied in notepad and saved as a text (plain text) file format. This file was later imported into Arc Map environment.

Queries were performed using the query builder. The queries performed were

- How many private health care centres were in Chikun?
- How many public health care centres were in Chikun?
- Where can new health centres be located?

The criteria used according to WHO (1997) in selecting the proposed sites for health care centres were:

i. *Proximity and Accessibility*

According to World Health Organization (1997), the criteria for sitting new health centre based on proximity are as follows:

1. The health centre should not be more than 4km from residential areas.

2. The health centre should be of distance not more than 20m from the major road.
3. There should be easy accessibility to source of water which should not be more than 250m from health the centre.

ii. *Population Size*

The condition based on the size of population for sitting new health centre is that:

1. An area with a population of 500 people should have access to at least 1 health centre.

III. Results and Discussion

The study identified the health centres on the field, collected the coordinates of the health centres and created a GIS database for both the public and private health care centres in the study area as shown in table 1.1.

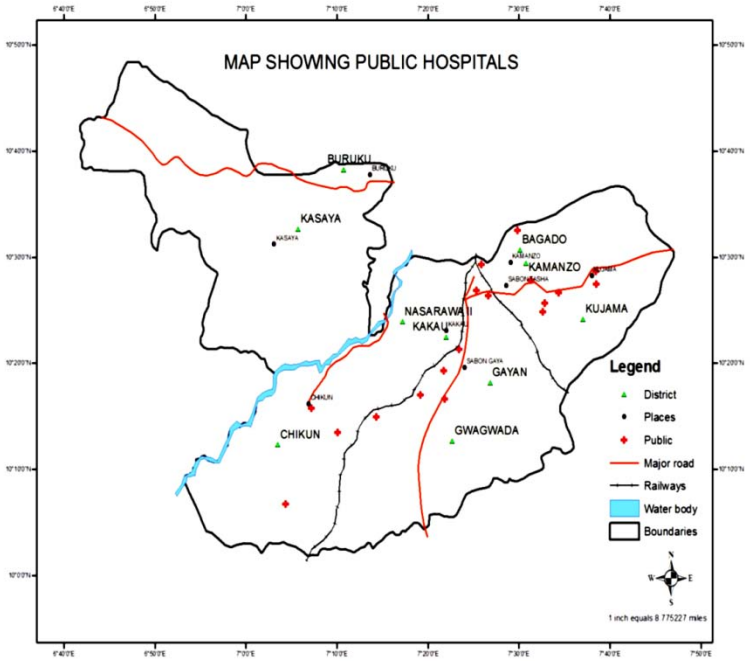
Table 1.1 : The database for Private and Public health care centers in Chikun LGA (2011).

Id	Easting	Northing	Name of health care centres	Address of health care centres	Ownership
1	$7^0$4'20.282"	$10^0$6'44.925"	Public Health Center Katarma	Katarma Village	Public
2	$7^0$10'3.823"	$10^0$13'31.309"	Health Center Gadani	Gadani Village	Public
3	$7^0$7'7.863"	$10^0$15'41.185"	Public Health Center, Chikun	Chikun Village	Public
4	$7^0$14'15.194"	$10^0$14'50.91"	Public Health Center, Gwagwada	Adjacent Primary School, Gwagwada	Public
5	$7^0$198'.461"	$10^0$174'.975"	Health Center, Kajari	Opposite Sarki House	Public
6	$7^0$215'1.853"	$10^0$163'1.459"	Health Center, Bakin Kasuwa	Adjacent Primary School, B/Kasuwa	Public
7	$7^0$213'9.284"	$10^0$191'9.04"	Health Center, Sabon Gaya	Sabon Gaya	Public
8	$7^0$214'3.474"	$10^0$192'3.229"	Public Health Centre, Sabon Gari	Adjacent ECWA Church, Sabon Gari	Public
9	$7^0$23'24"	$10^0$211'6.347"	Public Health Center, Kakau	By Railway Station, Kakau	Public
10	$7^0$252'1.329"	$10^0$265'1.509"	Public Health Centre, Sabon Tasha	Adjacent LEA Primary School, Sabon Tasha	Public
11	$7^0$264'5.12"	$10^0$262'2.182"	Public Health Center, Romi	Near Police Station, Romi	Public
12	$7^0$255'0.656"	$10^0$292'6.521"	Public Health Center, Narayi	Opposite Bayan Dutse Primary School, Narayi	Public
13	$7^0$294'5.269"	$10^0$323'0.86"	Taimako Clinic	Dan bushiya	Private
14	$7^0$312'1.628"	$10^0$275'0.162"	NNPC Industrial Hospital	NNPC Quarters	Public
15	$7^0$383'3.149"	$10^0$284'4.626"	Public Health Center, Tudun Wada Kujama	Behind Kujama Market	Public
16	$7^0$382'8.96"	$10^0$272'9.214"	Public Health Center, Tokache	Opposite Gidan Sarki	Public
17	$7^0$342'1.778"	$10^0$263'8.94"	Brethren Clinic	Opposite Deeper Life Camp	Private
18	$7^0$324'5.419"	$10^0$254'0.287"	Public Health Center, Dokan Mai Jama'a	Behind LEA Primary School, Dokan Mai Jamaa	Public
19	$7^0$323'2.85"	$10^0$245'0.012"	Iyali Clinic	Janruwa Kamazou	Public
20	$7^0$55'2.451"	$10^0$162'4.032"	Washiri Clinic	Opposite Market, Chikun Village	Private
21	$7^0$141'9.384"	$10^0$16'7.273"	Sunsungye Clinic	Near Railway Station, Gwagwada	Private
22	$7^0$243'9.434"	$10^0$191'5.802"	Aboki Clinic and	Sabon Gaya	Private

			Maternity		
23	$7^0$222'9.558"	$10^0$202'7.024"	Mission Clinic and Maternity	Kakau	Private
24	$7^0$163'7.638"	$10^0$241'7.448"	Public Health Center, Nasarawa	Behind Primary School, Nasarawa	Public
25	$7^0$191'6.84"	$10^0$252'0.291"	Freed Medical Lab	No. 18 Kaduna road. Nasarawa	Private
26	$7^0$213'9.284"	$10^0$263'5.702"	Salasi and Maternity	No. 4 Zaria road. Nsarawa	Private
27	$7^0$232'8.212"	$10^0$25'3.533"	Shalom Clinic	Hayin Rail, Gonin-Gora	Private
28	$7^0$245'6.192"	$10^0$242'1.638"	Zaitun Clinic	Buwaya, Gonin-Gora	Private
29	$7^0$273'9.583"	$10^0$252'0.291"	Ramadan Maternity	No. 20 Fulani Street, Nasarawa	Private
30	$7^0$304'3.923"	$10^0$263'5.702"	Adoro Clinic and Mternity	36, Abuja road, Sabon Tasha	Private
31	$7^0$322'0.282"	$10^0$265'2.461"	Lafia Clinic	Maraban Rido	Private
32	$7^0$254'2.277"	$10^0$271'7.598"	ECWA Clinic and Maternity	C6, Matazu road, Nasarawa	Private
33	$7^0$261'9.982"	$10^0$282'0.441"	Elshadai Clinic	Narayi Village	Private
34	$7^0$271'4.446"	$10^0$275'1.114"	Alheri Clinic and Maternity	66, Post Office road, Sabon Tasha	Private
35	$7^0$272'2.825"	$10^0$29'6.525"	Covenant Clinic	Adjacent Primary School, Narayi	Private
36	$7^0$285'0.805"	$10^0$281'2.062"	Maternity Clinic	Ungwan Baro	Private
37	$7^0$37'5.169"	$10^0$293'1.663"	Methodist Clinic	Tudun Wada, Kujama	Private
38	$7^0$401'7.888"	$10^0$284'5.578"	Sunday Dental Care	Kujama market	Private
39	$6^0$482'0.88"	$10^0$415'7.398"	Akiya Maternity Health Clinic	Kuriga Ungwan Uwaisu	Private
40	$7^0$112'3.424"	$10^0$35'2.635"	Hauwa Clinic and Maternity	Dantata, Quarters Buruku	Private
41	$7^0$111'5.045"	$10^0$374'6.027"	Alheri Clinic and Maternity	Tsohon Titi, Buruku	Private

The result of the data set for private and public health centres is as displayed in table 1.1. It shows the coordinates, names and addresses of the 41 health care centres in the study area. From table 1.1, it can be observed that there were more private health centres 23 (56.1%) than public health centres 18 (43.9%).The spatial distribution of the public heath care centres as mapped is also shown in figure 1.1 while that of the private health care centres as mapped is shown in figure 1.

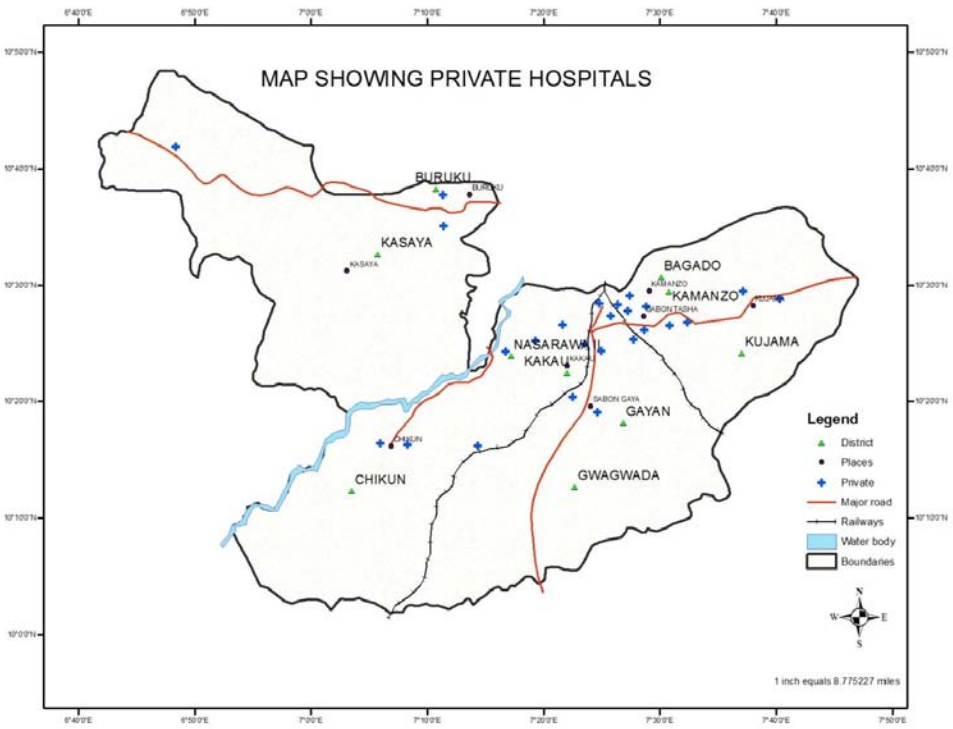
Figure 1.1 : The spatial distribution of public health centres in Chikun LGA (2011).



Source : GIS Analysis

From table 1.1 and figure 1.1, it can be observed that out of 41 health centres, there were 18 (43.9%) of public health centres spatially distributed in Chikun LGA. 12 (66.7%) of the public health centres were found to be clustered along the Eastern part of Chikun LGA inKamazou, Kujama, Kakau, Sabon Gaya districts while 6 (33.4%) of the public health centres were found at the southern part of the study area in Chikun and Gwagwada districts and none existed at the north western part of the study area.

Figure 1.2 : The spatial distribution of private health care centres in Chikun LGA (2011).

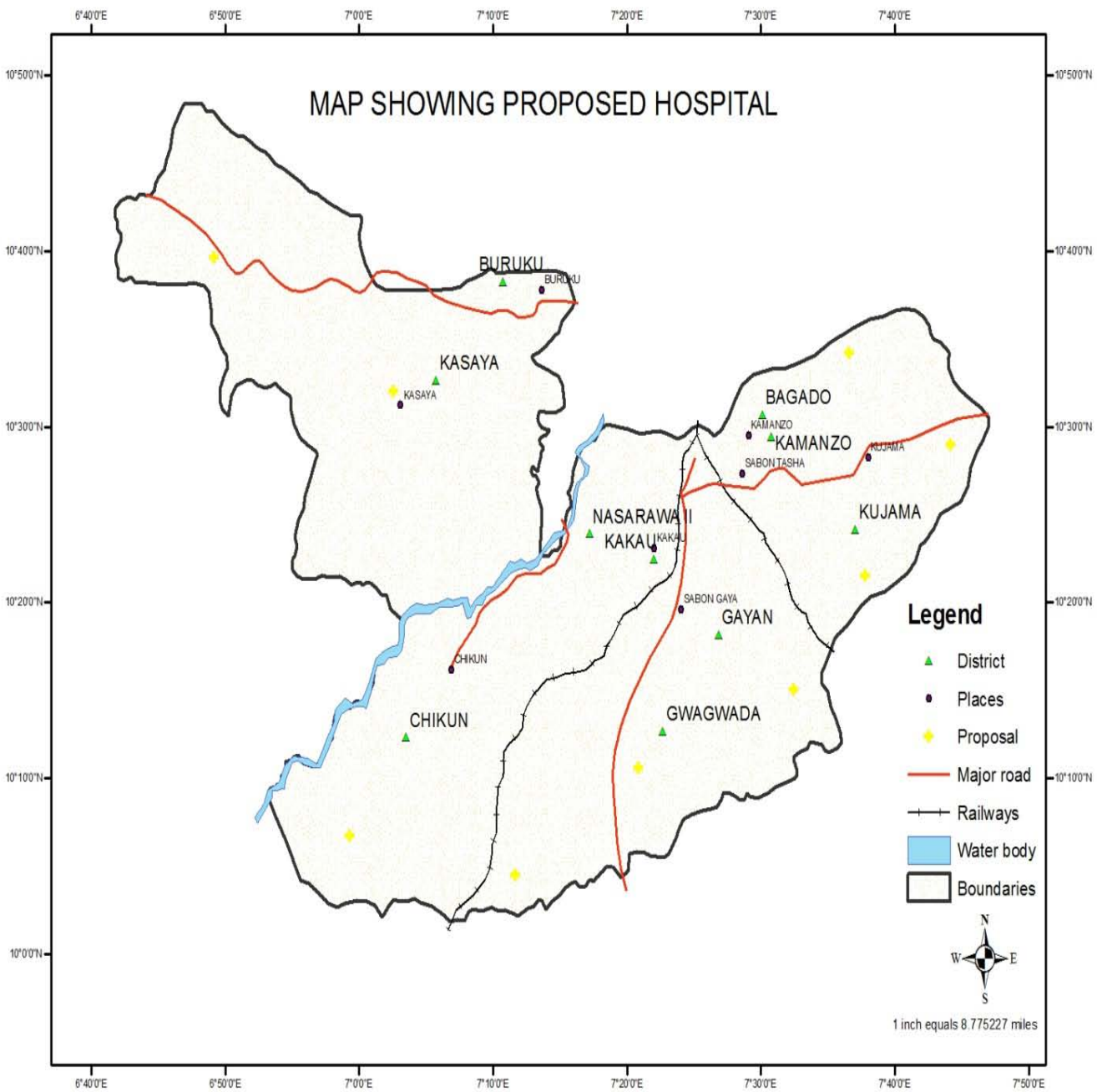


Source: GIS Analysis

From table 1.1 and figure 1.2, out of 41 health centres there were 23 (56.1%) private health care centres spatially distributed in Chikun LGA. It can also be observed that 17 (74%) of the private health centres were concentrated along the eastern part of the LGA in Nasarawa, Kakau, Sabon Tasha, Kamazou districts, 3 (13.1%) were located in the southern part of the study area in Chikun and Gwagwada districts while 3 (13.1%) were found along the north western part of the LGA in Buruku and Kasaya districts.

In proposing the sites for the location of new health care centres in Chikun LGA, WHO (1997) criteria were taken into consideration. The proposed sites are as shown in figure 1.3.

Figure 1.3 : Proposed sites for new health centres in Chikun LGA.



Source : GIS Analysis.

From figure 1.3, 9 sites were proposed for new health centres based on criteria set by World Health Organization (WHO) in 1997 as stated earlier.

IV. Discussion

The administrative map of Chikun LGA, list of health centres and the addresses were used in the analysis to generate several map layers and database as illustrated in chapter four.

Table 1.1 shows the database of all the health centres in Chikun LGA as at 2011. There were 41 health centres in Chikun LGA both public and private. From table 1.1, the coordinates of health centres are shown.

In figure 1.1, the map of Chikun LGA shows the spatial distribution of public health centres in the study area, there were 18 (43.9%). More public health centres 12 (66.7%) were located and clustered at the north eastern part of the study area and few health centres 6 (33.4%) were at the southern part of the study area and none at the north eastern part of the study area. It is obvious that the public health centres in Chikun LGA were not equally distributed. Some factors that could be responsible for these inequalities were population size of the people. For example, the areas where the health centres were located predominantly fell within urban Chikun while areas with sparse health centres fell within rural Chikun. Other factors that might have influenced the location were political influence and accessibility of the area to infrstructure.

From figure 1.2, the map of Chikun LGA shows the spatial distribution of private health centres in the study area. The private health centres were 23 (56.1%). The figure displays the existence of more private health centres 17 (74%) at the north eastern part of the study area, 3 (13.1%) private health centres at the southern part of the study area and (3) 13.1% at the north western part of the study area. Factors responsible for this distribution may be because the public health centres were not sufficient to meet the demand of the populace hence private investors established private health centres as a business outfit considering the fact that the population size especially in districts that fell within urban Chikun was good for business. The rural Chikun had fewer private health centres due to its population and lack of infrastructure.

Figure 1.3 shows the proposed sites for new health centres. 9 health centres were proposed and sites selected for them based on the criteria of the World Health Organization (WHO) in 1997 that include population size of the area, proximity and accessibility to major roads, residential area and water source.

V. Conclusion

It has been revealed by this study in Chikun LGA that serious inequality existed in the distribution of health care centres by both private and public sectors among the districts.

This study has effectively showcased the capability of GIS as a veritable tool for decision support system for site selection for new health centres. It is cost effective and fair method of selecting sites and it should be encouraged and adopted for policy making and implementation.

Finally, GIS technology has the potential to revolutionize health surveillance. It gives health professionals quick and easy access to large volume of data. GIS is valuable in strengthening the whole process of epidemiological surveillance information management and analyses. Moreover, this system provides analytical support for the planning, programming, and evaluation of activities and interventions in the health sector.

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Global Journal of human social science
Geography & Environmental GeoSciences
Volume 12 Issue 10 Version 1.0 Year 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Adsorptive Removal of Basic Dye Rhodamine B from Aquoeus Media onto Animal Bone Meal as New Low Cost Adsorbent

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Abstract - Adsorptive removal of a cationic dye – Rhodamine B – from aquoeus solutions was achieved by the use of Animal Bone Meal as a new low cost adsorbent. Adsorption of Rhodamine B was occured by studing the effects of contact time, adsorbent amount, dye concentration and temperature. Dye adsorption equilibrium was rapidly attained after 60 minutes of contact time. The isotherms of adsorption data were analyzed by Langmuir and Freundlich adsorption isotherm models. The adsorption capacity (Qm) obtained from the Langmuir isotherm plots were 62.11, 63.69, 64.13 and 64.95 mg/g respectively at 303, 313, 323 and 333°K. Thermodynamic parameters such as **Δ**H0, **Δ**S0 and **Δ**G0 were calculated, which indicated that the adsorption was spontanoeus and endothermic nature. The characteristic results and dimensionless separation factors RL showed that animal bone meal can be employed as an alternative to commercial adsorbents in the removal of Rhodamine B from aquoeus solution and wastewater.

Keywords : *Animal Bone Meal, Rhodamine B, Removal, Kinetics, Thermodynamic studies.*

GJHSS-B Classification : *FOR Code: 090403*

Strictly as per the compliance and regulations of:

Adsorptive Removal of Basic Dye Rhodamine B from Aquoeus Media onto Animal Bone Meal as New Low Cost Adsorbent

Mohammadine El Haddad [α] , Rachid Mamouni [σ] , Nabil Saffaj [ρ] & Saïd Lazar [ω]

Abstract - Adsorptive removal of a cationic dye – Rhodamine B – from aquoeus solutions was achieved by the use of Animal Bone Meal as a new low cost adsorbent. Adsorption of Rhodamine B was occured by studing the effects of contact time, adsorbent amount, dye concentration and temperature. Dye adsorption equilibrium was rapidly attained after 60 minutes of contact time. The isotherms of adsorption data were analyzed by Langmuir and Freundlich adsorption isotherm models. The adsorption capacity (Qm) obtained from the Langmuir isotherm plots were 62.11, 63.69, 64.13 and 64.95 mg/g respectively at 303, 313, 323 and 333°K. Thermodynamic parameters such as ΔH0, ΔS0 and ΔG0 were calculated, which indicated that the adsorption was spontanoeus and endothermic nature. The characteristic results and dimensionless separation factors RL showed that animal bone meal can be employed as an alternative to commercial adsorbents in the removal of Rhodamine B from aquoeus solution and wastewater.

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I. Introduction

Dyes are widely used in various industries, such as textiles, paper, plastics, cosmetics and leather for coloring their final product. The release of colored wastewater from these industries may present an ecotoxic hazard and introduce the potential danger of bioaccumulation, which may eventually affect man throught the food chain. Wastewater containing even a small amount of dyes can severely affect the aquatic life due to the reduction of light penetration and their toxicity [1,2]. Due to the good solubility of dyes, they are common water polluants and they may frequently be found in trace quantities in industrial wastewaters. An indication of the scale of the problem is given by the fact that 2% of dyes produced annually are discharged in effluent from manufacturing operations, while 10% was discharged from textile and associated industries [3].

Many treatment methods have been investigated to remove dyes from wastewater. These methods can be divided into physical, chemical and biological methods. Adsorption has been observed to be an effective process for color removal from dye wastewater. Use of activated carbon has been found to be effective, but it is too expensive. Many studies have been under taken to investigate the use of low cost adsorbents [4-6].

The aim of the present study was to investigate the effect of the adsorbent amount, contact time, dye concentration and temperature on the adsorption of Rhodamine B dye onto animal bone meal. Both Langmuir and Freundlich isotherm models were used to describe the adsorption process. Kinetic and thermodynamic studies were achieved to determine the adsorption rate constants and thermodynamic parameters ΔG0, ΔH0 and ΔS0.

II. Materials & Methods

Rhodamine B (Rd-B) is the cationic dye used in this study, which was supplied from Fluka and was used without purification. The chemical structure of Rd-B is shown in Figure 1. Colored solutions were prepared by dissolving requisite quantity of Rd-B in distilled water. The final volume prepared was 500 mL. Adsorption studies for the evaluation of Animal Bone Meal (ABM) adsorbent for the removal of Rd-B dye from aquoeus solutions were carried out in triplicate time using a batch contact adsorption method. Preliminary experiments demonstrated that the equilibrium was established at 55 min. A 50 mg sample of ABM was mixed with 50 mL dye solution of appropriate concentration. Samples of 10 mL of mixture were withdrawn from the batch at predetermined time intervals and the supernatant was centrifuged for 15 min at 3600 rpm. All dye solutions prepared were filtered by Millipore membrane type 0.45 μm HA, and the concentrations of dyes were determined from its UV/Visible absorbance characteristic with the calibration method. A BioMate 6, England UV/Visible spectrophotometer was used. A linear correlation was established between the dye concentration and the absorbance at λ_{max} = 554 nm, in the dye concentration

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range (0 – 100 mg/L) with a good correlation coefficient $R^2 = 0.999$.

In order to characterise ABM, elemntal analysis, IR and X-Ray diffraction spectrums were studied. Elemental analysis of ABM shows a high yield of Ca (49.62%) and P (42.36%) with a (Ca/P) ratio equal to 1.17. Small amounts of Si (3.88%), Mg (1.32%), Na (0.77%), Al (0.35%), Fe (0.24%), Cl (0.24%), S (0.11%), K (0.07%), Sr (0.03%), Cu (0,03%) and Zn (0.02%) are found. The IR absorption spectrum of ABM depicted in Figure 2 shows bands characteristics of hydroxyapatite and more particularly a carbonated fluorapatite type B. We note the bands located between 1455 and 1430 cm-1, these waves numbers are comparable with those of carbonated fluorapatites Type B prepared according to the procedure used by Bonel [7]. Moreover, the IR shows independently of the bands of phosphates, bands located between 780 and 800 cm-1 which could appear from the vibration of silicates groups. X-ray diffraction analysis confirms the presence of hydroxyapatite as shown in Figure 3. The specific surface area of ABM was determined by BET method from adsorption - desorption isotherm of nitrogen at its liquid temperature 77°K and was found to be Sp = 85 m^2/g.

The amount of adsorption at time t, Qt (mg/g) was calculated using the following formula :

$$Q_t = \frac{C_0 - C_t}{W} V \quad (1)$$

Where C_t (mg/L) is the liquid concentration of dye at any time, C_0 (mg/L) is the initial concentration of the dye in solution. V is the volume of the solution (L) and W is the mass of dye adsorbent (g).

The amount of equilibrium adsorption Q_e (mg/g) was calculated using the formula:

$$Q_e = \frac{C_0 - C_e}{W} V \quad (2)$$

Where C_0 and C_e (mg/L) are the liquid concentrations of dye initially and at equilibrium.

The dye removal percentage can be calculated as follows:

$$\%ofdyeremoval = \frac{C_0 - C_e}{C_0} x100 \quad (3)$$

Where C_0 and C_e (mg/L) are the initial and equilibrium concentrations of dye in solution.

To understand the adsorption mechanism, it was necessary to determine the zero point charge pH (pH_{ZPC}) of the adsorbent. The pH_{ZPC} of ABM was measured using the pH drift method [8]. In this fact, the pH_{ZPC} of the adsorbent was determined by adding 20 mL of 5.10^{-2} mol/L NaCl to several 50 mL cylindrical high-density polystyrene flasks (height 117 mm and diameter 30 mm). A range of initial pH (pH_i) values of the NaCl solutions were adjusted from 2 to 12 by adding 10^{-1} mol/L of HCl and NaOH. The total volume of the solution in each flask was brought to exactly 30 mL by further addition of 5.10^{-2} mol/L NaCL solution. The pH_i values of the solutions were then accurately noted and 50 mg of each adosrbent were added to each falsk, which was securely capped immediately. The suspensions were shaken in a shaker at 298°K and allowed to equilibrate for 48 hours. The suspensions were then centrifuged at 3600 rpm for 15 min and the final pH (pH_f) values of the supernatant liquid were recorded. The value of pH_{ZPC} is the point where the curve of ΔpH ($pH_f - pH_i$) versus pH_i crosses the line equal to zero. In this study, the determination of pH_{ZPC} of ABM was depicted in Figure 4 and was found to be 8.4 .

III. Results and Discussion

a) Effect of contact time and initial dye concentration onto the removal dye

In order to achieve accurate effect of contact time and Rd-B concentration, we have used initially a concentration dye of 60 mg/L, 50 mg of ABM quantity and 50 mL as solution volume. The results are expressed with percentage removal of Rd-B versus differents contact time in the range 10 – 90 minutes and are depicted in Figure 5. Percentage removal of Rd-B increases when increasing contact time and occurs that the adsorption equilibrium of Rd-B was rapidly attained after 60 minutes of contact time. Figure 5 reveals that the curve is single, smooth and continoeus leading to saturation, that suggesting the possible monolayer coverage of Rd-B onto ABM. In the second hand, we have achieved the effects of concentrations Rd-B (20, 40, 60, 80 and 100 mg/L) and temperature (303, 313, 323 and 333°K) on the percentage of removal dye. Table 1 depicts the different liquid concentrations of dye at equilibrium C_e (mg/L), amount of equilibrium adsorption Q_e (mg/g) and percentage of removal dye versus concentration Rd-B and temperature. At constant temperature, increasing concentration Rd-B causes an increasing of concentrations dye at equilibrium and amount of equilibrium adsorption. It means that the adsorption is hightly dependent on initial concentration of dye. The best percentage of removal Rd-B was observed at lower concentration dye. It is because of the fact at lower concentration, the ratio of the initial number of dye molecules to the availlable surface area is low subsequently the fractional adsorption becomes independent of initial concentration. However, at high concentration the availlable sites of adsorption becomes fewer and hence the percentage removal of dye dependents upon concentration. At constant concentration dye, the increasing of temperature decreases the concentration of dye at equilibrium and

increases simultanoeusly the amount of equilibrium adsorption and the percentage of removal Rd-B.

b) Effect of adsorbent dose onto the adsorption of Rd-B

To evaluate the effect of adsorbent dose on the adsorption of Rd-B, we have used 60 mg/L as initial concentration Rd-B and 50 mL of solution volume. Figure 6 depicts the variation of percentage of removal Rd-B versus adsorbent dose from the range of (10 – 90 mg). The percentage of removal Rd-B increases with increasing adsorbent dose. The decolorization of aquoeus solutions by Rd-B varied from 37% to 84% when the adsorbent dose increases from 10 to 90 mg. This was attributed to increased ABM surface area and availlability of more adsorption sites. Hence, the following experiments were carried out with the adsorbent dose of 50 mg using 50 mL of solution volume.

c) Adsorption isotherm

The adsorption isotherm is the most important information which indicates how the adsorbate molecules distribute between the liquid phase and the solid phase when the adsorption process reaches an equilibrium state. To optimize the design of an adsorption system for the adsorption of adsorbates, it is important to establish the most appropriate correlation for the equilibrium curves. The experimental data were analyzed according to linear form of the Langmuir and Freundlich isotherms [9,10]. The linear form of Langmuir isotherm is expressed as:

$$\frac{C_e}{Q_e} = \frac{C_e}{Q_m} + \frac{1}{Q_m b} \quad (4)$$

Where C_e is the equilibrium concentration of dye in solution (mg/L), Q_e is the amount of dye adsorbed per unit weight of adsorbent at equilibrium (mg/g), Q_m is the monolayer adsorption capacity (mg/g) and b is related with the energie of the adsorption (L/mg). Plots of C_e/Q_e versus C_e yield a straight line with slope $1/Q_m$ and intercept $1/Q_m b$ suggest the applicability of the Langmuir isotherm at different temperatures (Figure 7). Table 2 Lists the maximum adsorption capacity Q_m values for Rd-B adsorption onto ABM at different temperatures. From the results, it is clear that the value of adsorption efficiency Q_m and adsorption energy b of the ABM increases when increasing the temperature. From the values it is concluded that the maximum adsorption corresponds to a saturated monolayer of adsorbate molecules on adsorbent surface with constant energy and no transmission of adsorbate in the plane of the adsorbent surface. The observed b value shows that the adsorbent prefers to bind acidic ions and that speciation predominates on sorbent characteristics, when ion exchange as the predominant mechanism takes place in the adsorption of Rd-B, it confirms the endothermic nature process involved in the system. The essential characteristics of the Langmuir isotherm can be expressed in terms of dimmensioless constant separation factor R_L given by [11,12]:

$$R_L = \frac{1}{1 + bC_0} \quad (5)$$

Where L is the Langmuir constant and C_0 is the highest initial dye concentration (mg/L).

