UNIVERSITY OF LAGOS, NIGERIA

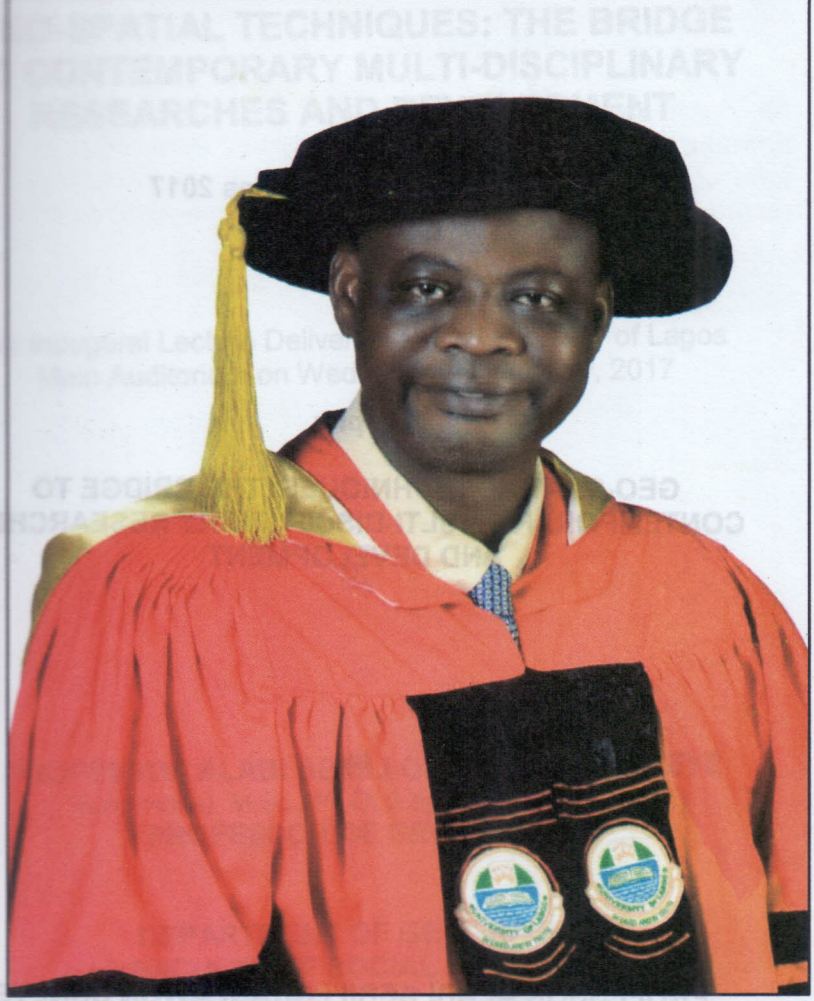
Inaugural Lecture Series 2017

TOPIC:

GEO-SPATIAL TECHNIQUES: THE BRIDGE TO CONTEMPORARY MULTI-DISCIPLINARY RESEARCHES AND DEVELOPMENT

By

PROFESSOR ALABI SEBILI OKANLAWON SONEYE



PROFESSOR ALABI SEBILI OKANLAWON SONEYE

B.A. (Hons), M.Sc., Ph.D. (Lagos), LEAD Fellow

PROFESSOR OF GEOGRAPHY

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GEO-SPATIAL TECHNIQUES: THE BRIDGE TO CONTEMPORARY MULTI-DISCIPLINARY RESEARCHES AND DEVELOPMENT

An Inaugural Lecture Delivered at the University of Lagos
Main Auditorium on Wednesday, 5th of July, 2017

By

PROFESSOR ALABI SEBILI OKANLAWON SONEYE
B.A. (Hons), M.Sc., Ph.D. (Lagos), LEAD Fellow
PROFESSOR OF GEOGRAPHY

DEPARTMENT OF GEOGRAPHY
FACULTY OF SOCIAL SCIENCES
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DEDICATION

I dedicate this Inaugural Lecture to the memories of all those that have departed to the life beyond untimely due to our inability to act geo-spatially and develop our 'neutral stuffs' into resources that could have changed their status.

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1.0 SALUTATION

The Vice-Chancellor, Sir
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The Registrar
The Bursar
The University Librarian
The Provost, College of Medicine
Deans of Faculties
Members of the University Senate
My Lords Spiritual and Temporal
Heads of Departments
Distinguished Academic and Professional Colleagues
Distinguished Non-Teaching Staff Colleagues
Dear Students, Past and Present
Gentlemen of the Press
Dear Guests, Ladies and Gentlemen

2.0 PREAMBLE

2.1 The Journey

Some five decades ago: *A man, Jimoh Alamu, son of Soneye-Yusuff, son of Ogunjobi, Ogunjobi Town; and a lady, Sarat Abeni, daughter of Adeosun of Morekete Town, all in Odeda Division of the Egba Nation, Nigeria conceived. When the fruit of the nine months pregnancy came, their only boy, he was named Alabi Sebili Okanlawon, having abbreviated Sebili from Fisebililah, an Arabic word meaning 'For The Sake of God'. And they sent him to St Peters Anglican School Abakuyamo for his Primary School Leaving Certificate. His uncle Ahmed Lamidi - Uncle Lam-Lam - re-enrolled him at St Bernadette's Private School Ibara Abeokuta. Having passed the entrance examinations to six other top class secondary schools, this visionary uncle decided for him Abeokuta Grammar School. Thereafter, he was at the School of Basic Studies Ogun State College of Education (now Tai Solarin University of Education) for his Higher School Certificate/ General Certificate of Examinations Advanced Level and was subsequently admitted into that citadel of learning, the University of Lagos, the University of First choice and the Nation's pride, where he had his three academic degrees. Thereafter, he was employed as an Academic Staff, and rose steadily to the post of a*

Professor. That boy is the one before you presenting his Inaugural Lecture.

Mr. Vice Chancellor Sir, above is a sketch of my life since the last half a century of sojourn on this planet. The story will be incomplete however if I do not inform the audience of my qualifications from the University of Lagos. I have my three academic degrees in Geography from three different Faculties where the Department had been domiciled though for administrative reasons rather than any other factor. While my Bachelors of Arts (B.A. Hons.) Geography was in the Faculty of Arts, Mr. Vice Chancellor Sir, my Masters of Science (M.Sc.) Geography and Planning was in the Faculty of Environmental Sciences and my Doctor of Philosophy (Ph.D.) in Geography was in the Faculty of Social Sciences. That my Minor Department at the Bachelors was Mathematics further qualified me as a product of the Faculty of Science. Rather than being a burden nonetheless, this Israelite journey of mine has been the pillar of my achievement, my exposure and my pride.

2.2 What about an Inaugural Lecture?

Mr. Vice Chancellor Sir. An Inaugural Lecture is known for two events traditionally. It is an occasion for a newly-appointed Professor like me to mark his career achievement by presenting his contributions to knowledge and development in his chosen field locally and internationally. It also affords the Professor an opportunity to present his vision for his discipline and faculty for improving their benefits to mankind. It is in this wise that this lecture of mine provides an opportunity for me to inform my audience, colleagues, the campus community and the general public of my work to date, including my current research and future plans. More significantly to me is that I reflected on the lecture as a payment of some form of debt that I owe my mentors and colleagues in the academic and professional domains. Though the Lecture is very personal and more self-indulgent with more of my own experiences and my references, parts of the presentation are drawn from the works I did with my mentors in the specialty thematic areas and whom I have gratefully acknowledged in the lecture.

2.3 Why my Inaugural Lecture at this hour

Not only is my delivering an inaugural lecture today a privilege, it is also symbolic for numerous reasons. Firstly, it is the second from my Department of Geography at the Faculty of Social Sciences and within a period of about two months. Secondly, it is the 10th in the Department of Geography at the University of Lagos, which makes it about the first double digit Inaugural Lecture from a department in the University and equally affirms the eminence of Geography as a field in the University. Thirdly, it is the 4th by my Faculty of Social Sciences in the last one year, the largest by any Faculty standard in the University recently. Kudos to my Faculty under the Leadership of my Dean, Professor Iyiola Oni, also a Geographer. Fourthly, it is the first to be delivered in the area of Geo-Spatial Techniques in this University. And from my end, Mr. Vice Chancellor Sir, I am delivering the lecture in less than a year after I received my letter of promotion to the peak of my academic career. Most significantly, Sir, the lecture is coming just a few days after the holy Month of Ramadan, which gives me a unique opportunity to thank the Almighty Allah for affording me opportunity to pass my own 'Message', which I prefer to qualify 'my Hadith'. ***Fisebilillah***.

2.4 The Title of my Lecture

The title of my Lecture 'Geo-spatial Techniques: The Bridge to Contemporary Multi-Disciplinary Researches and Development' is chosen deliberately to reflect on the inter-disciplinary nature of the field of geographical techniques for analyzing resources and development across borders. It reflects on my uniquely privileged opportunity to integrate and collaborate with colleagues across many Faculties in the pursuit of my degrees in Geography at the University and for multi-disciplinary deployment and applications for my independent and collaborative research endeavours across fields, universities and continents. My emphasis are on the key aspects of the scientific-based analytical techniques of Geography which is an integration of Geographical Information System, Remote Sensing, Cartography and Geo-statistical methods.

2.5 Summary of the Lecture

The lecture begins with an exposé on the fundamental field of Geography as a subject, a discipline and a profession with spatial and temporal perspectives. To illustrate its trans-disciplinary and multi-application opportunities aptitudes, I explored the Geographers' major perspectives and pursuits in the areas of research and development, which are summarized in 4Ms - Measure, Map, Monitor and Model. I also reflected on the concept of Geo-spatial techniques, my own type of Geography, and its significance for answering the questions of 'what', 'where', 'when' and 'how much' of resources, development and growth over time and space.

The second part of the lecture is a chronicle of my contributions to the field of Geo-Spatial Techniques as exploits of knowledge within the Geography domain. On these, I focused on my research and professional endeavours which include (i) System development and evaluation (ii) Areas of applications (iii) Research collaborations, (iv) Training and manpower development; and, (v) my current endeavours. My recommendations border on the necessity for spatio-temporal orientation in making sustainable development decisions which Geo-Spatial Techniques canvasses, the status of Geography in our educational programmes and its domicile in the University of Lagos. The last section is on my gratitude to all those that God has inspired to see me through to this pinnacle of my educational inquest and achievement.

3.0 RESOURCES, DEVELOPMENT AND SPACE

3.1 The Concept of a Resource

A resource is a particular feature or attribute of a substance that has a particular function or considered valuable to a user in its present form. Perceptions of what constitutes a resource differs from one discipline to the other. The philosophical view by Zimmerman (1951:3-15) which coincides with that of other Geographers is that 'resources are not, they become'. This implies that everything on earth remains a 'neutral stuff' until man is able to perceive its presence, recognize its usefulness and devise the means to utilize it. These explain that no

component of the earth including the lands, mineral deposits, water and vegetation is a resource until it has utility values. It is in these perspectives that resources should not be seen as merely tangible but subjective, relative and functional objects. They are not static but expand and contract over space and time in response to cultures, beliefs and anthropogenic forces. Mitchell (1991:1) concluded on what makes a resource to be a function of either (i) what man needs, (ii) what he can find a use for or (iii) what his technological know-how can support in the process of conversion from neutral stuff to useful materials.

Resources may be classified based on distinctive criteria such as (i) origin - biotic or abiotic (ii) stage of development - actual or potential, (iii) distribution - ubiquitous or localized (iv) renewability - renewable, non-renewable or flow and (v) appearance - tangible or intangible.

3.2 Resource Appraisal

Resource appraisal is concerned with determining the supply and demand of a resource. This involves identifying the location, distribution, and areal extent of resources, inventorying them and estimating their capabilities to meet up with demands. In a broadest perspective, analysis of natural resources means the listing of the available opportunities and use to man. The inventory can be further broken into different parts including:

- Identification - "where" and "when";
- Classification - "what" and "how";
- Enumeration and Mensuration -"quantity" and "distance";
- Presentation and visualization - "state" or "form".

Substantial differences abound in the details of examination, depending upon the analyst's interpretations of what constitutes a resource and as such different classification and categorization may be employed in identifying resources. Depending on the classification scheme for resource appraisal, a key step is to inventorize by gathering and analyzing information on its attributes scientifically. That the values of a resource is determined by the amount of the useful material available there-in, and that the demand for them compared with

others, account for why a state is adjudged by its wealth, political influence and status in the world economic system.

Resource Analysis is the ability to investigate the attributes of any section of the environment and thereby determine the characteristics that make it a resource. It is required for making decision on the actual transformation of 'neutral stuffs' into resources. A common problem of most developing areas is the erroneous impression of resource inexhaustibility. This is the consequence of the non-availability of the basic spatial data and resource information on which a more adequate judgment could be made. In Nigeria, the evidence could be traced to the fact that the data are either not collected or not adequately analyzed, stored or accessed.

3.3 Resources and Geography Link

Traditionally, geographical studies are structured according to administrative and regional boundaries such as communities, local government areas, states, nations and even regions. The indices generated from such characterization are not only over-generalized, the statistical indexes provided are usually skewed towards the advantaged few largely. For example, the richest 1% of most regions are richer than the poorest 60%, and yet such regions are said to be rich. They provide figures for wrong judgments on development and cannot accelerate the improvement of mankind.

The peculiar challenges to traditional techniques in geography also include data explosion whereby too many records are generated, from diverse sources at different scales and resolution, and in different formats. But accuracy problems are usually difficult to detect. Also, costs, roles and responsibilities have always been sources of data ownership, data copyright and data sharing dilemma. Furthermore, they pose concerns of legal and ethical issues both in collection and use. The problem of data ownership and roles are easily resolved in that the electronic platform on which the techniques are based supports 'mask', 'dongles' and/or passwords. The platform also facilitates standardization of techniques and enhance storage, portability,

speedy access and sharing. A lot of restrictions are traceable to traditional geographers and records have gone beyond statistics. Nonetheless, every data is available and accessible based on premeditated conditions.

As an integrated discipline, geography consolidates knowledge about the surface of the Earth and its resources and has perfected the traditional criteria for diagnosing the internal autonomy of scientific disciplines.

3.4 Resources Analysis and Geography

From the spatial perspective, resource analysis comprise of four activities according to Mitchell (1991:2):

a. Studies of natural resources themselves: surveying, mapping and measurement of the supply of and demand of resources as well as their geographical attributes;
b. Studies of alternative allocations (spatial, temporal, and functional) of resources in terms of users, facilities and activities;
c. Studies of variables (biophysical, technological, economic, social, political, institutional, legal, etc.) which condition resource allocation or developments; and
d. Studies of the impact of specific resource allocation.

The questions Geography answers include, but not limited to the following:

- Where are the resources?
- How much is there?
- What is their condition?
- How available are they?
- What are the demands for them?
- How will changing prices, technologies and values affect future demand?
- How will different resource uses interact to influence future supply?
- What opportunities exist to improve productivity?

Answers to these questions are provided using empirical data which Geography provides.

4.0 GEOGRAPHY AS A DISCIPLINE

4.1 Definition and Evolution

Geography is a systematic study of the Earth and its features. It studies the pattern and logics of spatial orientations and behaviour in the context of man-environment interactions. Its primary goal is to establish inequalities and inequities in arrangement, access and utilization and thereafter proffer solutions for balances. Geography is a distinct body of thought traced to creation, which makes it one of the oldest fields of study. It has attracted scholarly attention over time with the specific evolution explainable in its paradigm shifts in thoughts and methodologies.

Classical geography was dominated by spiritual influences and views of the Greeks on the riddles of the earth, its shape and place in the universe; charting and mapping of areas of the known world and gathering knowledge about the uninhabited world. Geographers of this era included Thales of Miletus (624 – 565 B.C.), Herodotus (484-425 BC), Aristotle (384-322BC), Erastosthenes of Cyrene (276 -195 BC) and Strabo (54B.C. to 25A.D.). The renaissance medieval era was dominated by the strong hegemony and intellectual acumen of the Roman Empire which commanded practical and theoretical opportunities to move and explore the lands lithoral regions of some parts of the Mediterranean in Europe, Asia and Africa as they went on quests for expansion, trade and conquests. Findings through voyages by geographers like Marco Polo, Prince Henry, Bartholomew Dias and Vasco da Gama around China, Africa and India were documented by others such as Strabo (64B.C. - 20A.D), Claudius Ptolemaeus (75A.D. to 153A.D) and Christopher Columbus (1451 –1506) (Davies, 1967).

Mr. Vice Chancellor Sir. Religious faith and belief pioneered geography and its philosophy throughout the known periods of human existence. For examples, the Holy Bible provides vivid descriptions on hydrology and landcover/landuse (Genesis, 1:6-10), the atmosphere (John, 3:8) and the shape and size of the earth (Isaiah, 11:26 and Isaiah, 40:22).

The Holy Quran is filled with Geography in scientific statements and explanations. For examples, the Hadith is explicit about the Universe (Qur'an, 41:53), the sun, the moon, the star and other celestial bodies (Qur'an, 7:054), environment and conservation (Qur'an, 6:99) and geomorphology and landforms (Qur'an, 33:27). It scripts the moon and its shape, tracks of orbital paths and calendar months twenty-eight times (from Qur'an, 2:189 through Qur'an, 91:2) while climate and climate change were ten times (from Qur'an, 7:57 through Q55:19-20). All the five pillars of Islam (Qur'an, 2:183-187) including proclamation of faith (Shahada), worship (Salat), fasting (Seyyawm,), obligatory charity (Zakat), migration (Pilgrimage to Mecca) are teachings and obligations of spatial dimensions.

The foregoing emphasize that God recognizes Geography and the Holy Books are good texts for many of its component topics such as weather, climate and climate change (ref.: the atmosphere, the sun, the moon, the day and the night, the ozone layer, formation of rain), hydrology/water resources (ref.: formation of rivers and seas), geomorphology (ref: description of relief, landforms and landscape of places including the deserts). The human components knowledge were propelled by faith, worship and evangelical travels which were documented in maps.

Religious beliefs are foundations to contemporary geography. Modern day Geography does not stop at 'what' of resources but further asks questions and provides answers to 'where', when, and above all 'why'. The analysis and explanation perspectives of areal differentiation and levels of development further seek to classify phenomena for comparison and examine their cause-effects systems, which explains why requisite knowledge of theories and laws are backed up with empirical data to describe, explain, predict and prescribe events **(Fig. 1)**.

The inquisitive disposition of contemporary geography differentiates it from every other disciplines and virtually makes all the global challenges the work of geographers **(Fig. 2)**. Since spatial environments are very dynamic and require many

parameters to understand the multi-relationships, Geography serves as a bridging science between the core areas of natural sciences and humanities. This accounts for why geographers must develop and adopt techniques of integrated analysis that can support sustainable decisions on resources planning, management and growth.

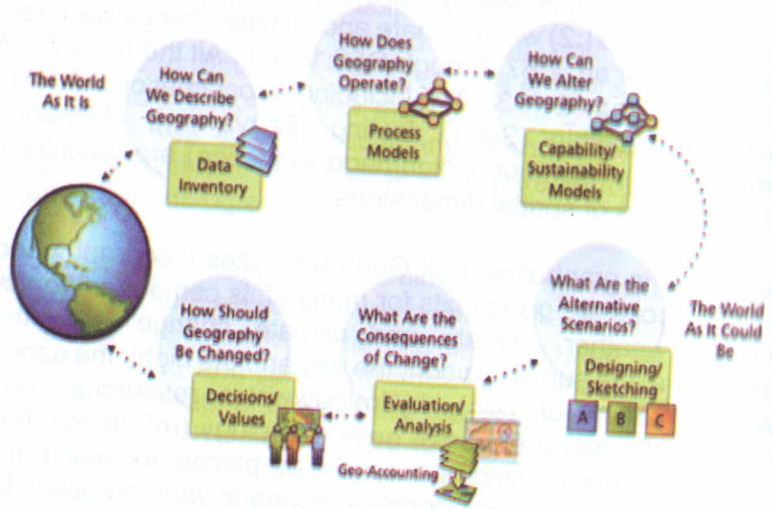


Fig. 1: The Multi-Perspectives of Geography (After Dangermond, 2013)

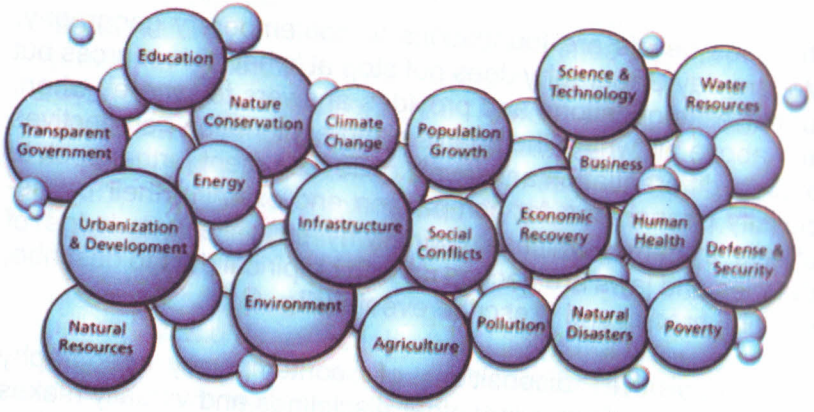


Fig. 2: Problems of the World are Problems of Geography
(After Dangermond, 2013)

4.2 Component Branches of Geography

Despite its wide scope, contemporary geography remains a single subject of three branches, namely Human Geography, Physical Geography and Geographical Techniques with their allied fields (**Table 1**).