R_L values indicate the type of Langmuir isotherm and to be [11,12]:

Irreversible: $R_L = 0$

Favorable: $0 < R_L < 1$

Linear: $R_L = 1$

Unfavorable: $R_L > 1$

According to the values of R_L calculated at 303, 313, 323 and 333°K are in range between 0 and 1 and are given in Table 3, which indicates that the adsorption process is favorable at operation conditions studied.

The Freundlich isotherm is an empirical equation based upon a heterogeneous surface [13]. A linear form of the Freundlich expression can be presented as below:

$$\log Q_e = \log K_f + \frac{1}{n}\log C_e \quad (6)$$

A plot of log Q_e versus log C_e enables to determine the constant K_f and n. K_f represents the quantity of dye adsorbed onto adsorbent for an equilibrium concentration. The slope n ranging between 0 and 1, is a measure of adsorption intensity or surface heterogeneity, becoming more heterogeneous as its value gets closer to zero. These values together with the correlation coefficients are summarized in Table 2.

d) Determination of thermodynamic parameters

The adsorption capacity of ABM increased with increase in the temperature of the system from 303 – 333°K. Thermodynamic parameters such as change in free energy ΔG^0 (kj/mol), enthalpy ΔH^0 (kj/mol) and entropy ΔS^0 (kj/°K.mol) were determined using the following equations:

$$K_0 = \frac{C_{solid}}{C_{liquid}} \quad (7)$$

$$\Delta G^0 = -RT \ln K_0 \quad (8)$$

$$\log K_0 = \frac{\Delta S^0}{2.303R} - \frac{\Delta H^0}{2.303RT} \quad (9)$$

Where K_0 is the equilibrium constant, C_{solid} is the solid phase concentration at equilibrium (mg/L), C_{liquid} is

the liquid phase concentration at equilibrium (mg/L), T is the temperature expressed in ° Kelvin and R is the gas constant. The ΔH^0 and ΔS^0 values obtained from the slope and intercept of Van't Hoff plots are presented in Table 4. The values of ΔH^0 are within the range of 1 – 93 kj/mol indicating the physisorption. From these results it is clear that physisorption is much more favourable for the adsorption of Rd-B. The positive values of ΔH^0 show the endothermic nature of adsorption and it governs the possibility of physical adsorption [14-16]. Since in case of physical adsorption, while increasing the temperature of the system, the extent of Rd-B adsorption increases, this rules out the possibility of chemiosorption [17,18]. The low value of ΔH^0 suggests that the Rd-B is physisorbed onto ABM adsorbent.

The negative values of ΔG^0 (Table 4) shows that the adsorption is highly favourable and spontaneous. The positive values of ΔS^0 (Table 4) shows the increased disorder and randomness at the solid solution interface of Rd-B with ABM adsorbent that bring about some structural changes in the Rd-B and the ABM. The enhancement of adsorption capacity of the ABM at higher temperatures was attributed to the enlargement of pore size and activation of the adsorbent surface [19,20].

e) Study of kinetics adsorption

In present study, the kinetics studies of dye removal was carried out to understand the behaviour of the low cost ABM adsorbent. The adsorption of dye from aquoeus media by the adsorbent follows reversible first order kinetics, when a single species is considered on a heterogeneous surface. The heterogeneous equilibrium between the Rd-B solutions and the ABM is expressed as:

$$(\text{Rd-B})_{\text{Liq}} \underset{k_2}{\overset{k_1}{\rightleftharpoons}} (\text{Rd-B})_{\text{Sol}}$$

Where k_1 is the forward rate constant and k_2 is the backward rate constant. $(\text{Rd-B})_{\text{Liq}}$ represents dye remaining in the aquoeus solution and $(\text{Rd-B})_{\text{Sol}}$ represents dye adsorbed on the surface of ABM. The equilibrium constant K_0 is the ratio of adsorbate concentration in adsorbent and in aquoeus solution:

$$K_0 = k_1/k_2 \qquad (10)$$

In order to achieve the kinetics of the adsorption process, we have used the following kinetic equation [21,22]:

$$\log \frac{C_0}{C_t} = \frac{k_{ads}}{2.303} t \qquad (11)$$

Where C_0 and C_t are the concentration of the dye (mg/L) at time zero and at time t, respectively. The rate constant (k_{ad}) for the adsorption processes have been calculated from the slope of the linear plots of log C_0/C_t versus t for different concentrations and temperatures. The determination of rate constants as described in literature is given as:

$$k_{ads} = k_1 + k_2 = k_1 + \frac{k_1}{K_0} = k_1\left(1 + \frac{1}{K_0}\right) \qquad (12)$$

Table 5 depicts the overall rate constants kad for the adsorption of Rd-B at different temperatures are found from the slope of the plots of equation (11). From these values shown in Table 5, the rate constant kad increases with increase in temperature suggesting that the adsorption process is endothermic nature. Further, kad values decrease with increasing initial concentration of the Rd-B. In cases of strict surface adsorption a variation of rate should be proportional to the first power of concentration. However, when pore diffusion limits the adsorption process, the relationship between initial dye concentration and rate of reaction will not be linear. Thus, in the present study pore diffusion limits the overall rate of Rd-B adsorption. The overall rate of adsorption is separated into the rate of forward and reverse reactions using the above equation. The rate constants of forward and reverse processes are also collected in Table 5. It indicates that at all initial concentrations and temperatures, the forward rate constant is much higher than the reverse rate constant suggesting that the rate of adsorption is clearly dominant.

IV. Conclusion

The results indicated that ABM is a promising new low cost adsorbent for removal of Rhodamine B from aquoeus solutions. The equilibrium data have been analyzed. The results showed that the Rhodamine B flollowed Langmuir isotherm model. Thermodynamic studies indicated that the dye adsorption onto ABM was a spontaneous, endothermic and physical reaction.

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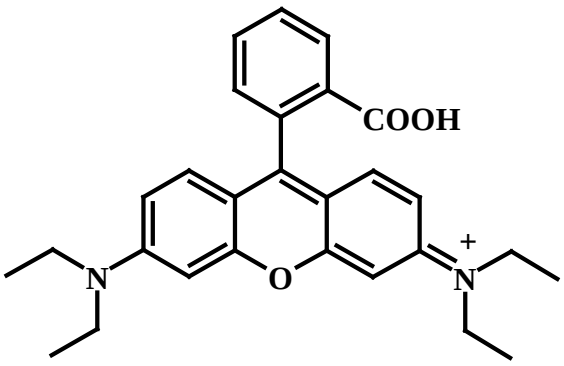

Figure 1 : Chemical structure of Rhodamine B.

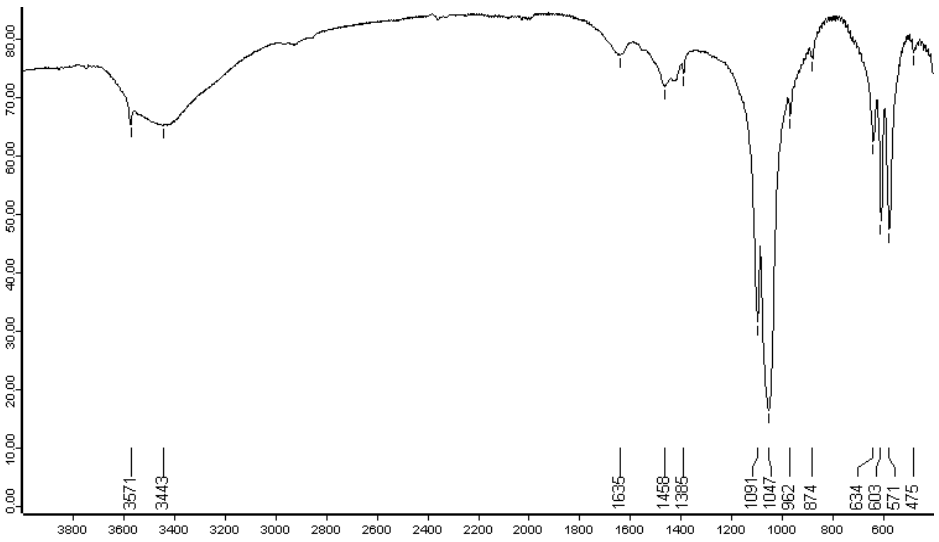

Figure 2 : IR spectra of ABM.

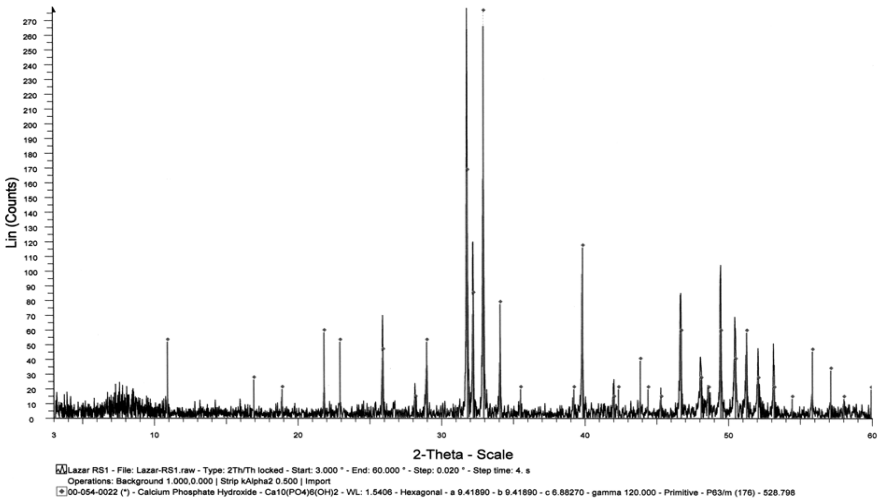

Figure 3: X-ray diffraction of ABM.

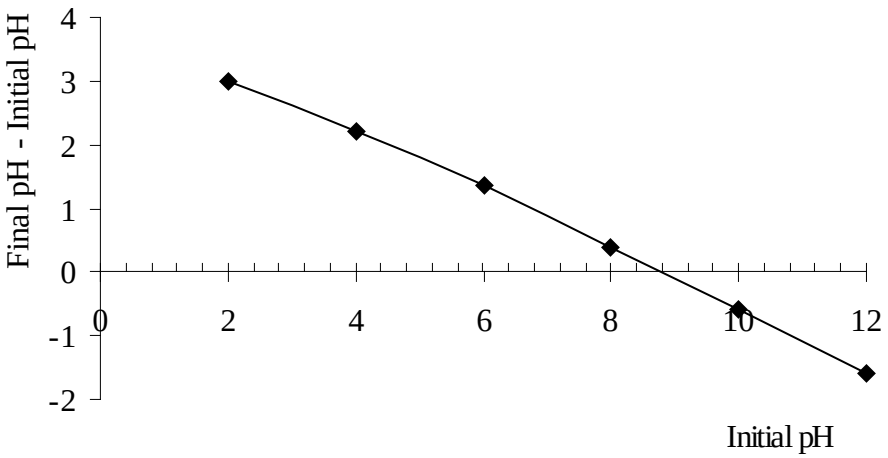

Figure 4 : Determination of Zero Point Charge pH.

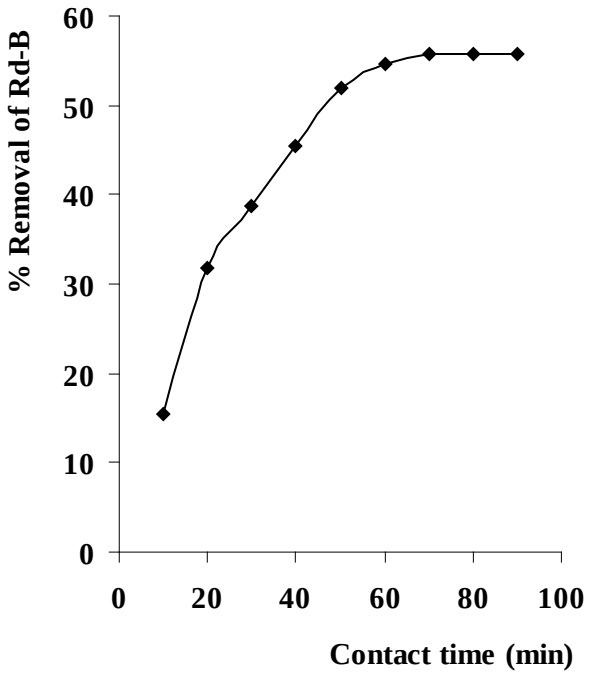

Figure 5 : Effect of contact time on the adsorption of Rd-B. [Rd-B] = 60 mg/L ; Adsorbent dose : W = 50 mg and V = 50 mL.

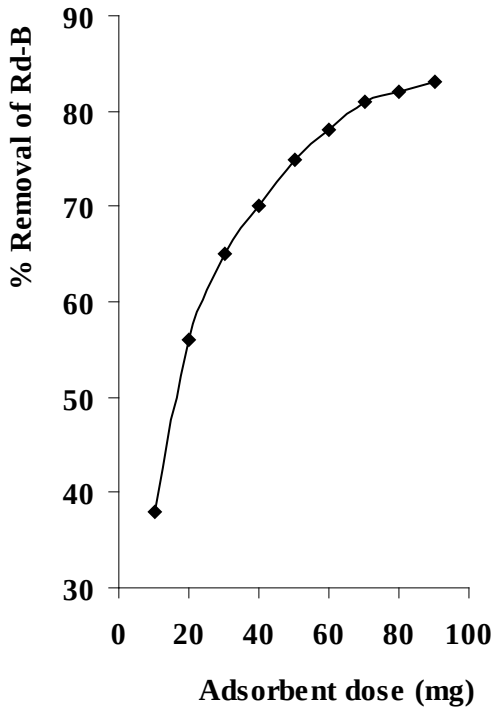

Figure 6 : Effect of adsorbent dose on the adsorption of Rd-B :[Rd-B] = 60 mg/L ; Contact time = 60 min

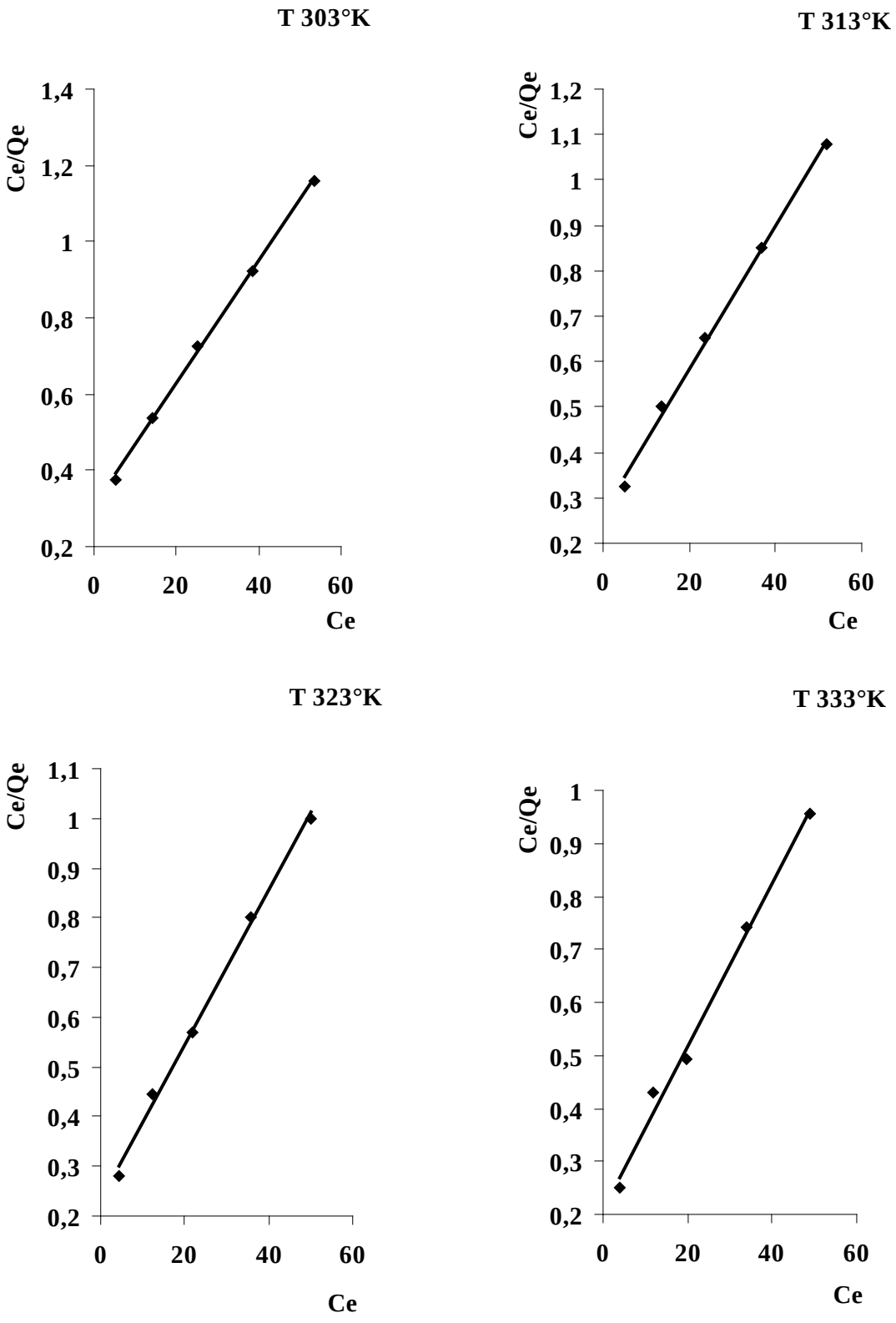

Figure 7 : Linear Langmuir isotherm for the adsorption of Rd-B onto ABM.

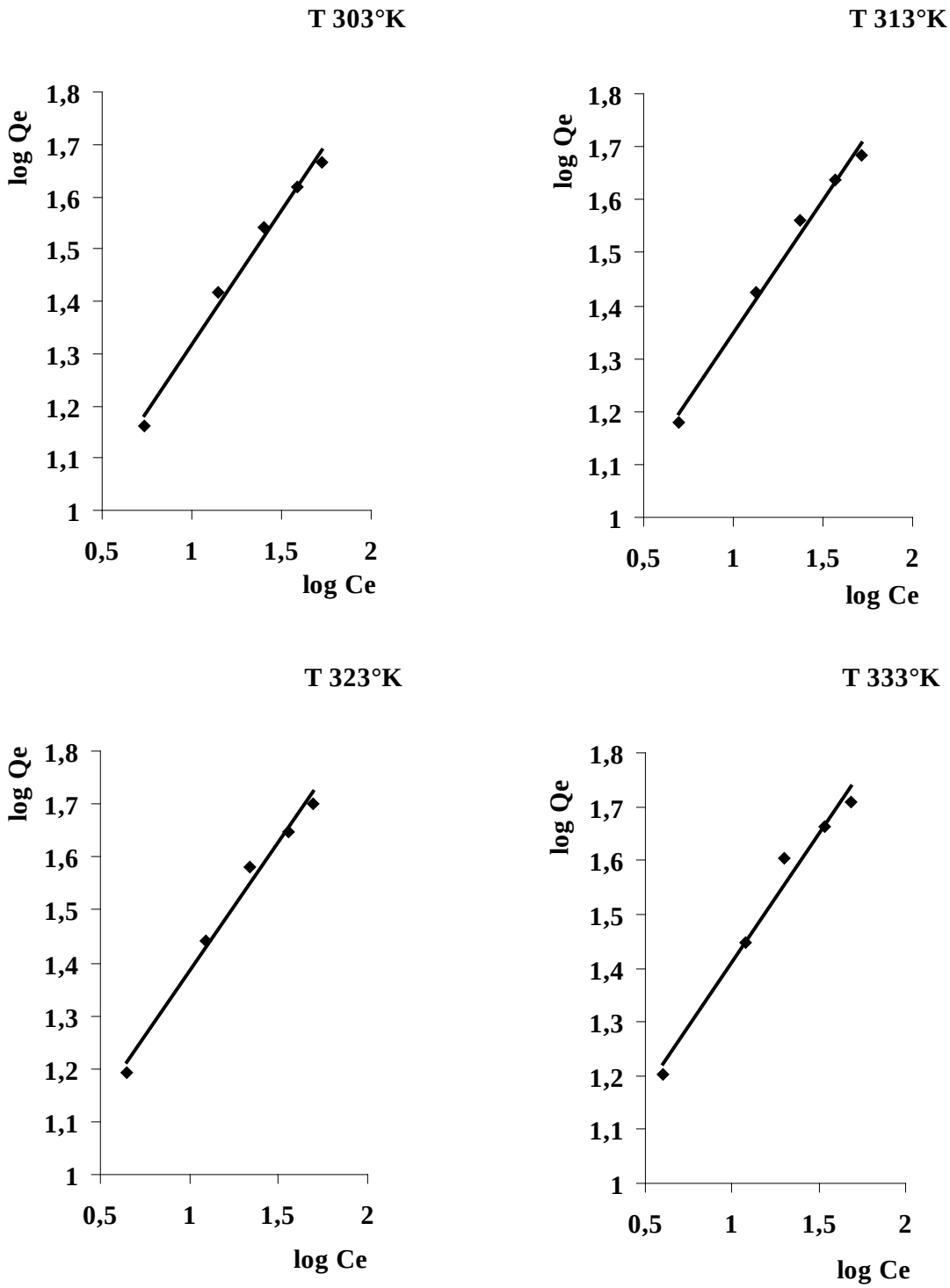

Figure 8 : Linear Freundlich isotherm for the adsorption of Rd-B onto ABM.

$[Rd\text{-}B]_0$ (mg/L)		20	40	60	80	100
C_e (mg/L)	303°K	5.4532	13.9876	25.2347	38.3456	53.6754
	313°K	4.9178	13.3567	23.6543	36.7456	51.8765
	323°K	4.4024	12.3425	21.7654	35.5643	49.9876
	333°K	4.0034	12.0125	19.7895	34.0453	48.8976
Q_e (mg/g)	303°K	14.5468	26.0124	34.7653	41.6544	46.3246
	313°K	15.0822	26.6433	36.3457	43.2544	48.1235
	323°K	15.5976	27.6575	38.2346	44.4357	50.0124
	333°K	15.9966	27.9875	40.2105	45.9547	51.1024
% Removal Dye	303°K	72.73	65.03	57.94	52.07	46.32
	313°K	75.41	66.61	60.58	54.07	48.12
	323°K	77.99	69.14	63.72	55.54	50.01
	333°K	79.98	69.97	67.02	57.44	51.10

Table 1 : Equilibrium parameters for the adsorption of dye onto ABM adsorbent.

	Langmuir isotherm results			Freundlich isotherm results		
Temp. °K	R^2	Q_m (mg/g)	b	R^2	K_f	n
303	0.9982	62.11	0.053	0.9883	6.41	1.96
313	0.9971	63.69	0.058	0.9899	7.05	2.00
323	0.9964	64.13	0.067	0.9861	8.35	2.06
333	0.9956	64.95	0.074	0.9762	8.61	2.10

Table 2 : Statistical parametrs/constants of Langmuir and Freundlich isotherms results.

[Rd-B] (mg/L)	Temperature °K			
	303	313	323	333
20	0.484	0.463	0.427	0.403
40	0.321	0.301	0.272	0.253
60	0.240	0.223	0.200	0.184
80	0.191	0.177	0.157	0.146
100	0.159	0.147	0.130	0.120

Table 3 : Dimensionless separation factor R_L.

$[Rd\text{-}B]_0$ (mg/L)		20	40	60	80	100
K_0	303°K	2,67	1,86	1,38	1,12	1,09
	313°K	3,07	1,99	1,54	1,18	1,10
	323°K	3,54	2,24	1,76	1,25	1,12
	333°K	4,00	2,33	2,03	1,35	1,15
ΔG^0 (kJ/mol)	303°K	- 2.474	- 1.563	- 0.811	- 0.285	- 0.218
	313°K	- 2.919	- 1.791	- 1,124	- 0.431	- 0.248
	323°K	- 3.395	- 2.166	- 1.518	- 0.599	- 0.304
	333°K	- 3.838	- 2.342	- 1.960	- 0.831	- 0.387
ΔH^0 (kJ/mol)	-------	14.76	12.46	6.76	5.97	5.05
ΔS^0 (kJ/°K.mol)	-------	30.78	25.56	23.28	19.47	17.67

Table 4 : Equilibrium constant and thermodynamic parameters for the adsorption of Rhodamine B onto ABM adsorbent

$[Rd\text{-}B]_0$ (mg/L)		20	40	60	80	100
303°K	k_{ad}	3.93	3.65	3.52	3.48	3.32
	k_1	2.96	2.36	2.04	1.84	1.73
	k_2	0.97	1.29	1.48	1.64	1.58
313°K	k_{ad}	4.64	4.19	3.95	3.86	3.69
	k_1	3.50	2.79	2.39	2.09	1.93
	k_2	1.14	1.40	1.56	1.77	1.76
323°K	k_{ad}	4.97	4.73	4.55	4.18	3.88
	k_1	3.88	3.27	2.90	2.32	2.05
	k_2	1.09	1.46	1.65	1.86	1.83
333°K	k_{ad}	5.17	4.87	4.65	4.51	4.48
	k_1	4.14	3.41	3.12	2.59	2.40
	k_2	1.03	1.46	1.53	1.92	2.08

Table 5 : Rate constants for the adsorption of Rhodamine B (10^3 k_{ad}, min^{-1}) and the constants for forward (10^3 k_1,min^{-1}) and reverse (10^3 k_2, min^{-1}) process

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Global Journal of human social science
Geography & Environmental GeoSciences
Volume 12 Issue 10 Version 1.0 Year 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Multiyear Analysis of Ground-Based Sunphotometer (AERONET) Aerosol Optical Properties and its Comparison with Satellite Observations over West Africa

By Oluleye A , Ogunjobi K.O , Bernard A , Ajayi V.O & Akinsanola A.A.
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Abstract - The Sahelian West Africa (Long 20W:20E, Lat 0:30N) by its climatological and geographical conditions is a key region for the characterization of global atmospheric aerosol optical properties. This study evaluates the spatial and temporal variation of the Aerosol Optical Depth (AOD440nm), aerosol particle size characterization (Angstrom exponent (**α**440-675nm) at four locations (Agoufou, Banizoumbou, Cape Verde and Ilorin) over a period of January 2005 to December 2009. Results of the day-to-day AOD440nm variations as well as the seasonal and annual variations are presented in order to establish the aerosol climatology in the region. We compared satellite derived data of Total Ozone Mapping Spectrometer - Aerosol Index (TOMS-AI), MODIS (Terra and Aqua) with those of ground-based Sunphotometer AERONET measurements. In general, there exits good relationship between MODIS (Terra and Aqua) and the ground-based AERONET measurements with correlation coefficients, R2 › 0.8 reported in all stations. However low coefficients (as low as 0.40) were obtained in all the stations for regressions between TOMS AI and ground-based Sunphotometer AERONET data.

Keywords : *AERONET AOD; MODIS; TOMS-AI; Angstrom exponent.*

GJHSS-B Classification : *FOR Code: 160511 , 160507*

Strictly as per the compliance and regulations of:

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Oluleye A [α], Ogunjobi K.O [σ], Bernard A [ρ], Ajayi V.O [ω] & Akinsanola A.A. [¥]

Abstract - The Sahelian West Africa (Long 20W:20E, Lat 0:30N) by its climatological and geographical conditions is a key region for the characterization of global atmospheric aerosol optical properties. This study evaluates the spatial and temporal variation of the Aerosol Optical Depth (AOD_{440nm}), aerosol particle size characterization (Angstrom exponent ($\alpha_{440\text{-}675nm}$) at four locations (Agoufou, Banizoumbou, Cape Verde and Ilorin) over a period of January 2005 to December 2009. Results of the day-to-day AOD_{440nm} variations as well as the seasonal and annual variations are presented in order to establish the aerosol climatology in the region. We compared satellite derived data of Total Ozone Mapping Spectrometer - Aerosol Index (TOMS-AI), MODIS (Terra and Aqua) with those of ground-based Sunphotometer AERONET measurements. In general, there exits good relationship between MODIS (Terra and Aqua) and the ground-based AERONET measurements with correlation coefficients, $R^2 \rightarrow 0.8$ reported in all stations. However low coefficients (as low as 0.40) were obtained in all the stations for regressions between TOMS AI and ground-based Sunphotometer AERONET data.

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I. Introduction

Dust particles appear to be the largest contributor to the column integrated total aerosol optical depth over West Africa. According to D'Almeida (1986), there are four major source areas which contribute to dust aerosols over the region. The first source extends from the Spanish Sahara to the north Mauritania, while the second is located in a triangular zone formed by the Hoggar, Andrar des Iforhas and Aiir Mountains, i.e. northeast of Geo (Mali). The third source is situated north to northeast of Dirku, north of Bilma (Niger) off the west side of the Tibesti Mountains in Chad Republic while the fourth source is located in the northern part of Sudan. Dust aerosols from these locations have wide range of impacts on visibility and health; modification of rains; reduction of temperature and largely affects the regional climate (Goudie and Middleton 2001). Therefore for comprehensive understanding of the role of aerosols in climate system, their properties, spatial and temporal variations must be properly understood. Hence, it is significant to obtain such information via ground-based monitoring networks such as the Aerosol Robotic Network, AERONET (Holben et al., 1998) and satellite observations such as Total Ozone Mapping Spectrometer (TOMS), Moderate Resolution Imaging Spectro-Radiometer, MODIS (Terra and Aqua), Multiangle Imaging Spectroradiometer (MISR), Polarization and Directionality of the Earth's Reflectance (POLDER) (e.g., El-Metwally et al., 2011; Christopher and Jones 2010; Bennouna et al., 2011; de Meij and Lelieveld, 2011). Ground- based instruments measure local observations while the air borne sensors have the ability to monitor aerosols on a global scale. Satellite-based remote sensing plays a vital role in gaining good knowledge and understanding of global aerosol variations and their interaction within the earth's climate (Kaufman et al., 2002). Satellite data have long been employed for aerosol studies however with some major challenges in almost every step of the retrieval process, such as, sensor calibration, cloud screening, corrections for surface reflectivity and variability of aerosol properties; size distribution, refractive index (King et al., 1999; Bennonua et al., 2011). Consequently, significant differences exist among various aerosol products generated from different sources e.g., AVHRR (Ignatov and Stowe, 2002; Ignatov et al., 2004), the MODIS (Remer et al., 2005), the Total Ozone Mapping Spectrometer (TOMS) (Torres et al., 1998; 2002), the Polarization and Directionality of the Earth's Reflectance (POLDER) instrument (Goloub et al., 1999; Deuzé et al., 2001), and the Multiangle Imaging Spectroradiometer (MISR), (Kahn et al., 2001) etc. A compilation of more than 2 decades of TOMS-AI data provided a more precise identification of tropospheric aerosol characteristics surrounding distinct source areas and long-range transport over continents and oceans (e.g., Chiapello and Moulin, 2002; Moulin and Chiapello, 2004). Myhre et al. (2004) compared a large number of global aerosol products and revealed the general features of agreement and discrepancies. However, insights into the causes of the discrepancies

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were lacking and the state-of-the-art aerosol product from the MODIS was excluded from their work. Comparing simulated and observed Aerosol Indices (AIs) in the near –ultraviolet, in West Africa Yoshioka et al. (2005) found that the best comparison at the Sahara-Sahel border is obtained by adding 20%-25% of dust from disturbed soils. The seasonal character of the aerosol flux especially its link with the harmattan dust at some locations in West Africa and the implications on weather and climate have been a subject of increasing interest to researchers (e.g. Holben at al., 2001; Dobovik et al., 2002; Adeyewa and Balogun, 2003; Ogunjobi et al., 2007; Ogunjobi et al., 2008). The objective of this study therefore is to document the long term seasonal and inter-annual variability of aerosol loading over Sahelian West Africa. It presents a comparison between Total Ozone Mapping Spectrometer Aerosol Index, MODIS AOD (Terra and Aqua) and the ground-based Sunphotometer AERONET AOD observations in four different locations in the region. The study further investigates the agreement and differences between the data sets while regression equations of the satellite derived data and the ground-truth were also presented in order to determine whether satellite measurements can adequately reproduce aerosol optical depth for the region.

II. Study Area and Methods

a) *Climate of the study region*

The regional map showing the locations of the AERONET Sunphotometers, TOMS Aerosol Index, and MODIS AOD data utilized in this study is shown in Figure 1. Results from daily observations from period January 2005- December 2009 at three West Africa sites and a location in the Atlantic Ocean is herewith presented. The stations under-study include Agoufou; Mali (15°21'N, 1°29'W), Banizoumbou; Niger (13° 45'N, 02° 39'E), and Cape Verde; Tropical Atlantic Ocean (16° 45'N, 22° 57'W); Ilorin; Nigeria (08° 32'N, 04° 34'E). The four stations differ in terms of their annual precipitation, temperature and relative humidity (see Table 1). The annual total precipitation values averaged over each month during this period were 333.0 mm/yr, 540.8 mm/yr, 69.5 mm/yr and 1185.0 mm/yr in Agoufou, Banizoumbou, Cape Verde and Ilorin respectively. Dry season starts in Agoufou from October and ends in May of the following year while the rainy season is June through September. Beginning in October, the harmattan trade wind blows sand, grit and dry air over the station with the hottest time of the year between March-June (Table 1). Banizoumbou is located in the Sahel region, between the Sahara desert to the north and the Sudanian zone to the south. The aerosol climate in Banizoumbou is influenced by the dry harmattan winds, an easterly or north easterly wind laden with dust transported from the Sahara during the dry months of November to March of the following year. The relative humidity during the *harmattan* months in Banizoumbou varies between 20-31% (Table 1). Cape Verde is located in the mid-Atlantic Ocean some 570 km off the west coast of Africa. The landscape varies from dry plains to high active volcanoes with cliffs rising steeply from the ocean. The climate is arid as December–June is cool and dry, with temperatures at sea level averaging 24 °C; July–November is warm and dry, with temperatures averaging 26°C. During the dry season (DJF), windstorms blowing from the Sahara sometimes form a dense dust cloud that characterizes the station. Although some rain comes during the latter season, rainfall is however sparse all over the year and very erratic. Ilorin is situated in the Guinea Savannah zone of West Africa; a transition zone between the Guinea coast and Sahelian West Africa. Ilorin is in the desert transition zone between the Sahara and the savanna of upper Nigeria and is influenced by the dusty harmattan wind (Ginoux et al., 2010). It is characterized by persistent conditions of high aerosol loading as well as intense dust outbreaks that affect the local climate during the *harmattan* season of November to March of the following year. The climate is a transition between the equatorial rain forest in the south and the Sahel Savannah in the north. The hot dry season commences from about the middle of October to late March when the North-Easterly (NE) winds from the Sahel dominates the climate pattern. The rainfall amount during the harmattan season ranges between 4.6mm/yr in November to 57.4mm/yr in March as shown in Table 1). However during the wet season from April to mid October, the climate is dominated by the South-Westerly winds from the Atlantic Ocean characterized with high relative humidity between 75% to 80%.

b) *Instrumentation*

AERONET an acronym of AERosol NETwork is a federated network of CIMEL Sunphotometers. Since 1994, fourteen (14) stations have been installed in West Africa by the PHOTONS component of the AERONET network, with different periods and durations of observations. This network of instruments have allowed the establishment of the seasonal cycle of the vertically integrated content (Aerosol Optical Depth, AOD) of mineral dust and biomass burning in different stations of West Africa (Holben et al., 2001). AERONET data are widely used as a reference for satellite validation and model evaluation studies, because the measurement characteristics are well understood and documented (Dobovik et al., 2000). The direct sun measurements are made every 15 minutes in eight spectral channels at 340, 380, 440, 500, 675, 870, 940 and 1020 nm (nominal wavelengths). The CIMEL Sunphotometer is a solar-powered, hardy, robotically pointed sun and sky spectral radiometer. The diffuse sky radiances, called almucantar, is a series of measurements taken at the

elevation angle of the Sun for specified azimuth angles relative to the position of the Sun. During almucantar measurements, observations from a single channel are made in a sweep at a constant elevation angle across the solar disc and continue through 360° of azimuth in about 40s. This is repeated for each channel to complete an almucantar sequence. A detailed description of the AERONET instrumentation can be found in Holben *et al.* (1998).

The AERONET site at Agoufou is located in a sand dunes area (grazing land) 30 km from Hombori while that of Banizoumbou location is located on a small isolated plateau in a cultivated sandy area near the village of Banizoumbou, 60 km east from Niamey. In addition, the location of the AERONET instrument in Banizoumbou was temporarily changed (~100m) during June-July 2006; and June 2007 and thus no data are available for these few days when displacement occurred (Marticorena et al., 2010). The calibrations of the Sun photometers in the AERONET sites were performed regularly at the Goddard Space Flight Center (GSFC) resulting in high accuracy AOD of ~0.01 in the visible and near-infrared and ~0.02 in the ultraviolet (Eck et al., 1999), Data are quality checked and cloud-screened following the methodology of Smirnov et al. (2000). TOMS - Aerosol Index (AI) constitutes one of the most useful space-borne data sets, offering long-term daily global information on UV absorbing aerosol (black carbon, desert dust) distributions (Torres et al., 1998). The TOMS on Nimbus-7 provided global measurements from November 1978 to December 1994. The earth Probe (EP) TOMS was launched on 2 July 1996 to provide supplementary measurements while the Aura-OMI algorithms is been available since 2004 to present. TOMS Aerosol Index is not a physical parameter but an index of aerosol that is sensitive to aerosol height (Torres et al., 1998). It is defined as a measure of the change of spectral contrast in the near ultra violet (341 and 380nm) due to radiative transfer effect of aerosols in a Rayleigh scattering atmosphere. By definition, AI is positive for absorbing aerosols, near zero (±0.2) in the presence of clouds or large size (0.2um or larger) nonabsorbing aerosols and negative for small size non absorbing aerosols. TOMS AI is therefore regarded as one of the potential sources for monitoring dust transport characteristics

The MODerate resolution Imaging Spectro radiometer (MODIS) has one camera, measuring irradiances in 36 spectral bands from 0.4μm-14.5μm with spectral resolution of 250m (bands 1-2), 500m (bands 3-7) and 1000m (bands 8-36) (de Meij and Lelieveld, 2011). The first MODIS instrument was lunched at the end of 1999 on board the polar orbiting Terra spacecraft, and has been acquiring daily global data since February 2000. The MODIS AOD_{440nm} over the stations under study are the standard Terra –MODIS level 2 and Aqua MODIS level 2 aerosol product MOD04(collection 005). It should be noted that in addition to the Terra MODIS AOD_{440nm} products, we also used the MODIS Aqua AOD_{440nm} products as well which are processed with the Deep Blue algorithm (Hsu et al., 2004). The Deep Blue retrieval provides AODs over bright surfaces including the desert regions. The difference between the MODIS Terra and Aqua algorithm and Deep Blue is that the former aerosol retrieval is based on a dark surface approach.

III. Results and Discussion

a) Aerosol optical depth (AOD_{440nm}) and Angstrom exponent ($\alpha_{440\text{-}675nm}$) Climatology

In this section, the day-to-day as well as the monthly variation of AERONET AOD_{440nm} and $\alpha_{440\text{-}675nm}$ are presented in order to establish the different aerosol climatologies over the region. Figures 2a-d show the cloud free daily mean AOD_{440nm} values at Agoufou (2005-2008), Banizoumbou (2005-2009), Cape Verde (2005-2009) and Ilorin (2005-2009). The plot of daily mean AOD_{440nm} for Agoufou represented by 1092 cloud free days indicate relative small day-to-day variations in the measurement period shows in figure 2a. However, in the months of February to May, AOD_{440nm} values shows large variations when it showed its obtainable maximum values while minimum AODs are obtainable between the months of October to December as well as July to August. The highest AOD was recorded in the year 2005 with an average daily value of 0.60±0.34 followed by that of 2007 (0.56±0.48) while the least was recorded in 2008 (0.47±0.33). Figure 2b provides similar time series plot in order to assess the temporal distribution of aerosols in Banizoumbou. Unlike Agoufou, Banizoumbou shows large day-to-day variability in AOD which may be attributed to large variations of aerosol particle in combination with large variability in meteorological conditions such as windspeed and direction, atmospheric stability and accumulation of aerosols in the boundary layer (Masmoudi et al., 2003; Kambezidis and Kaskaoutis, 2008). The largest day-to-day variation was noted mostly during the dry months of every year while the rainy season shows small variation due to scavenging action of precipitation (Ogunjobi et al., 2008). Small variability is observed in the day-to-day variation of AOD almost throughout the year in Cape Verde (Figure 2c). The AODs are generally low while occasional high values correspond to desert-dust aerosol in agreement with similar study of Kambezidis and Kaskaoutis (2008) for a remote Island of Nauru in the Pacific Ocean. Few days of high AOD were noted during the dry harmattan months of December to March the following year each year while major peaks were recorded in the summer months of June- August. During most of the year in Cape Verde the North Atlantic between 20-30^{0}N is dominated by high pressure. South of 25^{o}N wind is generally from the east transporting dust and biomass

burning aerosols westward into the Atlantic (Christopher and Jones, 2010). The produced maritime sea-spray aerosol components under strong sea surface winds lead to additional source of variations in the AOD reported in Cape Verde (Setheesh et al., 2006). At Ilorin the AOD is dominated by pronounced seasonal variations and marked increase in AOD values from December to March with peak daily values observed in the months of January-March of following year (Figure 2d). From November – December/January -March, large aerosol amounts (average optical depth >1.0 near the source regions) are generated by intense Saharan dust outbreaks and occasionally biomass-burning activities in the region. Ginoux et al. (2010) reported that during the dry season in the arid region of West Africa south of 20^0N, from December to February, dust sources are very active while at the same time large amount of carbonaceous aerosols are emitted by biomass burning.

Figures 3a-d show the day-to-day spatial variations of the Angstrom exponent, $\alpha_{440\text{-}675nm}$ for 440-675nm indicating large day-to-day variations in all stations. It is interesting to note that the variations are larger at low AODs when fine –mode aerosols dominate over the optical influence of the large coarse mode particles. For example in Agoufou (Figure 3a) high variations of $\alpha_{440\text{-}675nm}$ are noted under low AOD between February–June. Also observed are high $\alpha_{440\text{-}675nm}$ during the dry season when AOD are equally high indicative of the presence of biomass burning aerosols in the location (Eck et al., 2001b). The long term daily averages of $\alpha_{440\text{-}675nm}$ were 0.25±0.20, 0.33± 0.25, 0.67± 0.37 and 0.30± 0.22 for Agoufou, Banizoumbou, Ilorin and Cape Verde respectively. The values were lower than that reported by Eck et al.(1998) for smoke aerosol in Brazil. The variability of $\alpha_{440\text{-}675nm}$ noted in the stations may be attributed to variability in the size of the smoke particle proportional to the phase of the fire (Eck et al., 2001b), coagulation, humidification process and mixing of fresh smoke particles with other aerosols such as dust and urban pollution (Kaufman , 1998).

Figure 4 shows the frequency distribution of AOD_{440nm} and $\alpha_{440\text{-}675nm}$ for Cape Verde, Ilorin, Banizoumbou and Agoufou which is used to characterized aerosol load at the different sites. Also shown as insert is the line plots of AOD_{440nm} and $\alpha_{440\text{-}675nm}$ with their ± 5%standard deviation. Figure 4a shows that 98%, and 76%, of the AOD falls within the range 0.5-1.0 in Cape Verde and Ilorin respectively, while 82% and 89% in Banizoumbou and Agoufou respectively. It is further noted in figure 4a that only 0.5%, 0.4% and 0.3% of the AOD falls within the range of values 3.5- 4.0 in Ilorin, Banizoumbou and Agoufou respectively while Cape Verde does not have any value within this magnitude. The result here is in agreement with the earlier work of Ogunjobi et al.(2008) for the same region during an observation periods of 1999-2005. In all stations under consideration, $\alpha_{440\text{-}675nm}$ frequency distribution shows that inverse relationship exist between the AOD and Angstrom exponent with the exception of Ilorin. For example, 89%, 51%, 86%, and 92 % of the Angstrom exponent falls within 0.2-0.6 in Cape Verde, Ilorin, Banizoumbou and Agoufou respectively. The result shows that 8.0% and 0.3% falls within the range greater than 1.4 in Ilorin and Banizoumbou while Cape Verde and Agoufou does not have records of any Angstrom exponent within the range. An interesting feature of Figure 4b shows that at Ilorin only 5% of the Angstrom exponent falls in the range ≤ 0.2 while other stations has values greater than 40%. The Angstrom exponent dependence on aerosol optical depth has been used by several authors (e.g. Cachorro et al., 2001; Ogunjobi et al., 2008; Cheng et al., 2006; Kaskaoutis et al., 2007) to determine different aerosol types for specific location through determining of physical interpretable cluster regions.

Figure 5 shows the relationship between AOD and Angstrom exponent the in order to determine the dependence of aerosol loading on particle size. In general it is observed that $\alpha_{440\text{-}675nm}$ is low when AOD_{440nm} is comparatively high. In Agoufou, there is a wide range of $\alpha_{440\text{-}675nm}$ values at low AOD_{440nm}(<0.5) with $\alpha_{440\text{-}675nm}$ varying between near zero to 1.19 (Figure 5a). This suggests that under relatively clean atmospheric conditions very different aerosol types can be found over Agoufou (from pure fine-mode pollutants to coarse-mode particles). There is a slight reduction of $\alpha_{440\text{-}675nm}$ as AOD_{440nm} increases which reflect the transition of fine-mode particles to accumulation-mode through coagulation, condensation and gas-to-particle conversion. At Banizoumbou (Figure 5b) an increase in the values of $\alpha_{440\text{-}675nm}$ with corresponding increase in AOD_{440nm} indicated the contribution of fine fresh smoke particles in the atmosphere during episodes of biomass burning or mixture of smoke and other aerosols such as desert dust and urban pollution. The scatter-plot for Cape Verde shows high dispersion at low AOD suggesting that under relatively clean maritime atmospheric condition different aerosol types can be found in Cape Verde ranging from sea salt pollutants to desert dust aerosols (Figure 5c). The increasing values of α with increasing AOD_{440nm} indicate the significant contribution of fine “fresh-smoke” particles in the atmospheric column, especially under high turbidity at Ilorin (Figure 5d). During the period of measurements $\alpha_{440\text{-}675nm}$ computed in Agoufou and Cape Verde were observed to change less over a wide range of aerosol optical depth than in Banizoumbou and Ilorin which indicated more of coarse-mode particles in the two latter stations. There is a noted reduction of $\alpha_{440\text{-}675nm}$ as AOD_{440nm} increases in Cape Verde; thus reflecting the transition from the fine-mode particles to accumulation mode of mixed type aerosols through coagulation,

condensations and gas-to-particle conversion. Majority of the points in all the stations confines in the area corresponding to higher $\alpha_{440\text{-}675nm}$ values for $AOD_{440nm} \leq 1.0$, confirming the presence of fine mode particle of biomass burning, urban pollution, mixed type pollutants origin. However, there are also large population of points corresponding to low $\alpha_{440\text{-}675nm}$ and high AOD indicating presence of mineral dust aerosols especially in Banizoumbou and Ilorin. In general, despite the large scatter of data points in all stations (Figures 5a-d), $\alpha_{440\text{-}675nm}$ values decrease with increasing AOD. This further indicates that coarse aerosols dominate and also that the ratio of coarse/fine aerosols increases, under conditions of high turbidity. The generalized trend noted in this region in good agreement with the observed pattern at several other locations for different aerosol types (e.g., Eck et al., 2001a; 2001b; Masmoudi et al., 2003; Cheng et al., 2006; Kaskaoutis et al., 2007).

b) Satellite (MODIS, TOMS-AI) and AERONET ground-based measurements intercomparison

Analyses of the AERONET AOD_{440nm} profile, TOMS AI_{340nm}, and MODIS $_{440nm}$ for the four locations are shown in Fig. 6a-d. For consistency we choose the 440nm AERONET and MODIS channel because the 340 and 380nm wavelength channels are not available at all sites. For large particles like dust Bounhir et al.(2008) stated that the wavelength dependence between 340 nm and 440nm is very small and as such the 440nm AOD values is approximately equal to that of 340nm. Ground-based AERONET, TOMS-AI and MODIS AOD show extreme similarity in their daily variations. For example, Agoufou has AOD_{440nm} values of 3.88, 3.80 and 2.62 on 26th May 2006, 3rd and 4th May 2007 respectively which corresponds to TOMS AI and MODIS- Terra however no MODIS-Aqua retrievals were available (Figure 6a). Analysis of AERONET AODs at Banizoumbou during 2005-2007 also shows strong agreement with TOMS AI, and MODIS data (Figure 6b). For example on 5th April, 2007 AERONET AOD, MODIS (Terra and Aqua) and TOMS AI, were 2.51, 2.50, 2.50 and 2.80 respectively which yielded a difference of only 0.40% for MODIS terra and Aqua; 11.60% for TOMS AI when compared with ground-based AERONET AOD measurement. Figure 6d shows that both satellite and ground based instruments captured the high aerosol loading at Ilorin in March 2006, January 2007 and February 2008. The average aerosol optical depths at Ilorin during the dry harmattan months of December 2005 to March of 2006 were 1.11, 1.14, 1.17 and 1.02 for AERONET AOD, TOMS AI, MODIS Terra and Aqua respectively. The corresponding statistics of daily AERONET, TOMS AI, MODIS-Terra and Aqua are shown in Tables 2 - 5 respectively. Also shown are the number of cloud free days in each station as well as the 5th and 95th percentile lower (LCL) and upper (UCL) confidence levels. For example the P5 LCL and UCL at Ilorin was 0.243 and 0.244 respectively while the average AOD is 0.75±0.49. Table 2 shows the mean AERONET AOD_{440nm} in Agoufou is 0.52 ± 0.39 as compared to 0.57±0.43, 0.37± 0.24 and 0.75± 0.49 at Banizoumbou, Cape Verde and Ilorin respectively. The annual mean of AOD estimated for Cape Verde is much higher than the annual value of 0.07 reported by Kambezidis and Kaskaoutis (2008) for a Pacific Island station of Nauru between 2002-2004. The variance (u) of the mean values of TOMS AI at Agoufou, Banizoumbou, Cape Verde and Ilorin as shown in Table 3 yielded 0.11,0.17, 0.21 and 0.29 respectively which is observed to be very close to the 5th percentile lower and upper confidence levels. Tables 4 and 5 show the averages of MODIS-Terra and Aqua at Agoufou were 0.56 and 0.57 respectively.

The monthly variations for AERONET AOD_{440nm}, TOMS AI, MODIS-Terra and Aqua AOD are presented in Figures 7a-d as well as the 5 % standard deviation for each month. In Agoufou, AOD increased from February with peak values in May/ June, from the later onset of rainfall in June, after which once again, the increasing rainfall decreases aerosol load (Figure 7a). Banizoumbou recorded high AODs in March (AERONET, MODIS) with a secondary peak in June (Figure 7b) while AOD showed slight monthly variation at Cape Verde with highest AOD was observed in June-July (Figure 7c). The observed seasonal peak in March in Banizoumbou may be attributed to the long-range transport of primarily Saharan aerosols believed to be mainly from sources located in Niger, south Algeria, Libya and Chad (Holben et al., 2001). Results presented in Figure7d indicate that $AOD_{440\ nm}$ from ground-based AERONET and Satellite sensors at Ilorin are maximal in the dry cold months of December–March and drastically reduces to minimal at the onset of rains in April through September caused jointly by increase washout owing to the gradient of increasing precipitation and the location of source regions for the dust.

The previous discussion showed that the observations of AERONET AOD_{440nm}, TOMS-AI and AOD retrieved from MODIS-Terra/Aqua were relatively in good qualitative agreement. For the same data set Figure. 8a-d shows the regression plots of TOMS AI, MODIS-Terra and Aqua against ground based AERONET AOD. Linear regression expressions in the form of $AOD_{satellite} = m^*AOD_{AERONET} + c$ where obtained for the region. Summary of the AERONET AOD with TOMS AI, MODIS-Terra and Aqua linear relationships from daily observations are presented in Table 6. Also computed are the corresponding number of days, correlation coefficients, and standard errors in the slopes and intercepts.

Figure 8 shows that TOMS AI and MODIS–derived AODS are well correlated with ground -based observations in all stations although TOMS AI retrieval shows weak correlations at Banizoumbou and Cape

Verde (Table 6). The correlation between MODIS- Terra and Aqua and AERONET AOD_{440nm} is >0.80 in all stations while the correlation with TOMS- AI yielded 0.52 and 0.58 in Agoufou and Ilorin respectively and weaker correlation of 0.45 and 0.40 at Banizoumbou and Cape Verde respectively (Table 6). Low correlation coefficient observed in Banizoumbou can be explained by a combination of various factors such as sensitivity of the TOMS algorithm to altitude of the mineral dust layer, sub-pixel cloud contamination, aerosol composition, size distribution and sampling frequency for the Sunphotometer and TOMS algorithm (Toress et al., 2002; Kubilay et al., 2005). Figure 8 further shows that TOMS- AI is biased at low AOD values , which may be associated with a sensor calibration error or an improper assumption about ground surface reflection (Zhao et al., 2002); in addition, large errors in surface reflectance could also lead to large intercepts (Chu et al., 2002). A slope that is different from unity indicates that there may be some inconsistency between aerosol microphysical and optical properties used in the retrieval algorithm and that in the real situation (Zhao et al., 2002). For example slope lower than unity recorded in all the stations indicates an underestimation of AERONET AOD with respect to TOMS- AI retrieval. This is in agreement with the work of Myhre et al. (2005) that reported a tendency for the aerosol satellite retrievals to have higher AODs than the AOD from the Sunphotometers for low AOD and vice versa for high AODs. Hsu et al. (1999) shows that TOMS-AI measurements are linearly proportional to the AOD derived from independent ground based Sunphotometers instruments over regions of biomass burning and Africa dust. Their findings demonstrated that AI depends on aerosol optical thickness, single scattering albedo, aerosol layer height and viewing geometry. Ginoux and Torres, (2003) develops an empirical relationship to express TOMS AI for dust plumes as an explicit function of four quantities; single scattering albedo, AOD, surface pressure and altitude of dust plume. However, the strong dependence of AI on height distribution of aerosol decreases its sensitivity to the aerosol presences at altitude below 1.5km (Bounhir et al., 2008). Torres et al. (2002) confirms the good agreement between TOMS- AI and AERONET data for mineral, carbonaceous and sulphate aerosols. Bounhir et al. (2008) reported Pearson correlation coefficient varying from 0.68 to 0.92 between AERONET data and satellite derive aerosol optical depth (MODIS, MISR and TOMS OMI) for Morocco. The high coefficients of determination between the AERONET AOD_{440nm} values and satellite derive aerosol loading (TOMS- AI and MODIS) indicate a rather successful method of estimation of the AOD from TOMS- AI, and MODIS observation in Sahelian West Africa. This is really instructive especially for a region where ground observations are difficult to come-by.

IV. Conclusion

The study presents an analysis of the spatial, seasonal and interannual variability in absorbing aerosol loading over sahelian West Africa detected by satellite (MODIS and TOMS) and ground-based AERONET Sunphotometer sensors during 2005-2009. In general the daily, monthly and annual means of MODIS (Terra & Aqua) and TOMS retrieved AOD/AI are in good agreement with ground-based AERONET data. An important conclusion of this result is the creation of large data base from satellite and AERONET federation Network for the Sahelian West Africa. The seasonal cycle in aerosol optical depth corresponded to the seasonal variability in dust, biomass burning and mixed aerosol emission during the harmattan dry period to the dust free rainfall season. The aerosol optical depth showed large variation with high values during the harmattan dry months and low values during the rain/monsoon season. The mean and standard values of the Angstrom exponent were found to be lower during high dust hazy season (high AOD) except for occasional biomass burning episodes when high AOD corresponds to high Angstrom exponent. The AERONET data have been identified useful for validation purposes for the satellite data over the region. The results are confirmed by the plots of the regression comparison between ground-based AERONET and corresponding satellite daily data. The time series of the AOD retrieved from MODIS and TOMS are in good agreement with ground-based AERONET measurements, with correlation coefficients of >0.80 estimated in all stations for correlation between MODIS and AERONET retrieved AODs. Such study are important for improving aerosol parameterizations in radiative transfer models and evaluating the regional aerosol radiative forcing.

V. Acknowledgements

The authors wish to express their sincere thanks to the NASA/GSFC TOMS Ozone processing team and the principal investigator of the AERONET sites used in this study. We wish to also acknowledge the International Center for Theoretical Physics (ICTP), Trieste, Italy that provides accessibility to literatures used for this research output via the electronic journal delivery service (ejds).

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Table 1a : Monthly averages of Rainfall (mm), Temperature (°C) and Relative humidity (%) measure at the four stations during 2005-2008.

(a) Rainfall (mm)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	$mmyr^{-1}$
Agoufou	0.1	0.1	0.6	2.9	8.7	37.8	103.2	109.5	57.0	12.9	0.6	0.3	333.0
Banizoumbou	0.1	0.6	3.9	5.7	34.7	68.8	154.3	170.8	92.2	9.7	0.7	0.5	540.8
Cape Verde	5.3	3.8	1.3	0.7	0.6	0.8	0.8	14.1	33.6	6.5	2.5	1.6	69.5
Ilorin	6.2	18.2	57.4	107.1	151.6	189.0	149.1	152.9	211.1	130.2	4.6	7.6	1185.0
(b)Temperature													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Agoufou	24.8	27.4	30.6	33.4	35.5	34.2	31.2	29.6	30.8	31.9	28.6	25.1	30.26
Banizoumbou	24.3	27.3	30.9	33.8	34.0	31.5	29.0	27.9	29.0	30.8	27.9	25.0	29.28
Cape Verde	21.4	21.1	21.6	21.9	22.5	23.4	24.6	26.0	26.6	26.1	24.5	22.7	23.53
Ilorin	26.0	28.1	28.3	28.1	27.0	25.5	24.5	24.5	24.6	25.6	26.2	25.7	26.18
c. Relative Humidity (%)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Agoufou	22	19	19	21	23	42	56	63	56	36	22	26	34
Banizoumbou	24	20	21	29	44	56	67	72	68	48	31	27	42
Cape Verde	70	71	71	71	73	75	75	75	77	75	73	71	73
Ilorin	61	71	64	74	75	84	85	86	85	82	76	55	75

Table 2 : Statistics of daily AERONET AOD (440nm) for the period 2005-2009, including the mean (M), the standard deviation (σ), the median (ψ), the minimum (min), the maximum (max),the variance,(υ), the 5th and 95th percentile lower and upper confidence level (P5 and P95).

	N_{days}	M	σ	min	ψ	max	υ	P5LCL/UCL	P95LCL/UCL
Agoufou	1092	0.52	0.39	0.05	0.43	3.89 26th May2006	0.15	0.150/0.150	0.139/0.163
Banizoumbou	1358	0.57	0.43	0.05	0.45	3.61 7th Jan 2005	0.18	0.180/0.181	0.168/0.194
Cape Verde	1032	0.37	0.24	0.03	0.32	1.67 8th Jan 2005	0.05	0.057/0.057	0.052/0.062
Ilorin	1159	0.75	0.49	0.07	0.62	3.87 11th Mar 2006	0.24	0.243/0.244	0.223/0.265

Table 3 : Statistics of daily TOMS AI.

	N_{days}	M	σ	min	ψ	Max	υ	P5LCL/UCL	P95LCL/UCL
Agoufou	859	0.58	0.33	0.20	0.52	3.25 4th April 2007	0.11	0.109/0.110	0.101/0.121
Banizoumbou	1074	0.85	0.41	0.25	0.75	3.40 4th April 2007	0.17	0.164/0.165	0.151/0.179
Cape Verde	1077	0.84	0.45	0.25	0.75	3.25 14th May 2005	0.21	0.205/0.206	0.189/0.224
Ilorin	864	1.07	0.54	0.33	1.00	3.13 3rd Mar 2007	0.29	0.287/0.288	0.262/0.317

Table 4 : Statistics of daily MODIS-terra AOD (440nm).

	N_{days}	M	σ	min	ψ	Max	υ	P5LCL/UCL	P95LCL/UCL
Agoufou	592	0.56	0.47	0.02	0.43	4.70 4th April 2007	0.22	0.221/ 0.223	0.198/ 0.249
Banizoumbou	441	0.69	0.57	0.04	0.51	3.93 2nd Jan 2005	0.32	0.321/ 0.323	0.283/ 0.369
Cape Verde	284	0.37	0.29	0.03	0.31	3.31 8th Jan 2005	0.09	0.086/0.087	0.073/0.102
Ilorin	327	0.88	0.60	0.15	0.73	4.16 11th Mar 2006	0.36	0.357/0.361	0.309/0.420

Table 5 : Statistics of daily MODIS-aqua AOD (440nm).

	N_{days}	M	σ	min	ψ	Max	υ	P5LCL/UCL	P95LCL/UCL
Agoufou	397	0.57	0.41	0.08	0.46	3.11 11thMay 2007	0.17	0.169/0.171	0.148/0.196
Banizoumbou	437	0.62	0.50	0.06	0.47	3.94 7th Jan 2005	0.25	0.251/0.253	0.221/0.289
Cape Verde	279	0.39	0.30	0.03	0.34	3.10 8th Jan 2005	0.09	0.091/0.092	0.078/0.108
Ilorin	305	0.81	0.51	0.13	0.67	3.15 10th Mar 2006	0.26	0.259/0.262	0.223/0.306

Table 6 : Summary of the AERONET AOD with TOMS AI, MODIS-Terra and Aqua linear relationships from daily observations in the form $AOD_{satellite} = A*AOD_{AERONET} + B$. Also computed are the corresponding number of days, correlation coefficients, and the standard errors in the slopes and intercepts.