Table 1: Major Areas of Geography and Allied Disciplines

Physical Geography	Human Geography	Geo-Spatial Techniques
• Biogeography (Biology) • Climatology (Meteorology) • Hydrology (Marine / Oceanography Sciences) • Water Resources (Oceanography) • Geomorphology (Geology) • Soil Geography (Pedology) • Paleogeography (Anthropology) • Environmental Geography (Chemistry) • Landscape Ecology (Ecology)	• Transport Geography (Civil/Mechanical Engineering / Logistics) • Population Geography (Demography) • Economics Geography (Economics/Business Management) • Agriculture Geography (Agricultural Science) • Medical Geography (Medicine/ Healthcare) • Geo-Tourism / Hospitality Geography (Recreation / Hospitality Management) • Settlement Geography (Estate Management) • Geo-Politics Or Political Geography (Political Science) • Regional Geography (Urban And Regional Planning) • Historical Geography (History & Strategic Studies) • Social & Cultural Geography (Sociology) • Geo-Theology (Philosophy)	• Quantitative Technique (Mathematics / Statistics & Astronomy) • Cartography (Psychology/ Designs) • Geo-Information (Computer Sciences) • Remote Sensing (Surveying / Mapping) • Resource Analysis (Scientific Methods)

4.2.1 Human geography

Human Geography focuses on the built environment and how humans create, view and manage space influence. It is the synthetic study of the relationship between human societies and the resources of the earth. It views the world patterns and processes as are shaped by the society from the human, political, cultural, social and economic views.

The three closely linked aspects of Human Geography are (a) the spatial analysis of the human population, (b) the ecological

analysis of the relation between human population and environment and (c) regional synthesis of events. Human Geography borrows from the behavioural science, culture science, geosophy (geography of wisdom) and feminism. It is governed by the school of environmental probabilism which believes that, rather than nature, man himself is the dominant partner in the man-environment relationship therefore determines whatever he wants to happen in an environment depending on his technological knowhow.

4.2.2 Physical geography

Physical geography, often referred as physiography, examines the natural environment and how organisms, climate, soil, water and landforms are produced and interact. It examines the resources and patterns in the lithosphere, hydrosphere, atmosphere, pedosphere and biosphere. Physical Geography makes geography a natural and exact science. They are routed in the geography school of environmental determinism which is of the view that nature is the dominant partner in the man-environment relationship, influences the psychological mind-set of man and in turn defines the level of activities and development.

Each of the key branches is wide in scope but the individuality does not obstruct the philosophy and cordiality in the discipline which are governed by synthesis of evidences in the spatial realm. The interface between the physical geography school of determinism and human geography's possibilism gives a vintage advantage and a 'trade balance' in scientific exchange in its School of probabilism (Stachowiak and Bajerski, 2016), which is the view that people have considerable discretion to choose or alter the physical environment because it provides opportunity for a range of possible human responses and value in the new order of global village.

4.2.3 Technological Geography (or Geo-spatial Techniques)

Every profession has its methods and tools and techniques through which its objectives can be achieved. Technological Geography, often referred to as 'Geography Techniques', 'Geo-

spatial technology' or 'Geospatial sciences', encompasses the geo-spatial techniques and tools designed to (i) accept and integrate geographical-based data inputs in different formats (such as analogue maps, tabulations, overlay information and digital-image data); (ii) store and maintain data and information along with their established spatial relationships; (iii) manipulate the data through timely computation, search and retrieval; (iv) perform different levels of spatial modeling that take data interrelationships and cause-effect responses of relevant elements and systems into account; and, (v) present data outputs in a variety of ways such as maps in digital and analogue forms.

Geo-spatial techniques make use of pools of technology tools to create, analysis and manage data. The focus has been to revolutionize resource data by disaggregating them to smallest possible geographical units and also be capable of re-aggregated same to any level of analytical scales possible for users' needs, access and discourse. It is about the characterization and usage enablement for both the physical or social sciences components of Geography individually and interactively. It supports spatial and attributes data management and sharing using known standards. Geo-spatial techniques is a fusion of four (4) sub-specializations in Geography. These are Cartography, Quantitative methods, Remote Sensing and Geographical Information Systems.

(a) Cartography

Cartographers develop maps as models to visualize, analyse and interpret data on earth features. Maps are believed to be as old as other means of communication and even older than written language as earliest men were known to have made efforts in communicating with each other by sketching routes, locations and hazards on the ground, and later on hides and skins of animals especially horses even before the first alphabets (Penquet and Marble,1990). There were landmarks in the development of maps during the Babylonians, Egyptians, Greeks and the Romans as well as Christianity and Islam movements in the ancient and medieval eras, when data for the

compilation of earliest maps were based on personal experiences and familiarity with local events and later through voyages, pilgrimages and warfare for locations and routes.

Advent of instrumentation for astronomical observations and printing technology provided better details and accuracy for delineations of the shape, form and extent of locations on the earth surface and the production, re-reproduction, circulation and access to maps (Baker and Rummond, 1984). Modern cartography is a radicalization of the manual and hybrid-based techniques of mapping as well as digital-driven assemblage, design, visualization and production of spatial data from every source into maps, charts, relief models, globes and video displays for specific purposes.

(b) Quantitative methods

Sometimes referred to as spatial analysis or geo-statistics, quantitative techniques deals with analysis of numerical geographical data phenomena using methods and models that are founded in mathematics, statistics, econometrics and engineering for deductive and inductive reasoning to understand spatial distribution and interaction. The premise of *spatial* statistics currently is that 'maps are numbers first and pictures later'. Hence, mapping is a mathematical 'thing' for gathering insight and understanding of spatial patterns and relationships within the decision-making contexts better. Geographers have also contributed notably to conventional methods of quantitative techniques by stimulating spatial reasoning skills and proficiency for solving advanced geographical problems.

Geo-spatial analytical operations depend on the nature and typology of data in question. With the advent of computers, the analysis has been integrated into software packages and deployed on computers and web-centered technologies to process geographical data and information of numeric and alpha-numeric values on maps, images and other formats.

The marriage can be conceptualized as *map-matics;* covering mapping, interpolation of estimates for unmeasured points, geo-query, visualization and GPS navigation. This quantitative reality as functions of location, distance and relationships is a major unification of border disciplines in geography with other fields for data management in the science of quantitative realms especially mathematics, statistics and computer science. A key spatial analysis modules of Geo-Spatial software packages is that of ArcGIS in which Python is now fully integrated to rapidly become accepted as a standard scientific programming language.

Added to many software packages are modules for fuzzy overlay, modeling, enhanced mathematical and algebra operations for improved and faster analytic inquests. They are window-based and more user-interfaced for graphical visualization and searches in databases and, are internet, intranet and web-enabled.

Geo-spatial analysis will remain a branch of Geo-spatial technology for grid-based (i) *spatial analysis operations* which are extensions of traditional mathematics; (ii) investigative *map-matics* for such operations like basic mapping/query of discrete and continuous surfaces for relationships, algebra, calculus, plane and solid geometry; and, (iii) *spatial statistics* in GIS databases under unique analytics topics such as hybrid-based normalization and classification of images, descriptive and predictive statistics, graphs and overlays, neighborhoods and distance relations, transportation connectivity and networks optimization, operations research and integration, unification and location algorithm and surface modelling amongst others. They are becoming more customized and user-friendly for less mathematics-professionals to use and benefit from.

(c) Remote sensing

Remote sensing is the act of obtaining and analyzing information about earth features or areas from the aerial data acquired by technological devices that are not in physical contact with the targets (Campbell, Randolph & Wynne, 2011).

The sensors operate within different parts of the electromagnetic spectrum and the data are in signal codes of image. The common sensor are photographic cameras, laser microwave and thermal sensors. The platforms are both terrestrial such as pigeons and mechanical such as kites, balloons, aircrafts, spacecraft and drones **(Fig. 3).**

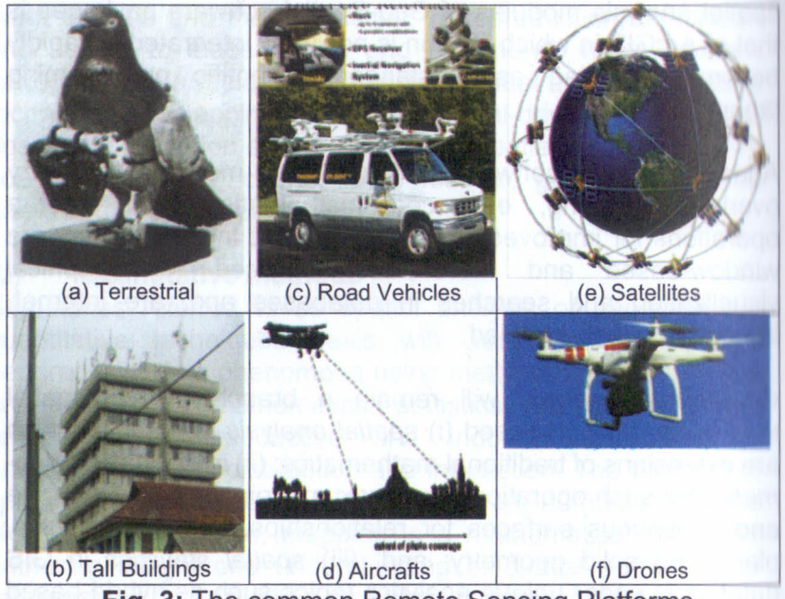


Fig. 3: The common Remote Sensing Platforms

Remote sensing as a data collection method is necessitated by the challenges of traditional methods of spatial data collection. Geographers are comfortable with remotely sensed data. When compared to other types of data, they provide uncensored synoptic recording. Remote sensing are capable of handling physically inaccessible and distant study areas and the repeated recording enables monitoring of specific places over time and space.

The data have the added advantages of consistency in details, geometric fidelity, multi-spectral resolution and cheaper costs.

They are also ideal for resource studies and as decision making tools in view of their improved compatibility with other data sets and ease of interpretation of features since they are map-like. Of all the sensing systems, satellites are most useful in land resources inventory because they have multiple capabilities for spatial and temporal resolution (**Fig. 4**).

Fig. 4: Remotely-Sensed Images of some strategic Places, Nigeria

They can cover very large areas than per scene, every part of the globe is covered by one orbiting satellite or the other at a point in time and different data from different sensors for the same region can be accessed for separate studies. This era of high-altitude orbiting satellites for images of the earth commenced post-1960 with the launch of Earth Resources Technology Satellite (ERTS-1, later renamed Landsat) by the USA.

The race for designs of different categories of satellite-based sensors for varied objectives and applications has been hyper-geometrically to the extent that the United Nations has opted for

the regulation of space missions for the safety and security of all (Abiodun, 1999). Modern-day remote sensing is supported by radical evolution of industrial-grade technology of drones which provide more efficient and real time data on sites and scenes for multi-disciplinary studies.

(d) Geographic Information Systems (GIS)

GIS is any digital data that contains location-based information in either geographical format of latitudes and longitudes, projective planes or other coordinates and geometry. It started in the 1980s, making it the most recent achievement in Geo-spatial technology through which map themes can be compiled, revised, managed and presented. The major activities in a GIS environment are summarized by Jeffrey and Estes (1990:13) in 4Ms - Measure, Map, Monitor and Model.

As GIS captures and stores individual thematic data in different layers of coverages digitally, the tool box uses computer facilities to organize, analyse, and predict the complex spatial and attribute characteristics and overlay them for visualization and queries with a view to establishing trends and relationships (**Fig. 5**).

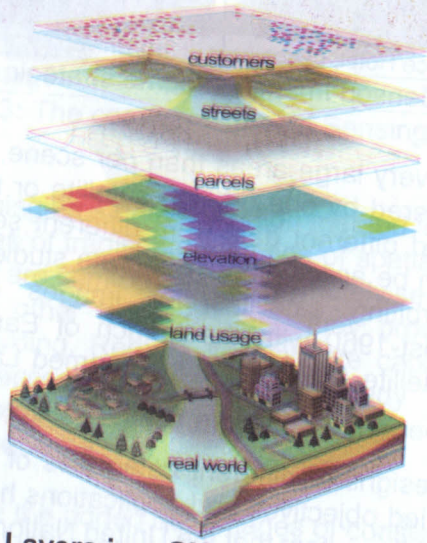


Fig. 5: Data Layers in a GIS *(After Rajeswari et al., 2015)*

There are over 500 types of data layers across the different variable components of physical and human Geography and other disciplines. Each has characteristic attributes that are tied to geographic-referenced plane in vector or raster data format. It is necessitated by the continuous changes in status of resources and dynamics in the environment for which large volume of data are being generated but which the traditional analytical procedures have limited and opportunities.

Burrough (1991) identified the advantages of GIS as follows:

- It accepts data inputs in different themes, scales and formats such as maps, overlay information, tabulations and images;
- It stores and maintains information with the necessary spatial relationships in either points, lines, areas or surfaces;
- It manipulates databases through search, retrieval, query and computation timely;
- It performs different levels of modelling that take data interrelationships and cause-effect factors into account; and,
- It presents information outputs in different ways such as tables, charts, statistical/mathematical values, maps, video displays, elevation and cross-sectional models.

The components of GIS are structured as dataware, hardware, software, peopleware and methodware (**Fig. 6**). They simplify the systematic understanding of relationships between categories of resources, objective analysis of their characteristics and modelling their complex interactions spatially and temporarily.

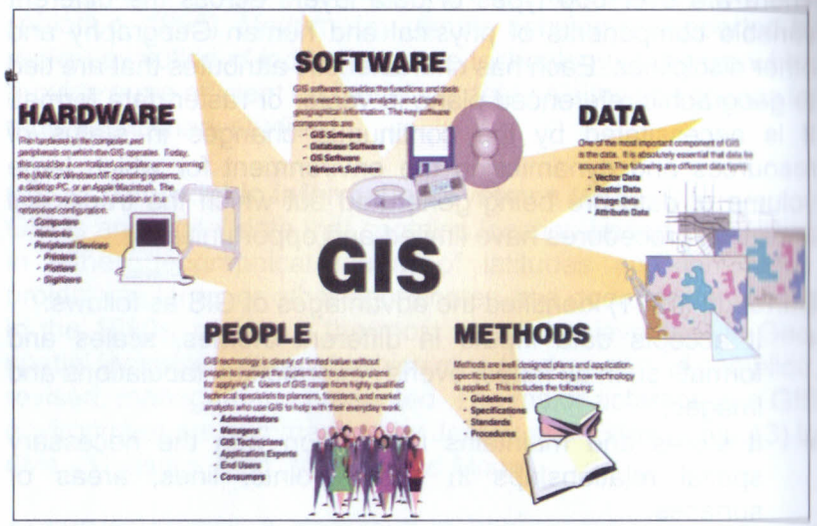


Fig. 6: The Components of GIS *(After Rajeswari et al, 2015)*

Though continuously evolving, the professionals can manoeuver through several GIS packages. This makes them very fluent in programming and scripting languages such as Oracle and SQL that can handle large data sets. Indeed, gone are the days when professionals are proficient in only one application package because the number of exploratory results required by co-researchers and decision making teams are sometimes unlimited once the location relatable aspects are established properly.

Within its short period of evolution, GIS has come to be recognized by GIS practitioners as a tool of unlimited potential. It has strengthened every component of geography and brought others closer thereby forcing new dawn of multi-disciplinary collaboration (**Fig. 7**). The most common areas of applications in research and resource development include demarcation of administrative areas of jurisdictions, land ownership and management, agriculture and food security, settlement and housing, transport, utilities, tourism, recreation and hospitality industry, climate and climate change, air quality and pollutants, health ad healthcare services, hydrology and water resources,

crime and policing, security and modern warfare, environment, forestry and ecosystem services, disasters, risks and humanitarian assistances, census and electoral matters (**Appendix 1**).

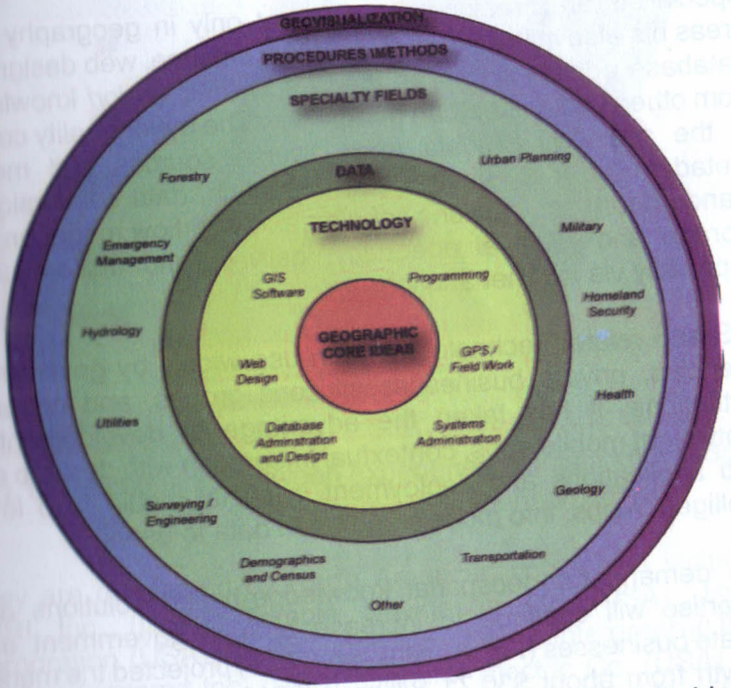


Fig. 7: Core Areas of Geography and the Allied Fields

Mr. Vice Chancellor Sir, the aspects of mapmaking, spatial analysis, remote sensing and GIS amalgamated into the field called Geo-Spatial Techniques. It arose from the explosion in computers and software development for user-friendly facilities in handling the complexity in the spatial data. Its advent and amalgamation improved the analytical and computing powers in geography had improved the handling of ever increasing data from its interdisciplinary fields. Not only do Geo-Spatial Techniques serve the two (2) traditional areas of physical and human Geography, it is a critical element of research frontier and for making fundamental decision on resources in its entity.

It is a new dawn for geography specialization and its relations with relevant life, environmental and social sciences. The application is limited only by the imagination of those who use it (ESRI, 1990).

Specialists are breaking grounds not only in geography core areas but also in the fields of computer science, web design and database administration as they apply their *apriori* knowledge from other fields other than geography. The major quality control is the accuracy of data from diverse sources and media, metadata (i.e. data about data) extraction, data conversion to standard formats, efficiency of data and workflow management, storage and retrieval adequacy, delivery and dissemination especially via internet and intranet.

GIS and related technologies is in use widely by government agencies, private businesses, citizens groups, and research institutions. It has taken the advantage of development in lightweight mobile apps, contextual integration with desktop and web applications and deployment in social media to o lever intelligent maps, info models and open data to users.

The demand for geospatial knowledge-based solutions and expertise will continue to increase both in government and private businesses (**Fig. 8**). Mukesh (2017) projected the market growth from about $30.71 Billion in 2016 to $73.91 Billion by 2021, at an annual growth rate of about 19.2% and with the Asia-Pacific market having the highest forecast. The key aspects of the markets are (a) technological development in the areas of remote sensing, GPS and GIS, (b) spatial statistical-based analysis of businesses with surface analytics, network analytics and geovisualization; and (c) application areas like business geographics, environment, medicine, utilities, disaster/public safety, geomatics engineering and administration.

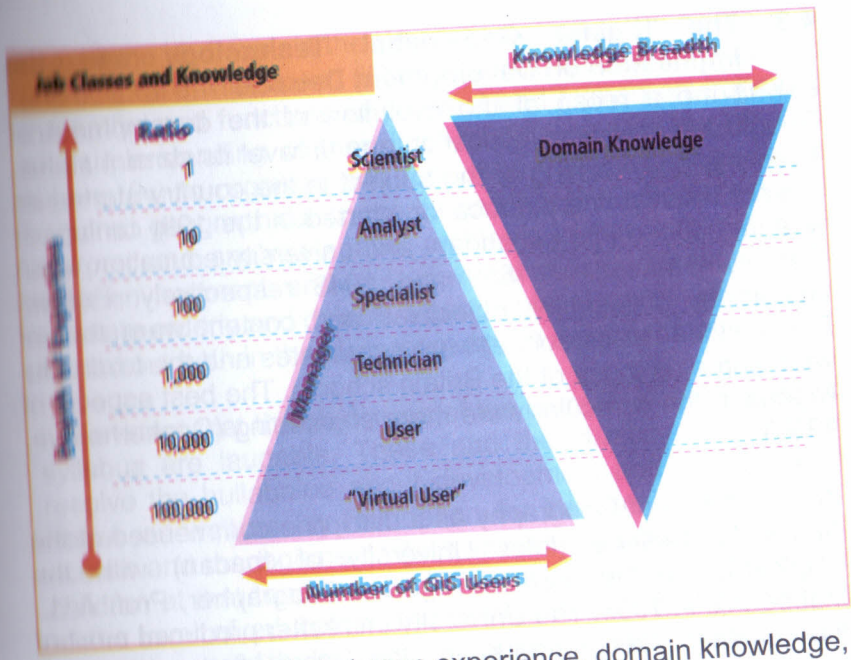


Fig. 8: Relationship between experience, domain knowledge, and types of GIS users (After Johnson, 2015)

They are dominated by North American companies including ESRI Inc. (USA), Trimble Navigation Ltd (USA), Harris Corporation (USA), DigitalGlobe Inc. (USA), Intergraph (USA), Bentley Systems Inc. (USA), General Electric Co. (USA) and MacDonald, Dettwiler & Associates Ltd. (Canada). A few others in Europe are Fugro N.V. (Netherlands), Hexagon AB (Sweden) and RMSI (India).

Often, progressive hybridization and development in geography and its component areas of specialty could give a wrong impression of upset in its identity as a modern science. Nonetheless, increasing knowledge of Geographers in several subfields and their ability to key into developments in computers and quantitative revolution serve as as a bridge between the traditional physical and human geography and to also serve other disciplines. I am proud to be part of this success story, Mr. Vice Chancellor Sir.

4.3 The Nigeria Geo-spatial Technology and the Implication on Development Debacle

Permit me a recap of the evolution of the development of Geography in Nigeria education and unravel its current status. Teaching and learning of the subject in the country started as subject when primary education started in the 19th century. It was introduced into secondary and university education when they commenced in 1859 and 1948 respectively. Earliest Geography philosophy, objectives and content were that of Britain since the personnel were expatriates and the textbooks were same as those of the Britain schools. The best aspects of Nigeria in the curricular were mere site-seeing (Onokerhoraye, 1994).

Indigenization of Geography as a discipline commenced at the University College (later University of Ibadan) with the employment of the foremost Nigerian Geographer, Prof. A. L. Mabogunje in 1958. The University thereafter produced most of the earliest Geographers in the other first generation Universities of Lagos, Ife, Nsukka and Zaria, from where the race to produce teachers for secondary schools and universities as well as administrators for the civil service followed (Oguntoyinbo, Areola and Filani, 1978). The status and content have been redefined with ensuing policies in education. It was a core subject at the primary and Secondary Schools for quite sometime. Few decades ago however, a little of the syllabus only became infused into Social Studies at the Junior Secondary Schools while at the Secondary School level, it became a core subject to be taught and examined for only science students.

As at the present, Geography is just an elective subject to be chosen in place of either History or Literature in English at the Secondary School. This shift in status is affecting its relevance in national discourse and resource development of the country. Aderogba (2016) identified the objectives of the current WAEC and NECO curricular and examinations as follows: (i) to understand the concepts of different characters and the spatial relationship of the features on the earth surface; (ii) to understand the concepts of man-environment relations, that is,

to examine and explain the interaction of man with his physical and cultural environment; (iii) to acquire the basic knowledge of the native and functions of physical and human environments and understanding of their inter-relationships in the resulting issues; (iv) to organize and formulate principles according to acquired geographical concepts and apply these principles to interpret and analyze spatial problems in the immediate and wider environment; and (v) to develop skills and techniques for accurate orderly and objective geographical investigations to be carried out both in the classroom and in the environment.

It is evident that the objectives of the current secondary school syllabus are laudable. These and the curricula content can resolve the hullabaloo about development and environmental issues as well as lay foundation for training in efficient data access and management which should have been instilled into children at that tender ages. The elective status of the subject at the level of education and certificate examination however has endangered the subject and also the post-secondary school disciplines that it is meant to serve.

The weak development of Geo-spatial Technology in Nigeria has remained unabated. Balogun (1992) for example identified five cartography eras for the country as that of (i) exploration and mapping of Nigerian rivers, 1788 - 1861 (ii) colony expansion and amalgamation, 1861 – 1910 (iii) rises of protectorate and nationalism, 1914-1960 and (iv) aerial survey and topographical mapping, 1946 – 1960. Existing maps in Nigeria are better classified as historical data only rather than for development decision making in view of their datedness.

Soneye and Akintuyi (2014) noted that the post-independence achievement by the country had been that of retrogression whereas only about 88% of its 1,352 sheets of the most popular and most widely used 1:50,000 series have been published till date, some 60 years after the project commenced (**Table 2**).

Table 2: Progress in Nigeria Topographical Maps Production *(Soneye and Akintuyi, 2013)*

Scale	Sheets Required	Project Started	Sheets Published	Sheets Completed & not Published	Sheets Outstanding	Major Constraints
1:250,000	100	1957	60 (30%)	10 (10%)	30 (30%)	-
1:500,000 (Old)	33	1952	16 (18.5%)	-	17 (51.5%)	1:250,000 sheets uncompleted
1:500,000 (New)	9	1960	4	3	2	-
1:50,000	1,352	1946	1,116 (83.4%)	167 (12.4%)	60 (4.5%)	Fund
1:100,000	342	1970	188 (55%)	20 (5.8%)	134 (39.2%)	1:50,000 sheets Uncompleted
1:25,000	5454	1981	-	256 (5%)	5198 (95%)	Fund, 1:50,000 uncompleted

The conventional cartographic procedures of collation, lithography and publishing are inadequate for processing the poorly generated data. Further deficiencies are in the subtle inconsistencies in the standards by individual mapping agencies vis-à-vis the time consuming, energy sapping, huge capital requirement and the painful begin-again syndrome when a particular sheet needs to be reproduced and/or revised. Some of the maps are barely published before the information contained are outdated grossly. Revision efforts are neither successful just as every attempt at new edition never goes beyond the stages of contract awards and mobilization (**Table 3**). Yet, the revision cycle for such maps should be 5-10 years for urban/sub-urban areas and 10-15 years for the rural environment (Gauthier, 1987).

Similar to almost every other fields of endeavor, most Geographers shy away from spatial analysis and map-matics because of poor quantitative minds resulting from general phobia and attitude towards mathematics at almost every level of education in the country. Some find the application in Geography so confusing and distressing that they would avoid

anything remotely equation, mathematics or statistics. As such it is the most relegated of all Geo-spatial techniques.

Table 3: Ages and Public Access to Nigerian Topographical Maps in Digital format *(After Adeniyi, 1992)*

Scale	Total Coverage	> 50 years	35 to 50 years	20 - 35 years	< 20 years	Available
1:1,000,000	100%	15%	25%	60%	none	none
1:500,000	100%	100%	None	none	none	none
1:250,000	100%	100%	None	none	none	none
1:100,000	95%	90%	None	none	none	none
1:50,000	95%	90%	None	none	none	none
1:25,000	5%	None	None	5%	none	none

Soneye and Akintuyi (2013) also assessed the developments in aerial-based remote sensing systems, noting that the earliest aerial photographic exercises in Nigeria were by the Royal Air Force (RAF) of United Kingdom in 1937 covering the Apapa – Ebute Metta axis of Lagos. By 1949 when the exercise was at its peak for township mapping, some 15,000 scenes were reported compiled at various scales ranging between about 1:3,000 to 1:10,000.

The planned coverage by a 1:40,000 series in 1956 for the purpose of compiling the 1:50,000 scale national topographic maps was never completed while a new set at 1:25,000 scale flown between 1972 and 1979 only got to about 70% coverage before the contract was abandoned in the late 1980s for human and technological factors such as atmospheric noise due to excessive cloud covers and haze most time of the year, the large number that can be handled and the obsolete equipment at the disposal of just a few agencies within the relatively diverse geographical environment (Areola, 1975).

As part of the effort to address the limitations of aerial photography, Nigeria joined the space race with a National Space Policy and Programme of 2001 aimed at building indigenous competence and designing appropriate hardware and software. The government has launched five satellites into outer space since then, three being for resource monitoring and

two for communications. The first NigeriaSat-1 with 32m resolution was in September 2003 at a cost of $30 million. It failed in orbit in November 2008. The second was NigComSat-1 in May 2007 also failed in November 2008 but was replaced at no cost with NigComSat-1R in December 2011. NigeriaSat-2 and NigeriaSat-X with 2.5m panchromatic spatial and 5m multispectral resolution were launched with NigcomSat-1R to replace Nigeria-Sat1 in December 2011.

The National Space Research and Development Agency (NASRDA) manages the earth satellites programmes as part of the Federal Ministry of Science and Technology, overseen by the National Council on Space Science Technology. NigComSat manages the communication satellites as part of the Ministry of communications Technology and is regulated by Nigeria Communication Commission (NCC) and Nigeria Broadcasting Corporation (NBC). However, Nigeria-sat1 was built by Surrey Satellite Technology Ltd. UK, Nigcomsat-1 was with China Great Wall Industrial Corporation while NigeriaSat-2 and NigeriaSat-X were jointly by Surrey Satellite Technology Ltd and International Space Company. Efforts to build NigComSat-2 and NigComSat-3 communications satellites in 2012 and 2013 have remained in the pipeline leading some communication companies to adopt available options.

The status of Geography at the secondary school level and challenges to Geo-spatial technology in Nigeria manifest in its development debacle. The missing link in Nigeria development is that of data to answer geographical questions while the long-term impacts on sustainable development are ubiquitous and have started manifesting. In particular, our inability to have good grasp of our resources types, base and rates of exploration have always been responsible for the common impression and official statements like 'we have abundant resources', 'we have large deposits of this or that', etc., Yet, we hardly know *what specific* resources exists, what are their stocks, where are they, why they are found where they are as at when, and, *why* they are being extracted at what rate. These account for why decisions on them are non-coherent and their management are jeopardized.

The skewed distribution of natural resources and facilities have always been to the advantage of the few rich in urbanized areas against the majority in rural and urban periphery. In Nigeria, poor coordination and management exert greater burdens of inefficiency in resource supply and value chains thereby worsening spatial inequities. In particular, there is always a higher concentration of authority and logistics around urban areas especially the administrative capitals. The primary resource to the people and governments of developing nations is *land*. Yet, reliable figures for positive decision making have remained elusive.

Mr. Vice Chancellor Sir, there is hardly any administrative unit that can provide appropriate records on the location and attributes of its lands such as the exact size, the types and values of the landcover and how much is devoted to specific uses. Indeed, there is no specific land classification scheme for the country. It is also difficult to monitor when approved uses of a particular land is changed, say from forests to farmlands and farmlands to built-up facilities, or when residential buildings are converted to commercial or religious facilities. Another worrisome example is the case of climate and climate change.

The extermination of Geography at secondary schools implies that students would no more hear about of climatic gardens or Stephenson Screen while the data by NIMET and some independent weather stations on weather and climatic elements would thereby remain meaningless. Certainly, some university graduates even in Geography have never seen a climatic station and will never do. From all indication, it is obvious that the Geography subject, both physical and human, is going into oblivion, which literarily implies that Nigeria development will also go into stupor.

4.4 What alternatives in Nigeria?

The alternative sources of resource data to cartography and remote sensing in Nigeria are from conventional (or traditional) procedures including the system of trial and error, ground visual

observation and measurement, sampling and integrated regional surveys and archival procedures mainly from administrative sources. These are reviewed below:

(a) The System of Trial and Error: This is the oldest of all the techniques. Being wanderers and later agrarians, earliest people tried to determine the characteristics, make inventory, monitor and manage their resources by varying the exploration methods and practices over space and time. This involved observing the outcome of combination of outlays over seasons and noting the potentials of different methods at different locations over time. The method could only support the needs of earliest societies and not at pace with the present in observatory periods for reasonable conclusion, more so with the dynamic nature of most environmental processes and elements.

(b) Ground visual observation and measurement: Field observation involves being physically present in the area of study for physical observation, survey and description of the characteristics of a phenomenon in-situ. A routine traveler would observe and record the relevant information for the current objectives which would change with time while stakeholders are interviewed where necessary,. The accuracy and details of data generated are functions of the knowledge and experience of the researcher. The entire process also involves approximations that are also subjected to human errors, misjudgment or oversight. They can sometimes become very tedious. A lot more depends on the adequacy of the sampled points and 'representation' on the field. Since seeing is believing, the technique remains valuable for monitoring and review of changes but not for serious quantitative analysis, multiple uses of output nor presentation of data spatially.

(c) Land Surveys: Arising from a first attempt by Dudley Stamp in 1933 over Britain, field survey exercises have been known to be tedious, costly and time consuming for large areas. The data by separate surveyors are characterized by varied challenges standardization and often difficult to integrate. The data and information are prone to being outdated before being

published or made available for users, depending on the adequacy of controls and verification which are also laborious.

(d) Statistical Records: Statistical records for spatial evaluation are as good as their sources. Statistics and estimates showing squares of kilometers of land, waterbodies and vegetation covers, figures on the number and volumes of facilities provided, by administrations are always accessible locally and globally from statistical bureau, development boards, public agencies and political parties amongst others. Most of these are controversial, wrong and often instigate disputes amongst parties.

(e) Archival Sources: Administrative records are usually gathered periodically, published and/or made available to the public by government institutions responsible for managing specific aspects of public resources. They are sourced using the any of the available techniques discussed in this paper, through socio-economic surveys or projections from already existing data. They are domiciled in respective units in charge of their planning, evaluation, research and/or statistics. They are stored in physical files and sometimes difficult to access for personal and official reasons. Data from administrative records are as limited as their sources. They are characterized by both conscious and unconscious errors of omission and commission. The data lack spatial components.

Mr. Vice Chancellor Sir, a general overview of the shortcomings of most conventional data collection techniques is provided by Adeniyi (1987) when he noted that data from field visual observation and recording techniques are resource consuming, administrative records are subdued by insincerity and undeserved restriction of access, interviews and questionnaire surveys are affected by inaccessibility factors while field measurements are prolonged and energy sapping. With rapid human imprints on resources in recent years, more parameters necessary for robust resources understanding and development are becoming unsuitable for needs and aspirations of decision

making. The traditional techniques of data collection are only valuable in small environments of static events (**Fig. 9**)

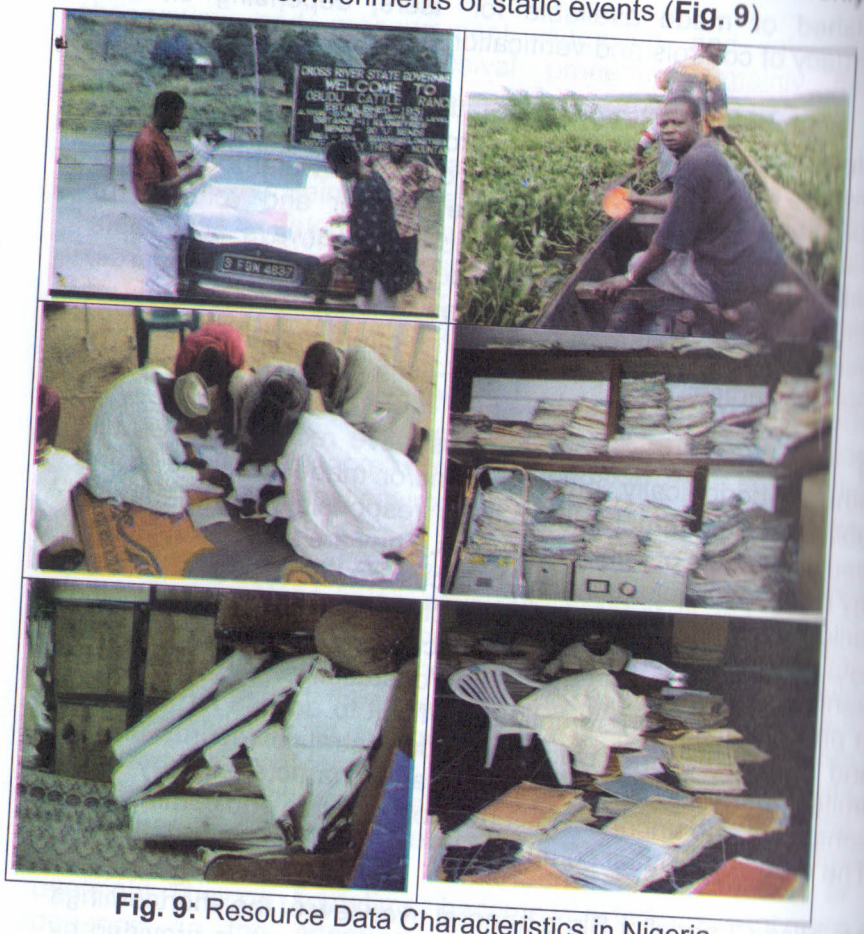


Fig. 9: Resource Data Characteristics in Nigeria

With increasing spatial data dimensions required on numerous themes at different scales, varied formats and levels of reliability, training in Geo-spatial Technology provides profound knowledge as enhanced toolbox over the traditional methods. Geo-spatial technology are quite better for contemporary researches and decision making. The current generation of Nigerian Geographers to which I belong is famous for good training and achievements across the globe. Not that most disciplines do not have the data and information, the challenge

is that they are either lack the capability of processing in large volumes through which adequate conclusions can be derived and linked tto unravel hidden treasures. The essence of Geo-spatial technology is that nobody gets to lie for any overt reason as every information cannot be apparent in a Geo-spatial database.

5.0 MY CONTRIBUTIONS

5.1 Systems Development

5.1.1 Cartography and Map Revision

The best people know of geography are maps. As a focus in my Ph.D. Thesis 'The Application of Satellite Remote Sensing and GIS in the Evaluation and Revision of Nigerian Topographical Maps' I identified the necessity for input by map users in the processes of map compilation, design and production. This was never attempted and had always affected the information that users were able to retrieve from the latent data of the real world depicted by the makers. I developed an instrument to engage ninety three (93) users across twenty two (22) intensive map-user organizations (shown on **Table 2)** on their map needs, how much of these were depicted and what they considered necessary for a revision.

The findings published in Soneye (1998a) established that 70% of the maps in use for various mandates are topographical maps primarily because there are hardly any other maps and that the particular maps are of limited usefulness for their institutional mandates. This is a situation triggered by some crucial factors, amongst which are: insufficiency of information contained, overgeneralization of the features shown, inappropriateness of some symbols adopted, and datedness of the mapped information. I established further that map maker had never consulted any of the user-respondents on their specific needs on a map and their preference for specific cartographic models.