	N_{days}	Regression equation	R	R^2	Std Error (intercept)	Std Error (slope)
Agoufou	859	AI: y = 0.804 x + 0.420 Terra: y = 1.059 x + 0.057 Aqua: y = 1.020 x + 0.195	0.72 0.96 0.96	0.52 0.93 0.92	0.040 0.009 0.010	0.001 0.012 0.015
Banizoumbou	1012	AI: y= 0.601 x + 0.502 Terra: y= 1.051 x + 0.010 Aqua: y= 1.067 x + 0.013	0.67 0.93 0.94	0.45 0.87 0.89	0.010 0.013 0.011	0.009 0.015 0.014
Cape Verde	761	AI: y= 0.838 x + 0.224 Terra: y= 1.010 x + 0.002 Aqua: y= 1.032 x + 0.007	0.63 0.98 0.96	0.40 0.96 0.92	0.003 0.006 0.005	0.011 0.014 0.012
Ilorin	836	AI: y = 0.812 x + 0.451 Terra: y = 1.022 x + 0.009 Aqua: y = 0.979 x + 0.013	0.76 0.93 0.98	0.58 0.88 0.96	0.015 0.031 0.017	0.021 0.031 0.017

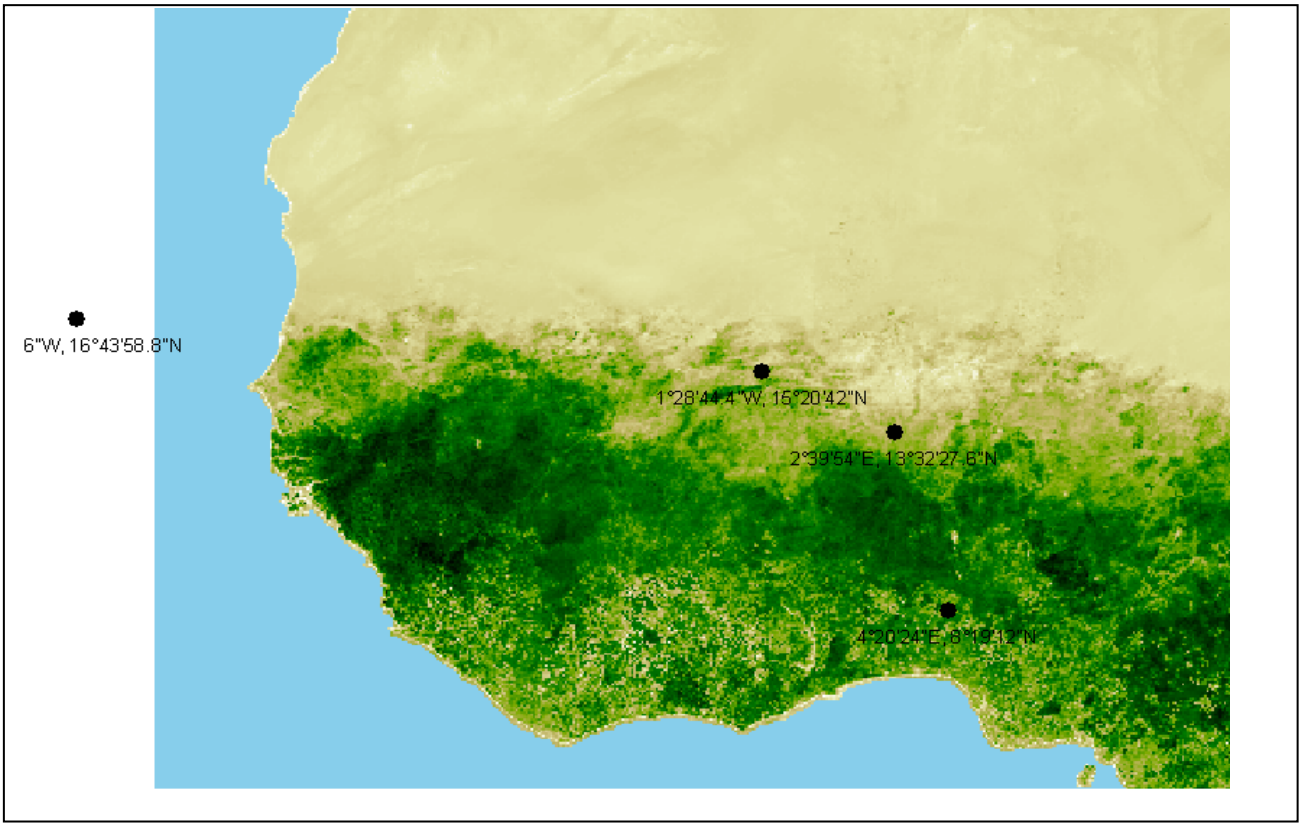

Figure 1 : Maps of locations.

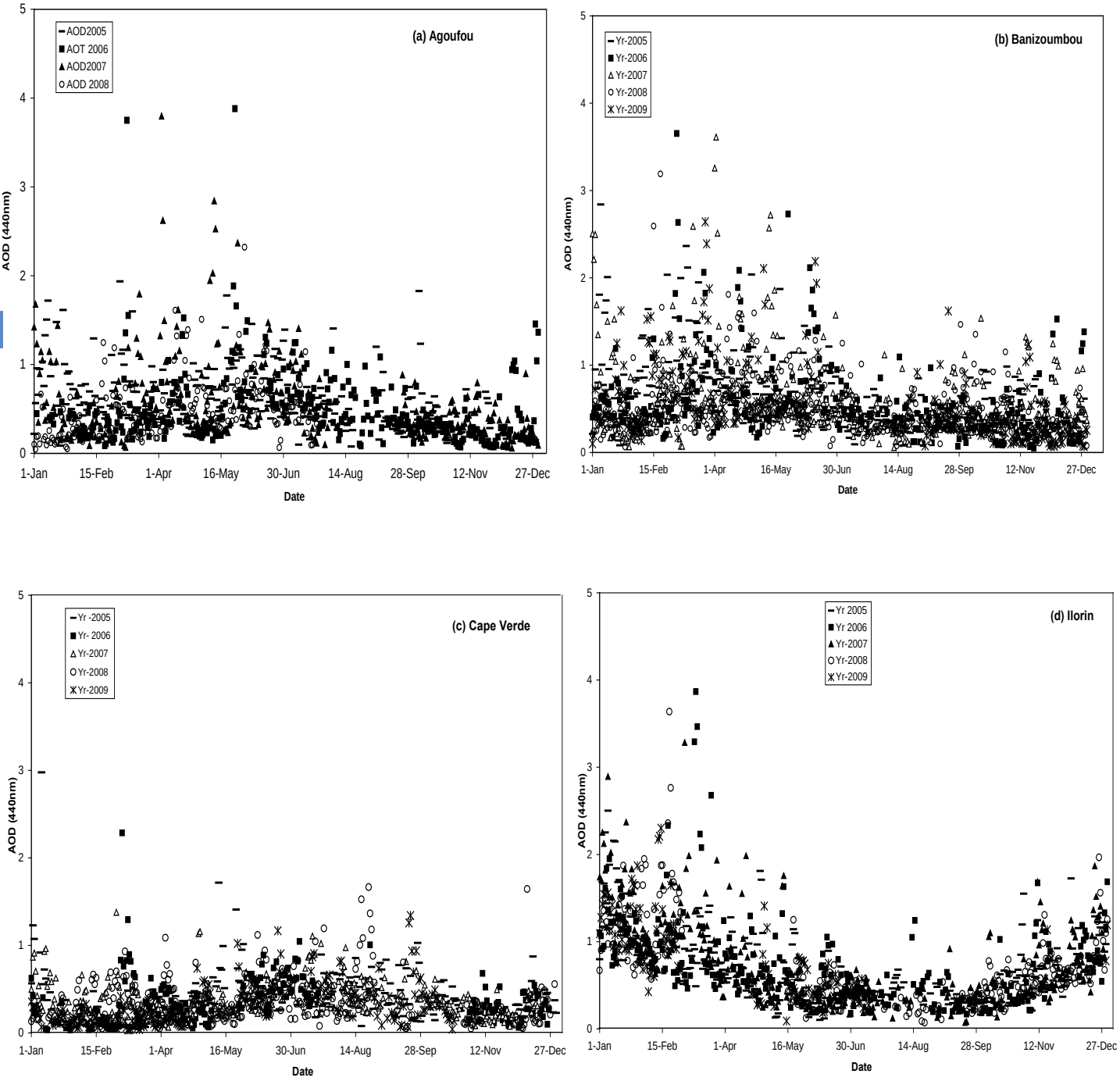

Figure 2 : Day-day variability of AERONET aerosol optical depth (440nm) in the stations under consideration: (a) Agoufou, (b) Banizoumbou, (c) Cape Verde and (d) Ilorin.

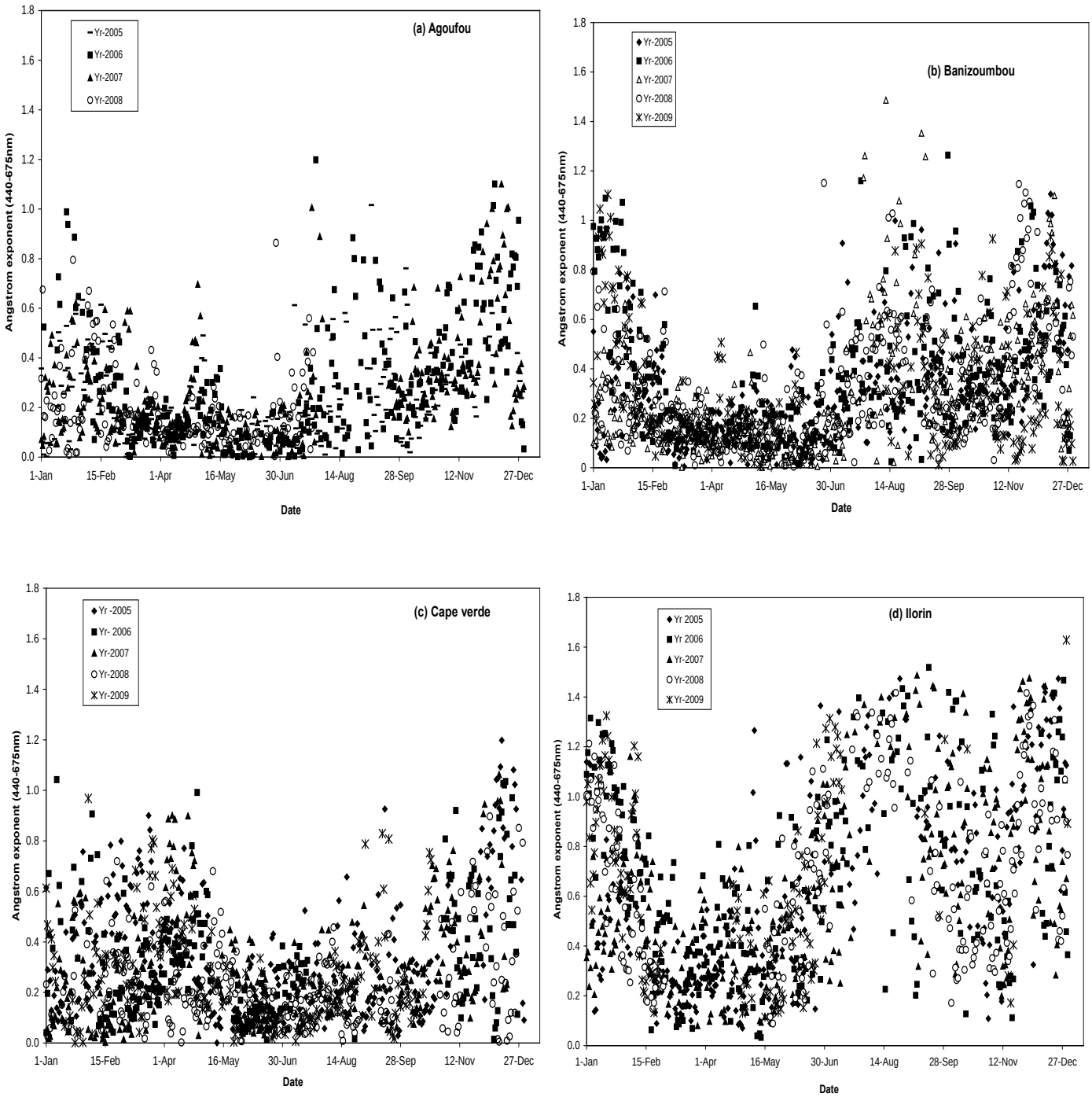

Figure 3 : Day-to-day variation of $\alpha_{440\text{-}675nm}$ at Agoufou, Banizoumbou, Cape Verde and Ilorin.

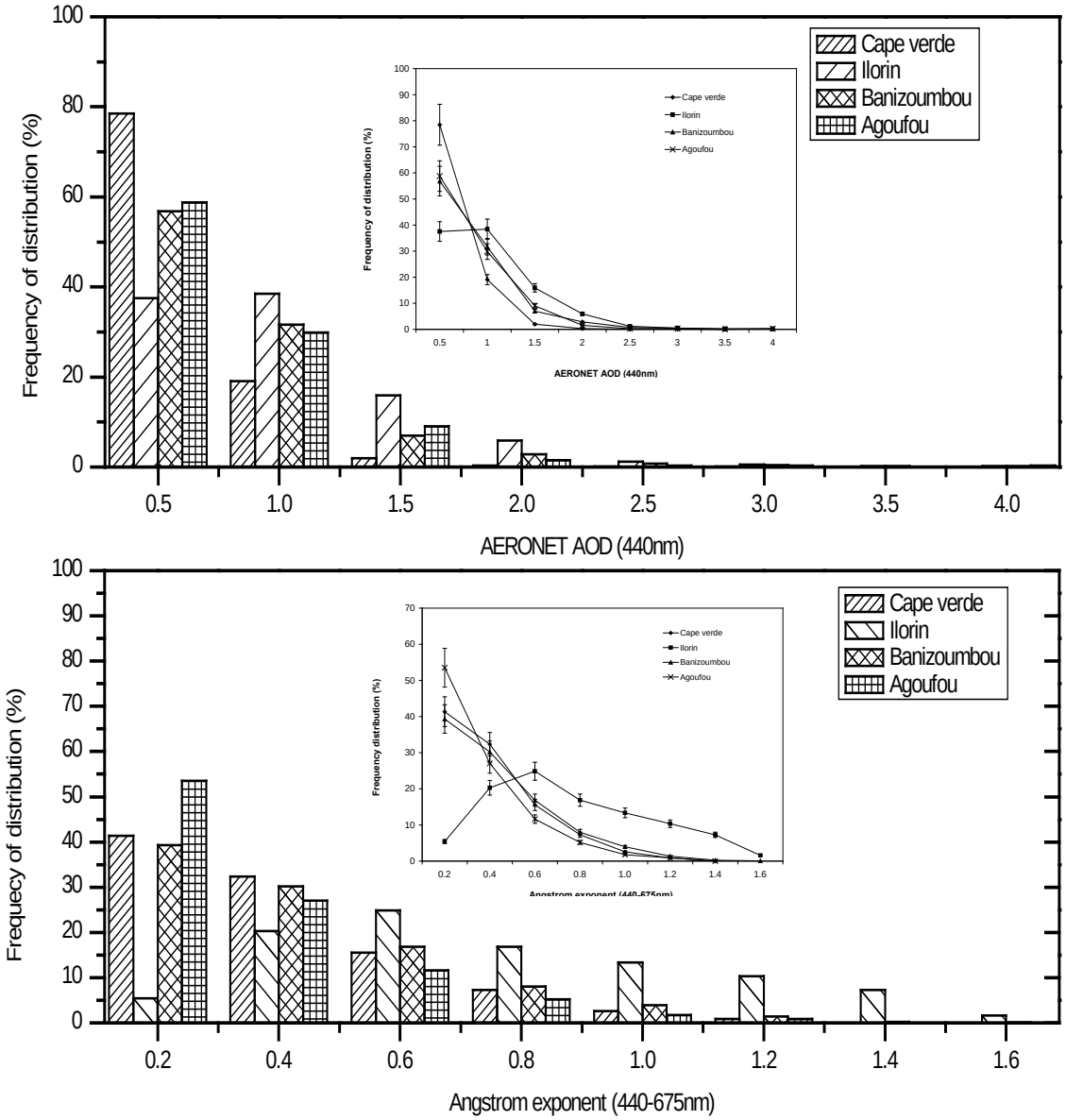

Figure 4 : Frequency distribution of AERONET aerosol optical depth in percentage and Angstrom exponent during 2005-2009.

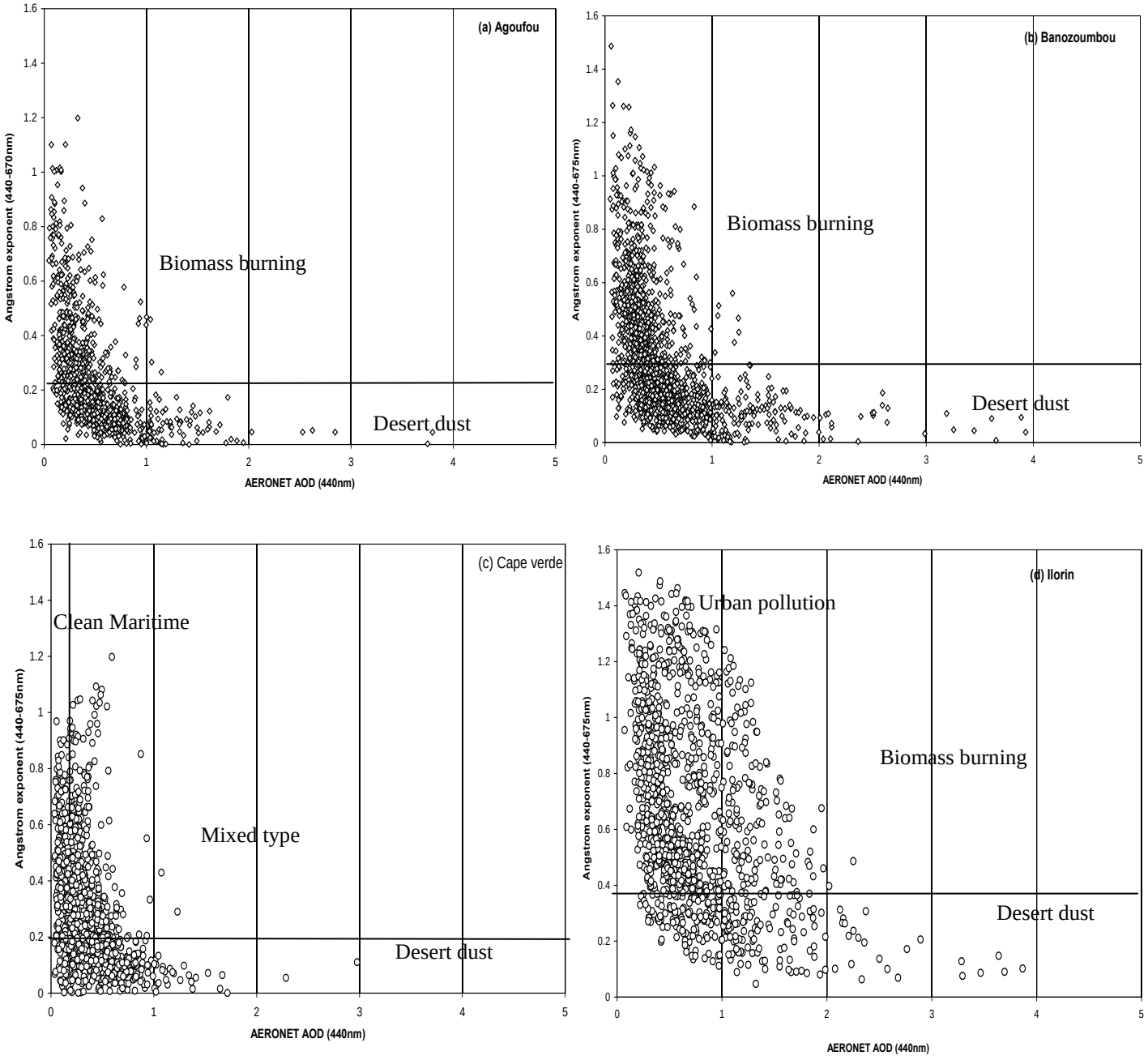

Figure 5 : Scatter-gram of daily averages of AERONET aerosol optical depth against Angstrom exponent (440-675nm).

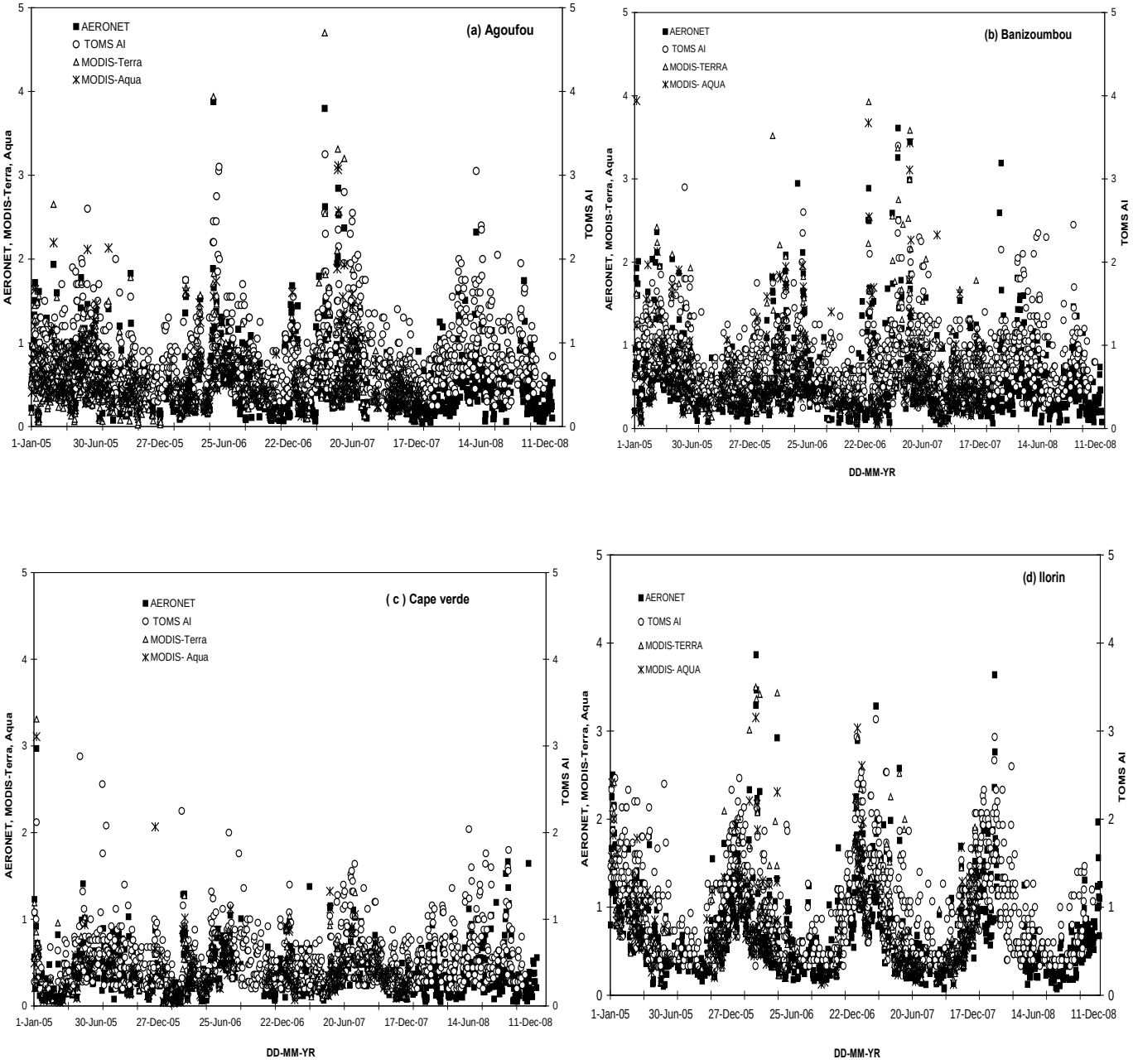

Figure 6 : Day-to-day comparison of AERONET, MODIS-Terra, MODIS-Aqua aerosols optical depth and TOMS AI observations at (a) Agoufou, (b) Banizoumbou, (c) Cape Verde, and (d) Ilorin.

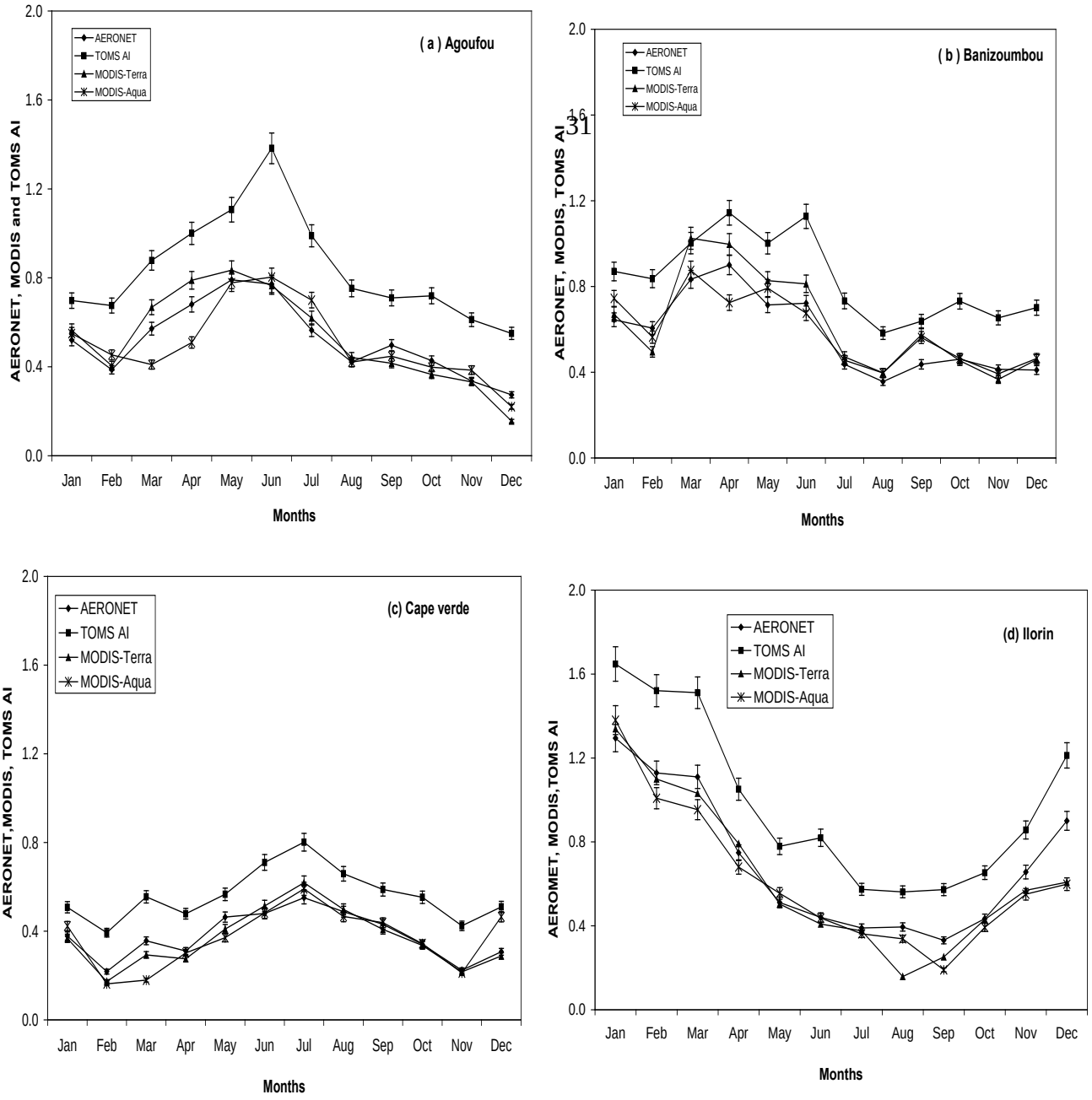

Figure 7 : Long-term monthly averages of aerosol optical depth from satellite and ground-based AERONET observations for at (a) Agoufou, (b) Banizoumbou, (c) Cape Verde, and (d) Ilorin. Also shown are the error bars corresponding to 5% standard deviation.

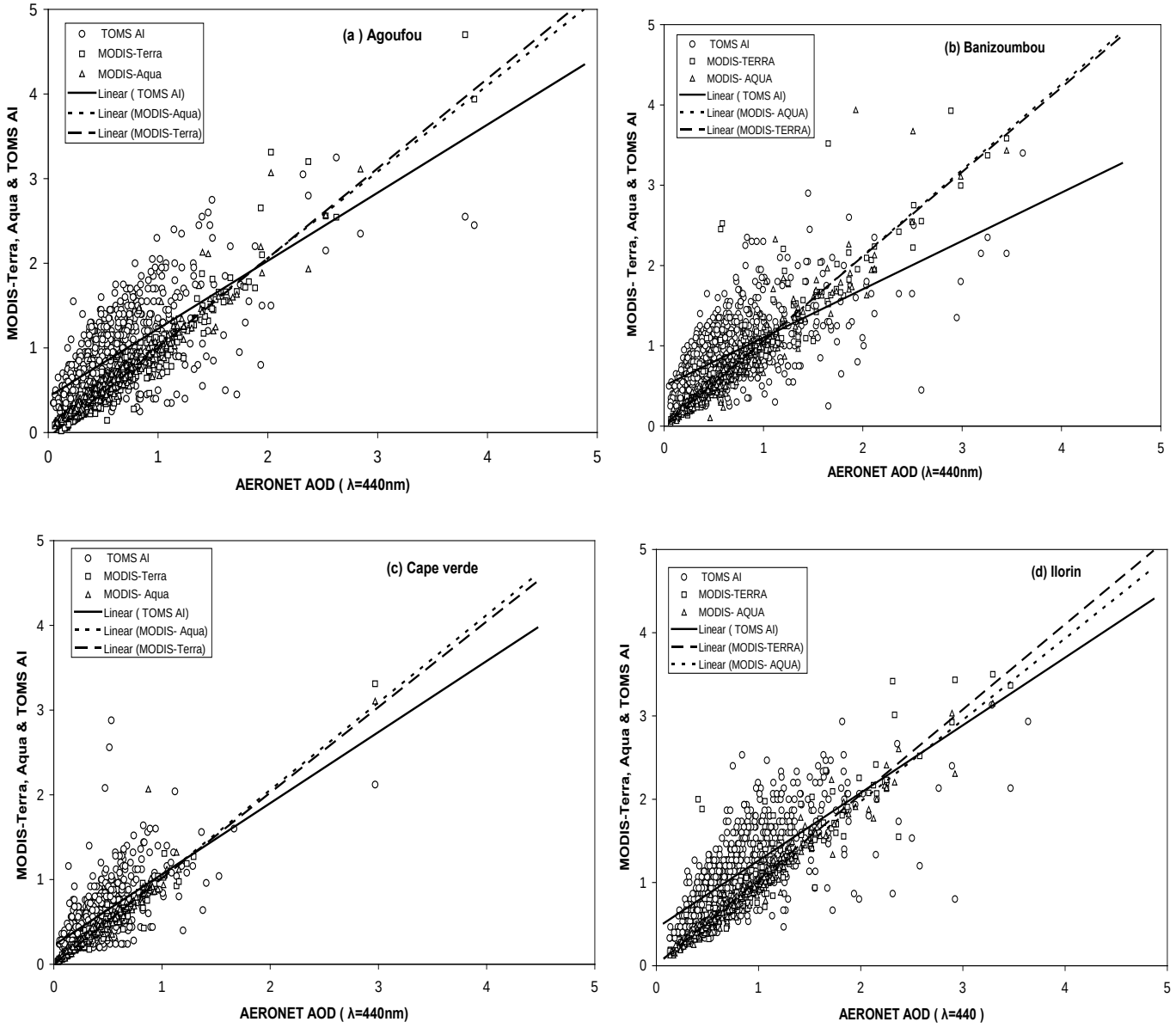

Figure 8 : Regression plots of satellite observations from MODIS & TOMS against ground-based AERONET observations for (a) Agoufou, (b) Banizoumbou, (c) Cape Verde, (d) Ilorin.