Table 2: Agencies assed for Map user-needs *(Soneye, 2000)*

1.	Federal Dept of Agriculture and Land Resources *(Owerri and Kaduna)*
2.	Federal Department of Meteorology *(now Nigeria Met. Agency) (Sokoto, Lagos & Kano)*
3.	Federal Environmental Protection Agency *(now Federal Ministry of Environment), Abuja*
4.	Federal Road Safety Commission *(Lagos)*
5.	Federal School of Soil Conservation *(Jos & Owerri)*
6.	Federal Urban Mass Transport Authority *(Abuja, Lagos)*
7.	Federal Water Research Institute *(Kaduna)*
8.	Mass Media *: Punch Newspaper*
9.	*Mass Media: Guardian Newspaper*
10.	*Mass Media: Newswatch Magazine*
11.	Ministry of Agriculture and Natural Resources *(Lagos State)*
12.	National Institute of Freshwater Fisheries Research *(Jebba).*
13.	National Livestock Project *(Lokoja)*
14.	National Population Commission (Lagos, Sokoto & Abuja)
15.	Nigerian Immigration Department *(Lagos)*
16.	Nigerian Ports Plc. *(Lagos)*
17.	Oil Company: Ashland Oil Nigeria Ltd *(Port Harcourt)*
18.	Oil Company: Chevron Nigeria Ltd *(Lagos)*
19.	Research Institute: University of Ibadan
20.	Research Institute: University of Ilorin
21.	Research Institute: University of Lagos
22.	River Basin Dvpt Authorities *(Sokoto-Rima & Benin-Owena)*

Instances of delayed and suspended project plans and implementation due to paucity of maps were cited. Some suggestions for revised editions were provided. These were discipline-specific on data needs, mode of presentation, political boundaries, coordinate systems and units of measurement. More than two-thirds of the respondents suggested a 2 to 5 years revision cycle at scales ranging between 1:10,000 and 1:100,000 for rapid urban change areas and 5 to 10 years for others.

The worrisome findings led me to enquiries on who actually were the Nigeria map makers. The findings in Soneye (1999a) showed that they were low cadre surveyors photogrammetrists, cartographers and lithographers under the supervision of senior technicians in typical civil service. I discovered also that they had no flair for research or problem-solving investigations while the academics were interested tangentially on the map

utilization and critique of the sheets already produced rather than suggestions on what should be corrected on subsequent editions. I went further to examine the implications of these findings for digital database creation and management of the Nigerian map series in a GIS environment using four map sheets covering different parts of the country.

I used the (then) state-of-the-art PC ARCINFO / Atlas (ver. 2.0) package by ESRI to digitize on an A_0-Altek and analyze two sheets each of the 1:25,000 scale being compiled by the Federal Surveys Department (now Office of the Surveyor General) and the latest 1:50,000 series on a Pentium II computer. My findings reported in Soneye (1999b) affirmed the challenges created in adopting imperial and S.I. units on different sheets, variation in projective styles and reference datums, the data classification scheme and typology vis-à-vis the map symbols and the legend. These were resolved successfully in the simpler, cheaper and more sustainable methodology adopted in Soneye (2000). Examples of the products are shown in **Fig. 10**.

Suffice to note that the 1:25,000 maps were still being compiled more than thirty years (30) after the exercise commenced while none of the sheets had been revised because of failure to adopt my findings/recommendations. Soneye and Akintuyi (2013) reviewed the landmark achievement of Nigeria in map production and revision; and found a steady growth prior to independence and a downward turn from the early 1980s till the present time. We also revealed that the achievement made by the country in launching the Nigeria-sat remote sensing satellites into space had not made any significant impact on map revision in Nigeria. The images are hardly available for use for some reasons.

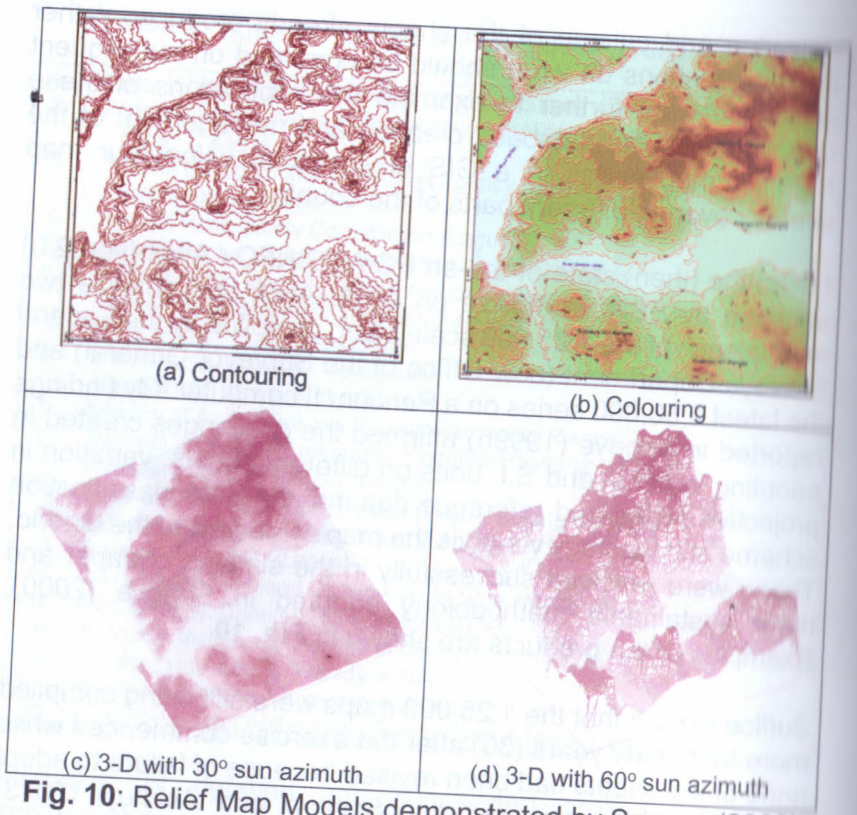


Fig. 10: Relief Map Models demonstrated by Soneye (2000)

5.1.2 Quantitative Analysis

With inspiration through the knowledge gathered from Professor Nurudeen Alao, Professor Adalemo and my other lecturers in the Departments of Geography and Mathematics at the University of Lagos, I am a 'born-again' disciple of quantitative minds. I have employed some substantial spatial analytical models in mathematics and statistics into my core geography areas of resources investigation through research as discussed in relevant sections. I have always supported the integration of analytical methods into the Department of Geography curricular and have co-taught them at various levels.

5.1.3 Remote Sensing and Geographical Information Systems

The Department of Geography, University of Lagos is the pioneer of contemporary geo-spatial techniques in Nigeria and among the first three in Africa, courtesy of the novel research focus of Emeritus Professor Peter Adeniyi and Professor Ademola Omojola. They created the Department's Laboratory for Remote Sensing (now Laboratory for Cartography, Remote Sensing and Geographic Information System).

In 1986, I was appointed a Research Assistant and Graduate Student on the Local Level Mapping of the Sokoto-Rima Basin and environs Project, a joint study by the Departments of Geography at the University of Lagos and University of Waterloo, Ontario, Canada. They exposed me to the interdisciplinary techniques of remote sensing, cartography, spatial analysis and Geographical Information Systems. I owe them a lot in this wise and I so acknowledge.

My academic sojourn which the University of Lagos nurtured both as a student and as a staff has taken me to the nooks and crannies of the Nigeria nation on both individual and collaborative researches and professional assignments. I have visited eighteen (18) countries in five (5) continents for the same cause). Some of my key research findings are presented in the next section.

5.2 Some of my Key Research Contributions

5.2.1 Administrative Areas of Jurisdictions

In Soneye and Omojola (1995), we appraised the rationale for the continuous creation of administrative units in Nigeria but noted that there were no relevant statistics that could enhance their rapid development. Having realized that there was no record of the geographical extent of the 31 states and 593 LGAs created in 1991, we mapped the administrative units digitally in the GIS environment to determine their absolute sizes and analyze them as a precursory decision-making tool for their development comparatively.

The results showed that the smallest states in Nigeria were Lagos (3,902km^2), Anambra (4,739km^2), Akwa Ibom (7,208km^2) and Osun (9,069km^2) while the largest were Niger (72,528km^2), Borno (68,868km^2), Sokoto (67,158km^2), Bauchi (65,531km^2) and Taraba (57,787km^2). On LGA basis, Mushin in Lagos State was the smallest (15.2km^2), followed by Aba in Abia State (16.2km^2), Onitsha South in Anambra State (21.4km^2) and Ibadan SW in Oyo State (34.0km^2) while the largest were Bali in Taraba State (14,339km^2), Chachanga in Niger State (12,009km^2) and Baruten in Kwara State (9,978km^2). It is doubtful if there had been any other source of objective information on till now.

5.2.2 Landcover and Landuses

Our paper, Omojola and Soneye (1993), adopted high resolution SPOT Satellite data and GIS to map and analyze the landuse and landcover resources of the sudano-sahelian middle Sokoto-Rima River, North Western Nigeria with the SPOT Image satellite system. My other research studies on landcover and landuse resources mapping and change evaluation over years and seasons are published in Soneye (1998b); Soneye (2010); Soneye (2014a); Soneye and Akintuyi (2012); Ayeni, Kapangaziwiri, Soneye, Vezhapparambu and Adegoke (2014), Fasona, Soneye, Ogunkunle, Adeaga, Fashae and Abbas (2014) and Ayeni, Cho, Ramoelo, Mathieu, Adegoke and Soneye (2013) **(Figs. 11 and 12)**.

The results provided requisite geo-spatial databases on the static and temporal characteristics of the resources at various geographical environments. As demonstrated in **Table 3**, basic spatial statistics and change matrix were generated and cartographic models in different perspectives which are capable of being integrated with other sets of data for decision-making objectives were produced. It is appropriate to conclude that the distribution and available stocks of the resources and their development are region-specific as determined by bio-physical and socio-cultural factors.

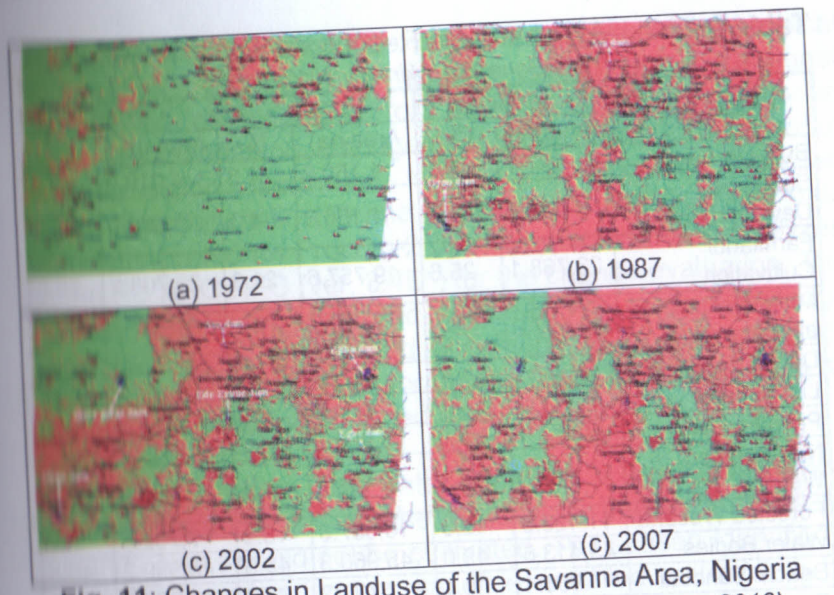


Fig. 11: Changes in Landuse of the Savanna Area, Nigeria *(Ayeni, Cho, Ramoelo, Mathieu, Adegoke and Soneye, 2013)*

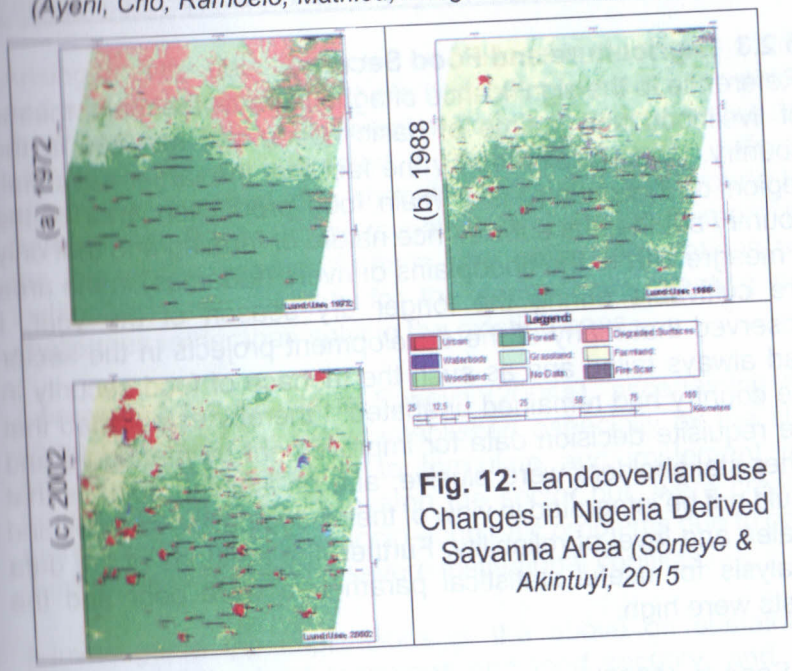


Fig. 12: Landcover/landuse Changes in Nigeria Derived Savanna Area *(Soneye & Akintuyi, 2015*

Table 3: Lekki–Ajah Landuse Resources; 1964, 1994 & 2006
(Soneye & Akintuyi, 2012)

Resource	1964		1994		2006	
	Area(ha)	%	Area ha)	%	Area (ha)	%
Built-Up Area	97.7	0.1	1,160.2	1.3	4,010.0	4.3
Scattered Development			1,150.8	1.3	8,544.0	9.2
Farmland/ Cultivation	23,768.1	25.6	19,757.6	21.3	23,708.2	25.6
Mosaic of palms and farmlands	3,697.9	4.0	2,614.5	2.8		
Dense Forest			61.4	0.1		
Light Forest			164.9	0.2		
Palm Forest	7,958.1	8.6	3,903.6	4.2		
Non-forested Wetland	45.8	0.1	113.8	0.1	1,823.4	2.0
Forested Wetland	11,428.0	12.3	16,907.6	18.2	7,792.5	8.4
Water Bodies	45,413.6	49.0	45,960.3	49.5	45,999.2	49.6
Beach/ Sandbar	366.4	0.4	572.02	0.62	926.8	1.0
Bare surfaces	4.0	0.0	437.71	0.47		

5.2.3 Agriculture and Food Security

Reference to the significance of agriculture as the major means of livelihood and source of basic needs and services in the country. I was fascinated by the fact that the larger savannah region of the country is a main food production area of the country but that the subsistence nature of farming and that only a meagre part of the floodplains of rivers (fadamas) in the area are cultivable during the longer dry season of the year. I observed that many of the development projects in the sector had always failed and as such the menace of food security in the country had remained unabated. I thereby established that the requisite decision data for improvement by managers and other stakeholders were elusive; and on isolated pockets that could not be integrated in view of their incompatible sources and scales and level of reliability. Further, the methods of the data analysis for useful statistical parameters were poor and the costs were high.

In Soneye (1998b), I designed my first study on agricultural application of geo-spatial techniques to test the potentials of the

(then) emerging satellite remote sensing, Geographical information systems and spatial technology to national agricultural development for assessing the dynamics in agricultural lands and management within about 200,000km^2 of Sokoto region, Northwest Nigeria. The digitally-processed SPOT Panchromatic (P) and multispectral (XS) satellite data were interpreted on Procom-2 optical equipment and analyzed in the PC ARCINFO (ver. 3.4D$^+$) for the change evaluation. The results were integrated and verified with local knowledge systems directly on the field and found to have a very high accuracy of close to 100% for upland farms and about 95% for fadamas and multiple-cropped areas.

The results showed that water, which is a most critical input reduced by about 80% in the dry season and as such all the uplands areas could not be cultivated. The season identified is when the teeming farmers sacrifice anything to travel to big cities in search of 'security' and menial jobs.

Arising from the data I collected on the local knowledge systems and archival sources that there had been various intervention programmes by the government at both the national, states and LGA levels, I was interested in examining how the different organs had succeeded in changing the status-quo around the Sokoto-Rima Basin. It was revealing that rather than improving the lots of the peasant farmers, the policy formulations and institutional arrangements for the sector were creating new challenges rather than solving the existing ones.

I presented my results in Soneye (2004a), ascertaining that some new agencies were established especially by the state and federal governments to formulate and implement new programmes that could revamp the sector but were creating more environmental and socio-economic problems due to gross duplication of duties and severe institutional conflicts.

I investigated the implications of the above on sustainable utilization of the land resources and food security, and also analyzed the per capita farm-size holding by farmers in six (6)

LGAs of the Sokoto region in a wet season using interactive application of hybrid remote sensing and Geo-Information Systems. My findings show that 66% of the land upland was cultivable only in the short wet season of less than three months per annum with a value of 0.61 ha per head while the remaining 34% in the prime fadama area was less than 0.1 ha per head. Sokoto LGA had the lowest figures for all the categories of farmland while Rabah LGA had the maximum of 1.2ha. These and the gloomy scenario portended by the results were discussed in Soneye (2014a) with emphasis on the food sustainability and social security in the region **(Fig. 13, Table 4)**.

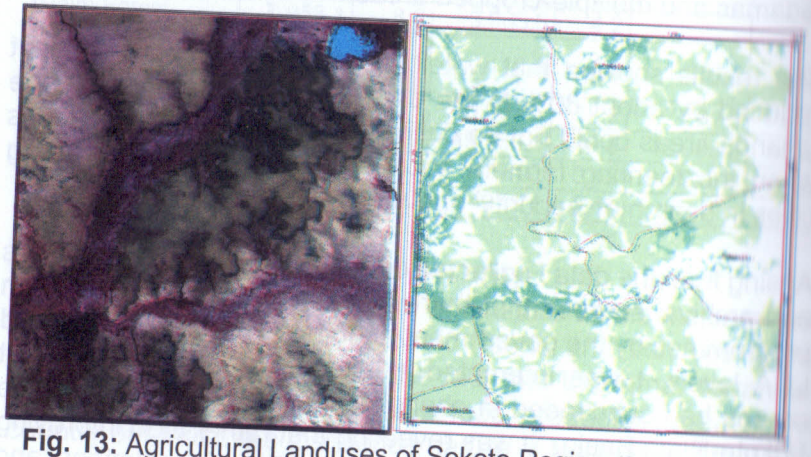


Fig. 13: Agricultural Landuses of Sokoto Region *(Soneye, 2014a)*

Table 4: Per Capita Farm Holdings in **Sokoto** LGAs (**in** ha) *(Soneye, 2014a)*

Farms	Total Farmland	Dange Shuni	Kware	Rabah	Sokoto	Wamako	Wurno
Cultivated Uplands Intensively	0.195	1.152	0.316	0.886	0.019	0.0	0.441
Cultivated Fadamas	0.037	0.008	0.094	0.182	0.002	0.248	0.023
Partly Cultivated Fadamas	0.063	0.0	0.103	1.026	0.0	0.169	0.074
Plantation/ Orchards	0.001	0.0	0.002	0.003	0.0	0.025	0.0

5.2.4 Transport

Noting the significance of road projects in development and impacts on bio-physico-chemical and socio-economic resources, I evaluated the implication of upgrading the 13km long Ojota - Ikorodu Expressway from a single carriage (Trunk A road) constructed to link the Lagos Metropolis with Ikorodu Township in 1973 versus its dualization of 1993 to accommodate increasing vehicular traffic and congestion.

The study employed geo-spatial technology to examine the highway impacts on adjoining landuses resources between1989 when it was just dualized to 2007, some 18 years later. I used overlapping aerial photographs and satellite images respectively for the 2-time periods with auxiliary data from relevant sources.

The results, published in Soneye (2010) showed a rapid increase in streets around the corridor which leads to increase in nodes, segments and connectivity **(Table 5; Fig. 14)**. Fully built-up areas within some 2.5km threshold of the highway increased by +102% from 17,487ha in 1989 to 35,371ha in 2007, an average of 994ha (6%) per annum. All the other landuses within the 500m buffer lost to the physical development. Palms were depleted completely, reserved/ forested areas reduced by -0,874ha (-68%) and -567ha annually. Similar changes in amenities along the corridor were determined along with the implications for sustainable road corridor management. Related findings were found in my study of the Port Harcourt–Onne East-West Road (Allott, 2007) and so many others in transport application areas.