Global Journal of human social science
Geography & Environmental GeoSciences
Volume 12 Issue 10 Version 1.0 Year 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Characteristics of Urban Heat Island in Enugu During Rainy Season

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Abstract - Aim : The rainy season UHI characteristics at several sites in Enugu urban were evaluated using paired measurement programme. The aim was to determine the characteristic of urban heat island in the city during rainy season periods. Study Design: Survey Study. Place and Duration of Study: Enugu urban between months of June – July of 2006 and 2007.
Methodology. Results : The results indicate that UHI at day and night during rainy season were very different. A downtown –centered heat island was observed both day and night. The day time variations were strongly correlated to the amount of tree shading while in the night, city climate was highly correlated to sky-view factors and thermal properties in the city. Maximum UHI was about 3.20c during the day and hour-to-hour difference was observed at night around (1800hrs to 2300hrs).Conclusion: UHI over Enugu have been analyzed and results reveal some spatial and temporal characteristics. The UHI has been found to occur throughout the day and night during rainy season. Its structure was observed to be greatly influenced by weather, city, metabolism, anthropogenic activities and local geographic features, land-use, land-cover as well as vegetation and population.

Keywords : *Urban heat island, rainy season, paired measurement programme, temperature, urban, rural.*

GJHSS-B Classification : *FOR Code: 120504, 120507*

Strictly as per the compliance and regulations of:

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I. Introduction

One particularly important environmental characteristics of cities is the ''Urban heat Island" where by Urban areas are hotter than their surrounding county site. This is a real problem, which will be made even worse by climate change (Roland, 2010). It has therefore become a prime focus of research. An urban heat Island is the name given to describe the characteristic warmth of both the atmosphere and surfaces in cities (Urban areas) compared to their rural surroundings. The heat Island is an example of unintentional climate modification when Urbanization changes the characteristic of the Earth's surface and atmosphere.

These urban heat Island may be up to 10-150c under optimizing conditions. With increasing urban development, heat Islands may increase in frequency and magnitude. These heat Islands have impacts that range from local to global scales and highlight the importance of Urbanization to environmental change.

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The Scientific awareness of urban climate anomaly arose at least in the mid-eighteenth century. However, experimental studies had not been carried out until the development of meteorological instruments such as the thermometer in the mid-nineteenth century (Oke, 1991).It was especially from the mid-twenty Century that Urban heat Islands was observed practically in most part of the world except in extreme cold climates (Emmanuel, 2005).

Heat Islands develop when a large fraction of the natural land cover in an area is replaced by built surfaces that trap incoming solar radiation during the day then re-radiate it at night (Oke, 1982; Quattrochi et al, 2000). This shows the cooling process thereby keeping nighttime air temperature high relative to temperatures in less urbanized areas (oke, 1982). Heat Island of varying extent and magnitude as been observed in most urbanized areas in the world (Lansberg, 1981). As before, it is evident that urban heat island would cause various serious environmental problems in the tropics, but the urban climate of tropical cities has not been intensively studied (oke, 1982). This story is not different for Enugu Urban. This study, therefore investigates the spatial characteristics of urban heat Island in the city of Enugu during rainy season.

II. Conceptual Framework

Modification of the earth's surface through urbanization can have a dramatic impact on local climates. And one of them is a phenomenon known as the urban Heat Island (UHI). Cities are typically about 40c hotter than the surrounding countryside and the larger they are, the bigger the difference. In a city, although heating, air-conditioning and transport, all produce energy, this is surprisingly small component of their heat balance - only about 50W m2 (Roland, 2010).The difference between temperatures in a city and the surrounding countryside is therefore mostly due to what happens to the suns energy in the two environments.

The amount of energy stored is a function of the mass and heat capacity of the layer and the rate at which energy is lost and absorbed. The ambient temperature within will be a function of the amount of energy stored there, the nature of the surface, its albedo, water heat capacity and thermal conductivity. The ambient temperature is an element of the microclimate modified by such surface properties (oke,

1987). In rural areas, vegetation reflects about a quarter of the incoming short-wave radiation (visible light or short- wavelengths). Of the three-quarters that is absorbed, much of the energy is used to evaporate water from leaves a process known as "evapotranspiration". This cools the vegetation, which therefore radiates little long-wave radiation (infrared) and even less energy remains to heat the air by convection and to heat the soil by conduction.

In cities, where vegetation has largely been replaced by buildings and roads, the energy balance is dramatically altered. Dark, artificial materials reflect less and absorb more radiation than vegetation. This lower "albedo" means that only about 10% of the suns radiation is reflected down into urban 'canyons' (Oke, 1982). Almost all of this energy goes into heating the dry roads and roofs, where it is either stored in bricks and mortar or heats the air above, thus raising daytime surface and air temperature well above those of the surrendering countryside. However, this ''average" effect is complicated by the presence of parks, forested areas, rivers and streams and other non-urban features that exist in the landscape. This, detailed spatial investigation of the UHI can reveal micro-climatic details that explain how various surface features enhance UHI effect.

At night the difference in temperature between the countryside and the urban can become even more pronounced. Cities cool down more slowly because there is more heat stored in its buildings, which continues to dissipate into the night; (Quattrochi et al 2000); there is more pollution to trap long-wave radiation; and within urban canyons less of the cool sky is visible, so less radiation can escape.

All this causes major problems for city-dwellers. The rise in urban air temperature above that of the surrounding countryside, which can reach 7oc in metropolis, makes cities less comfortable and less sustainable places to live in during rainy season months. Soaring temperature increase ill health and can even kill people during heat waves.

In an urbanized environment, the significant modifies of natural cycle of heating and cooling: man-made structures (buildings, paved surfaces); anthropogenic heat sources: industrial processes, internal combustion engines. The heat from these sources cumulates to give rise to pockets of high temperatures in urban centers that we call urban heat Island (UHI). Thus areas with high infrastructural development, industrial concentration and high density buildings and Lange population are expected to always encourage urban heat Island (UHI).

III. Study Area

Enugu State is one of the states in southeastern Nigeria. Its capital is Enugu. The state was created in 1991 from the old Anambra State. Enugu state is located within latitude 60.00'N and 70.00'N and longitude 70.00'E and 70.45'E. The state is called the Coal City State because of the discovery of coal in a commercial quantity in Enugu Urban in 1909. Enugu was then the capital of East Central State of Nigeria. Some of the important towns in the State are Enugu Urban, Oji, Udi and Nsukka Urban.

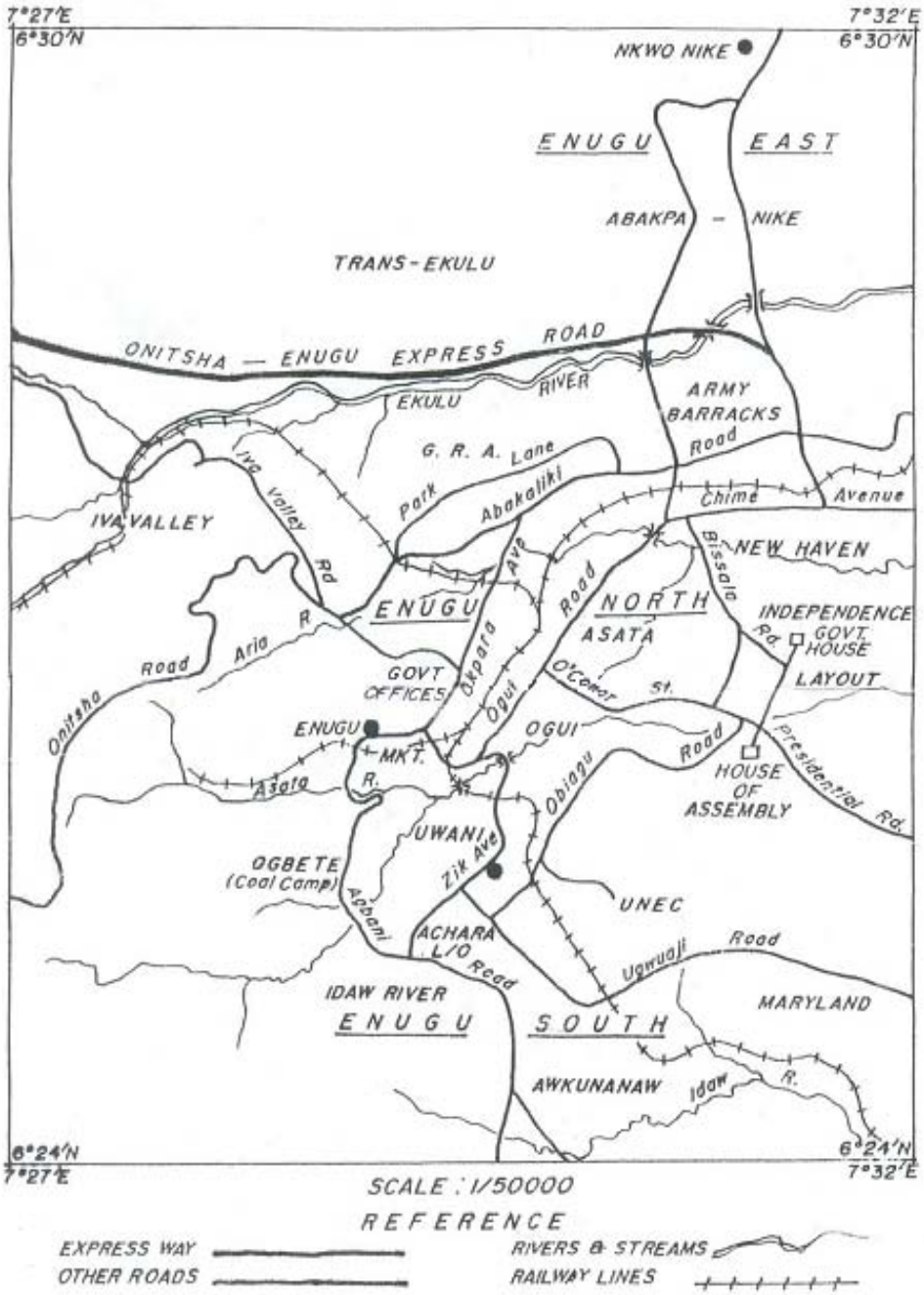
The state shares borders with Abia State and Imo State to the south, Ebonyi State to the east, Benue State to the northeast, Kogi State to the northwest and Anambra State to the west. Enugu State is made up of 17 local government areas. These include Igbo Eze North, Igbo Eze South, Udenu, Nssuka, Isi Uzo, Uzo Uwani, Igbo Etiti, Udi, Enugu East, Enugu North, Enugu South, Ezeagu, Nkanu West, Nkanu East, Oji-River, Awgu and Aninri local government areas.

Enugu Urban which is the study area is made up of Enugu East, Enugu North, and Enugu South (figure 1.). Enugu Urban is also located within latitude 6.240N and 6.300N and longitude 7.270E and 7.320E. It is an hour's drive from Onitsha, one of the biggest commercial cities in Africa and 2 hours drive from Aba, another very large commercial city, both of which are trading centers in Nigeria. Enugu Urban shares boundary with Igbo Etiti and Isi-Uzo Local Governments in the north, Udi local Governments in the west, Nkanu West Local Government in the south and part of Nkanu East Local Government Area in the east. There are 18 prominent residential areas in the Urban. These are Abakpa, Trans-Ekulu, Nike, GRA, Ogui, Asata, New Heaven, Obiagu, Ogbete, Iva valley, Independence Layout, Achara Layout, Ugwuaji, Maryland, Awkanaw, Uwani, Agbani, and Coal Camp. Enugu Urban is the most developed urban area in Enugu state.

The study area falls within the humid tropical rain forest belt of Southeastern Nigeria. It has two seasons, the raining season and the dry season. The rainy season which is characterized by heavy thunderstorms lasts from April to October with the South Westerly moisture accompanied by air mass moving northwards into the city. The turbulent runoff result in leaching, sheet erosion and eventually gullies (Akabuike, 1990). The mean temperature varies from about 20.30°C to about 32.16°C in the dry season and rainy season respectively, (Akabuike, 1990). During the dry season the humidity is lower than in the rainy season. Temperature is most often high during the day and low during the night. This results in high evaporation rate during the day. Harmatten which occurs between the months of November and February is always accompanied by poor visibility mostly at night and early in the morning. The rivers and streams which flow from the Udi hills dissect the study area into several sections. Thus there are rivers such as Ekulu, Idaw, Asata and Nyaba Rivers which separates Enugu South from Nkanu East. These rivers have many tributaries; the study area

is generally marked by low land, slopping towards Enugu South Local Government Area and the Southern part of Enugu East Local Government Area. The elevations are between 182.88 meters and 219.45 meters above the sea level. Below is a table showing the population of each local government area that make up the study area. This is based on the figure of National population Census of 2006.

Figure 1.2 : Map of Enugu Urban.



Source : Ministry of Lands and Survey Enugu

IV. Methodology

Data collection spanned over two seasons (2006 to 2007). The essence was to capture the peak periods, frequency, magnitude and seasonality of urban heat variations in places. The months to June-July were selected because of high rainfall during this period. Temperature data were collected during the day and night. The following land use/land cover sites were selected for data collection.

a. High-density, high-rise, non-residential areas with no greenery (DTL).
b. High density, high-rise, residential areas with low greenery (HDR).
c. Medium density, mixed residential (some residential, some commercial/ institutional area with a greenery extent between DTL and HDR.
d. Areas with similar land-use, building density and greenery one having more fully developed vegetation canopy than the other (LVR and LOR)

During the study period, transect and fixed point measurements were taken hourly and averaged over a month. All temperature differences were calculated as site temperatures minus reference temperature. Thus a negative (-) temperature deference indicates that the site was cooler than the reference station; and positive (+) indicated the site was Warmer than the reference station. The reference station is the rural environment.

V. Results

a) Rainy Season(Day-Time)

Table 1 shows temperature variations during stable atmospheric conditions during the day.

Table 1 : Temperature Variation under stable Day-Time Conditions.

Sites	Location Names	Temperature Difference
DTL	Ogui Road	+ 0.64
LOR	Independence L/O	- 0.22
LVR	GRA	- 3.3
NW2	UNEC	- 2.0
HDR	Achara L/O	- 2.1

The downtown location site was the warmest (+0.64) warmer than the residential sites. Places like Ogui road, Asata, Ogbete, Okpara Avenue and parts of zik Avenue were warmer than neighboring sites. The high density, urban residential sites (HDR)- Achara Layout, and heavily vegetated urban sites (LVR)-(GRA, with fully developed vegetation canopy were the coolest (-2.31 and -3.3) respectively. The low-density residential sites (LOR) like independence layout, was only -0.22oc cooler than the reference site. Except for sites (NW2) where institutions and residential quarters are housed, hour-to-hour variation in air temperature during the day-time was not much. The NW2 sites witnessed higher temperatures during the day than in the night.

The number of sites that witnessed unstable conditions on multiple days was very few (sites DTL, LVR and NW2); the patterns were very similar to those produced by stable conditions. The average air temperature differences during unstable day-time are shown in table 2.

Table 2 : Temperature under unstable Day-Time Conditions.

Sites	Location Names	Temperature Difference
DTL	Ogui Road	+ 1.52
LVR	GRA	- 3.45
NW2	UNEC	- 3.0

Under unstable, conditions too, downtown location sites (DTL) were the warmest. Maximum day time UHI was about 3.2oc and hour-to-hour difference was about 3.5oc. Unlike stable conditions, differences between LVR and NW2 under unstable conditions were 0.45oc warmer than the reference site.

b) Rainy Season (Nighttime)

Unlike the daytime temperature differences, night temperature variation (DTN) showed a clear downtown centered heat Island. Table 3 clearly depicts this variation.

Table 3 : Rainy Season Temperature during the Night.

Sites	Location Names	Temperature Difference
DTL	Ogui Road	+ 1.48
LOR	Independence L/O	- 0.64
LVR	GRA	- 0.34
NW2	UNEC	- 0.39
HDR	Achara L/O	- 0.52

All residential sites were cooler than the reference site (from-0.34oC to 0.34oC) while the downtown location was up to 1.48 oC warmer. The intra-urban differences among the other sites (LOR, LVR, NW2 and HDR) however, were very small.

VI. Discussion

Rainy season heat Island at the city wide scale correlated well with ground cover characteristics. Green cover alone explained about 40% of micro-climate variations. The influences of buildings and vegetative maturity were apparent. The magnitude of the temperature differences decreased as background climate became hotter. But hotter conditions led to higher intra-urban thermal comfort difference than the cooler nights. This finding highlights the need to distinguish between temperature Islands and thermal comfort Islands. The former peaks at clear calm nights while the latter reaches its maximum under overcast or hazy conditions.

Under very hot conditions, the low ground cover at the more open residential sites did not significantly improve day-time cooling. This suggests that shading was more central to daytime cooling than ground cover. Extensive tree canopy produced some cooling during the day, but the cooling provided by building shade at the high-density sites (like Achara Layout) had the same effect.

The highest nighttime intra-urban air temperature difference was observed early night period (1800 hrs. to 2300hrs). Unlike day-time, the hour-to-hour variation in air temperature during the night was very significant, particularly at the residential sites. Observations showed that there was a clear downtown-centre heat Island at night. A maximum nighttime air temperature of about 2.0 oC heat Island was observed during the study period.

VII. Conclusion

Air temperature measurements over Enugu have been analyzed and results reveal some spatial and temporal characteristics of the UHI in Enugu. The urban heat Island has been found to occur throughout the day and night with the highest intensity occurring around 1800hrs and 23000hrs, with mean values reaching 3.2 oC and 3.5 oC during the day and night respectively. Its structure was also observed to be greatly influenced by weather, city metabolism, anthropogenic activities, local geographic features, land-use and land-cover as well as vegetation, and population.

Finally, further study is needed to examine the possible mitigation measures for the effects of urban heat Island in Enugu, focusing especially on the temperature reduction effects caused by the green areas.

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Global Journal of human social science
Geography & Environmental GeoSciences
Volume 12 Issue 10 Version 1.0 Year 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Chongming Island Ecological Conservation Project

By Raanan Katzir

Abstract - Chongming Island Is under the framework of Shanghai administration. It is an alluvial Island in the mouth ol the Yangtze River. The area is 1041 km2 and the population is about 700,000 inhabitance. An expected tunnel will combine the island to the main land in the future. The local population will increase and the island is becoming very attractive to tourists. The island could be regarded as a Peri Urban system of Shanghai neighborhood. All these turn Chongming Island into an ecological conservation project directed by Shanghai Academy Agricultural Science (SAAS) organization. The following are few ideas that can reduce the hazard of soil, water, air contamination and other environmental distur-bances. Also activities proposed to change the island agricultural features, ecological education campaign and eco-agro tourism projects.

Keywords : *Agraecology, urban and peri urban agriculture, suburb ecological conservation project.*

GJHSS-B Classification : *FOR Code: 149902*

Strictly as per the compliance and regulations of:

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I. Ecological Conservation Activities Recycling City Garbage into Compost

City garbage derives from homes contains a very high percentage of organic material that can be turned after fermentation procedure into valuable compost, which could be used as organic fertilizers.

The garbage if not treated can become a resource of soil, water and air pollutant. The compost produced of the garbage is a main natural fertilizer for organic agricultural production. The near by Shanghai city is a high potential market for organic products (Katzir, 1993, 1996a, 1996b, 1999).

II. Recycling Sewage Water

Origin sewage water from people homes has about 400 BOD (Biological Oxygen Demand). This water could be intensively recycled through oxygenized ponds into water with lower BOD as 30 - 40. Such water could be used as irrigation water for agriculture and public gardens. This water could be also be used for the ecological rehabilitation of rivers, lakes and cultivation fish in ponds. Recycling sewage water is an essential ecological urban solution and at the same lime a solution for agricultural and environmental purposes (Katzir, 1999, 2000).

III. Recycling Oils

Oils residues could be a serious nuisance for nature. It is important to prevent organic and synthetic oils from reaching the site of sewage water recycling plants.

Organic oils collected from restaurants to be used as a component of the biodiesel production. Synthetic oils could be also collected Iron garages and later treated through biological means as bacteria and micro planktons to be decomposed. The above mentioned procedures are generating jobs and important to ease on the environment pollution (Katzir, 2006)

IV. Plant Residues

Various plant residues from agriculture, gardens and Industry could be used as components in the above mentioned compost production.

By recycling these residues we turn organic waste into productive compost production and avoiding environmental pollution. Using industrial organic waste will Improve also the profitability of the industry (Katzir, 2000).

V. Animal Husbandry Urine and Manure

Animal husbandry waste is a high risk to environment. Animal urine could be collected and use as organic fertilizers in organic agriculture. Animal urine and manure could be used for compost preparation and bio gas production as methane gas to be used at home as an energy resource. The sludge remains after mixing with straw and peat could be used as a media to mushroom production. The sludge still rich with organic compounds is an adequate resource lor producing champignon mushroom (or the near by big market of Shanghai. Introducing this sophisticated agricultural branch will generate occupation and income (Katzir, 2003)

VI. Chicken Manure to Feed Cattle and Fish

Chicken manure accumulate in big amount is an ecological disturbance. Chicken manure treated through paste- rizing and cleaning by magnet to get out metals residues could be used to feed cattle and fish.

The chicken industry is common on the island since the near by Shanghai market is a big consumer of chicken meat and eggs.

Cattle could be deeded with chicken manure up to 70% of the daily portion. Feeding with chicken manure will save land used regularly for forage production (Katzir. 1999)

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VII. Planting Mangroves to Protect Shores and Rivers Banks

Sea shores and river banks could be very vulnerable to erosion and other destructions occur. Planting mangroves trees on the water edges of sea, lakes and river banks protect and avoid destruction. Mangroves are also favoring the reproduction of fishery. Mangroves are essential for fish laying eggs and fish fingerlings production. In case of Tsunami storm, mangroves trees serve as a very efficient protection wall (Katzir. 2002).

VIII. Harvesting of Rain Water from Urban Areas, and Rural Drainage System

Rain water could be collected through the urban city drainage system and could be added to the ponds where the sewage water is being recycled. This will improve the Biological Oxygen Demand (BOD) and the recycled water produced will be on higher quality. Also drained water from agricultural fields could be added to the same system (Katzir, 2003)

IX. Ecological Ponds of Fish Production

The Integrated Aquaculture Farming (IAF) clearly state that to maintain fish ponds under reduces pollution is more ecological. The principles is stocking the ponds with various fish specious that live in the different pond's levels (up, medium and bottom), and mutually consume the excretion of the neighbor specious.

As a result the ponds will be kept cleaner from organic waste, bad odors and also free ol mosquitoes. Such a system does not bother the near by urban dwellers. As mentioned, il Is possible to feed the fish In the pond with chicken manure (Katzir. 1999)

X. Changing the Agricultural Features

Introducing changes in the local agricultural features could reduce the ecological disturbances and improve environmental conditions (Katzir, 1992, 1994, 1999a, 1999b, 2000, 2001). The following changes are recommended:

- Organic agriculture to reduce the use of pesticides and fertilizers (Katzir, 2002).
- Integrated Pest Management (IPM), to reduce the use of pesticides,
- Biological Control by using beneficial Insects to reduce the use of pesticides.
- Producing and using compost as organic fertilizers to reduce the use of synthetic fertilizers
- To encourage the use of recycled sewage water for irrigation (Katzir. 2004).
- Maintain efficient field drainage system to avoid high under ground water level.
- Promoting nurseries to propagate fruit trees and other trees.
- Encouraging trees planting for soil conservation and improving natural sight conditions.
- Planting wind breakers to reduce damage of storms.
- Planting fruit trees.
- Promoting flowers and pot plants production.
- Agricultural demonstration and educational farms for urban visitors.

All these mentioned systems will turn the local agriculture into a high sustainable agriculture which conserve better the natural resources and cope better with the near by urban sector (Katzir, 2005)

XI. Ecological Education to Farmers, City Dwellers, Industry, Commerce and Youth

An educational campaign should be plan and launch to increase the conscience of farmers, city dwellers. Industry. commerce and youth to ttie environmental issues. Such campaign will also increase the engagement of all society forms to improve the ecological level of Chongming Island (Katzir, 1995, 2001, 2006).

XII. Eco and Agro Tourism Projects

Agro and eco-tourism can become a major income to the island. The following activities should be encouraged:

Promoting attractive tourist activities as boat surfing, swimming pools, tennis courts, sport clubs, aquarium, fishing and others.

- Avoiding oars from entering the island from the main land to reduce noises, air contamination and traffic jams.
- Attractive hotels and resort villages.
- Gardens and parks.
- Entertainment centers
- Museums
- Natural reserve site open to public

Agro and eco-tourism are regarded at present as very attractive lo urban dwellers. Chongming Island can become an out standing model for such activities for the mutual benefit of the near by urban population and the local rural agriculture producers (Katzir, 2003).

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Global Journal of human social science
Geography & Environmental GeoSciences
Volume 12 Issue 10 Version 1.0 Year 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Philosophy, Mythology and an African Cosmological System

By Dr. Amaechi UDEFI
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Abstract - There is a tendency by some scholars, especially those professional African philosophers who belong to the analytic school of African philosophy, to deny any relationship between philosophy, myth and cosmology. Their denial is based on their characterisation of philosophy as a rational and critical inquiry, while myth and cosmology are taken by them as belonging to the realm of stories, folktales etc. created by so-called primitive or traditional society to satisfy some emotional and instinctual need. Hence, they conclude that the concepts are unrelated. However, I shall argue that there is a deeper relationship between them than it is acknowledged since myth and cosmology constitute the raw material for philosophy. Again, both concepts offer a perspective for an interpretation of the world and the mysteries and phenomena of existence in general.

GJHSS-B Classification : *FOR Code: 160609, 160502*

Strictly as per the compliance and regulations of:

Philosophy, Mythology and an African Cosmological System

Dr. Amaechi UDEFI

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I. Defining Philosophy, Mythology and Cosmology

a) *Philosophy*

It is pretty difficult to give a precise definition of philosophy as a discipline unlike what we see in some other disciplines like sociology, history, economics, physics etc where there is a kind of straightforward definitions of them. This perhaps accounts for the apparent disappointment of a student taking a first course in philosophy as to the lack of agreement in the definition of the subject by philosophers. However, saying this does not mean that it is impossible to articulate "ideas and attitudes that could be regarded as philosophical (Nwala, 1985, p.2)

a. Philosophy tries to understand the real nature of any given thing, facts, or events;
b. It understands the object in itself.
c. Hence, the goals of any philosophical system consist on the one hand the inculcation of habits of clear, exact logical and critical thinking a other hand the avoidance of blind indoctrir the adoption of a critical attitude towards issues in life.
d. Philosophy is a form of rational activity, a critical and conscious effort to understand the universe, its origins, nature and man's place in it.
e. It is also a critical thinking about the concepts and principles we use to organise our experience in morals, in religion, and in social and political life, in law in psychology, in history, education and in the natural sciences (Sodipo, 1972, p.3)

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What is obvious from the views articulated above is that philosophy is susceptible of two senses, one broad or general and the other technical or narrow. In the broad sense, philosophy is nothing more than world-view (Weltanschanung), culture, opinion, beliefs etc of an individual or a people. This sense of philosophy is captured by Nwala (1985:p.2) when he says:

> *Philosophy may mean a world-view…, that is, the basic beliefs which a people have or a person has about the origin, nature and of the universe, life or existence, whether the ideas are explicitly stated or implied in action stated in another ways, it could be basic ideas and beliefs which express a people's or a person's outlook in life.*

In this case, every society has some philosophy since there is a stock of beliefs, ideas, opinions that is commonly shared by the people of a particular culture concerning man, society and nature.

In the technical or narrow sense, the practice of philosophy is now reserved for the professional philosophers who, in a critical and conscious manner, attempt to theorise about the world and reality. According to Kwame Gyekye, philosophy is essentially a rational, critical and systematic inquiry into the fundamental ideas underlying human thought, experience and conduct-an inquiry whose subject matter includes epistemological concepts and categories (Gyekye, 1995, p.4)

This technical sense is what Odera Oruka prefers to call "exact" philosophy (in opposition to 'debased' or diffused philosophy) where philosophy is a rational and critical reflection on man, society and nature (Oruka, 1972, p.7)

The two senses of the term-philosophy stated above chime with what W.E. Abraham, in his highly illuminating book, *The Mind of Africa*, calls a "public philosophy" and a "private philosophy". According to him, the former is concerned with the traditional society and the laying-bare of the communal mind while the private philosophy is the thinking of an individual philosopher (Abraham, 1962, p.104)

b) *Mythology*

It is a difficult task to give a precise definition of myth because it is prone to many definitions and interpretations as there are myth analysts. In other words, each analyst or scholar tries to give a definition

of myth based on a certain perspective. Some might adopt a dismissive attitude towards myths and deny them any truth-value, while others might be charitable and accord some cognitive-value to them. According to Martin S. Day, "definers of myth are so varied and irreconcilable as delegates to the United Nations" (Day, 1987, p.2). However, we shall attempt to give a characterisation of myths or its collective mythology following its etymology and other relevant literature. Before we proceed, it is important to note that man from the pre-historic times has been grappling with some perennial and perplexing problems like the origin of the world, man and things as well as the question of existence. The responses to these are usually encapsulated in the stories, narratives and cosmogonic myths of the people or culture group.

It is important to note that the term myth is derived from the Greek *mythos*, meaning 'word' or 'story' (Madu, 1996, p.232). We shall, however defined myth following Mercatante as:

> *…traditional story, orally passed on from one generation to the next, believed to be literally true by the culture that produced it, about gods and goddesses, heroes, heroines, and other real and fantastic creatures, taking place in primeval or remote times* (Mercatente, 1988, p.xiv)

For the functionalist theory whose Chief advocate is Malinowski, myths are like songs and fairy tales which are owned by certain sub clans. According to him, it is a rule that a myth will be best known in its locality, that is, known with all the details and free from any adulterations or not quite genuine additions and fusions (Malinowski, 1922, pp. 327-329). In the same vein, Isidore Okpewho defines "myth as a set of ideas about man and his environment" (Okpewho, 1983, p.1). What unites the above definitions is that myth is concerned with the traditional tales of a people, gods, nature and the universe (Oruka, 1972, p.6)

Thus, Levy-Bruhl in his book, *Primitive Mentality* believes that primitive people are unlettered since they are incapable of purely abstract reasoning. Hence they are regarded as being pre-logical. And their myths are mere stories or narratives devoid of any truth and cognitive 'cash-value'. However, some scholars, like B. Malinowski, have challenged the above and similar views and consequently described "myths in primitive culture as a pragmatic charter for primitive faith and moral wisdom. According to him, a myth serves as a clear presentation of the outlook of the life of people living in communities as well as objective and permanent philosophy of life. This point is well taken by Ikenga Metuh when he says:

> *Myths definitely do tell us about certain realities including religious truths, people's understanding of them environment, their geography history, medicine and their social and political institutions could very easily be revealed in their myths* (Metuh, 1999, pp. 27-28).

Thus myths are used to express the views of the people concerning the existence of man, gods, universe, their fears and aspirations in life.

c) Cosmology

The term is derived from the Greek (*Kosmos*) meaning world and (*Logos*) which means discourse. Then it can be defined as the study of the origin, structure and development of the world or universe in its totality. Again it can loosely be defined as that branch of metaphysics after ontology (which is the study of the meaning and nature of being), which treats of the universe as an ordered system. Nwala defines the term as:

> *… that framework of concepts and relations which man erects in satisfaction of some emotional or intellectual drive, for the purpose of bringing descriptive order into the world as a whole, including himself as one of its elements. The resulting cosmology will accordingly reflect the sociological, philosophical or scientific predilections of the individual and his group* (Nwala, 1985, p.7).

Both cosmology and myths are related since they attempt to address through narratives, the problems bordering on the origin and nature of the world, man and existence generally. These cosmogonic myths have to do with the treatment of "the origin of the world and other phenomena" contained therein.

II. The Interplay of Philosophy, Mythology and Cosmology

The present day philosophy or art of philosophizing started from the speculations of the Greek poets in narrative forms or genres. Their endeavours sparked off the philosophical firmament in the Ionian philosophers towards a pursuit of systematic philosophic thought. Such philosophers include Thales, Anaximander and Anaximenes. These Ionians, who were also called cosmologists, made a remarkable contribution into philosophical thinking by delving into the origin of the whole world and the ultimate causes of things as did the poets that preceded them. Apparently amazed by the phenomena of birth and death, the movement of ocean, the amazing variety of things, the concept of time, the basic unity in the apparent diversity, they asked: what is the first principle from which all things draw their origin at birth and whence do they 90 at death? That is, what is the original stuff that underlies the universe? The leading figure of Ionian philosophers was Thales, who posited that the ultimate constituent of the universe was *water*. According to him, water is the primordial substance underlying all things in the world. Understandably, Thales may have come to this conclusion because of the importance of water to the

Miletians, who were largely sea-going fishermen and peasant farmers.

Also, Plato, like the Ionian philosophers before him emphasises the connection of myths and cosmology to philosophy. A perusal of the works, of Plato, especially the Republic and Symposium, will show how he uses symbols, allegories and legends to explain issues in knowledge, morals, politics, aeasthatics etc. A clear illustration of the relationship between myths, cosmology and philosophy can be seen in the allegory of the cave, which Plato was to explain the distribution between appearance and reality.

The connection between these concept is reinforced by Inge (1936; p. 139) when he says;

> *Myths… is an observation of things encumbered with all that they may suggest to a dramatic fancy. It is the common root and raw material of both poetry and science, and also of art. The Hebrew, who denied themselves a rich mythology, had no science or plastic art; the Greeks who indulged in… myths, were the founders of science and philosophy. Myth is the natural prologue to philosophy.*

Now, philosophy began in wonder and like cosmology and mythology concerns the basic beliefs of the people about the world, man and existence in their totality. Granted that myths and cosmology may be said to characterise traditional or primitive society, but saying so does not imply that such society is impervious to some sort of rational or philosophic elements no matter how rudimentary. If philosophy, in its broadest sense, is defined as world-view and as certain basic beliefs and conceptions about the world, man and existence, then it makes sense to say that traditional society possesses some philosophy.

According to Jacques Maritain, as quoted by Nwala:

> *… some of the most elementary truths with which philosophy deals were known long before philosophy itself had come to birth, and the more important of these are to be found in a more or less rudimentary form…among all peoples of antiquity, event at the most remote epoch… (Thus) the primitive tradition has preserved for mankind throughout the ages a deposit…of fundamental truths. In this deposit …were included many philosophic conceptions* (Ibid, p.6).

It is obvious that what Jacques Maritain is alluding to here is the relationship between philosophy, folktales and cosmological systems of societies and the imperative need to abstract philosophy from the mass of deposits of such societies. Also, Nwala seems to subscribe to the above view when he says:

> *If 'primitive societies could be said to possess cosmologies then there is also a sense in which we can rightly say that they too possessed philosophies. Cosmology …is an integral part of classical philosophy. Their philosophies may not be systematised as ours but philosophers can draw out or abstract this philosophy from the life, culture and institutions of the people* (Ibid, p.7).

The point being made here is that there is a thin line between philosophy, mythology and cosmology since both serve as a platform for the interpretation of man's experience about reality. This is perhaps what Bolaji Idowu intended when he said:

> *Myth (is) a vehicle conveying a certain fact or a certain basic truth about man's experience in his encounter with the created order and with regard to man's relation to the supra-sensible world* (Idowu, 1976, p.84).

Again there are some moral lessons to be drawn in both concepts, that is, through axiology and metaphysics, which are basic themes in philosophy, we learn about those intrinsic values which are the imperatives for a good life; the structure of the world; and the nature of being which are abstracted from myths, narratives that are immanent in Greek cosmology.

Still on the link between the concepts, Dipo Irele and Okpewho, among others, have argued for a complementarity between them rather than being seen as a kind of binary opposition to each other. Specifically, Irele contended, following the insights of some philosophers of science like Thomas Kuhn, Paul Feyerabend, Mary Hesse, for the revision of the view (Enlightenment) which tends to deny any rational contents to myths and other forms of knowledge other than science. According to him, Ifa- a literary corpus in Yoruba culture contains certain basic ingredients of scientific and philosophic thought namely; conceptualisation of phenomena of nature, abstract causal thinking and abstraction of contraries in nature (Irele, 1998, pp. 102-110).

Okpewho, on his part maintained that rationalisation and speculation which are the basic ingredients of philosophical activity are accounted for by the oral traditions, (Okpewho, 1981, p.44) contrary to the submissions of some scholars like Levy-Bruhl, Jack Goody, Karl Popper, Robin Horton, and Peter Bodunrin, Odera Oruka, among others, that literacy, criticism, argument etc are a pre-condition for a philosophic thought".

III. Igbo Cosmology

Let us suspend our argument above and turn attention to Igbo cosmology to buttress the point about the link between philosophy, mythology and cosmology. We argued above that traditional societies possess philosophy and traditional Igbo society is no exception to this, since it possesses not only philosophy, but also

there are "myths and ideas which embody and describe their cosmogony (Nwala, 1985, p.29).

IV. The Dual Nature of Igbo Universe

In traditional Igbo society, there is the belief that the universe is bifurcated into two, namely:

Elu – Igwe – sky

Elu-Uwa- (*Ala*) the Earth. The former is the abode of the spirits or supernatural entities- *Ala-Mmuo* and the latter is inhabited by human beings- *Ala-Mmadu* and other things like animals, plants, fishes, vegetables etc. it is also believed by the Igbo that the two worlds, though distinct, maintain a kind of correspondence or interaction with each other in order to guarantee social balance or order. This point is well taken by Mazisi Kunene as:

> *Common to all these bodies are two special laws (a) Continuous growth resulting in a expanding universe (b) The existence of cosmic boundaries enabling each entity to follow its own direction. A cosmic balance regulates all things from the smallest unit to the largest. The interplay among the cosmic entities aims at enriching each other* (Kunene, 1980, pp.191-192).

The channel by which this is transmitted from one generation to another is through any of these:

Akiko - Ifo : Folktales, stories with songs during moonlight plays essentially for relaxation and entertainment with strong moral lessons.

Akiko – Gboo : Legends which are stories about the distant past.

Akiko - Odi-nala : Myths, i.e. narratives about tradition and customs, *Omenala,* of *ndi- Igbo*-race.

The Igbo, for instance, can narrate how the world and man were created, through the platform of *Akiko-ifo*, (folktales) by saying that *Chukwu-okike, Chineke* (God the creator) created *Uwa* (world) and *Mmadu* (human being). The instruction by *Chineke* is that the world should provide a shelter or home for the human being and other things including plants, animals, vegetables etc. for consumption by man. What is of interest here is the philosophy underlying the story. The belief in a created universe is common to both the traditional society and finds supports or justification in the "creation stories in the Holy Books – Bible (Genesis) and the Qu'ran".

Again, the story attempt to explain the place of man in the cosmic order, putting him at the centre of the universe. In his interaction with other forces in nature, man recognises his freedom and the sacredness of himself, gods, earth and other things associated with spirits. It is important to mention that within the universe of forces, man is not subservient to the gods. For he "appeals to the gods only when he needs them and may choose to denounce them when they fail (Ibid, p. 199).

Thus, contrary to Popper, Horton and others who maintain that traditional society is characterised by an absence of alternatives to established authority and are largely conservative, the traditional society is as innovative, creative, dynamic as any other in so-called modern, societies. The tendency by some professional African philosophers to stress vigour and critical analysis as the essential hallmarks of philosophy seems presumptions. This is because they fail to understand there is a 'critical' as well as 'narrative' aspect of philosophy. The two aspects according to Richard Bell, (1989:p.364) are not mutually exclusive but are complementary.

According to Bell, Socratic philosophy is a typical example of both the critical and narrative aspects of philosophy. As he puts it.

> Socrates *as oral philosopher*, makes his way into subsequent philosophical history independent of Plato as his critic and he gives shape to a distinctive philosophical style. Socrates was no only engaged in doing philosophy with his fellow citizens in the streets of Athens, but the very form of *elenchus* caught in his dialogues and the literary form of dialogue itself shaped the thought of socres of philosophers who followed him in a distinctly Socratic mode. (author's. italics).

Within the context of traditional or non-literate societies both aspects are also found in the decisions and dialogue in their town hall meetings. For instance, if there is an impending war, the people usually rise up to the occasion by looking for solutions and strategies to either avert or prosecute the war. Whichever way the decision goes may have been arrived at through 'critical dialogue'.

V. Concluding Remarks

We can now conclude by reiterating the point that there is a link between philosophy, mythology and cosmology, since in both there are certain assumptions and conceptions about the universe, life and existence in general. The characterisation of traditional society as 'closed' and conservative is an exaggeration because how the traditional man arrives at these assumptions and conceptions is not fortuitous but embodies some speculative elements based on the 'exercise on reason'. These assumptions and ideas may not have been written down in terms of systematisation, but this should not diminish the meaningfulness and aesthetic value of oral tradition. We also argued that philosophy has both 'critical' and 'narrative' aspects and that they are not mutually exclusive.

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Global Journal of human social science
Geography & Environmental GeoSciences
Volume 12 Issue 10 Version 1.0 Year 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

An Assessment of the Influence of Calabar Carnival on the Economy of the Residents of Calabar Metropolis, Cross River State, Nigeria

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Abstract - This study investigated the influence of Calabar Carnival on the economy of the residents of Calabar Metropolis of Cross River State, Nigeria. Special focus was on the resident's income from tourism jobs and related activities during the period of the Christmas festival celebration in the state. Information for the study was basically from the questionnaire survey and participatory research method. The generated data were analyzed using descriptive statistics such as mean, simple percentages and graphic illustrations. The study demonstrated that there was a steady increase in the number of tourists' visits for the Christmas festival with a corresponding increase in the number of people involved in tourism related activities during the time under investigation, with the greatest number of people involved in trading during this time and recording the highest income. The result shows that tourism influenced economic activities vis-à-vis enhancement of the people's income in the area. Based on the above findings, it is recommended that all stakeholders in the tourism industry should be involved in the planning and execution of tourism projects and that tourism activities be organized all through the year to ensure more tourists visitation and avoid seasonality in the tourism industry.

Keywords : *Tourism, Influence, Carnival, Economic development, Residents.*

GJHSS-B Classification : *FOR Code: 160505, 160510*

Strictly as per the compliance and regulations of:

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I. Introduction

Carnival is a street festival which brings communities together in celebration, largely on the back of voluntary participation – the archetypal big society showcase. In the UK it can encompass highly localized British traditions, such as Notting Hill's flagship African-Carribean event, to more recent hybrids accommodating both Brazilian and world music and a variety of street and performing arts (Goodwin, 2008).

Carnival's community spirit is the result of the cumulative efforts of many talented artists – musicians, costume designers, dancers, street theatre performers and sound engineers. Carnival arts are now recognized by the Arts Council as a "combined art": one that, at its best, brings together many art forms and traditions in new innovative production and performance (Agnes, 2004).

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Investment in combined arts is considered important for future social and economic returns.Carnival can engage the communities – especially young people and disadvantaged groups – that more traditional art forms cannot reach. It can also create new commercial opportunities in digital and creative industries, among the priority sectors in the government's plan for growth. And the best carnivals are also major boosts for the local economy (Cole, 2006).

Carnival, according to the Chambers paper back thesaurus is a noun used to describe festival fiesta, gala, jamboree, fair holiday, jubilee celebration, merry making, and revelry. With these it is said to be a recreational activity and a part of tourism. Tourism is the temporary movement of people to destinations outside their normal places of work and residence, the activities undertaken during their stay in those destinations and the facilities undertaken during their stay in those destinations, and the facilities created to cater to their needs. (Mathieson and Wail, 1982). The study of tourism is the study of people away from their usual habitat of the establishment which respond to the requirement of travelers and of the impacts that they have on the economic, physical and social wellbeing of their hosts. It involves the motivations and experiences of the tourists the expectations of and adjustments made by residents of reception areas, and the roles played by the numerous agencies and institutions which intercede between them. Tourism is a luxury, until recently; participation was restricted to the selected few who could afford both the time and money to travel. Increased leisure, higher incomes and greatly enhanced mobility have been combined to enable more people to partake of tourism. Improvements in transportation, the proliferation of accommodation and the growth of inclusive tours and others form of relatively cheap vacation travel, have further extended the opportunity to travel for pleasure. Today the majority of people in the developed world and increasing numbers in developing countries are tourists at some time in their lives. Tourism is no longer the prerogative of a few but is an accepted and accustomed, even expected, part of the lifestyle of a large and growing number of people. Tourism is of major economic and social significance because about 270 million tourists spend $92 billion (US) annually in places outside their own countries. This is one of the

largest items in the world's foreign trade. Will a world growth in visitor arrivals rate of approximately 6 percent per annum, tourism is also one of the fastest growing economic activities. It is the most important export industry and earner of foreign exchange in many countries. Looking at benefits and relevance of tourism, it could be in terms of its economic significance, where receipts from international tourism can provide a valuable source of earnings for both development as well as developing countries. Visitors spending generate income for both public and private sectors, besides effecting wages and employment opportunities. According to the world tourism organization (WTO) among the world's top 40 tourism earners in 1995 about 18 were developing countries including India. Regarding the number of visitors arrivals than the population, France with a population of 57 million received 70 million visitors in 1998. Similarly, Spain with a population of 37 million received 47 million visitors during the same year. (Bhatia, 2002). Tourism has also influenced expansion and modernization of infrastructure. It has been noticed that many regions in the world are not in a position to reap the benefit of tourism simply because of the lack of infrastructures. In fact, if we look at the countries and the regions within the countries, the ones having adequate infrastructure are the greatest beneficiaries. The world's top to tourist generating and recurring countries all have excellent infrastructures to support the insatiable quest of tourists' visiting the areas (Uwadiegwu, 2000).

Another importance of tourism is that, it creates employment. The world travel and tourism council had estimated that in the year 1999, travel and tourism was expected to generate almost 200 million jobs across the world economy, both direct and indirect. Looking toward, world travel and employment in travel and tourism is expected to grow at 2.6 percent per annum. The majority of the job will come in the form of direct service jobs in tourist related facilities and attraction at the destination and in tourist generating areas. Tourism also makes a tremendous contribution to the improvement of social and political understanding. Travel fosters a better rapport between people with different lifestyle. Personal international contacts have always been an important way of spreading ideas about other cultures. Carnivals are thus an important means of promoting cultural exchanges and international cooperation. The experiences gained through travel have a profound effect upon the life of the individual as well as upon society as a whole. Travel exercises a very healthy influence on international understanding and appreciation of other people's style of life. Tourism thus is a highly complex phenomenon. It is an important human activity of great significance in addition to its economic significance. As a mass phenomenon of an essentially social nature, tourism can no longer be viewed as a fringe activity, both in the use it makes of time and space and its relationship with the production of goods and services, tourism has become one of the pivotal concerns of nations and of the international community. (Bhatia 2002). It's an established fact today that tourism is a huge industry, the world's largest and arguably fastest growing industry. Every country has something to offer in tourism even the poorest nations can offer their heritage, traditional culture and national sites which today happens to be of great interest to tourists.

Nigeria is a vast country richly endowed with ecological and cultural resources. The country offers a with variety of tourist attractions such as extended and many rivers and ocean beaches ideal you summing and other water sports, unique and dowers wildlife, vast tracts of unspoiled nature from tropical forest magnificent waterfalls and climatic conditions in some parts particularly conducive for holidaying. Other attractions include traditional ways of life, local customs, rich and varied handicrafts and other colorful products depicting native arts and lifestyle and the authentic unsophisticated but friendly disposition of many of the Nigerian populace. However, many of these attraction are still largely untapped and are even at their raw state, although are enjoyed by few outsiders, very rich visitors in question of exoticism or adventurous people in search of new challenges and experiences.

Calabar Carnival festival in Cross River state, Nigeria, also tagged "Africa's Biggest Street Party", was created as part of the vision of making the Cross River State in Nigeria, the number one tourist destination for Nigerians and tourist all over the world. The carnival which begin on every 1st of December and last till 31st December has boosted the cultural mosaic of Nigeria people while entertaining the millions of spectators within and outside the State, and boosting industry for all stakeholders.

The Calabar Carnival has gone a long way since its inception in 2004, when the then governor of the State, Mr. Donald Duke had a vision of making the state the hub for tourism and hospitality in Nigerian and in Africa. The Carnival presents a perfect platform from brand visibility for consumer and market awareness. "According to Osima-Dokubo, the carnival aimed to include more aspects of local heritage and culture and at the same time strengthen the capacity of the locals to participate in an economically beneficial way". Recently, Cross River State and Calabar has become the pride of Nigeria or Africa as far as tourism, carnivals and hospitality are concerned.

Calabar Carnival, as it is called, is a unique display of African heritage, showcased through music, dance, drama and visual creativity, which is reflected in the design of floats, costumes and make-up. Since inception, this festival, which has become one of the biggest tourism and leisure attractions in West Africa, has grown tremendously in popularity and scope.

Over the past years, the Cross River State government has used this carnival to drive its tourism sector and provide exposure for its citizens, as well as develop its vast tourism sites and infrastructure such as the Obudu Ranch Resort, the Tinapa Business Resort, Marina Resort.

The festival commenced with a tree-lighting ceremony on November 30 at the Millennium Park, Calabar and will end with a thanksgiving ceremony on January 1 of the succeeding year. Usually, musical concerts that feature renowned national and international artistes are used to make the carnival very attractive. People like the late Lucky Dube, Joe, Alpha Blondy, Hugh Masekela, Oliver Mtukudzi, Akon, Kirk Franklin, Donnie McClurkin, Chevelle Franklyn, Fat Joe, NeYo, Asa, D'banj had at one time or the other graced the event with their rhythms and lyrics. Calabar Carnival takes place on December 26 and 27 each year, The carnival features 5 major competing bands and many others which has continued to draw the patronage and visits of more and more tourists to the state at this point in time.

It is with regards to this incessant increase in the number of tourists visiting every year for this said event that this paper seeks to investigate if the carnival festival influences income generation of the region.

II. Tourism and Income Generation

In recent times, Africa has been said to be the fastest growing tourism region with international arrivals reaching a 7.5 percent increase over that of the previous year with 360 million tourists recorded in 1998, 25 million (6.94%) visited Africa (Odunsanwo, 2009) . The World Tourism Organization (WTO, 2004) rating Nigeria as the most visited country in West Africa, projections had it that if benefits and activities of travels and tourism is utilized effectively, it could be a force for positive growth and economic especially for a developing state such as Cross River State (Ajake, 2008).

Tourism markets have the potential to enhance lives in a sustainable framework through its incessant wealth creation, choice, innovation and competition. The travel and tourism industry contains elements that enable it become a dynamic market force for sustainability in the future. It has the capacity to increase exports, bring in capital investment, boost economies (GDP) and create employment. Travel and tourism generates jobs through companies/agencies directly involved in the business and in related supplier industries such as retail, construction, telecommunications and manufacturing sectors of the economy. World Travel and Tourism Council (WTTC), estimated that travel and tourism generated 203 million jobs over 8% of all jobs worldwide in 2000, rising to over 207 million in 2001. Within a decade, this is estimated to increase to over 260 million jobs or 9% of all employment. The jobs employ a significant proportion of women, minorities and young people and are predominantly in small and medium scale enterprises (SMES) (WTTC, 2011). The Cross River State Government recognizes that tourism is potentially one of Nigeria's fastest growing industries and can therefore serve as a key means to promoting social and economic development for the benefit of the people of the state, that the then state Governor on the 15th of December 2003 gave his account to the law establishing the Cross River State tourism Bureau (Law No.1 of 2004) to "promote sustainable tourism development in the state and to establish the Bureau as the regulator to the tourism sector in the state.

The major underlying assumption of ecotourism is that visitors can provide the necessary economic incentives to achieve local conservation and development. In theory, ecotourism generates revenue that can be used to protect and conserve biodiversity and the natural resources that draw visitors to a particular site. It is also regarded as a mode of eco-development, which represents practical and effective means of attaining social and economic improvement for all countries (Ceballos- lascurain, 1996).

Community peoples participation (which can mean a level of control, ownership or influence) in a tourism initiative appears to be closely linked to the derivation of livelihood and other benefits from the initiative to the same people (Tosun, 2005). According to Jafari (1996), "Tourism is sustainable when its development and operation include participation of local population, protection of the total environment, fair economic return for the industry and its host community, as well as a mutual respect and gratification to all involved parties".

A definition of ecotourism must account for the local population, and should minimize negative impacts on the host community, otherwise the local population may come to dislike the presence of tourism and this could undermine its long term prospects. Tourism is likely to have the greatest socio- cultural impacts on small, isolated communities (Pearce, 1994), which may themselves be one of the tourist attractions. As a result, any cultural changes in the community's way of life may reduce the overall marketability of tourism products and therefore provide future prospects. At the same time, ecotourism should produce direct economic benefit for the local community if it is to elicit their continued support, benefits that compliment rather than overwhelm traditional practices and sources of income (Wallace & Pierce 1996). However, such economic benefits and material wealth obtained by the local community may themselves lead to cultural changes in their way of life.

Wall (1997) notes that "ecotourism is an agent of change" and the wide spread misuse of the term "sustainable development", asserting that it should be considered as "tourism which can maintain its viability in

an area for an indefinite period of time". Ecotourism can be viewed as part of a longer term strategy of sustainable development in which tourism is later phased out (Prosser, 1994). It is widely agreed that the host population receives economic benefits from ecotourism without which they will have little reason to view the intrusion of tourists positively and so have little incentive to protect the environment upon which tourism depends (Mowforth & Munt, 2009).

Great importance is attached to the need for local participation in ecotourism. Ecotourism is a type of tourism that maximizes the early and long term participation of local people in decision-making process that determines the kind and amount of tourism that will occur (Wallace & Pierce, 1996). The degree of control the local population has over tourism in their locality is generally perceived as being a significant element of sustainability (Mowforth & Munt, 2009). Communities located near major attraction sites, such as; national parks, reserves, archaeological and historic sites should have the opportunity to participate in tourism activities. These communities can provide hotels (accommodation), restaurants, shops, transportation and tour services; they can also be employed in management and operational activities (Okech, 2008).

Huge financial benefits obviously play an important part in ensuring smooth partnership between government, resort managers and local people and considering the fact that community people have a final say on how much and the extent tourism develops in their areas. This partnership should be based on a commitment to hire community people as managers or workers in protected areas and this should rest on improving the quality of lives through providing health care services, education and economic advancement and on empowering communities to manage their resources effectively.

Hinch and Butler (2007) in their study on indigenous peoples' perception towards tourism development made strong recommendations for indigenous tourism above ecotourism. He defines indigenous tourism as any form of tourism that involves adequate participation by indigenous people in the tourism industry in either direct or indirect way (Hinch & Butler, 2007). Involving the community is a critically important and complex subject for successful community based ecotourism. An important principle is to seek to work with existing social and community structures, though these can create challenges as well as opportunities. The principle can also help to identify potential leaders and also assist in the achievement of broad and equitable benefit throughout the community (Denman, 2001).

Community people need to be empowered by increasing their understanding and where possible strengthen their knowledge of their legal rights and responsibilities over resources in their territories. It is also important to remember and note that ecotourism is a business, and as such, community-led initiatives in private enterprise and investment should be encouraged within a structure that enables community people to benefit and have decision-making power over all levels of tourism activities in their area.

Studies have examined the involvement and participation of Indigenous people in the tourism development process like in (Tosun, 2000; Tosun, 2006; Li, 2005; Li, 2004; Timothy, 1999). The process of tourism development as pointed out in the works of Doxey (1976); Butler (1976); Butler (1980); Keller (1984) as cited in Simmons (1994) and Tosun (2000), appears to suggest that there is a high degree of dependence on residents for their acceptance of the industry before it starts in a particular destination. This is to say, initial adequate involvement of local people is fundamental to enable the initial stage of tourism development (Simmons, 1994; Tosun, 2000), which Butler (1980) called the exploration stage.

Implicitly, the above argument about the relationship between tourism development and indigenes participation indicates that community involvement is, indeed, crucial in order to avoid more likely uncertainties and misunderstandings about tourism development in the area (Simmons, 1994). While local peoples participation in the tourism development process is highly desirable as an element of development, it is important to note that active involvement and participation of the local people in tourism especially at the exploration stage is crucial because at this initial stage of tourism development there is normally little or no tourism infrastructure in the area and therefore local people, after accepting the idea of introduction of tourism in their area, usually start, own and operate small scale guest-houses, low-class hotels or souvenir shops, and supply the workforce for the industry especially in many developing countries (Tosun, 2000). More importantly, providing local people with the opportunities to own and operate tourism facilities is thought to increase their tolerance to tourist activities in the area and eventually creates a sense of ownership, a feeling of responsibility and practical involvement in tourism (Simpson, 2008).

Andres Barona points to the frequent justification for ecotourism as a means to benefit community people without detrimental social or environmental consequences and increase income for tribal communities while also lowering pressure on the natural resources. Also cited by Jorge Nahual of the coordination of the Mapuche organizations, tourism can increase community and personal income and bring empowerment and self-confidence to traditionally subjugated people. The experience in Latin America has led to greater respect for the local people on the part of national and local authorities and their active

incorporation in development planning for tourism as respected players (Timothy, 2000).

The literature seems to acknowledge the fact that indigenous peoples' participation is vital in the tourism development process. However, Tosun (2000) while exploring limits to local people's participation in the tourism development process in developing countries, further observes that "opportunities for local people to participate may vary over time with the type and scale of tourism developed, thresholds of entry, and the market served". His study views the relationship between local community participation and tourism development process in the context of Butler's tourist area cycle of evolution model. He also notes that, such variations are due to the reality that as the destination becomes more popular and attractive after considerable development (or as a result of growing commercialized tourism).

More investors, especially large capital owners, are attracted to the destination making competition stiffer than before. In this regard, local people are likely to lose control over tourism development since they often have limited financial resources (Zhao & Ritchie, 2007) and therefore it gradually becomes more difficult for them to open large scale businesses (Tosun, 2000). To avoid this situation, Tosun (2000) suggests that there is a deliberate need to empower local people at the initial stage of tourism development to enable them to keep control over tourism development in their area. One way to achieve this is through removing barriers that hinder local communities' effective participation in markets (Zhao & Ritchie, 2007).

Guan (2008) in the study on "Tourism, cultural survival and host ethnic participation", sought to evaluate the impact of tourism on host cultures, he discovered that development of tourism on a large scale should include beneficial cross-cultural exchange and result in inter-ethnic understanding and appreciation. He also noted that in tourist's destinations there is bound to be conflict in value between the hosts living in closed societies with traditional lifestyles and the quests from modernized regions with foreign behaviours and new ideas. These conflicts lead to host cultural drift and tourist misunderstanding. The ultimate answer to this conflict is host participation, which means making the local people take part in tourist organization, administration, guiding and services; and decide the amount and quality of cultural content as well as the communication methods in tourist activities.

He also noted that tourism without host participation can be a major set-back to the host ethnic culture while noting that one major negative impact of tourism on host culture is that members of the host communities especially the youths susceptible to the apparent material superiority of the outsiders, may copy the latter's behaviours and consumption patterns, feeling ashamed of their own social customs and life styles, and consequently accepting alien values and attitudes without choice. In conclusion, he noticed that host participation in tourism plays a decisive role in meeting tourist expectations, which attracts visitors to particular destinations with special cultural characteristics, and helps the visitors' understanding of the host culture; as a result, successful tourism with local participation could have a particular ethnic flavour in keeping with traditional host cultural values and customs. To satisfy the tourists' cultural desire, some cultural forms which may have been forgotten can be revived, there-by rejuvenating the cultural heritage of the native people. The result of this study shows that it is only when local people have a good knowledge of their culture that they can possess self-confidence and self-respect and successfully helps visitors to understand and accept the meaning of their culture.

III. History of Carnival Calabar

Just like the Rio de Janeiro carnival, Brazils annual carnival festival attracts visitors from all over they would to Rio de Janeiro. The famous celebration, held before the start of lent, include dance (notably samba competitions), parade, song and music the Calabar carnival now known as carnival Calabar, is an annual state event that look forward to take place, each year on the 26th of December as a high point of the services of activities organized by the state government to celebrate both the end of the year and Christmas season. It has always been a showcase of talents, the performing arts and culture and on exciting rallying point not only for residents but also for indigence living away from home. Participation has consistently grown from a modest few thousand to the hundreds of thousands from within and outside the state. Participants and dancers are organized into bands that are required to display their skills, talents, costumes, masquerades and dances routines during the parade that promenades along a 12km route through the city of Calabar. The five registered bands are:

i. The bayside band; which goes with the blue colour.
ii. The freedom band; which goes with yellow
iii. Passion four; with green
iv. Master blaster in orange
v. Seagulls in Red.

The carnival Calabar of 2006 also comprised of a cultural carnival which is a unique feature and a further enrichment of the festival. This is the introduction of the cultural carnival group into the carnival band. The Governor's vision was to ensure that cultural values and contents form a major component of the experience. Thus a band of cultural dance troupes' drama from the 18 local government of the Cross River State, cultural group from other states of the federation as well as non-indigenous communities living in Cross River State

participated for a total experience. In all these, the cultural content of the carnival has been heightened to play up trado-originality and above all the cultural African content (Cross River state Tourism Bureau, 2010).

IV. Methodology

Data collected for this study was based on the study objective, with information on people's involvement in tourism related and non-tourism related activities during the Cross River state Christmas festival celebration which span from 30th November through 1st of January the following year (2011) in the study area.

Primary and secondary sources of data collection were used to obtain data for this research. The primary sources involved the use of questionnaire, interviews and the researcher's direct field observations. The secondary sources involved information from textbooks, journals, Cross River State Tourism Bureau.