Table 5: Segments of Ikorodu Road, 1989, 2007 *(Soneye, 2010)*

Category	1989		2007		Change in Length		Change in Segment	
Type of Road	Length	Segment	Length	Segment	km	%	No	%
Dual Carriage	10.8	24	41.5	113	30.7	28	89	371
Main Roads	19.6	42	23.2	56	3.6	4	14	33
Streets	157.1	553	164.2	581	7.1	18	28	5
Total	203.5	632	244.9	778	41.4	5	14	23
						20	6	

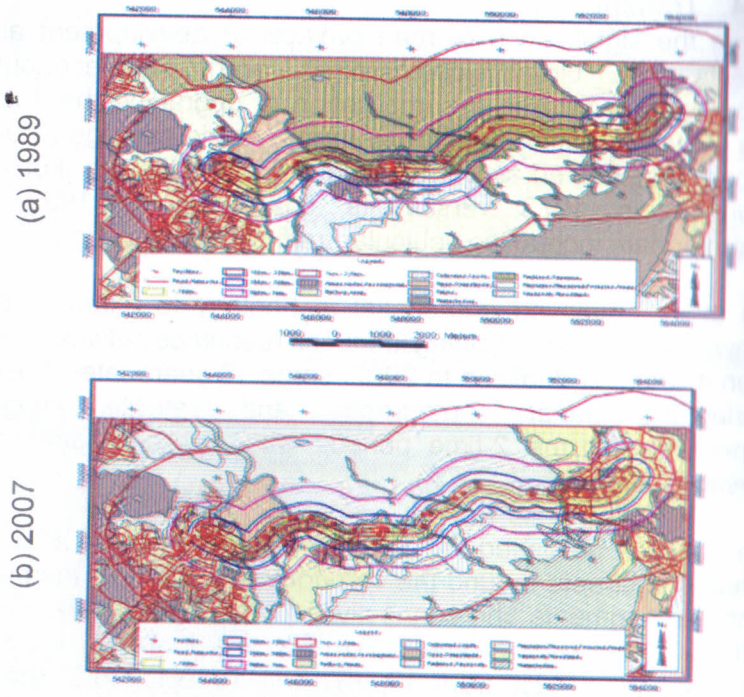


Fig. 14: Changes around Ikorodu Road Corridor *(Soneye, 2010)*

On water transportation, I used geo-spatial technology for my study of the extensively debated capital dredging of Niger River for enhanced maritime transportation and service delivery. As a contributor to the assessment of the socio-economics and waste management impacts, I navigated the 572 km stretch from Baro Koton Karfi and Onitsha to Warri through Lokoja, on intensive reconnaissance, groundtruthing for image interpretation and mapping the shoreline settlements.

Notable amongst my findings which I published in Soneye (2007) included (i) that there were a total of two hundred and thirty six (236) communities across the twenty eight (28) LGAs and five (5) states of the federation traversed; (ii) that the communities were mostly rural and with potentials for transport, tourism, mining and industrial development but would suffer

access to their basic domestic water and aquatic resources; (iii) that the negative impacts would be aggravated by paucity of data on their existence, site and existing infrastructure; and, (iv) that comparatively, Koton Karfe to Lokoja and Bomadi to Burutu, which are two of the five segments and located respectively in the savannah-dominated escarpment of Kogi State and the lowlands swamps of the Niger Delta had different impacts magnitudes and directions in view of the variation in their resources and development spatio-temporarily.

I was on a similar investigation of the Bonny River dredging (Unilag Consult, 1996) and a jetty upgrade and expansion programme at Elegbata Marina Lagos (Akopeb, 2014). From these, we further established the menace of ship wrecks along Nigeria waterways and the implications for navigation safety. In particular, we found out further that the Marina - Apapa axis on the Apapa Quay - Lagos Lagoon channel affected severely with jetty and maritime operators had abandoned numerous relics of sank ships and boats of different sizes in the water for years running. They include government agencies such as the Nigeria Defence private operators. We recommended a more detailed barthymetry survey to inventorize and cause for removal by NIMASA and other stakeholders before they constitute hazards.

5.2.5 Climate and Climate Change

I established that climate change and variability were significant determinants of the success or otherwise to the sustainability of human activities in the entire Nigeria, commencing with the Sokoto Rima valley right from the period of my postgraduate studentship in the late-1980s. For examples, the agricultural landuses and landcover resources and changes around tudulands were totally dependent on rainfall regimes and intensity while that of fadamas included regulations by upstream dams that were built to manage water resources in the area (Soneye, 1998b, 2004a).

A singular contribution to knowledge was in Soneye (2014b) in which changes in the surface water resources of the Nigeria sudano-sahellian environment were evaluated with satellite remote sensing and *map-matics* over a 40-year period spanning

1965 to 2005. The results showed that despite the construction of large-scale dams upstream of major rivers, floodplains had reduced by an alarming rate of -40% (**Fig. 15**). Surface waterbodies reduced by -37.1% in length and -9.7% in area over the period indicating some whooping -10.9km and -9.7ha annually. All the headstream tributaries with Orders O_4 and O_5 and their ponds were found to have dried up leaving dry channels of bare sands and mudflats behind while those in Orders O_3, O_2 and O_1 diminished by -1.5, -4.0 and -5.3 segments per annum respectively (**Table 6**).

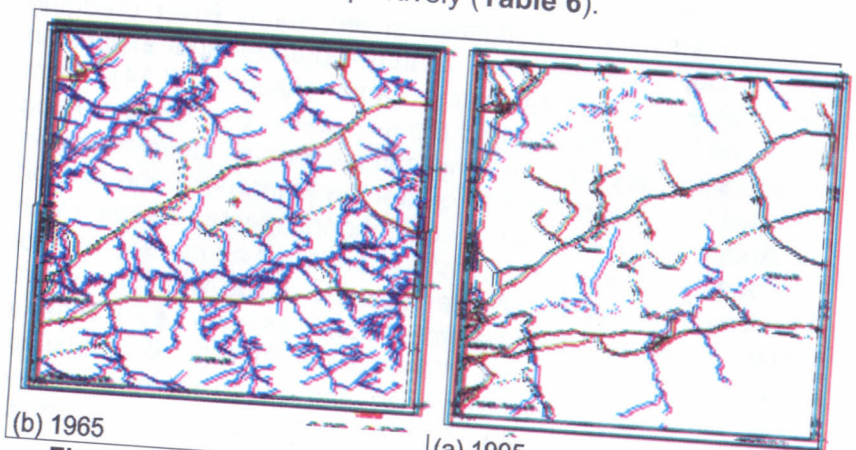


Fig. 15: Changes in Stream Netwroks of Sokoto – Rima Valley *(Soneye, 2014b)*

My other contributions in climate and climate change studies with geo-spatial tehnology include:

(i) Ayeni, Soneye, Fasunwon, Miteku, and Djiotang – Tchotchou (2011) on water resources development optimization in climate change scenarios;

(ii) Soneye and Akintuyi (2012) on urban expansion, population changes and wetlands depletion of Lekki–Ajah axis Lagos;

(iii) Fasona, Soneye, Ogunkunle, Adeaga, Fashae and Abbas (2014) on simulation Landcover /LandUse change in the Savanna under different Climate Scenarios; and,

(iv) Ayeni, Kapangaziwiri, Soneye, Engelbrecht and Adegoke (2014) on impact of climate changes on water resources.

Table 6: Changes in Surface Water Characteristics of Sokoto-Rima Valley *(Soneye, 2014b)*

Parameter		1965 (A)	2005 (B)	Change (1965 to 2005)		Mean Annual Change	
				Size (C = B - A)	%age (D = C/B%)	Size (E = C/40)	%age (F = D/40)
Order (O_i)	O_1	219	7	-212.0	-30.3	-5.3	-0.8
	O_2	164	3	-161.0	-53.7	-4.0	-1.3
	O_3	64	3	-61.0	-20.3	-1.5	-0.5
	O_4	19		-19.0		-0.5	0.0
	O_5	6		-6.0		-0.2	0.0
Bifurcation Ratio (B_{ri})	B_{r1}	2.1	2.3	0.2	0.1	0.0	0.0
	B_{r2}	1.6	1.0	-0.6	-0.6	0.0	0.0
	B_{r3}	3.4		-3.4		-0.1	
	B_{r4}	3.2		-3.2		-0.1	
Drainage Density(km^2)	1.18	0.74	-0.44	-60.07	-0.01	-1.50	
Drainage Density(m)	0.88	0.37	-0.51	-137.84	-0.01	-3.45	

Mr. Vice Chancellor Sir, though almost gone are those days when almost every secondary school, higher institutions and government projects would have their independent weather stations for training, recording and monitoring climate, permit me, however, to announce that the University of Lagos has three (3) stations installed currently. The Department of Physics and Geophysics has one at the Science complex and another on the Senate Building while the third by the Department of Geography is on the Arts Block. My investigation confirms that the University of Lagos is the only University in Nigeria that can boast of this feat. I am fulfilled to have initiated that of Geography during my first tenure as Acting Head of the Department in 2009.

5.2.6 Air Quality and the Case of University of Lagos

There were no records of air quality characteristics in the country presently because no agency is saddled with the mandate. I however attempted an evaluation of some Green House Gases around Petroleum Tank Farms on Apapa-Oshodi Expressway Lagos over a period of six (6) months, lasting between February and July 2010. I measured in-situ the CO, NO_2, SO_2 and noise around six (6) bus stops and correlated the data with existing

regulatory limits with a view to identifying areas of serious concerns.

The results in Soneye (2012) show that NO_2 was nil at all the stations, SO_2 was detected continuously at a station around the foot of a bridge and CO was high in bus stops proximate to some products depots and garages for fairly-used vehicles popularly known as 'tokunbo vehicles' in Nigeria. Noise and temperature were high in all the bus stops. Nonetheless, the values were within acceptable limits but for a few occasions **(Fig. 16)**.

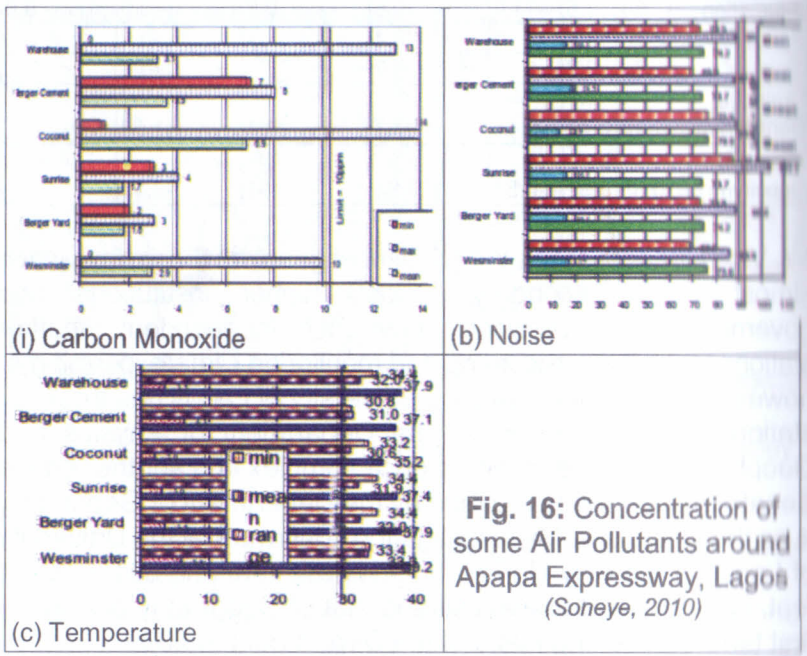


Fig. 16: Concentration of some Air Pollutants around Apapa Expressway, Lagos *(Soneye, 2010)*

I presented, in Soneye (2013), the preliminary results of the 2009 to 2012 results of my personally-funded daily *in-situ* monitoring of eleven air pollutants at forty-four (44) geographically-selected sites around twelve (12) main landuses of the University of Lagos Akoka Campus. The results were statistically analyzed spatio-temporarily and compared with known regulatory limits **(Table 7)**.

Table 7: The Sampling Sites for my Air Quality Monitoring Study in the University of Lagos and number of *in-situ* measurements, 2009 – 2012

Landuses		Location	2009	2010	2011	2012	Total
Administrative		Senate Building			30	37	67
		Student Affairs		7	27	36	70
Commercial		FSS Shopping Complex	18	26	22	31	97
		New Hall Shopping Complex	19	24	22	31	96
Educational		Fac. of Art	17	30	26	37	110
		Fac. of Business Administration			30	36	66
		Fac. of Education	19	22	21	32	94
		Fac. of Engineering	19	21	0	0	40
		Fac. of Science	20	38	23	33	114
		Fac. of Social Sciences	19	20	22	31	92
		Staff School			26	34	60
Medicals		Medical Centre	18	27	43	63	151
Recreational	Sporting	Guest House Quadrangle	17	22	26	36	101
	Pool	Sports Centre	19	23	22	32	96
	Hall	University Multipurpose Hall	16	22	22	32	92
Religious		Chapel Catholic axis	19	20	22	31	92
		Mosque			28	31	59
Staff Quarters	High Pop	High Rise Complex	18	23	22	32	95
		High Rise Round About			25	32	57
	Low/ Medium Pop	Kosoko Dr. (Baiyajjida Junction)	19	23	21	30	93
		Ozolua Road	16	22	22	32	92
		Ransome Kuti Road			24	32	56
Students' Hostels		Amina-Kofoworola Halls	18	21	21	32	92
		Honours Hall			25	32	57
		Moremi Hall	13	22	0	0	35
		Madam Tinubu Hall			28	30	58
		Makama Bida Hall	19	22	22	30	93
		Eni-Njoku Hall			25	30	55
Transportation	Garages	Mariere Cab Garage	20	20	26	36	102
		Danfo Garage (CITS)	18	24	22	30	94
	Main Roads	AP Filling Station Round About			24	31	55
		Bookshop Round About			25	33	58
		ISL Round About			25	32	57

Landuses		Location	2009	2010	2011	2012	Total
		Long Bridge (Access Road)	19	22	0	0	41
		University Main Gate	16	18	22	32	88
		University Second Gate	15	21	22	32	90
Vegetation	Mangrove Swamps	Guest House Monkey Bush		12	26	36	74
		Wooden (Foot) Bridge	19	27	27	36	109
	Horticultural	Lagoon Front (Botanical Garden)		11	26	36	73
		UBA Park			25	32	57
	Vegetation & Utilities	Services Area	18	28	19	30	95
		Works & Services Department	19	20	19	31	89
Wastes/ Dump Sites		Fac. of Art Refuse Dump		16	26	37	79
		E-library – Guest House Gen. Site	2	12	26	36	76
Waterbodies		Guest House Lagoon Front	0	8	26	35	69
		Man-O-War Bay Lagoon Front	18	34	26	36	114
Total			**487**	**708**	**1,059**	**1,446**	**3,700**

Amongst others, I established that NO was never detected in any of the locations throughout the 4-year period; CL_2, H_2S and NO_2 were detected marginally; HCN and PH_3 were fairly detected while CO, Noise and NO_2 were high, sometimes beyond acceptable regulatory limits particularly around the main public transport areas by the Main Campus Gate and indiscriminate burning at refuse dump sites around Ransome Kuti Road (now closed) (**Fig. 17**).

Unfortunately I decided to suspend my further investigations and integration of the results with the medical records of residents around the flash points when I was admitted at National Orthopedics Hospital Lagos for surgical operation in 2014.

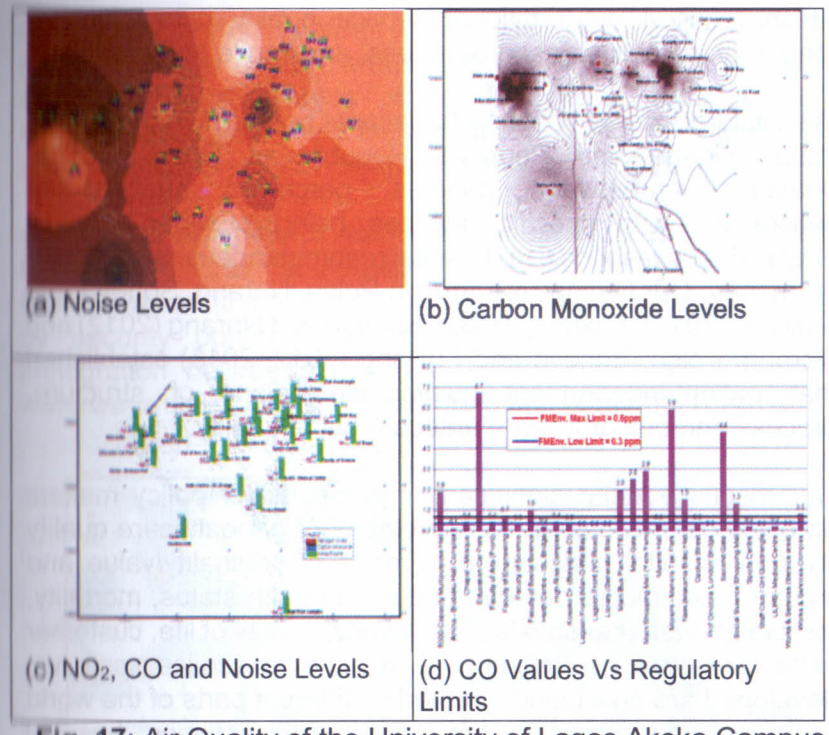


Fig. 17: Air Quality of the University of Lagos Akoka Campus
(Soneye, 2013)

5.2.7 Health ad Healthcare Services

Starting from the literary knowledge that the healthcare services being offered by private hospitals are superior to those by public hospitals, Polsa, Spens, Soneye and Antai (2011) investigated the service quality perception of patients in the two healthcare systems in Nigeria. A 7-score Likert Scale earlier developed by the Research Team on their studies of Finland was adopted for survey of 220 in- and out-patients in 23 hospitals in Lagos.

Our results showed that the two systems scored very high positively but that the scores became higher for private hospitals when we excluded the responses from high-level specialist hospitals. We were not satisfied fully with our survey instrument

which focused on traditional service quality dimensions of tangibility, reliability, responsiveness, assurance and empathy.

We explored a new frontier international perspective of Finland, India, Nigeria and People"s Republic of China on the relationships between patients' perceived quality and satisfaction with specific services being provided, clinical effectiveness, service use, hospital recommendations and value for money. Our findings reported in Polsa, Narang, Soneye and Fuxiang (2011), Fuxiang, Polsa, Soneye and Narang (2012) and Narang, Polsa, Soneye and Fuxiang (2012, 2015) established that patient-independent quality dimensions of structure, process and outcome were antecedents to quality.

Our results portend significant implications for policy makers and service providers in the development of healthcare quality through hospital atmosphere in terms of originality/value and focus on healthcare outcome focus on health status, mortality, morbidity, customer satisfaction, loyalty, quality of life, customer behavior and consumption. The healthcare service scale we developed are now being adopted in different parts of the world as alternative views to the relationship between hospital environment and atmosphere on one hand and healthcare services quality and delivery on the other hand.

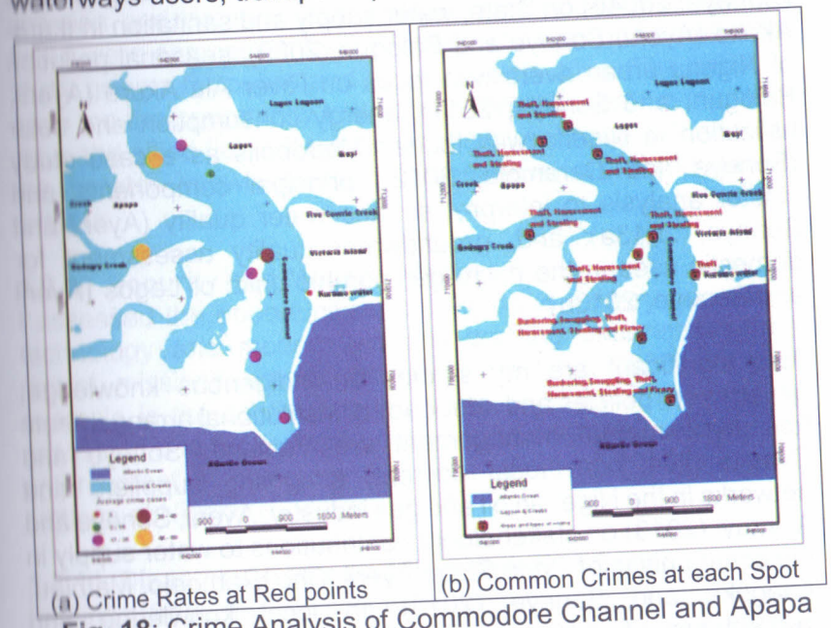
5.2.8 Crime and Policing

My interest in the use of Geo-Spatial Techniques in this aspect was stimulated by the positive correlation between development growths, crime waves and inability of the Police to maintain peace and protect lives and properties fairly in Nigeria despite continuous re-organization of the force and establishment of additional stations. In Soneye (2002), I employed the techniques to assemble and analyze spatially the crime incidences in Ikeja LGA against the locations and areas of jurisdiction of the exiting police stations.

The results showed that stations' distribution neither conformed to the sizes of the wards in which they were sited, the demographic characteristics nor the crime locations. The

relatively higher crime areas were found to be the low income - high population density areas and had less proximity to the stations. The thresholds of existing police stations were therefore evaluated using the geo-spatial facilities to determine areas that deserve additional stations.

Our spatial analysis of maritime crimes and security around Commodore Channel / Apapa Quays by Soneye and Giwa (2015) was multi-stakeholder based with data on crime reports by security personnel in the police, navy, customs and immigration between 2004 and 2009 as well as survey of waterways users, transport operators and residents (**Fig. 18**).



(a) Crime Rates at Red points (b) Common Crimes at each Spot

Fig. 18: Crime Analysis of Commodore Channel and Apapa Quays, 2004 – 2009 *(Soneye and Giwa, 2015)*

We found out that though ports establishment encourage anti-social behaviors, the root causes of crimes along Apapa Quay were poverty, laziness and peoples' predisposition to offend. It was discovered that crime rates along the channel vary significantly, the control agencies were not well distributed over

space and were hindered by facilities to combat incidences promptly.

5.2.9 The Environment

I have participated in a series of professional application of geo-spatial techniques for some numbers of research studies and technical applications. Most of them were multi-disciplinary and of national and international collaboration in view of their scopes.

Some of my key researches on mapping and monitoring of the environment include urban wastes management in Lagos State (Soneye, 2004b) on State; water supply and sanitation in Ikare-Akoko (Ayeni, Soneye and Balogun, 2009); seasonal pollution of Nigeria urban rivers with focus on River Ala Akure (Ayeni, Balogun, and Soneye, 2011); energy consumption and solar utilization in Nigeria with Ibadan Metropolis as a case study (Soneye and Daramola, 2012); principal components and cluster analysis to interpret surface water quality (Ayeni and Soneye, 2013a); and, groundwater quality assessment for domestic uses in the micro-geomorphic units of Lagos (Ayeni and Soneye, 2013b).

Also significant are my studies on indigenous knowledge, government policies and adequacy of institutional arrangements for environmental management are Vaaland, Soneye and Owusu (2012) on local content, struggling suppliers and networks in the Nigerian oil and gas industry; Ayeni, Soneye and Akintuyi (2013) on stakeholders contributions to water supply in the communities of Ondo State; Ayeni, Cho, Ramoelo, Mathieu, Adegoke and Soneye (2013) on local knowledge and perceptions of water stress for explaining landuse and landcover changes in Nigeria; and, Ayeni, Soneye and Badru (2014) on indigenous knowledge adaptation and socio-cultural nexus of water resources management and humanitarian services in Nigeria derived savanna region.

I have collaborated with others on about two hundred studies on (i) environmental impact assessments, post-impact

assessments and evaluation reports; (ii) designs and reviews of development projects; (iii) sensitivity mapping (iv) trajectory modelling for fate of oil and other pollutants from projects (v) bathymetric and seismic surveys (vi) Evaluation of public-private-partnerships options for government projects especially dams and ports development; as well as (vii) formulation of environmental, risks, security, strategic, community, hazards, waste management actions and monitoring plans.

Primarily, I cover the components of landuse, socio-economics, climate/meteorology and air quality while my main responsibilities included coordination, fieldworks, report collation and defence at respective fora. Quite a number of these were engineered by the Unilag Consults and some other study groups for public and private clients alike. The activities gave me the opportunity to work with practitioners on my study area and allied fields for gown and town endeavors. It afforded me greater knowledge and experiences on my academic outputs.

5.2.10 Security and Modern Warfare

I assessed the opportunities for Nigeria in military geo-spatial technology and modern warfare drawing experiences from recent missions across the globe (Soneye 2006). A good example is the spatial support systems of the techniques for assessing and modelling human and material vulnerability and enforcement of peace in the multi-ethnic and multi-religious settings of Nigeria (Soneye, 2011a).

5.2.11 Disasters, Risks and Humanitarian Services

Findings from my studies on disasters, risk modelling and management with geo-spatial techniques studies are published in Soneye (1995); Fasona, Soneye, Nwokedi and Oladeinde (2011); Fasona, Omojola and Soneye (2011); Fasona, Omojola, Soneye and Akintuyi (2014) and Soneye (2014c). We unearthed that over two-thirds of the producing oil and gas wells in the Niger delta were on inland areas and have high potentials for disrupting the socio-ecological systems if not properly managed.

It was established by Soneye (1995) that some settlements along the entire Atlantic shoreline of Nigeria were being washed away completely in recent times though more pronounced around Escavos-Forcados, Nun-Brass – Akassa, Bonny-Andoni and New Calabar – Bonny river mouths. Areas with shoreline protection and water breakers were mapped to have recorded low results.

Suitability of the techniques for sustainable disaster relief operations and environmental protection were established in Soneye (2011b). In Fasona, Omojola and Soneye, (2011), we mapped the sensitivity, risk levels and degradation potentials of the oil and gas producing Mahin area of Ondo State and discovered that mangrove ecosystems, scrub/coastal grassland, farmland/fallow and built-up areas had highest probabilities currently in that order while further simulations identified soil, geology, elevation, distance to ocean and location of abandoned wells as having some highest probabilities in about the next 100 years from now.

Impacts of perennial flooding and humanitarian reliefs supply chains for forty two (42) affected neighbourhoods of six (6) Lagos Metropolis LGAs were mapped for 2010 and 2012 in Soneye (2014c) and proved that the incidences emanated from both natural and human-induced activities, led to large-scale human displacement and loss of lives and assets; and that reliefs were mostly from neighbours, spiritual homes and relatives directly to victims.

Mr. Vice Chancellor Sir, some of my key research and fieldwork experiences are shown in **Fig. 19.** My publications are in reputable journals and most of them are accessible online. They are cited in multi-disciplinary studies widely across the globe as revealed by frequent notifications at the respective websites.

Fig. 19: Some of my Research and Fieldwork Experiences

5.3 Research Collaborations

The foregoing exhibits the collaboration perspectives of my research endeavors and practices across disciplines and nations. I work with colleagues both in the sciences, social, medical, marketing, environmental, education and business sciences. My most recent encounter with the biological sciences led to a joint University of Lagos Botany – Geography Study Group under the Leadership of Professor Toyin Ogundipe, DVC Academic and Research. We have got two key TETFUND-sponsored awards in 2015-2017 and 2017-2019.

The first on 'palynological and GIS modelling of climate and land-cover changes around the Lagos coastal environment' with the DVC as Principal Investigator established that the Lagos coastal environment is recording severe losses of its ecosystem over time and that there is limited concern due to poor knowledge and scanty chronological records on its landcover/landuse, climate and palynology which can hardly be integrated for meaningful deductions and decisions. It aims at generating the current land-cover patterns from remote sensing, climate data from downscaled models and analyze the field palynological samples to recreate the past and predict the future landcover and climate with probability surface databases and maps.

The second project on 'Land-use change and carbon emissions in south West Nigeria' has Dr. Mayowa Fasona as the Principal Investigator. It aims at investigating the drivers and relationship between landuse changes and carbon emission with a view to reducing the contribution of landuse change-derived emissions to climate change in Nigeria. The project is just taking off. I am in joint supervision of postgraduate students in other departments. Mitchell Iyabo Fasona whom I am co-supervising with Prof. R.I. Egonmwan is on the last lap of her programme in the Department of Zoology on 'Landscape conservation and connectivity analysis for large mammals in Omo-Shasha-Oluwa Forest Reserves, South-West Nigeria'.

Internationally, I started with the joint Lagos and Waterloo sponsor of my trip to Ontario as a University of Lagos Research Assistant and Postgraduate Student in 1991. I also have a dedicated Research Team on Healthcare, Disasters and Humanitarian Logistics domiciled at the Hanken School of Economics Finland with members from Finland, Sweden, India, China, USA and Ghana; and another domiciled at the University of Stavanger Norway with members in Finland and Sweden. N doubt the hardworking relationship and support we maintain in the teams have contributed to my current academic status.

Mr. Vice Chancellor Sir. My international collaboration has not only afforded me the opportunities to exhibit my knowledge of geo-spatial techniques, it has also given me an edge to bridge gaps in contemporary multi-disciplinary researches on resource analyses and development over the geographical space of diverse culture and tradition. Perhaps, my career in geo-spatial techniques and resource analysis was first aroused by my mixed rural and urban background, typical of an Egba indigene though unconsciously at that age, and my NYSC assignment at the (then) Gongola State which has seven different eco-climatic zones and close to 100 languages/ethno-cultural regions.

5.4 Training, Capacity Building and Mentoring

I have produced four Ph.D. graduates as follows: Amidu Owolabi Ayeni (2010), Post-Doc in South Africa 2012); Isaiah Sewanu Akoteyon (2014); Akinlabi Oluyemi Akintuyi (2015); and Adebola Oluwatimilehin Daramola (2016). They have all remained in academics with a view to improving capacity building in their respective areas of Geo-spatial techniques. At the concluding stage of Approval of Titles and Supervisors on their programmes are: Kayode Adeyemi Biney, Chukwuemeka Anthony Onyekwelu and Michelle Iyabo Fasona. Mbom-Abasi Inyang, Emmanuel Wunude, Kayode Fasunhan, Aramide Adebola and Adepoju Olukayode Faderin are on the field conducting their data collection.

I have supervised more than 100 Masters Students in the Department of Geography since I was employed in the

University of Lagos as follows: M.Sc. Geography (42), Masters in Geographical Information Sciences (61) and Masters in Transportation Planning and Management (11). I have also supervised about 160 Bachelors Students, some of whom I have mentored for further academic and professional careers pursuits in geo-spatial technology within and outside the country, and have been good ambassadors of their Alma matter.

5.5 My key Services to the University community

a. Member, Business Committee of Senate, University of Lagos (Elected by the Senate) (2017–2019)
b. Ag. Head, Department of Geography, University of Lagos (2008 – 2009; 2015-2016)
c. Member, Board of Unilag School of Postgraduate Studies (2003–2005; 2006-2007, 2010-2013 and 2016-2017)
d. Pioneer President, Unilag Academic Cooperative Multipurpose Society Ltd (2004–2010)
e. President, University of Lagos Senior Staff Club (2011–2012)
f. General Secretary, University of Lagos Senior Staff Club (2000-2001; 2005–2006)
g. Chairman, University of Lagos Students Union Electoral Committee (2015)
h. Senate Member, University of Lagos, University of Lagos (Elected by Congregation) (2006 – 2010)
i. Member, Housing Committee, University of Lagos (Elected by Congregation) (2008–2010)
j. Member, Vice Chancellor Search Team, University of Lagos (Elected by Senate) (2011)
k. Hall Master, Eni Njoku Hall, University of Lagos (2014–2016)
l. Hall Warden, King Jaja Hall, University of Lagos (2006-2014)
m. Welfare Secretary, ASUU, Unilag Branch (2010 – 2012)
n. Chairman, Faculty of Social Sciences Results Vetting Committee, University of Lagos (2011 – Date)
o. Faculty of Social Sciences Representative, Task Force on Missing Results, University of Lagos (2010 – 2011)
p. Pioneer Coordinator, Masters in GIS & PGD GIS Programme University of Lagos (2001 – 2008)
q. Initiator, Masters in Disasters Management, University of Lagos (2016)
r. Chairman, Geography Curriculum Development & Review Committee (2010 – 2013; 2015-2016)

s. Coordinator, Customized Programmes in Remote Sensing, Cartography & Geo-nformation (1997-2000)

Outside the University of Lagos, I have served as External Examiner to the Lagos State University (2016 – 2018) and the Regional Centre for Training and Aerospace Surveys, Ile Ife (2012–Date). I have also assessed good numbers of Thesis from some institutions for Ph.D. Awards and publications for academic appointment and promotion. I served on the NUC Accreditation Team to the University of Abuja in June 2017.

5.6 My on-going researches and practice currently

i. *Title:* Palynological and Geographical Information System Modeling of Climate and Landcover Changes around the Lagos Coastal Environment
Project Initiator/Principal Investigator: Prof. Oluwatoyin Ogundipe (DVC, A&R), University of Lagos
Principal Researchers: Prof. Alabi Soneye, Drs. Sola Adekanmbi, Gbenga Adeonipekun, Tope Onuminya & Mayowa Fasona (University of Lagos) and Dr. S. K. Muyiolu (NIMET)
Funders: Tertiary Education Trust Fund (TETFUND) / University of Lagos
Duration: 2015 – 2017 (Six papers already a*ppeared* in peer-reviewed conference proceedings or journals)

ii. *Title:* Landuse change and Carbon Emissions in South-West Nigeria
Principal Investigator: Dr. Mayowa Fasona, Department of Geography, University of Lagos
Principal Researchers: Prof. Oluwatoyin Ogundipe, Prof. Ademola Omojola, Prof. Alabi Soneye and Dr. Gbenga Adeonipekun (University of Lagos)
Funders: Tertiary Education Trust Fund (TETFUND) / University of Lagos.
Duration: 2017 – 2019

iii. *Title:* Cross-national studies of Healthcare Services Quality, Atmosphere and Outcome of Finland, India, Nigeria, the Peoples' Republic of China and United States of America

Project Initiator//Principal Investigator: Professor Pia Polsa, Department of Marketing & Corporate Geography, Hanken School of Economics, Helsinki, Finland

Principal Researchers: Profs. Karen Spens (Hanken School of Economics, Finland), Alabi Soneye (University of Lagos), Ritu Narang (Lucknow University, India), Wei Fuxiang and Fan Xiucheng ((Tianjin University of Commerce, China), Imoh Antai (Jönköping University, Sweden) and Melea Press (University of Berth, United Kingdom).

Funders: Liikesivistysrahasto (2006-2007); och Näringslivets (2009-2011); Samt Hanken Foundation (2011-2013) & Academy of Finland/Hanken School of Economics (2014-Date).

Duration: 2009 till Date

Publications: Three (4) papers in reputable international journals and four (4) papers in peer-reviewed Proceedings.

iv. *Title:* Industrial Networks, Local Content and Competitiveness of Companies in Nigerian Oil and Gas Business Development

Project Initiator//Principal Investigator: Professor Terje Våland, University of Stavanger Norway (Project Initiator).

Principal Researchers: Profs. Alabi Soneye (University of Lagos, Nigeria) and Richard Owusu (University of Vaasa Finland/ Business School Linnaeus University, Sweden).

Funders: EPCI Foundation Norway and Shell Petroleum Development Corporation.

Duration: 2010 – Date.

Publications: One (1) major international journal publications and two (2) conference papers presented and/or published in peer-reviewed proceedings.

v. *My Personally-funded Researches and Professional Practices*

a. Measurements, database creation and monitoring of Concentration of Green House Gases (GHGs) around Landcover/Landuse Areas in Nigeria (2009-Date);
b. Disasters Assessment and management, humanitarian assistance, supply chain and service quality (2010- Date).

c. Environmental impact assessment, post-impact assessment and evaluation; sensitivity mapping, bathymetry surveys and trajectory modelling; and,
d. Formulation of environmental, community, hazards, risks and waste management plans.

5.7 Professional Associations and Boards of Journals

I am an active member of the following professional associations:

a. Leadership in Environment and Development (LEAD), United Kingdom, of which I received my Fellow in Mexico City (2009),
b. Nigerian Geographical Association (NGA)
c. Nigerian Cartographic Association (NCA)
d. Production Operation and Management Society (POMS), USA
e. International Association of Science and Technology for Development (IASTED), Canada.
f. Sustainable Energy and Environment, Malaysia.
g. International Academy of African Business and Development (IAABD).

I am the initiator and pioneer Editor-in-Chief on the Lagos Journal of Geographical Information System (LJGIS). I am also on the Editorial Boards of the Journal of Humanitarian Logistics and Supply Chain Management of Elsevier and the Unilag Journal of Humanities (UJH).

6.0 RECOMMENDATIONS

(a) Geography Status should be revisited for Secondary and Post-Secondary Schools

*'Then the man and his wife heard the sound of the Lord God as he was walking in the garden in the cool of the day, and they hid from the Lord God among the trees of the garden. But the Lord God called to the man, **'Where art thou?'**. He answered, . . **'I was naked**; so I hid."* (Genesis 2: 8-10).

Mr. Vice Chancellor, Sir. The above suggests that Adam, the father of human race was the first to fail a Geography examination. Perhaps, God would have pardoned him and Eve, and would neither had kicked them out of the Garden of Eden nor allowed him suffer any resource needs ever if he (Adam) had oriented himself spatio-temporally and replied God's Geography question with a Geography answer. This aspect of the scripture underscores the relevance of Geography to humanity. In view of its emphasis on teaching resources, and development opportunities and challenges, I therefore recommend that the current status of Geography as optional subject in the curriculum be reversed to a compulsory subject status at the Secondary School level.

University students should be able to utilize simple web-based maps now on phones. Drivers need not stop at unauthorized places, on fast lanes, in moving traffic most times to make enquiries on directions to destinations. Some end up being misdirected, tricked to commit (traffic) offences or kidnapped. I recommend that Universities should have a dedicated course for Geography in General African Studies where students would be exposed to geo-spatial technology and learn the geography of their university neighbors. Students wishing to offer courses in similar interdependent areas should not be discouraged or prevented either. Some fundamental topics in geo-spatial techniques should also be taught as part of general studies in other post-secondary institutions.

(b) Application of Geo-Spatial Techniques in Decision Making: Relevant Ministries, Agencies and Parastatals should embrace geo-spatial technology for database creation, management and revision, for which there are ample opportunities in some institutions. Cadre positions also must be created for career promotion and to integrate knowledge by gown and town.

(c) Disaster Warning, Preparedness and Management: I recommend geo-spatial techniques for warning and response to the increasing spates of various hazards and disaster risks in

the country. It is high time that disaster insurance, corporate and humanitarian supports, and logistic decisions are managed with the technology.

(d) Census Enumeration: Geo-spatial techniques allows for accuracy and transparency on resources and development characteristics in view of its being location-specific. Consequently, I recommend the technology absolutely for the next census exercise in Nigeria, including the analysis and dissemination of the results at the levels of household, enumeration/supervisory areas, communities/localities, LGAs and States. When this is done it will address the problem of rejection of census results by stakeholders as witnessed in previous enumerations.

(e) Multi-disciplinary Researches and Collaboration: The University of Lagos is the first in Nigeria to get an educational license of the state-of-the-art ARCGIS package of ESRI Inc. USA, courtesy of the efforts of the Department of Geography. Students of some departments across Faculties including Environmental Sciences, Engineering, Sciences and Social Sciences of the University are using the facility in good number both at the undergraduate and graduate levels. I plead with the University to keep faith with the agreement with ESRI to enable students and staff benefit maximally. I propose that regular exhibitions be organized to showcase the application benefits of the initiative and the output by users particularly those of the students for enhanced information and career opportunities. For this I plead with those that are still frightened by Geography to focus on the message rather than the messenger(s) and tap other numerous opportunities that abound locally and internationally.

(f) Data sharing: Any data not used is no data and any knowledge not applied is a waste. It is in this wise that I suggest to colleagues to imbibe the spirit of sharing data, which they usually lock up in offices, to fill the gaps in research knowledge and professional tasks of enhancing human needs in respective units. The University can digitalize spatially and make records

accessible online for information management and to demonstrate trust on finances, properties and stewardship

(g) Faculty of Geographical Sciences in University of Lagos: Arising from my academic experience and this lecture presentation, Mr. Vice Chancellor Sir. It may be right to view Geography both as an environmental, a medical, a pure/applied, a social science, a technological, a business and a humanity science. Its multi-relationship with other disciplines in addressing fundamental development questions distinguishes it as a field of knowledge. Thus, it might be appropriate to categorize it beyond the realms of a single department in a faculty. As shown in **Appendix 2,** the focus, name and domicile of the discipline varies across the globe and are determined by the specific development needs and challenges of each university regional environment.