The population of the study is made up of the house-hold heads in the study area. Information was also gathered from women and youths who were involved in tourism and non-tourism related activities. They are mainly residents who are bread-winners of their families and are involved in economic activities within the study area which comprises of parts of Calabar south and Calabar municipality which makes up what is known as Calabar metropolis.

All house-hold heads in the area were purposely adopted for this study questionnaire survey process because this category of people makes up the population involved in economic activities in the area, while the choice to use all the house-hold heads in the area was based on the consideration of the limitation of the number of house-holds present in the area. This is sometimes referred to as judge mental sampling because the selection of units to be included in the sample is on the basis of the judgment of the researcher because most of the information required was elicited through questionnaire survey and interviews with key informants. The sample of this study is made up of two thousand and five hundred (250) respondents randomly selected from ten streets in Calabar metropolis (see table 1).

Table 1 : Study area and sample size.

STREET	SAMPLE	PERCENTAGE
MARIAN	280	11
BIG QUO	320	13
AKIM	360	14
GOLDIE	220	9
MOUNT. ZION	260	10
IBB WAY	160	6
EKPO ABASI	240	10
ETTA AGBOR	280	11
MEKENGE	180	7
HEWWET	200	8
TOTAL	2500	100

Source : Researchers field survey, (2011).

The method of data collection was through questionnaire administration, interviews and participatory research method (PRM). The people were given the questionnaire to respond to and the researcher collected the questionnaire as soon as the responses were completed to avoid indoctrination by other persons. The interviews were organised and their responses were recorded and used as a veritable tool to provide answers to the questions on their contribution and benefits from tourism related and non-tourism related activities during the period under investigation. During the field work, ten field assistants (mainly local people who are secondary school leavers) were trained and employed for the questionnaire survey session (one for each street).

Data collected were analysed and presented using descriptive and quantitative techniques. The descriptive technique includes the use of tables, graphs, charts, mean, standard deviation and simple percentages.

V. Results and Discussions

The study investigated the influence of tourism activities during the Christmas festival celebration on economy of residents of the study area. Table 2 shows details of the occupational distribution of the respondents.

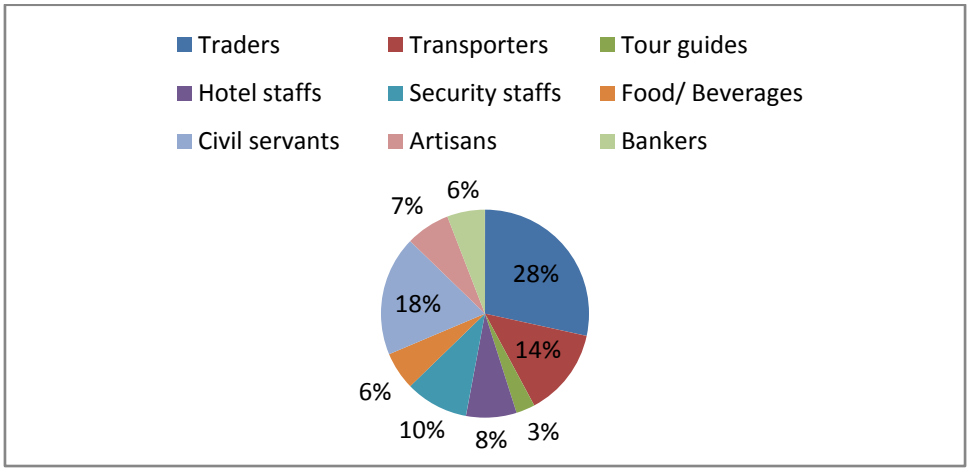
Table 2 : Occupational distribution of respondents in the area (december 2010).

	ECONOMIC ACTIVITIES									
Streets	Traders	Transporters	Tour guides	Hotel staffs	Security staffs	Food/ Beverages	Civil servants	Artisans	Bankers	Total
Marian	82	32	6	28	35	15	52	14	16	280
(*)	(29)	(11)	(2)	(10)	(13)	(5)	(19)	(5)	(6)	(100)
Big-Quo	108	49	8	12	21	11	71	28	12	320
	(34)	(15)	(3)	(4)	(7)	(3)	(22)	(9)	(4)	(100)
Akim	112	51	12	20	42	15	73	21	14	360
	(31)	(14)	(3)	(6)	(12)	(4)	(20)	(6)	(4)	(100)
Goldie	73	34	5	18	22	9	32	16	11	220
	(33)	(16)	(2)	(8)	(10)	(4)	(15)	(7)	(5)	(100)
Mount.	71	34	6	29	29	12	48	12	19	260
Zion	(27)	(13)	(2)	(11)	(11)	(5)	(19)	(5)	(7)	(100)
IBB-way	34	21	7	13	17	10	38	11	9	160
	(21)	(13)	(4)	(8)	(10)	(6)	(24)	(7)	(6)	(100)
Ekpo	63	39	5	17	26	15	42	19	14	240
Abasi	(26)	(16)	(2)	(7)	(11)	(6)	(18)	(8)	(6)	(100)
Etta-	71	36	8	22	23	27	49	26	18	280
Agbor	(25)	(13)	(3)	(8)	(8)	(10)	(18)	(9)	(6)	(100)
Mekenge	36	21	6	23	14	21	29	14	16	180
	(20)	(12)	(3)	(13)	(8)	(12)	(16)	(8)	(9)	(100)
Hewwet	62	28	3	18	12	16	31	18	12	200
	(31)	(14)	(2)	(9)	(6)	(8)	(16)	(9)	(6)	(100)
Total	712	345	66	200	241	151	465	179	141	2500
	(29)	(14)	(3)	(8)	(10)	(6)	(19)	(7)	(6)	(100)

(*): Percentage representation.

Source : Researcher's field work, 2011.

Figure 1 : Proportional distribution of occupation status of respondents (December, 2010)



Source : Researcher's field work, 2011.

The findings in table 2 shows that most residents (712 persons representing 29%) of this study area are involved in business (buying and selling) activities also taking into consideration that it was also observed that some of this persons are civil servants and since the government normally declares public holiday for civil servants in the state for the whole of December, some of them get involved in trading activities which is normally encouraged with the opening of the Christmas village always located at the state cultural centre. It was also observed that apart from traders, 465 persons out of the total population of study

which represents 19% are civil servants who sit at home and enjoy the Christmas holiday declared by the state government while the least proportion of 66 persons representing 3% of the total sample are involved in tour-guiding showing that there is a very minimal number of packaged tours in the state during that time. Figure 1, clearly shows the percentage distribution of occupational pattern in the study area. This shows that the people are mainly traders (29%), sit-home civil servants (19%), transporters (14%), security staffs (10%), hotel staffs (8%), Artisans (7%) while those involved in the banking and food/ beverages industry are (6%) respectively. It is an established fact that tourism has a trickle-down effect on it host in terms of the benefits accruing from the presence of tourists visiting such destination (Hinch and Butler, 2007; Tosun, 2006; Okech, 2004). Since the main objective of this study is to determine the influence of not just tourism but the Christmas festival on the economy of the residents of the study area, the researcher for the purpose of this study classified economic activities in the area into tourism related and other activities, with tourism activities having to comprise those economic activities that made the people have direct and at the spot benefit from their interaction with the tourists such as; trading, tour-guiding, transportation, hotel jobs, artisans and food & beverages dealers, while others (non-tourism related activities as those economic activities that had to do with indirect contacts and benefits through salaries which are fixed irrespective of the period and this included activities such as; those involved in civil service, banking and security jobs. In a bid to fully understand and determine the financial influence of tourism activities through this various activities on the people, table 3, therefore shows the average income of the people.

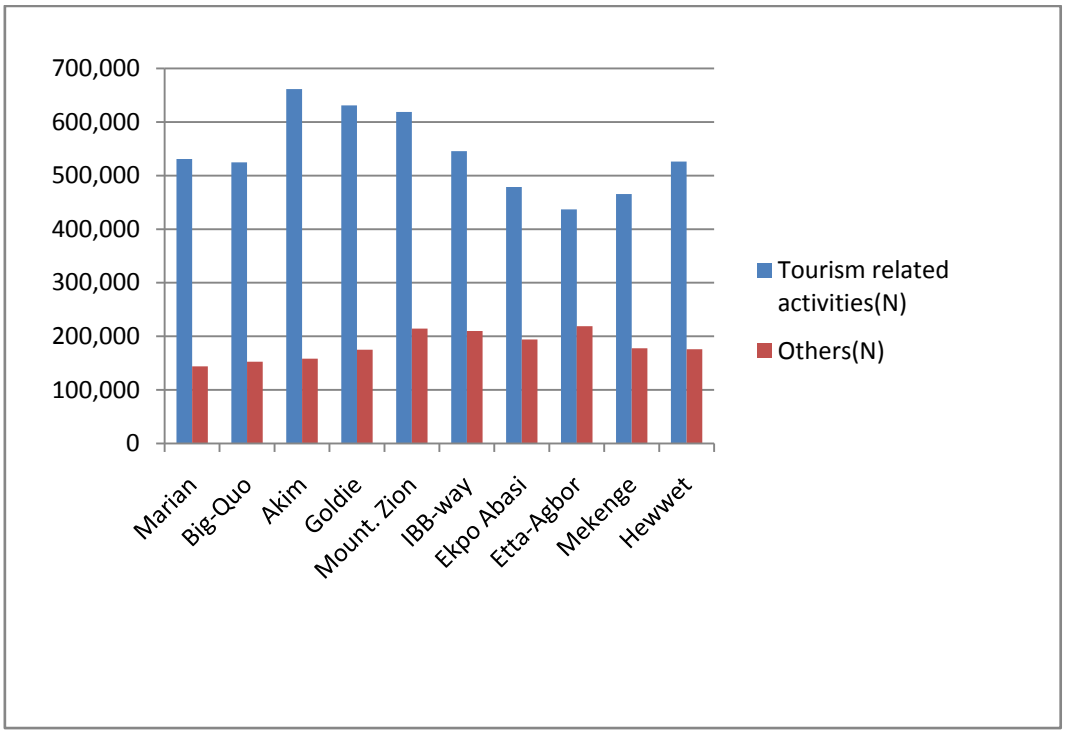
Table 3 : Average income of respondents by street of resident (December, 2010).

	TOURISM RELATED ACTIVITIES						OTHERS			
Streets	Traders (₦)	Transporters (₦)	Tour guides (₦)	Hotel staffs (₦)	Artisans (₦)	Food/ Beverages (₦)	Civil servants (₦)	Security staffs (₦)	Bankers (₦)	Total (₦)
Marian	121,100	132,000	67,000	55,000	87,980	67,900	41,000	35,700	67,200	674,880
Big-Quo	98,050	143,670	72,900	62,000	92,800	55,200	53,200	47,890	51,500	677,210
Akim	116,200	139,080	98,650	48,500	132,920	126,000	48,320	63,200	46,900	819,770
Goldie	76,800	102,110	121,020	54,400	155,600	121,050	58,890	41,840	74,270	805,980
Mount. Zion	87,130	98,700	100,200	65,800	162,800	104,020	72,200	35,680	106,600	833,130
IBB-way	92,530	111,230	132,100	70,500	87,900	51,200	58,240	72,700	78,900	755,300
Ekpo Abasi	94,250	98,200	81,000	42,000	121,100	42,120	62,710	68,920	62,450	672,750
Etta-Agbor	87,110	119,900	78,900	42,000	76,020	32,900	68,860	98,890	51,250	655,830
Mekenge	97,450	87,960	94,800	52,560	75,960	56,910	75,320	53,600	48,800	643,360
Hewwet	145,000	76,790	102,120	46,700	89,900	65,600	51,140	47,860	76,800	701,910
Total	1,015,620	1,109,640	948,690	539,460	1,082,980	722,900	589,880	566,280	664,670	7,240,120
Total	5,419,290						1,820,830			7,240,120

Source : Researcher's field work, 2011.

The findings on the economic influence of tourism during the Christmas festival celebration in the study area shows that during this time, most people in this area get themselves involved in one tourism related economic activity or the other and it is discovered that they exists great increase in income generation during this time by individuals involved in such businesses all year round with information on table 3, showing that tourism related activities contributed more income to individual resident in the area than non-tourism related activities in the area. Figure 2, also shows a clear picture of the total income generated pattern of the people in the study area.

Figure 2 : Total income generated by respondents in the study area (December, 2010).



Source : Researcher's field work, 2011.

It discovered that in all the streets under investigation, people that were involved in tourism related activities were more than those engaged in other activities and this has a corresponding influence on the average income of the people of the area. This analysis indicates that tourism during the annual Christmas festival celebrations has a positive influence on the economic life of the residents of Calabar metropolis who are host to the Christmas festival event in the state.

VI. Summary of Findings

The result from the questionnaire survey indicated that the Christmas festival has positively influenced the economic activities within the period under investigation. The people have continued to appreciate that the increase in the number of tourists visiting the area at this time means a direct increase in the benefits from the tourism activity in the area. It was therefore acknowledged that the people's level of participation in touristic activities during this time has continued to increase year after year and their level of hospitality have also improved with their appreciation of the tourism event owing to the benefits accruing with it.

From the interview sessions held during the field work exercise, the following summations were made;

i. Inadequate funding was seen as one of the biggest obstacle of development of the tourism industry in the area. External funding for tourism is crucial in local communities with local government and private sources such as banks also often have limited resources to invest in tourism. The need for community infrastructure, provision of money/funds for creation of tourist attractions and tourism promotion were observed to be very important
ii. The respondents also emphasized on lack of good tourism planning and incorporation of local people in tourism planning as an important challenge of the tourism industry.
iii. The respondents also emphasized lack of coordination between community residents and government in terms of tourism development in the area as one of the challenge in the area.
iv. On the overall, lack of good planning, tourism knowledge funding, advertisements, marketing and sensitization were among major reasons tourism challenges affect the economy of individual and the state as a whole.
v. The respondents also complained on the issue of seasonality of tourism events in the state, stating that this have served as an impediment to the people participating immensely in tourism activities as a full time occupation.

VII. Conclusion

In conclusion, since local communities often support tourism events which they believed would contribute to their livelihood. It is expected that such projects should in-corporate them especially in planning

and implementation. The study showed that most of the respondents were willingly ready to support more tourism events in the area. It was discovered that the increase in tourists' visitation especially for the Christmas festival event benefited most people through provision of employment and business opportunities it offered. All these have contributed to the economy of the residents of Calabar Metropolis.

Based on the above, the study recommended that tourism development should integrate all the stakeholders' especially local people resident in such tourism destination whose presence and activities also determine the level of hospitality of such a region. This is intended to increase more tourists' visits and economic benefits associated with tourism and tourism initiatives need to be managed carefully if they are to yield the desired benefits without undermining the local economy and the environment, social traditions and cultural resources.

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Global Journal of human social science
Geography & Environmental GeoSciences
Volume 12 Issue 10 Version 1.0 Year 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Observed Urban Heat Island Characteristics in Enugu Urban During the Dry Season

By Enete, Ifeanyi. C & Alabi, M.O
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Abstract - Aim : The dry season microclimate variation at several sites in Enugu was assessed with the sole aim of determining the UHI characteristics during dry season periods.
Study Design: The study design employed in the study was survey design. Place and Duration of the study: Enugu urban was the study area and the study occurred between the months of Feb – Mar 2006 and 2007.
Methodology : During the study, transect and fixed point measurements were taken hourly and averaged over a month. All temperature difference was calculated as site temperature minus reference temperature. Thus, a negative (-) temperature difference indicates that the site was cooler than the reference station. The reference station is the rural environment.
Results : Dry season months showed strong variability in temperature. The downtown site was the warmest (2.0 0c) during the day. The heavily vegetated urban residential site (LVR) and suburban site (LOR) with fully developed vegetation canopy were the coolest (-3.8 and -2.68).

Keywords : *Urban heat island, rural, intraurban.*

GJHSS-C Classification : *FOR Code: 120504, 120507*

Strictly as per the compliance and regulations of:

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Conclusion : The diurnal march of the urban heat island of Enugu is revealed to have a close link to the diurnal cycle of human activities as well as the meteorology characterizing daytime and nighttime conditions. The study recommended the use of extensive green cover, light- colored materials for roofing and pavements and compact designed cities.

Keywords : Urban heat island, temperature, urban, rural, intraurban.

I. Introduction

Urbanization is a defining phenomenon of this century. Developing countries are at the focus of this transformation, as highlighted in the World Bank's 2009 urban strategy. It is often repeated that more than half of the world's population is now urban. Most of the population of both industrialized countries is urban (UN, 2010). Many developing countries in other regions of the world are following the same path. This transformation represents a challenge.

Urban heat island is one of those challenges. The city of Enugu has witnessed remarkable growth in its urbanization in recent years and its population during the past few decades has more than tripled. The higher temperature in urban areas than the surrounding rural areas is described as the urban heat island effect (Oke and Maxwell, 1975). UHI is also referred to as the increase of air temperature in the near-surface layer of the atmosphere within cities relative to their surrounding countryside (Voogt, 2002).

Based on numerical simulation, Taha (1997) found that the UHI is a result of the changes in surface albedo and vegetation cover owing to urbanization. As controlled by different assemblages of energy exchange processes, the characteristics of UHI can vary from place to place and from time to time (Arnfield, 2003). Modification of air temperature by urban areas at roof level has been reported extensively in mid-latitude cities (Chandler, 1962; Oke, 1982), but it has however been noted that transferability of results from knowledge regarding the mid-latitude studies is still limited (Oke et al, 1990, 1991). Consequently, it becomes necessary to undertake a first hand analysis of urban heat island characteristics of our cities. Again, few studies have attempted to describe the seasonal behavior of the heat island during an annual cycle. Filling these identified gaps forms the objective of this study. As such, the study intends to analyze the characteristics of UHI in Enugu urban during dry season period. This idea is born of the fact that the essence of studies of the UHI is not only predicated on the necessity to gain knowledge of its numerous secondary effects when excessive, but also its practical needs in town planning and creation of optimum bioclimatic conditions (Rosefeld, 1995, Balogun, et al, 2010).

Although, it is not uncommon to refer to UHI as a noctural phenomenon (Gdaelman et al, 2003; Bonacquisti, 2006) because of the lower UHI intensity in daytime (Alonso et al, 2003), there were studies focusing on daytime UHI (Giridharan et al, 2004; Hidalgo et al, 2009).

II. Study Area

Enugu State is one of the states in southeastern Nigeria. Its capital is Enugu. The state was created in 1991 from the old Anambra State. Enugu state is located within latitude 6^0.00'N and 7^0.00'N and longitude 7^0.00'E and 7^0.45'E. The state is called the Coal City State because of the discovery of coal in a commercial quantity in Enugu Urban in 1909. Enugu was then the capital of East Central State of Nigeria. Some of the

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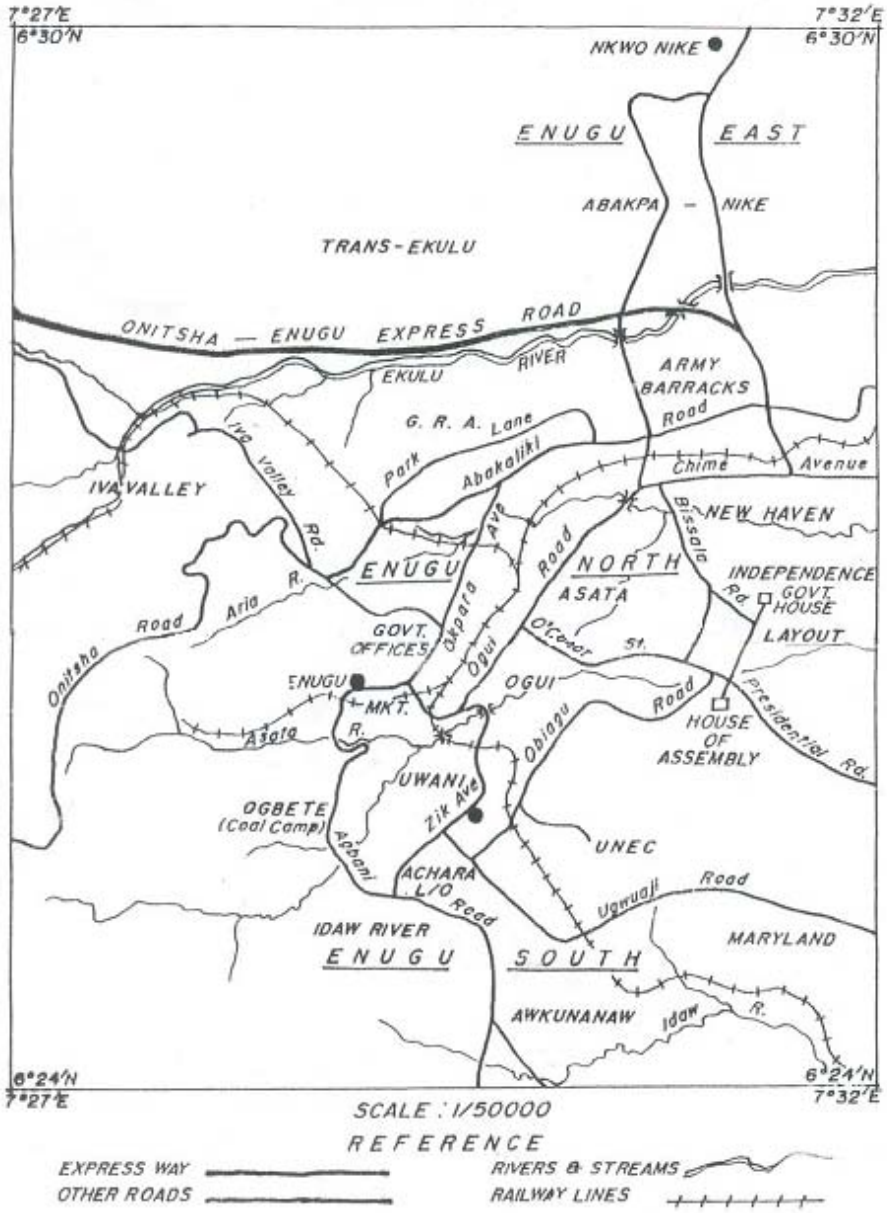
important towns in the State are Enugu Urban, Oji, Udi and Nsukka Urban.

The state shares borders with Abia State and Imo State to the south, Ebonyi State to the east, Benue State to the northeast, Kogi State to the northwest and Anambra State to the west. Enugu State is made up of 17 local government areas. These include Igbo Eze North, Igbo Eze South, Udenu, Nssuka, Isi Uzo, Uzo Uwani, Igbo Etiti, Udi, Enugu East, Enugu North, Enugu South, Ezeagu, Nkanu West, Nkanu East, Oji-River, Awgu and Aninri local government areas.

Figure 1.2 : Map of Enugu Urban.



Source : Ministry of Lands and Survey Enugu.

Enugu Urban which is the study area is made up of Enugu East, Enugu North, and Enugu South (figure 1.2). Enugu Urban is also located within latitude 6.24^0N and 6.30^0N and longitude 7.27^0E and 7.32^0E. It is an hour's drive from Onitsha, one of the biggest commercial cities in Africa and 2 hours drive from Aba, another very large commercial city, both of which are trading centers in Nigeria. Enugu Urban shares boundary with Igbo Etiti and Isi-Uzo Local Governments in the north, Udi local Governments in the west, Nkanu West Local Government in the south and part of Nkanu East Local Government Area in the east. There are 18 prominent residential areas in the Urban. These are Abakpa, Trans-Ekulu, Nike, GRA, Ogui, Asata, New Heaven, Obiagu, Ogbete, Iva valley, Independence Layout, Achara Layout, Ugwuaji, Maryland, Awkanaw, Uwani, Agbani, and Coal Camp. Enugu Urban is the most developed urban area in Enugu state.

The study area falls within the humid tropical rain forest belt of Southeastern Nigeria. It has two seasons, the raining season and the dry season. The rainy season which is characterized by heavy thunderstorms lasts from April to October with the South Westerly moisture accompanied by air mass moving northwards into the city. The turbulent runoff result in leaching, sheet erosion and eventually gullies (Akabuike, 1990). The mean temperature varies from about 20.30^oC to about 32.16^oC in the dry season and rainy season respectively, (Akabuike, 1990). During the dry season the humidity is lower than in the rainy season. Temperature is most often high during the day and low during the night. This results in high evaporation rate during the day. Harmatten which occurs between the months of November and February is always accompanied by poor visibility mostly at night and early in the morning.

The rivers and streams which flow from the Udi hills dissect the study area into several sections. Thus there are rivers such as Ekulu, Idaw, Asata and Nyaba Rivers which separates Enugu South from Nkanu East. These rivers have many tributaries; the study area is generally marked by low land, slopping towards Enugu South Local Government Area and the Southern part of Enugu East Local Government Area. The elevations are between 182.88 meters and 219.45 meters above the sea level. Below is a table showing the population of each local government area that make up the study area. This is based on the figure of National population Census of 2006.

Table 1 : Enugu Urban Local Government Areas Population.

LOCAL GOVERNMENT AREA	MALES	FEMALES	TOTAL
Enugu East	131, 214	145, 905	277, 119
Enugu North	118, 895	123, 245	242, 050
Enugu South	93, 758	104, 274	198, 032
Total	343, 867	373, 424	717, 201

Source : National Population Commission (2006).

Enugu Urban is the educational, commercial, industrial and administrative base of Enugu State. The biggest market within the Urban is located within Enugu North Local Government Area; Ogbete Main Market. There are some other prominent markets such as Kenyeta market in Enugu South, Abakpa Market in Enugu East including New Market situated also in Enugu North. As the administrative center of the State, a reasonable percentage of the inhabitants are civil servants. They work in various Government establishments and offices.

III. Methodology

Data collection spanned over two seasons (2006 to 2007). The essence was to capture the peak periods, frequency, magnitude and seasonality of urban heat variations in places. The months of Feb- Mar were selected because of high temperature during this period. Temperature data were collected during the day and night. The following land use/land cover sites were selected for data collection.

a. High-density, high-rise, non-residential areas with no greenery (DTL).
b. High density, high-rise, residential areas with low greenery (HDR).
c. Medium density, mixed residential (some residential, some commercial/ institutional area with a greenery extent between DTL and HDR.
d. Areas with similar land-use, building density and greenery one having more fully developed vegetation canopy than the other (LVR and LOR)

During the study period, transect and fixed point measurements were taken hourly and averaged over a month. All temperature differences were calculated as site temperatures reference temperature, thus a negative (-) temperature deference indicates that the site was cooler than the reference station; and positive (+) indicated the site was warmer than the reference station.

a) Atmospheric Stability Estimation

The magnitude of microclimate variations in urban areas depended on the atmospheric conditions at the macro-level. Since simultaneous measurement at all the30 sites were not made, it was necessary to classify the measurement period according to atmospheric conditions so that data from different sites could be compared.

Wind speeds and cloud-cover amounts are closely related to the timing and the magnitude of urban heat island (Landsberg, 1981). Among other things, these two parameters also influence atmospheric stability. Fine sunny days with little wind usually lead to unstable surface atmospheric conditions. Stable atmospheric conditions are generally associated with clear, calm nights while cloudy and windy days tend to produce neutral atmospheric conditions (Oke, 1987). Therefore, data on atmospheric stability near ground can be used to estimate the combined effects of wind speed and cloud cover on the development, timing and the magnitude of urban heat island.

Although many methods of estimating atmospheric stability near the ground exist, Pasquil-Turner Index modified by Karlson (1986) is the most relevant for the present study since it utilizes solar radiation and wind speed data only. Solar radiation being heavily influenced by cloud cover, the modified Pasquil-Turner (MPT) index provides the best estimate of the combined influence of cloud cover and wind on intra- urban micro- climate differences. Karlson's MPT is given by the following equation:

$$MPT = Q^*/ (U)^2$$

Where Q* = hourly average net radiation at 1.5m above ground (Wm^{-2})

U= hourly average wind at 7.4m above ground (Ms^{-1})

The following MPT values were selected as cut-off points for the three atmospheric stability conditions examined in the present study:

MPT >30 Unstable

-10 <MPT < 30 Neutral / Near Neutral

MPT < -10 Stable

IV. Results

a) Dry season (Day-time)

Dry season months showed strong variability in temperature. The months of February and March were used as a good example of dry season months. No rain was recorded during the 119 days study period in dry season. Temperature variability was high especially between day and night. The dry season day-time temperature deviation during the day is shown in table 1.

Table 1 : Dry season temperature variation during the day.

Site	Location Name	Temperature
DTL	Ogui Road	+2.0
LOR	Independence L/O	-2.35
LVR	GRA	-3.8
NW2	UNEC	-2.2
HDR	Achara L/O	-0.45

The downtown site was the warmest (2.0°c). The heavily vegetated urban residential sites (LVR) and suburban sites (LOR) with fully developed vegetation canopy were the coolest (-3.8 and -2.68) respectively. The hour-to-hour variation in air temperature during day time was significant. Also, it was observed that the magnitude of the temperature differences decrease as background climate become hotter. During the day very few cool islands were observed. The thick vegetated areas of GRA (Bent Lane) recorded few days of urban cool islands. The extensive tree canopy of GRA and the urban plantation along WAEC road (adjacent Okpara Square) produced cooling during the day. The peak temperature value was recorded between 1300hrs and 1500hrs.

b) Dry season (Nighttime)

Unlike the daytime (dry season), nighttime temperature showed a clear downtown – centered heat island. Table 2 clearly depicts this variation.

Table 2 : Nighttime temperature variation in Dry Season.

Site	Location Name	Temperature
DTL	Ogui Road	+2.3
LOR	Independence L/O	0.4
LVR	GRA	1.1
NW2	UNEC	0.8
HDR	Achara L/O	2.1

All residential sites were warmer than the reference site (by 0.4 to 2.1°c) while the downtown location was up to 2.3°c warmer. This leads to a maximum nighttime air temperature heat island of about 2.3°c during the study period. The highest nighttime intra-urban air temperature difference was observed during the early evening period (15hrs to 2300hrs).

V. Discussion

The result showed that the downtown location was warmer than other residential sites both at night and in the day. The condition was the same both in stable and unstable atmospheric conditions during the dry season. Strong urban heat island develops preferentially on calm dry season days. It also showed that urban heat island in Enugu has a close link to the diurnal cycle of human activities as well as the meteorology characterizing day and night conditions. Extensive tree

canopy produced some cooling during the day, but results in warm micro-climate at night.

VI. Recommendation

The study, based on these findings, proposed some design strategies for the mitigation of Enugu urban heat island. Most of these strategies are applicable to the downtown location. Employing these strategies will result in substantial green cover increase in the downtown locations while street level thermal comfort is enhanced by arcades and suitable building massing (compact designs).The building massing is such that tall buildings are on the eastern side of the city blocks while green area is in the center and to the northeastern side of the city. In most of the sampled areas, street tree planting offers the greatest cooling potential per unit area, followed by light surfaces. However, light surfaces offer the greatest absolute temperature reductions, because 23.02% of Enugu urban surface area could be lightened, whereas only 9.45% of the city's surface area could be planted with new street trees.