I hereby propose a Faculty of Geographical Sciences for the University of Lagos considering the importance of the fifteen unique areas of specialization in the department currently for the Lagos Region, the staff capability and resources potential. I recommend the following seven departments for the proposed Faculty:

(i) Department of Geo-Information (for degrees in Remote Sensing, Cartography and GIS)
(ii) Department of Transport and Logistics (for degrees in Transport and Logistics)
(iii) Department of Climate Sciences and Climate Change
(iv) Department of Tourism and Planning Development (for degrees in Tourism and Planning Development)
(v) Department of Disasters Management (for degrees on disasters management)
(vi) Department of Physical Geography (to accommodate other existing physical geography areas of biogeography, geomorphology, Hydrology/Water Resources)
(vii) Department of Human Geography (to accommodate other existing human geography areas of settlement geography, agricultural geography and medical geography,

This recommendation is compatible with our institutional, regional and national missions. It will strengthen local and international collaborations and there are evidences of availability of staff and facilities for take-off, and students will be available for admission. Graduands would have better job opportunities for the graduates, and the faculty could be self-sustaining in a not too distant future using resources from collaborations.

(h) *Profelaria* Disease in the University of Lagos

Finally Sir, VC Sir. I wish to request for the eradication of *profelaria* in the University, a disease of the mind resulting from a state of great expectation, anxiety and weariness by a person being assessed for promotion or appointment to the professorial cadre. As periods of recommendation, advertisement and processing become elongated, the symptoms become more prevalent ranging from severe anxiety, weariness, hostility and outbursts at meetings to disillusions, hypertension, loss of weight and sometimes loss of appetites for food.

This was once eradicated by the doggedness of the current University Management in clearing the backlogs of promotion sometimes ago but has resurfaced strongly due to 'no vacancy, no promotion'. That our Medical Centre has no effective drug may account for why some colleagues are into alternative therapies such as drinking and becoming prayer warriors. We can adopt the templates of some other premier Universities that do not have this syndrome.

To my fellow colleagues suffering from this ailment, I salute your courage and patience, and can see many testimonies around the corner. May your handwork be crowned with positive divine intervention according to your worth. I also suggest that you present your Inaugural Lectures in less than two years after possessing your possession.

7.0 CONCLUSIONS

Not to die is to live. The challenges of underdevelopment are overwhelming. Yet the path to success looks simple. Any society that aims at breaking the jinx of the cycle of underdevelopment cannot afford not to know what resources people need, where they can find uses for them and how they can be transformed from 'neutral stuff'. Geo-spatial techniques are revolutionizing perspectives in researches by aiding simplification and integration of spatial and non-spatial data at geographic scales with spatial precision for visualization, and understanding of resources relationships.

The gaps in the dichotomy of strategies and processes for broad-based planning, management and development of resources which cut across disciplines are being bridged. Geo-spatial techniques are providing greater choices for data and information gathering and access.

The demand for thematic-focused systems in geo-spatial analysis will continue to grow in line with new frontiers in development and need for openness in decision processes. Researchers in multiple disciplines and professionals with different perspectives will continue to strive for innovative ideas for which spatial technology is known to support. Hence sustained growth in the area of geo-spatial techniques, especially those that are at the early stages of development and applications presently, would remain sustained. Developing nations will thereby have beneficial opportunities in the problem-solving tools for facing their challenges. Meaningful development of resources and humanity will continue to elude those without appropriate interest in the multi-disciplinary researches of using Geo-Spatial Techniques and application.

In the words of Stein (2017), spatial is now a first-class citizen in most databases. People in Geo-spatial technology have been

working with, and are organizing, other researchers following the advent of modern geo-spatial technology.

It is a lot of work, sometimes ideal for only convicts. But it is done because the only way to make it happen is 'someone' willing to do it. He must like to learn about what academic and professional things others are up to. He must love sharing in their victories and commiserate on their failures. For if these do not happen, who would they share data and ideas with over their limitations. Mr. Vice Chancellor Sir, I am never frightened to be one of the 'someone'.

Ladies and Gentlemen, may you never fail Geography Questions like Adam. Mr. Vice Chancellor Sir. This is the end of my lecture.

8.0 GRATITUDE

It is no doubt that this component of my Lecture is the most difficult to write because I have come across so many people in my career that space and time would not afford me to mention. I am really grateful and I sincerely thank everyone, I wish to be convinced of being forgiven by whoever I am not able to acknowledge by name in person or in group.

First to acknowledge is the Almighty Allah, the most Beneficent and the most Merciful, without whom I would not have been, or attain this academic pedestal. I am proud of the factory of 'baami' Mr. Jimoh Alamu Soneye and 'Maami' Abeni Sarat Soneye (of blessed memory) for manufacturing and training me. I appreciate my siblings: Mrs. Suwebat Oseni, Mrs Olabisi Akinbode (USA), Mrs. Anifat Sofolahan and Mrs. Mutiat Adekeye, Muyiwa and Bukola Sami and their families.

I particularly acknowledge my uncle and de-facto father, Mr. Hameed Alamu Soneye and his family on my academic career. To my 'mother' Mrs. Sifau Soneye and children, Alhaji Surakat Soneye, my entire paternal Yusuff – Soneye and maternal Adeosun families of Abeokuta, I say thank you for your values

and supports. My paternal Uncle, Late Alhaji Kafaru Oluwole Tinubu (K.O.) has always wished I am a Professor and I am happy I have not disappointed him, the wife Alhaja Bintu Tinubu, the Children (Messrs. Sola, Deji, Wale, Kunle and Jide Tinubu), Dr. Jide Idris and their families. I appreciate my in-laws, Mrs. Olufunke Lawal, Uncle Samson Akande (*aka* Samrose), Mrs Oyetunde Adepelu, Uncle Segun Fabiyi, Mr. Sunday Akande and indeed the entire Akande, Lawal and Fabiyi families.

I am grateful to all my Elders and Leaders from 'home' and my teachers at St. Peters Anglican School Abakuyamo, St. Bernadette's Private School Abeokuta, Abeokuta Grammar School and School of Basic Studies Ijebu Ode. Special acknowledgement to the following laid the foundation for my University pursuit: Mr. Fredrick Olawale Oridota, my 'Abeo' Principal of blessed memory and his Team; my Lecturers at School of Basic Studies Ijebu Ode: Professors Dele Badejo, Kofoworola Aderogba, Wakil Ishola and Joyce Omenai; and, Dr. Fakolade (of blessed memory) who convinced me to accept admission into Geography rather than changing to Finance or Actuarial Science.

I acknowledge all my colleagues at different schools and their families: Members of my Agsoba Club 782, Agsoba Unilag Chapter and Agsoba Lagos Branch; SBS: TPL Tayo Awomosu, Omokehinde Odutola, Bamidele Aluko, Adetola Owuye, Rotimi Adetola Ahmed, and Dolapo Ogundaini; Professors Samuel Gbadebo Odewumi (LASU), Jay-Kay Aremu (NDA), Adunbi Ogundele (UNAD), Dr. Kola Adewuyi, Dr. Oluyemi Akande (FECOLART), Dr. Oladayo Ibrahim, Dr. Abimbola Odumosu, Kayode Biney, TPL Nelson Ojoade, Messrs. Niyi Alayaki, Adebayo Ojo, Chief Tunji Rosiji, Yinka Obafemi-Moses (Sofekun), Kareem Lawal, Nsikak Ukim, Lastman Etuk, Kehinde Ozowuro, Adelani Adeleye, Tee-Kay Oyekan, Mrs. Iyabo Ayinla, Abiodun Ajayi, Engr. Sunkanmi Somoye, etc.

I thank Professors Kayode Oyesiku, Niyi Gbadegeshin, Sanni Mashi Abubakar, Ayo Omotayo and other Members of the Council of Association of Nigeria Geographers. I also

acknowledge Professor Adeniyi Osuntoku, Mrs Maurine Akintayo and the entire LEAD Teams especially my Cohort-13 Colleagues. Thank you my mentors and friends from other Universities: Professors Funsho Olorunfemi, Olusegun Areola, Geographers Kayode Bamgbose, Dixon Ajayi, Cornelius Akanni, and indeed all the colleagues and delegates from other institutions such as Universities of Ibadan, Obafemi Awolowo University, University of Ilorin, University of Benin, University of Port Harcourt, Federal University of Agriculture Abeokuta, University of Abuja, Federal University of Technology Akure, Nigeria Defence Academy, Bayero University Kano, Uthmanu dan Fodiyo University, Lagos State University, Olabisi Onabanjo University, Tai Solarin University of Education, Moshood Abiola University of Technology/Polytechnic, Nasarawa State University, Yaba College of Technology, Federal College of Land Resources Technology, Adeyemi College of Education and NIOMR.

I am able to sit under a shade today because some people planted the tree a long time ago. My University Lecturers deserve profound appreciation for infesting me their workaholic traits and respect with razor-sharp mind on teaching and research. Emeritus Professor Adeniyi and Professor Ademola Omojola not only discovered me during my undergraduate days by employing me as their Research Assistant, they mentored me ceaselessly and supervised my Ph.D. with innumerable assistance from Professor Olayinka Balogun - my 'Third' Supervisor and Professor Babajide Alo - the (then) Dean School of Postgraduate Studies as well as Mr. A. J. Aliu and Barrister M. A. Alaga in the (then) School of Postgraduate Studies. Other SPGS Deans and their Teams have also been so encouraging especially Professors Aloy Ejiogu, Vincent Olatunji, L.O. Chukwu and Solomon Akinboye.

Professors Nurudeen Alao infected me with Analytic Geography, Jonathan Ekpeyong exposed me to practical Cartography and Michael Abegunde (RIP) was my erudite Geomorphology Teacher and Supervisor of my Bachelors Project. Thank you for everything Emeritus Professor Ayinde

Adalemo, Emeritus Professor Oyebande, Late Professors Simeon Oyediran Ojo, Olukunle Adegbola, Mr. Adefolalu (RIP), Professor David Oyeleye and Professor Akintola-Arikawe. I acknowledge my other Lecturers in the Department of Mathematics: Professors 'Baba' Esan (RIP), Ray Okafor, S. O. Ajala, Kenku and Dr. Deshmock. I thank Professors Ezekiel Ogundowole and Sophie Oluwole, my Philosophy Lecturers.

I enjoyed the support of my colleagues in the Department especially when I acted as the Head in 2008/2009 and 2015/2016 Academic Years. Professor Iyiola Oni (my Dean), Professor Demola Omojola (my Head of Department current), Drs. Tunji Babatola, Idowu Balogun, Joyce Omenai, Oscar Uluocha, Kunle Ogunkunle, Feyi Oni, Segun Adeaga, Akin Akintuyi, Owolabi Ayeni, Godwin Ekop, Mayowa Fasona, Sakiru Odunuga, Emmanuel Ege, Alex Uriri, Peter Elias, Vide Adedayo, Kemi Ojekunle and Bunmi Adegun. I acknowledge the past and present administrative staff members of the Department of Geography: Mrs. Abegunde (former Registrar of the University), Mrs. Aderiye, Mr. Johnson Fasunhan, Mrs Apata, Bukola Kazeem, Taiwo Salawu, Margaret Achor, Sidikat Adeyanju, Victoria Adebiyi, Sarah Babawale, Titilayo Olayiwola, Samuel Udofia and Alimi Waidi as well as our GAs including Temitope Ogunbiyi, Toyyebat Taiw. You contributed immensely to my administrative experience and services to the community. I pray God will reward you all accordingly.

I am happy to have produced very unique, hardworking and mentorable Ph.D. holders: Drs. Amidu Owolabi Ayeni, Isaiah Akoteyon, Akin Akintuyi and Adebola Daramola. I acknowledge those at various stages of their theses completion: Messrs. Kayode Biney, Michelle Fasona, Chukwuemeka Onyekwelu, Inyang Mbom-Abasi Udofia, Emmanuel Wunude, Oluwakayode Fasunhan. Adebola Aramide and Adepoju Faderin. All my numerous former and current masters and undergraduate students and all those that have passed through my Resource Analysis Research Group are acknowledged. Great Akokites!

I have received exceptional fellowship from my own at the University of Lagos Senior Staff Club where I wrote appreciable portion of my Ph.D. Thesis and Papers as a result of its serene location and working facilities, courtesy of successive University Administrations. I thank my colleagues for their inputs and for tolerating me at our Unilag Academics Cooperative Multipurpose Society Ltd, Business Committee of Senate, Academic Staff Union of Universities, my co-researchers and staff of the Faculties of Social Sciences, Sciences, Arts and Environmental Sciences, the Board of School of Postgraduate Studies and 'MAT' 840' Team. I appreciate the Federal Road Safety Corps Family and my brothers from another mothers: Generals Benjamin Ipinyomi and Enitan Kuti, Chief Adedokun Adekanye and Alhaji Sunmola Bakare and their families.

Professor Bruce Mitchell, Ron Bullocks and Wendy Wynia and their families were influential to my training at the University of Waterloo Canada in 1992. They gave me unrestricted access to their libraries and facilities, and equally ensured I mixed Waterloo academics with Shakespeare fun at Waterloo-Kitchener with Toronto CN Towers, Niagara Falls relaxation, Ontario Wonder Lands and that Bumpy-Jumpy. Dr. Idowu Balogun survived that accident of 1993 that could have cut our lives short as we drove to Sokoto regularly between 1990 and 1994 on our joint Nigeria - Canada Research Project.

My cross-continent researches and international collaboration have been facilitated by my former student, Dr. Imoh Antai of Jonkoping University Sweden. Professors Pia Polsa – our Principal Investigator at Hanken School of Economics Helsinki Finland, Karen Spence and Jyongi (Hanken School of Economics), Ritu Narang (Lucknow University India), Wei Fuxiang (Tianjin Normal University, People's Republic of China), Richard Owusu (University of Vaasa, Finland/Linnaeus University School of Business Sweden), Terje Valaand (University of Stavanger, Norway) and Kate Hughes (Macquarie University, Australia) are role models, very accommodating and exceptionally liberal.

The following nurtured me into contributing my technical expertise to services and development at various levels: The five Unilag Consult musketeers and pioneers of EIAs in Nigeria (Professors Kola Kusemiju, Babajide Alo, Kayode Amund, Dele Olowokudejo and Jonathan Ekpenyong) with Professor Olusoji Ilori leading us boys on assignments. I thank the following and their Study Teams: Professors Lucian Obinnna Chukwu, Aderopo Akinsoji on Mambila voyages, Prof. Yemisi Dayo and Tripple E, Dr. Jude Amaefule Patrick Egekenze and Emerald, Late Dr. N.V. Okoye and Multient, Dr. Oluyemi Akande and Owerri Team, Engr. Alex Akintoye Akinuliola and Bright Consults, Engr. Alex Egenti and Millennium Shipping, Asiwaju Anthony Ojesina Ojesina, Engr. Tayo Seriki and Global, Messrs. Niyi Arimoro and AFEL, Babatunde Osho and Global Impact, Adeolu Adeojo and , Babsal, Kaybordsons, Sterling, the FMEnv, DPR and other Teams from the Federal and State Ministries, Agencies and Parastatals.

While putting this lecture together I reflected again on the miraculous trips to volatile and youth-restive communities and sites by roads, air, low and higfworkh waters; the kidnaps at Kula, Brass, Ogidigben, Cawthorne Channel, Soku, Aboloma, Brass, Bille and Bonny; coming face-to-face with illegal bunkerers unexpectedly, the treks on rugged terrains hours, sleeping in a N20 hotel with my current Dean at Kaduna, etc. etc. The experiences I gathered there-from taught me to be appreciative of challenges to development and afforded me to contribute in turning such to blessings geo-spatially.

Many thanks to all the University Management Teams that God has used on my career. I was employed as an A.L. during the Vice Chancellorship of Professor Nurudeen Alao, promoted by Late Professor Jelili Omotola to LII, Professor Oye-Ibidapo Obe to LI and S.L. and Late Professor Tokunbo Sofoluwe /Professor Rahamon Bello to Associate Professor. I shall not forget my Deans at various faculties including Professor Olayinka Balogun who employed and promoted me in the Faculty of Environmental Science as well as Professors M.O. Adejuyigbe, Layi Olurode, Tunde Makanju, Omololu Soyombo and Iyiola Oni of the Social Sciences as well as their families.

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REFERENCES

Abiodun A. (1999): Africa In the Global Future: Challenges and Opportunities in Space Activities. in Adeniyi. P.O (Ed): *Geoinformation Technology Applications for Resource and Environmental Management in Africa*. Abuja. African Association of Remote Sensing of the Environment.

Adeniyi P.O. (1979) "Some Fundamental Issues in Land and Landuse Planning in Nigeria: *Nigeria Geographical Journal,* 22, pp. 59-79.

Adeniyi P.O. (1987). Using remotely sensed data for census surveys and population estimation in developing countries: Examples from Nigeria. *Geocarto International.* **2(4)**:11-31.

Aderogba K.A. (2016). Dearth of Maps for Effective Teaching and Learning about Geography in Nigerian Schools and Colleges: A Case Study of Ogun State, Nigeria. *International Journal of Research in Education* Development Universal Consortia. **3(2)**: 213-227.

Aiyedun J.O. and B.O. Olugasa (2010). Use of aerial photograph to enhance dog population census in Ilorin, Nigeria. *Sokoto Journal of Veterinary Sciences.* **10(1)**:22-27.

Akopeb Resources Ltd (2014). Environmental Impact Assessment of Elegbata Marina jetty upgrade and expansion Lagos Island Lagos State Nigeria. Millennium Shipping and Marine Services.

Allott (2007). Environmental Impact Assessments of the Dualization of East – West Port Harcourt – Onne and Onne - Oron Roads. Ministry of Niger Delta Affairs.

Areola O. (1975). The ERTS-1 Images of South Western Nigeria: A Preliminary Survey. *Savanna,* **4**:63-69.

Ayeni A.O., I.I. Balogun and A.S.O. Soneye (2011). Seasonal Assessment of Physico-chemical Concentration of Polluted Urban River: A Case of Ala River in Southwestern – Nigeria. *Research Journal of Environmental Sciences*, **5(1)**:22–35.

Ayeni A.O., M.A. Cho, A. Ramoelo, R. Mathieu, J. Adegoke and A.S.O. Soneye (2013). Could Local Perceptions of Water Stress be explained by LULCC? *Geoinformatics and Geostatistics.* **1(2)**:1–8

Ayeni A. O., E. Kapangaziwiri, A.S.O. Soneye, S. Vezhapparambu and J. Adegoke (2014). Assessing the impact of land use/land cover and climate changes on water stress in the derived savanna. *Climate and Land Surface Changes in Hydrology.* **359**:92-98.

Ayeni A.O. and A.S.O. Soneye (2013a). Interpretation of surface water quality using principal components analysis and cluster analysis. *Journal of Geography and Regional Planning,* **6(4)**:132-141.

Ayeni A.O. and A.S.O. Soneye (2013b). Groundwater Quality Assessment for domestic uses in the micro-geomorphic units of Lagos, Nigeria. *FUTY Journal of the Environment.* **8(1)**:93–106.

Ayeni A.O., A.S.O. Soneye, and A. Akintuyi (2013). Contributions by Stakeholders to Water Supply in the Rural - Urban Communities of Ondo State, Nigeria. *Lagos Journal of Geo-Information Sciences (LJGIS).* **2(1)**:63–71.

Ayeni A.O., A.S.O. Soneye, and I.I. Balogun, (2009). State of Water Supply Sources and Sanitation in Nigeria: Implications for Muslims in Ikare-Akoko Township. *The Arab World Geographer/Le Géographe du Monde Arabe,* **12(2)**:95–104.

Ayeni A.O., A.S.O. Soneye and F.A. Badru (2014). Adaptation to Water Stress in Nigeria Derived Savanna Area: The Indigenous Knowledge and Socio-Cultural Nexus of Management and Humanitarian Services. *Journal of Management Policy and Practices (JMPP).* **15(3)**:78-87.

Ayeni A.O., A.S.O. Soneye, O.O. Fasunwon, R.T. Miteku and L.A. Djiotang–Tchotchou (2011). Water Resources Development Optimization in a Climate Change Scenario: Case study of Benin - Owena Basin, Nigeria. *Research Journal of Environmental Sciences.* **5(1)**:59–67.

Baker J.R. and J.E. Rummond (1984). Environmental Monitoring and Map Revision using Integrated Landsat and Digital Cartographic Data. *ITC Journal.* **1**:10-18.

Balogun O.Y. (1989). The DOS and Mapping in Nigeria. *The Cartographic Journal.* **24**:3-14.

Balogun O.Y. (1992): *A Century of Colonial Mapping in Nigeria*; In Ikhuoria, I.A. (Eds) *Nigeria Cartographic Journal.* **2(1)**:30-43.

Burrough P.A. (1991) *Principles of GIS*. London. Claredon Press.