Planting street trees has greater cooling potential than planting open-surface/plantation trees, because the temperature differential between trees and impervious surfaces is greater than that between trees and grass. Also, the cooling effect of open-space trees tends to be localized. For example, surface cooling around judiciary quarters (Okpara square) tends to be limited to 61 meters from the square's borders. Again, mitigation strategies should be chosen to reflect neighborhood conditions. For example, in most case-study areas, curbside planting is the individual strategy with the greatest cooling potential. However, in Achara Layout, Abakpa and New Heaven, with the greatest available rooftop, space, living roofs could have a greater impact. Finally, using light-colored materials for the roofing of downtown locations as well as improving the reflectivity of pavements within the urban centers and the adjoining suburbs could minimize the impact of urban heat islands in Enugu urban.

VII. Conclusion

The dry season air temperature measurements over Enugu have been analyzed and results reveal some spatial and temporal characteristics of the urban heat island in Enugu. Some of the observed characteristics include:

a. The downtown location (DTL) was warmer than other residential sites both at night and in the day. The condition was the same for both stable and unstable atmospheric conditions during dry season.
b. Observation has also shown that although urban heat island exists over the city, thermal levels vary considerably within the city with a direct relationship to land use and vegetation coverage.
c. Extensive tree canopy produced some cooling during the day, but results in warm microclimate at night. Sites LVR (e.g. GRA) exemplify this pattern.
d. Dry season months showed strong urban heat island develops preferentially on calm dry season days.
e. Urban heat island during dry season peaks between 1500hrs and 2300hrs.
f. The diurnal march of the urban heat island of Enugu urban is revealed to have a close link to the diurnal cycle of human activities as well as the meteorology characterizing daytime and night time conditions.
g. The study recommended the use of extensive green cover, light-colored materials for roofing and pavements; and compact designs.

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Global Journal of human social science
Geography & Environmental GeoSciences
Volume 12 Issue 10 Version 1.0 Year 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

An Analysis of Temporal Nature of Urban Activities in Ilorin, Nigeria

By Adedokun Olutoyin Moses (Ph.D)
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Abstract - The paper analyses Spatial nature of activities of the people in Ilorin especially the length of time spent on each activity. Data were collected from 500 residents of Ilorin, each of whom completed a time budget diary over one week. Descriptive statistics wereused to summarize the data while stepwise regression analysis was used to determine the factors responsible for the spatial fixity of respondents' activities. The result shows that the activities were fixed in time and three variables: age, income and occupation were the major determinants of the time spent on the activities. The study also shows clearly that the temporal structure of activity in Ilorin is different from what obtains in Western cities where there is flexibility in the usage of time.

GJHSS-B Classification : FOR Code: 120504, 120507

Strictly as per the compliance and regulations of:

An Analysis of Temporal Nature of Urban Activities in Ilorin, Nigeria

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Abstract - The paper analyses Spatial nature of activities of the people in Ilorin especially the length of time spent on each activity. Data were collected from 500 residents of Ilorin, each of whom completed a time budget diary over one week. Descriptive statistics wereused to summarize the data while stepwise regression analysis was used to determine the factors responsible for the spatial fixity of respondents' activities. The result shows that the activities were fixed in time and three variables: age, income and occupation were the major determinants of the time spent on the activities. The study also shows clearly that the temporal structure of activity in Ilorin is different from what obtains in Western cities where there is flexibility in the usage of time.

I. Introduction

The study of the interaction between population, activities and times is a complex one with many dimensions. These dimensions include the location, timing, duration, sequence and type of activities and or trips. These characteristics of space-time behaviour have made the simultaneous analysis of its many dimensions imperative (Kwan, 2002, 2003). Although geographers view places in a two dimensional ways: space and time or spatio-temporal, they often tend to ignore the time element. Previous researches have either focused on spatial dimensions (Main, 1982) or have completely ignored time element as if it is not important. This paper, thus, discusses the temporal nature of activities, that is, the degree of spatial fixity of each activity and its implication on urban infrastructural planning.

The approach of integrating individual spatial behaviour overtime was pioneered by Hägger trand (1969). He used a simple diagram to illustrate his concept of space-time dimensions (Figure 1) Hägger trand postulated the geographers' two-dimensional space on the surface of the earth or on the surface of a map. A line on this surface indicated movement in space but not in time. He suggested a third dimension to signify time.

Figure1 represents a very simple working day. Solid lines represent the path of all obligatory activities and dotted lines the prism or feasible regions of movement in periods for which there are no fixed activities. The worker is assumed to be effectively fixed at home until 7:30am to 8:00am where he can conveniently sleep and take breakfast. He must then take a direct route to work, where he is obliged to stay until lunchtime. During the lunch hour he has a certain amount of freedom; he must be back in the office exactly an hour. From 2pm until about 5pm he is again expected to stay at work. But after 5pm he has no need to be home until 7pm for supper. In this period, 5-7pm, he can stay on at work or he can go somewhere near or stop off on the way back for a drink or visit. The main feature implicit in this model of daily behaviour is the idea that certain activities are fixed in both space and time.

II. Methodology

a) Source of Data

The Activity Network Approach (ANA) was adopted for this study. ANA is a micro-behavioural, inductive approach that makes 'predictions about the whole from disaggregate data of the behaviour of individuals using Time Budget Diary (TBD). TBD questionnaire focuses on the socio-economic attributes of the individual, types of activities, location of activities, beginning and end time of activities, number of participants in each activity, extent to which each activity was arranged and whether an individual could have done:

- anything else at the time of this activity,
- this activity at any other time,
- this activity elsewhere, and whether,
- been anywhere else at the time of his activity is taking place.

b) Sampling Procedure

The 20 electoral wards in Ilorin formed the spatial framework for primary data collection. The use of these wards was based on the fact that it makes it easier to obtain data on population. The sample size was 500 literate individuals. This number was proportionally distributed among the 20 wards based on their 1991 population projected to 2006, using 3.5 percent annual growth rate. Number of respondents to be interviewed from each ward was randomly selected. This sample is considered adequate for the study of this

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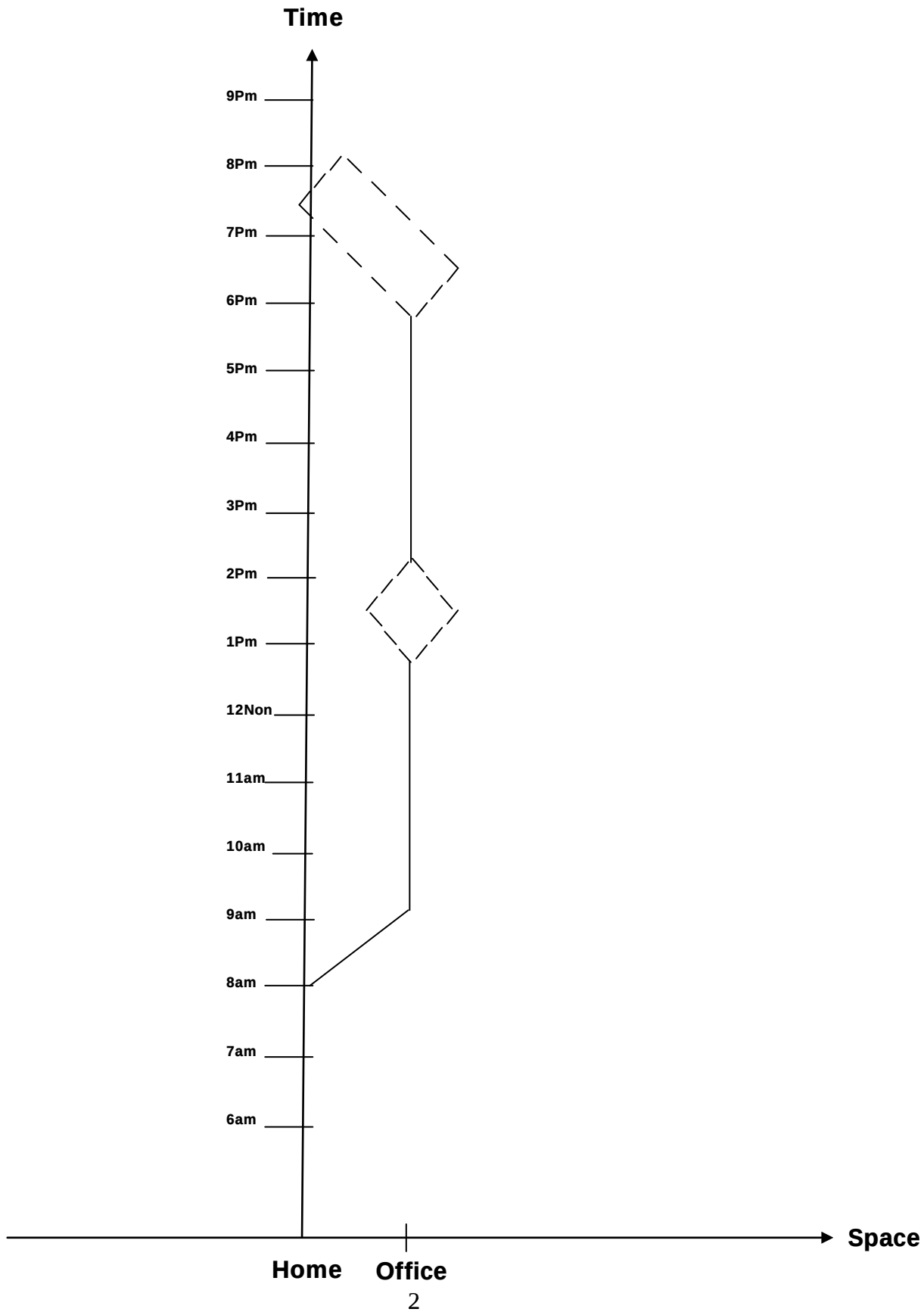
Figure 1 : Man's daily space-time dimensions.



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Source : Adapted from Haggerstrand (1969).

nature because of the complexity of completing the questionnaire, the time and cost involved in administering the questionnaire, monitoring the respondents, and more importantly, because researches involving Time Budget Diary do not normally accommodate large samples (Timmermanns, 2000; Kwan, 2005). Each respondent was issued seven copies of the TBD questionnaire, one for each day of the week. Research assistants monitored the respondents at home and work places.

c) Method of Data analysis

The following methods were use to analyse the data: (i) descriptive statistics and tables to summarise the data; (ii) Stepwise regression analysis to determine the temporal fixity of the respondents.

III. The Study Area

When the present city of Ilorin was founded is not very clear. Indeed, little is known about its pre-jihad political development. Ilorin is today the capital of Kwara State. It is located on latitude 80.30N and Longitude 40.35'E. It lies on the southern fringes of the savanna region and north of the forest zone. Ilorin is located in the Guinea savanna grassland belt of middle belt region of Nigeria. The main river in Ilorin is the Asa which flows in the south-north direction. It divides Ilorin into two parts: a western part representing the core or indigenous area and the eastern part where the Government Reservation Area (GRA) is located. (Oloru, 1998)

Ilorin has experienced a rapid growth in its population over the years. The first population census in 1911 put the population of Ilorin at 36,343 while the 1953 population census put the town's population at 40,994. The 1963 and 1991 censuses recorded the population of the town as 208,546 and 532,088 respectively. The projected population of Ilorin in 2005 when this research was carried out was 748,150 based on an assumed annual growth of 3.5 percent.

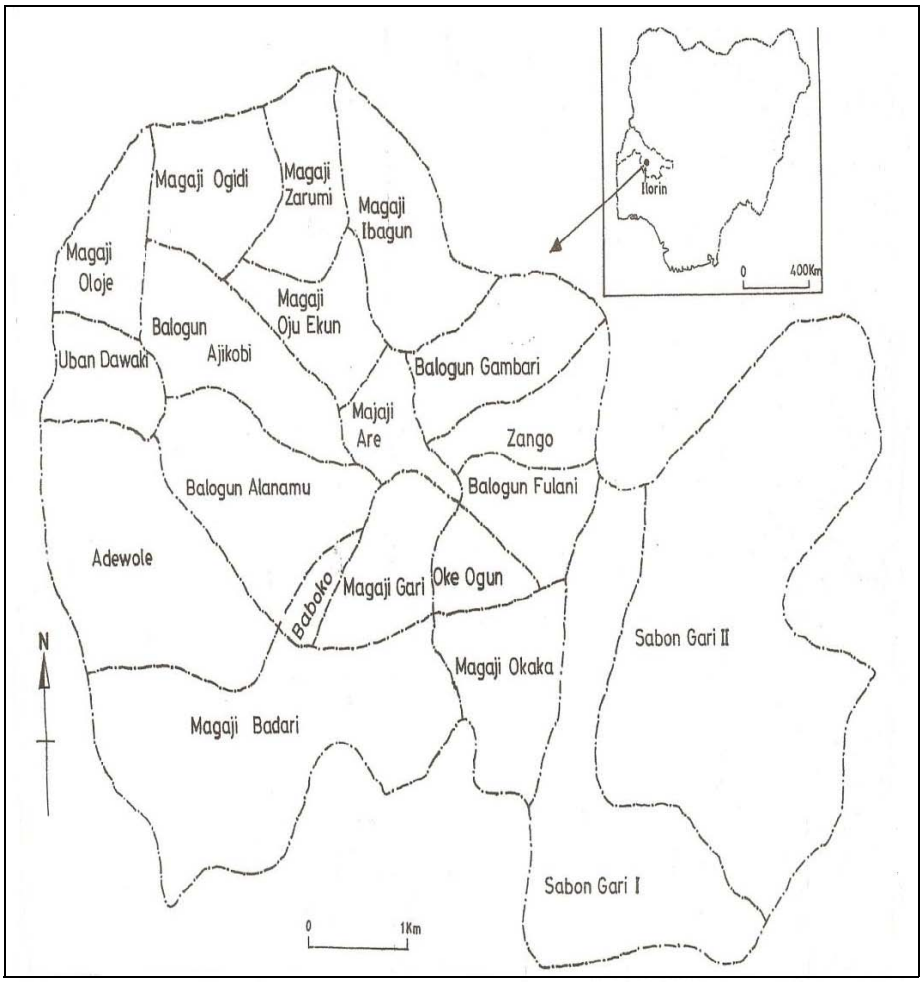


Figure 2 : Map of Ilorin, the sampled wards.

IV. Temporal Fixity of Activities

To establish the temporal nature (fixity) of activities, respondents were asked whether they could have done anything else at the time they did a particular activity. The number of respondents that answered this question was 296. The result shows that 280 (94.6%) respondents said they could not do anything else at the time

Table 1 : Temporal fixity and activity location.

Activity type	Could you have done anything else at this time?					
	Yes	%	No	%	Total	%
Home based	14	4.72	112	37.8	126	42.57
Office/work place	2	0.68	166	56.08	168	56.76
Outdoor	_	_	2	0.69	2	0.69
Total	16	7.43	280	91.9	296	100

This result, however, varies with different socio-demographic groups:

a) Gender, marital status and activity fixity

Among the males, 5.4 per cent could do something else at the time while 94.6 percent indicated that they could not do anything else at the time they were engaged in a particular activity. Among the were females none could do something else at the time they engaged in a particular activity, 47.0 percent had their activity fixed in time.

Among the married respondents 4.1percent can do something else at a time and 45.6 percent had their activities fixed in time. Among the singles, 1.4 percent could do something else and 49.0 percent had their activities fixed in time.

Table 2 : Gender/Marital status and Activity fixity.

Could you have done anything else at the time	Gender						Marital Status					
	Male	%	Female	%	Total	%	Married	%	Single		Total	%
Yes	16	5.4	_		16	5.4	12	4.1	4	1.4	16	5.4
No	141	47.6	139	47.0	280	94.6	135	45.6	145	49.0	280	94.6
Total	157	53.0	139	47.0	100	100.0	147	49.7	149	50.3	296	100.0

Source : Field work, 2005.

b) Religion, Age and Activity Fixity

Among people of different religious and age groups, temporal fixity of activity varies. Table 2 shows that s 4.1 percent Christians and 1.4 percent Muslims could have done something else at the time, while 47.3 percent each among Christians and Muslims respectively could not trade off the times they were performing their activities. Among people of different age groups, 1.5 Percent, 3.1 percent and 6.2 percent of the respondents between ages 18-30 years, 31-45 years and 46-60 years respectively could do something else at the period they were performing activities, while 51.4%, 39.0% and 3.5% among the 3 respective age groups had their activities fixed in time.

Table 3 : Religion/age and Activity Fixity.

Could you have done anything else at that time	Religion						Age Group							
	Christianity	%	Islam	%	Total	%	18-30	%	31-45	%	46-60	%	Total	%
Yes	12	4.1	4	1.4	16	5.4	4	1.5	4	1.5	8	3.1	16	6.2
No	140	47.3	140	47.3	280	94.6	101	39.0	101	39.0	9	3.5	243	93.8
Total	152	51.4	144	48.6	296	100.0	137	52.9	105	40.3	17	6.6	259	100

Source : Field work, 2005.

c) Education qualification and activity fixity

Furthermore temporal fixity of activity varies among people of different educational qualification. As shown in Table 3, activity fixity varies among respondents with different qualifications. Among respondents with primary education, NCE and other qualifications, they all had their activities fixed in time with 1.4%, 23.6% and 1.4% respondents having their activities fixed in time. Among secondary, polytechnic and university degree holders 1.4%, 0.7% and 3.4% respondents can trade off their activity times while among the same group, 32.1%, 12.5% and 29.1% had their activity fixed in time.

Table 4 : Educational qualification and activity fixity.

Could you have done anything else at the time	EDUCATION QUALIFICATION												Total	%
	Primary	%	Secondary	%	NCE	%	Poly	%	University	%	Others	%		
Yes			4	1.4			2	0.7	10	3.4			16	5.4
No	4	1.4	91	30.7	70	23.6	35	11.8	76	25.7	4	1.4	280	94.6
Total	4	1.4	95	32.1	70	23.6	37	12.5	86	291.	4	1.4	296	100.0

Source : Field Work, 2005.

d) Occupation type and Activity Fixity

Temporal fixity of activity also varies among people with different occupations. Among the artisans/technicians, students and those with other occupations, their activities were fixed in time with 28 (9.6%), 60 (20.6%) and 3 (1.0%) respondents who could not do anything else at the time of performing their activities. Among civil servants, traders and professionals, 3.4%, 1.4% and 0.7% respectively could do some other things else at the time of their normal activities. On the other hand 39.5%, 16.8% and 6.9% among the same group had their activities fixed in time, as shown in Table 5

Table 5 : Occupation type and Activity Fixity.

Could you have done anything else at the time	OCCUPATION												%	Total
	Civil Service	%	Trading/ Business	%	Artisan/ Technician	%	Profe-ssional	%	Students	%	Others	%		
Yes	10	3.4	4	1.4	–	–	2	0.7	–	–	–	–	16	5.5
No	115	39.5	49	16.8	28	9.6	29	6.9	60	20.6	3	1.0	275	94.5
Total	125	43.0	53	18.2	28	9.6	22	7.6	60	20.6	3	1.0	291	100

Source : Field work, 2005.

e) Nature of Activity and Activity Fixity.

There is also a difference between the nature of activity (i.e. whether an activity is arranged, planned, routine or unplanned) and its temporal fixity.

Table 6 : Nature of activity and fixity of activities.

Nature of Activity	Could you have done anything else at the time				Total	%
	Yes	%	No	%		
Arranged	_	_	28	9.5	28	9.5
Planned	_	_	04	1.4	4	1.4
Routine	16	5.4	248	83.8	264	89.2
Total	16	5.4	280	94.6	296	100

Source : Field work, 2005.

From Table 6; it is evident that the nature of activity determines its time fixity. For instance, respondent could not perform "arranged" and "planned" activities at any other time. The entire 9.5% and 1.4% arranged and planned activities could not be done at any other time. While in case of routine activities only 5.4% out of 296 respondents could have done their routine activities at any other time; and the remaining 83.8% had their activities fixed in time.

f) Location of Activity and Activity Fixity

Finally, temporal fixity of activity also varies with the type of activity, i.e. where the activity is based. In Table 7, 288 (97.3) of the respondents concerned could not have done anything else at that time i.e. they had their activity fixed in time. This comprises 47.6% who were engaged in home based activities, 51.7% who were engaged in office/work place-based activities, and 0.7% who were engaged in outdoor activities. Only 8.0% respondents did not have their activities fixed in time, these were 6.0% and 2.0% who were engaged in home based and office/work place-based activities.

Table 7 : Location of Activity and Activity Fixity.

Activity Location	Could you have done anything else at that time					
	Yes	%	No	%	Total	%
Home based	6	2.02	135	45.6	141	47.6
Office/work place	2	0.7	151	51.0	153	51.7
Outdoor	_	_	2	0.7	2	0.7
Total	8	2.7	288	97.3	296	100

Source : Field work, 2005.

The temporal fixity of activities was further established when it was asked if these activities could be done at some other time. From Table 8, it is evident that only 8.5% of the respondent do not have their activity fixed in time. This include 7.4%, 0.7% in office/work place activities. On the other hand 91.5% of the respondents could not have done their activities at some other time. This includes 40.0% who are engaged in home based activities, 51.0% in office/work place activity and 0.7% in outdoor activities.

Table 8 : Activity location and temporal fixity.

Activity Location	Could you have done this at some other time?					
	Yes	%	No	%	Total	%
Home based	21	7.4	119	40.20	141	47.64
Office/work place	1	0.4	153	51.7	153	51.7
Outdoor	2	0.7			2	0.7
Total	24	8.5	272	91.5	296	100

Source : Field work, 2005.

Temporal fixity of activity varies with different occupational groups as presented in the Table 9 which shows that the majority of the respondent (82.48%) could not have done their activities at some other time. This consisted of 35.73% civil servants, 15.46% traders/businessmen, 8.29% artisans, 4.46% professionals and 17.52% students. The few (17.52%) who could have done their activities at some other time consisted of people in different occupations as well.

The result of this analysis is related to the one obtained for the earlier question that is, could you have done anything else at that time? (Table 4) where 16 respondents (5.4%) answered in the affirmative and 280 (94.4%) said they cannot. All these go to establish that most of the activities are fixed in time and space.

Table 9: Temporal fixity and occupation type.

Could you have done this at some other time	Occupation													
	Civil Servants		Trading Buss.		Artisan Technical		Professional		Students		Others		Total	
Yes	21	7.21	8	2.74	4	1.37	9	3.0	9	3.0			51	17.52
No	104	55.73	45	15.46	24	8.27	13	3.46	51	17.2	3	0.10	240	82.48
Total	125	42.95	53	18.21	28	9.62	22	7.56	60	20.61	3	0.10	291	100

Source : Field work, 2005.

From the analysis above, the temporal nature of the activities of the respondents is mainly routine. That is, they perform the same type of activities everyday and these activities are fixed in time irrespective of the socio-economic status of respondent and activity type. Since the activities of the respondents were fixed in time and space, there was a generalized pattern in the sequencing of these activities. The fixity in time of the respondents activity is determined by a number of factors. These factors were analyzed by using the stepwise multiple regression analysis. The result of the stepwise regression is presented in Table 10

Table 10 : Stepwise regression analysis for determinants of temporal fixity of activities.

DAY	Model	Step	Variable Description	B	Standard of b	Beta	T	Significance level	R	R^2	Adjusted R^2	Standard Error
1	1	1	Age (yrs)	-28.502	4.403	-479	-6.474	001	479	.229	.224	526.216
	2	A B	Age (yes) Estimated annual income (₦)	-22.792 -6.13	4.701 .000	-333 -234	-4.849 -2.959	001 004	.524[b]	.274	.264	512.318
	3	A b c	Age yrs Estimated Annual Income Occupation	-21.695 -6.03 69.772	4.682 .000 34.585	- .364 - .230 .145	- 4.634 - 2.943 2.017	001 004 046	.542[c]	.295	.280	506.792
2.	1 2 3	A b c	Estimated Annual Income (₦) Estimated Annual Income Age (Yrs) Estimated Annual Income Age Yrs Occupation	-1.112E.04 -9.09E.05 -12.069 8.96E.05 -11.811 53.529	.000 .000 3.435 .000 3.401 26.746	- .562 - .454 - .260 - .448 - .225 .134	- 8.004 - 6.137 - 3.514 - 6.102 - 3.473 2.001	.000 .001 .001 .047	.562[a] .610[b] .624[c]	.315 .372 .390	.311 .363 .376	380.816 366.165 362.242
3	1 2	A b	Estimated Annual Income (₦) Estimated annual income (₦) Ag (Yrs)	-1.3E-04 -9.18E-05 -11.813	.000 .000 3.438	- .563 - .458 - .255	- 8.038 - 6.187 - 3.436	.000 .000 .001	.563[a] .609[b]	.317 .371	.312 .362	380.450 366.470
4	1 2	a b	Estimated Annual Income (₦) Estimated annual income (₦) Ag (Yrs)	-1.14E-04 -9.64E-05 -10.231	.000 .000 3.663	- .555 - .467 - .213	- 7.805 - 6.142 - 2.793	.000 .000 .006	.555[a] .588[b]	.308 .345	.303 .336	397.092 387.592
5	1	A	Age (in Yrs) Estimated Annual Income (₦) Occupation	-5.597 1.782E-05 17.522	3.003 .000 23.538	- .173 .129 .063	- 1.864 1.385 .744	.065 .168 .458	.181[a]	.033	.011	317.361
6	1	A	Age (yrs)	-7.507	2.902	- .226	- 2.587	.011	.226[a]	.051	.044	326.226
7	1	A	Age (yrs)	-6.922	3.357	- .194	- 2.062	.042	.194[a]	.038	.029	338.251

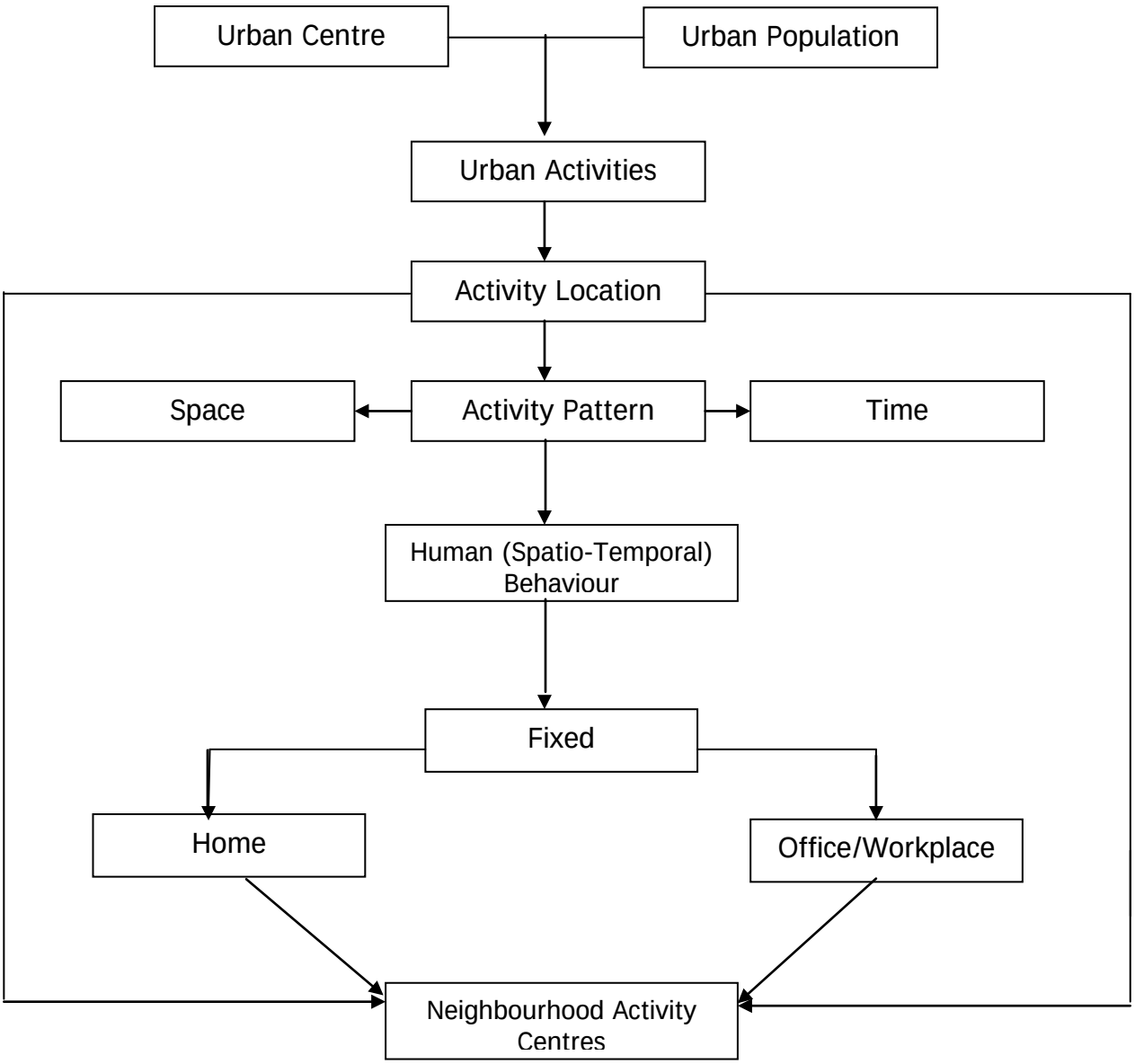
Source Author's analysis, 2006

The result of the stepwise regression in Table 10 shows that only three steps are possible. The criterion for selecting variables in the analysis is set at 0.05 level of significance. The result shows that age estimated annual income and occupation of respondents are significant. The level of significance is as high as 0.001. This implies that apart from age, annual income and occupation, all other variables are not significant in explaining time devoted to activities; although this variables differ vary from day 1 to 7.

The age factor is significant in the sense that all the sampled respondents fall within the age group of economically viable or productive segment of the population (i.e. between the age brackets of 18 years to 60 years) in all gender, qualification and occupational groups. On the other hand, annual income as a factor significant in explaining time devoted to activities is due to the fact that majority of the respondents belong to low income group, hence they have to work from morning till evening to make ends meet while those in public service engage in multiple occupations. Finally, occupation as a significant factor explains one of the characteristics of third world cities where people engaged in mostly informal sector and self -owned occupations hence they can afford to spend longer time. (Adedokun, 2012, Adedokun and Ajayi, 2012)

Based on the above findings in the study area, we would like to construct a generalized model of land use planning and facility location in a traditional medium size urban center using Ilorin as a case study. (Fig. 2)

Figure 2 : A Model of Urban Neighbourhood Activity Centers.



Source : Author's analysis (2009).

Given a medium size urban centre with its population, there would emerge various types of urban activity located in different parts of the city. The location of these activities would in turn generate activity pattern in space. The activity pattern itself would generate human spatial behavior. In the study area, the human behaviour in time was fixed. The fixity in human spatial behaviour is shared between home and office/work place. The urban neighbourhood activity centre model is of the view, therefore, that in planning for a medium size urban centre in developing world; there may be the need to adopt a strategy that would incorporate the behaviour of the people. Instead of strict land use zonation approach, facilities may be located closely to or around neighborhoods where people are fixed to. In this case and as demonstrated, facilities and infrastructures should be located between homes and work places. Obviously, if there is a demonstrable linkage between two activities in space, it makes sense to locate the facilities housing them in the same space so as to eliminate time and energy consuming travel.(Adedokun, 2008, 2009, 2011)

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the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. **Pick a good study spot:** To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. **Think technically:** Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be

sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page

- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to

shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.
- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic

principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.

- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

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- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

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ISSN 975587