Campbell J., H. Randolph and Wynne (2011). *Introduction to Remote Sensing.* New York. The Guilford Press.

Dangermond J. (2013). *GIS, Design and Evolving Technology*. Downlaoded at http://www.esri.com/news/arcnews on 25 May 2017.

Davies A. (1967). Columbus Divides the World. *Geographical Journal,* **133**:337-344.

ESRI (1990). *Understanding GIS: The ARCINFO Method*. ESRI Inc., Redlands California. Pp. 1-1 to 1-31.

Eze C.G. (2009). The role of satellite remote sensing data and GIS in population census and management in Nigeria: A case study of an enumeration areas in Enugu, Nigeria. *Scientific Research and Essay*; **4 (8)**:763-672.

Fasona M.J., A.S. Omojola and A.S.O. Soneye (2011). A Study of Land Degradation Pattern in the Mahin Mud-beach Coast of Southwest Nigeria with Spatial-statistical Modelling Geostatistics. *Journal of Geography and Geology*. **3(1)**:141-159.

Fasona M.J., A.S. Omojola, A.S.O. Soneye, A.O. Akintuyi and I.I. Abbas (2014). Geographic Information for Disaster Management in Nigeria: Case Study of the Mud-beach Coast of Southwestern Nigeria. *UNILAG Journal of Humanities*. **1**:43-57.

Fasona M.J., A.S.O. Soneye, O. J. Ogunkunle, O.A. Adeaga, O.A. Fashae and I.I. Abbas (2014). Simulating Land-Cover and Land-Use Change in the Savanna under Present and Future Climate Scenarios: A GIS-Based Approach. *Earth Science Research*. **3(1)**:25–40.

Fasona M.J., A.S.O. Soneye, M. Nwokedi and M. Oladeinde (2011). Baseline Ecosystems and Sensitivity of the lowland areas of Forcados River, Western Niger Delta Nigeria, to Oil Spills. *Lagos Journal of Geo-Information Sciences (LJGIS)*. **1(1):**49–62.

Fuxiang W., P. Polsa, A. Soneye and R. Narang (2012). Atmosphere Influence in Patient Perceived Healthcare Quality and Outcome: An International Study of Finland, India, Nigeria and PRC. *Psychology Research*. **06:**21-26.

Gauthier J.R.R. (1987). Topographic Mapping from Satellite Data: A Canadian Point of View. *Geocarto International*. **3**:61–66.

Jefferey S. and J. Estes (1990) *Geographic Information System: An Introduction* Prentice Hall, New Jersey.

Johnson A.B. (2015). Developing a GIS Curriculum. ESRI. Downlaoded at http://www.esri.com/news/arcuser on 25 May 2017.

Rajeswari K, S.R. Aravind and R.A. Prakash (2015): K6226 KM Measurements. ESRI. Downlaoded on 23 May 2017 at https://www.slideshare.net/aravindsraamkumar

Mitchell B. (1991): *Geography and Resources Analysis*. London. Longman.

Mukesh S.K. (2017). Increasing demand for Geospatial Analytics solutions..... and Markets. Downloaded on 23 March 2017 at http://www.marketsandmarkets.com.

Narang R., P. Polsa, A. Soneye and W. Fuxiang (2012). Does hospital atmosphere have an impact on perceived health care outcome? A cross-cultural international study in China, Finland, India and Nigeria. *Proceedings, International Conference in Marketing by Indian Institute of Management*. Lucknow, India. January 12-14.

Narang R., P. Polsa, A. Soneye and W. Fuxiang (2015). Impact of hospital atmosphere on perceived health care outcome.

International Journal of Healthcare Quality Assurance (IJHQA). **28(2):**129-140.

Oguntoyinbo J.S, O.O. Areola and M. Filani (Eds.) (1978). *A Geography of Nigerian Development*. Ibadan. Heinemann.

Olorunfemi J.F. (1984). Land use and population: a linking model. *Photogrammetric Engineering Remote Sensing*. **50**:221–227.

Olorunfemi J.F. (2007). Towards a philosophy of population census in Nigeria: remote sensing inputs. International Journal of Remote Sensing. **4(4)**:731-738.

Omojola A.S. and A.S.O. Soneye (1993). Application of Remote Sensing and GIS Techniques for Landuse and Landcover Mapping in the Middle-Sokoto River, North western Nigeria. *Nigerian Journal of Remote Sensing*. **1(1)**:8-17.

Onojeghuo A.O., A.G. Blackburn, F. Okeke and A.R. Onojeghuo (2015). Habitat Suitability Modelling of Endangered Primates in Nigeria: Integrating Satellite Remote Sensing and Spatial Modelling Techniques. *Journal of Geoscience and Environment Protection*. **3**:23-38.

Onokerhoraye A. (1994). Geographic Thought, Philosophy and Methodology. *The Benin Social Science Series for Africa*. Benin City, University of Benin Press.

Penquet J.P. and D.F. Marble (1990) *Introductory Reading in GIS*, Taylor & Francis, London.

Polsa P., K. Spens, A. Soneye, I. Antai (2011). Comparing Perceived Quality of Private and Public Health Services in Nigeria. *Journal of Management Policy and Practice (JMPP)*. **12(7)**:18 -26.

Polsa P., R. Narang, A. Soneye and W. Fuxiang (2011). Cross-Cultural Scale Development in Healthcare Service Quality. *Proceedings 15th Cross Cultural Research Conference*, Kona, Hawaii. 11–14 December.

Singhal A. (2004). *In search of Military GIS*. Downloaded on 25 Jan 2005 at http://www.gisdevelopment.net/application/military. 5 Pages.

Soneye A.S.O. (1995). Integrated Development of the Niger Delta Area: The Real Issues. in Al-Amin A. (Ed.): Abu Dhabi (Eds.): Proceeding, International Desalinization Association Congress. Abu Dhabi United Arab Emirates University. Nov 18 – 24. Pp. 531–547.

Soneye A.S.O. (1998a). Generalization and Classification on Nigerian Topographic Map Series. in: Balogun, O.Y. and N.O. Uluocha (Eds.): *Cartography and the Challenges of the 21st Century in Nigeria*. Nigeria Cartographic Association. Chapter 3. Pp. 25–40.

Soneye A.S.O. (1998b). Land Resources Information Systems for Sustainable Agricultural Development: A Nigeria Experience. in Mama V. (Ed.): *Land Vulnerability Assessment for Food Security using AEZ/LRIS Information*. Pp. 46–53.

Soneye A.S.O. (1999a). The Contribution of the Nigerian Academia to the Development of Cartography, Remote Sensing and GIS in Nigeria. in Balogun O.Y. and A.S.O. Soneye (Eds.):*Cartography in the Service of Government*. Nigeria Cartographic Association. Chapter 10. Pp. 80-91.

Soneye A.S.O. (1999b). Creating GIS Spatial Database from Nigerian 1:25,000 Topographical Maps: A Technical Appraisal. in Balogun O.Y. and A.S.O. Soneye (Eds.):*Cartography in the Service of Government*. Nigeria Cartographic Association. Ch. 5, Pp. 32-45.

Soneye A. S. O. (2000). The Application of Satellite Remote Sensing and GIS in the Evaluation and Revision of Nigerian Topographical Maps. *Ph.D. Thesis*. University of Lagos: 284 Pages.

Soneye A.S.O. (2002). A GIS-based Evaluation of the Adequacy of Police Stations in Ikeja LGA, Lagos State. In Uluocha, N.O. and F.O.A. Dada, (Eds.): *Maps and Resource Management*. Nigeria Cartographical Association. Chapter 6. Pp. 50-59.

Soneye A.S.O. (2004a). Fadama Resources Management in Nigeria: Implications for Sustainable Agricultural Development in the Sokoto-Rima Basin. in Badejo O. and A. Omitogun (Eds.): *Strategies and Tactics for Sustainable Agriculture in the Tropics.* **2(1)**: 209 – 226.

Soneye A.S.O. (2004b). Institutional Dilemma of Urban Waste Management in Developing Nations: the Lagos State Experience. in Adejuyigbe M.A. (Ed.): *Industrialization, Urbanization and Development in Nigeria: 1950–1999.* Lagos. Concept Publications: Chapter 8. Pp. 169–175.

Soneye A.S.O. (2006). GIS and Military Operations. What Opportunities for Nigeria? *Academy Journal of Defence Studies.* **12:**39–56.

Soneye A.S.O. (2007). Environmental and Human Impacts of Capital Dredging of River Niger: A Comparative GIS Analysis. *The Nigerian Journal of Business and Social Sciences*. **1:**111– 123.

Soneye A.S.O. (2010). Environmental Impacts of Road Transport Development in Nigeria: An Assessment of Lagos – Ikorodu Highway Using GIS. *Interdisciplinary Journal of Contemporary Research in Business (IJCRB)*. **2(6):**24-37.

Soneye A.S.O. (2011a) 'Preventive Planning, Assessment and Modelling of Ethnic and religious Violence: The Spatial Support Systems of GIS. in Ogundipe O.T., A. Akinade and M. Omoegun (Eds.): *A Book of Readings on Ethno-Religious Violence in Nigeria: Security and Socio-Economic Perspectives*. Lagos. University of Lagos Press. Pp. 123-143.

Soneye A.S.O. (2011b). Disaster Relief Operations and Environmental Protection for Sustainable Development in Nigeria. In *Environment and Community Security for Sustainable Development: Innovative Perspectives and Approaches* by Sofoluwe A.B., A. Akinade and O. Soyombo (Eds.). Pp. 220–232.

Soneye A.S.O. (2012). Concentrations of Greenhouse Gases (GHGs) around Tankfarms and Petroleum Tankers Depots, Lagos, Nigeria. *Journal of Geography and Regional Planning*. 5(4):108-114.

Soneye A..S.O. (2013). Air Toxics around Urban Landuses: A Spatio-Temporal Analysis of the University of Lagos Akoka Campus, 2009 – 2012. Paper presented at the Faculty of Social Sciences University of Lagos Staff Seminar. 17 April, 2013. 17 Pages.

Soneye A.S.O. (2014a). Farm Size Holdings in Northern Nigeria: A Remote Sensing Assessment and Implication for Food Sustenance. *African Journal of Food, Agriculture and Development (AJFAND)*. **14(2):**1-15.

Soneye A.S.O. (2014b). Stream Dynamics in Semi-Arid Regions: An Assessment of Sokoto-Rima River, Nigeria, 1965 – 2005. *Journal of Geospatial Science and Technology (JGST)*. **1(1):**17-30.

Soneye A.S.O. (2014c). An Overview of Humanitarian Relief Supply Chains for victims of Perennial Flood disasters in Lagos, Nigeria (2010–2012). *Journal of Humanitarian Logistics and Supply Chain Management (JHLSCM)*. **4(2)**:179-197.

Soneye A.S.O. and A. Akintuyi (2012). Urban Expansion, Wetland Resources Depletion and Population Changes: A Geo-Spatial Assessment of Lekki – Ajah, Lagos, Nigeria. in Ogundipe O. (Ed.): Proceedings of the conference on national dialogue and exhibition on wetlands in Nigeria, 5- 6 December 2012, University of Lagos, Nigeria. Pp. 126-137.

Soneye A.S.O. and A. Akintuyi (2013). Nigeria Remote Sensing and Topographical Mapping, 1937 – 2010: A Critical Appraisal. *Lagos Journal of Geo-Information Sciences (LJGIS)*. **2(1)**:15-27.

Soneye A.S.O. and A. Daramola, (2012). Sustainable Energy in Nigeria: An Assessment of Solar Utilization in Ibadan Metropolis. *International Journal of Renewable Energy Resources (IJRER).* **2:** 6-12.

Soneye A.S.O. and O.S. Giwa (2015). GIS Assessment of Crime Incidences and Controls around Apapa Lagos Waterways, Nigeria. *Lagos Journal of Geo-Information Sciences (LJGIS).* **3**:61-71

Soneye A.S.O. and A.S. Omojola (1995). The Size of the LGAs and States in Nigeria as Generated through Computer-Aided Techniques. in Ojo S.O., S. O. Okedele and A.S. Omojola (Eds): *Environment and Dwellings*. Faculty of Environmental Sciences University of Lagos Special Publication. **1**:34-45.

Stachowiak K. and A. Bajerski (2016). Relations of geography with other disciplines: a Bibliometric Analysis. *Geographia Polonica.* **89(2)**:203-220

Stein G. (2017). *Spatial is now a first-class citizen in most databases.* Geohipster. Downloaded at http://geohipster.com on 30 May 2017.

Ukor D.C., H. Okeke, A.T. Alaga and Rakiat H.L. (2016). Population Census and Demography Operation in Nigeria Using GIS and Remote Sensing Techniques. *International Journal of Trend in Research and Development*. **3(6)**:383

Unilag Consult (1996). *Environmental Impact Assessment for Capital Dredging of Approach Channel Offshore Bonny Rivers State Nigeria*. Final Report for Mobil Producing Nigeria Unlimited Lagos, Nigeria

Vaaland T.I., A.S.O. Soneye and R.A. Owusu (2012). Local content and struggling suppliers: A network analysis of Nigerian oil and gas industry. *African Journal of Business Management (AJBM);* **6(15)**:5399-5413.

Zimmermann E.W. (1951). *Introduction to World Resources*. New York, Harper and Row.

Appendix 1: Some Key Research and Development Application Areas of Geo-Spatial Techniques

A1 Boundaries Demarcation and Conflicts Resolution

Issues of boundaries on land, air and maritime regions for administrative purposes in Nigeria recently can be traced to the amalgamation of several hitherto independent ethnic, socio-linguistic and cultural groups into a political colony and later a federation. Boundary disputes result from disagreement on administrative territories, boundary position and control of borderline resources. Many communities in almost every state of the federation have continued to experience one case of boundary disputes or another with a neighbor for political, socio-religious or economic reasons. Neighbouring communities with natural divides such as relief and waterbodies are not spared while the number and degree of violence have been increasing. Creation of states and LGAs, aimed at addressing identified imbalances at particular points in time have always raised new contention of boundary demarcation, adjustment and disputes. Most administrators of LGAs especially the elected Chairmen and Councilors do not know their areas of jurisdictions however.

Boundary lines in Nigeria must be mutually defined by stakeholders and resolution of ensuing conflicts be so resolved explicitly with geo-spatial technology. The areas of application include mapping, demarcation and evaluation of frontier resources, production of established boundary limits, zoning and pillars on boundary maps and geo-spatial databases and utilization as burning proofs of documentation evidences and investigation of cases of acquisition, trespass and encroachment. Cameroon used such an evidence to win its case against Nigeria on the Bakassi Peninsular at the International Court of Justice t. Incidental deployment of interactive analysis of maps and remotely-sensed images in the GIS environment is the most fundamental for these operations and for researches and development on the aspects of jurisdiction, peace and justice.

A2 Land Ownership and Management

The laudable intention of the Nigeria Landuse Decree of 1978 to improve land administration in Nigeria has continued to be marred by non-availability of spatial data. Hence the current spate of land ownership cases by land speculators 'omo oniles', land grabbers ('ajagungbales') and other land possession crimes which usually lead to unwarranted wastages and sometimes untimely deaths of disputing parties. Data for good landuse and ownership evaluation and monitoring must be timely, easily retrievable and cost-effective in spatial formats. Geo-spatial techniques will support the major objective of carrying out landcover and landuse mapping and analysis with a view to reducing uncertainties about the land which is the major natural resources in developing countries.

A3 Agriculture and Food Security

Based on the data that are collected on crop performance, agriculturists are interested in the aspects of physico-chemical characteristics of soils, their capability and suitability for maximum production. Hydro-meteorological services for weather and climate are required for better understanding of climatic elements (mainly rainfall and temperature) as well as the potentials of hydrology and water resources for irrigation, soil retention and erosion. With these, prediction plans and early warning forecasts can be made of land suitability and capability, the types of crops to grow and the specific inputs required for target yields.

Spatial analysis of transport network and connectivity will enhance plans for accessing the fields for administration of inputs and transporting the produce to storage sites, processing plants and markets. Other areas of agricultural application are mapping the locational distribution of farms and farmers target assistance, growing regions and field acreages, soil surveys, government extension services, water resources and irrigation potentials. Others include crop and livestock surveys for area extent, plant vigour and drought, pests and diseases, and control of weeds, diseases and pests. Decision makers need to know where.

A4 Settlement and Housing

As one of the basic essentials of man, settlements and housing landuses and ownership are in constant changes all over the globe. The data required for taking appropriate decisions have always been elusive especially in developing nations in view of the conventional techniques of collecting such. Depending on the resolution, aerial imageries have enhanced the data access on settlements such as the precise sites, nature of terrain and landscape, sizes and changes over time, number of buildings, available amenities and effectiveness of urban and regional plans.

Image texture, alignment of roads and footpaths and interspersing both vegetation and agricultural landuses are some of the surrogates to map rural settlements on while geometrical shapes and layout of buildings, nature of roads and reflectance characteristics of roofs, parks and ornamental trees directly reveal a lot of spatial information on houses in both rural and urban areas. With spatial analysis, it is easier to determine attributes such as settlements and housing densities as well as nearest neighbors and hierarchies.

Geo-spatial technology is useful for creating seamless property databases for documentation of numerous cadastre attributes including ownership, tenancy, available amenities, status of tenements and other charges in addition to the revision and evaluation of observed or reported modification legally and otherwise. It supports visualization and further

analysis of the attributes and pictures of the properties, facilities and owners for necessary technical, legal and institutional decisions. With this, it has become easier to develop and revise landuse plans, plan and implement revenue generation, query and extract approval and conformity of ownership and functions as well as expose mutation of regulations and approvals. In this wise Building Information System (BIS), has emerged as a new branch of Geo-spatial technology for assets management, renewability and 'future city' projects, infrastructure engineering, structural, architectural and energy designs, construction of buildings and interiors, emergency responses and building life cycle.

A5 Transport

Users are critical of the transportation network and connectivity for panoramic views of streets, real-time traffic conditions, distances between locations, route planning and travel times by trekking, bicycle, car and public transport. The most significant routes are by roads and footpaths and are of linear typology in the geo-spatial environment. They are the easiest to discern on maps and remotely-sensed images and the best surrogates for identify other features especially settlements and amenities. They are about the most evaluated using different models in spatial analytical technique.

Geo-spatial techniques are used to provide interactive web *maps* and aerial imageries which are now deployed on phones and computer by many countries and languages as solution to travelling problems of times and distances in many-to-many scenarios, routing services, time-specific isochrones of complex township traffic as well as movement of heavy duty vehicles and hazardous materials. Information such as road characteristics and controls of distance matrix, speed limits, restrictive uses of roads and bridges, weight limits and turning radius are spatially referenced and built into the transport systems to access in panoramic (360°), horizontal/vertical, rotational and three-dimensional views of static and motion information and pictures.

Geospatial techniques support safe water transport through bathymetry surveys, Environmental Impacts Assessments and numerous strategic studies for water transport development plans. Established hazards and risk spots such as wrecks spots which characterize many Nigeria waterways currently, shallow areas in need of dredging and high turbid zones are part of the spatial databases on water transport. Risk zone maps for surging seas allow for establishing areas of future vulnerability to submergence, flooding and erosion from sea level rise and maritime activities. They provide good selection of data layers to choose from by users. They generate estimates and projections for coastal area extents and visualization of models in digital elevation perspectives.

Most of the transport applications are operational on Google, Google Chrome, Mozilla, Firefox, Internet Explorer, Apple Iphone, Android, Safari, Blackberry and Research-In-Motion (RIM) browsers. Other essential location attractions of geo-spatial technology on road transport databases for displays and search are basic commuter amenities and services such as feature names and house numbers, packing spaces and transit stops, parks and hotels, cinemas and theatres, restaurants and bars. Some navigational packages support customized visualization in aerial and oblique angles. They are also deployable on mobile application such as iOS, Android and Windows phones.

A6 Utilities

Utilities around settlements areas include schools, recreational centers, markets, water and telecommunication facilities. Specific areas of application include planning, inventory and monitoring of utilities locations and attributes such as ownership, age, usage and performance functionalities, site conditions and encroachment, facility compliance and safety code for routine management, schedules for maintenance and upgrades, emergency response and environmental assessment.

A 7 Tourism and Recreation

Geo-spatial technology is useful in tourism, recreation and hospitality business in terms of systematic inventory of tourism resources, ascertaining suitability of sites and sights, simulating and modeling spatial outcomes of facilities, establishing areas of recreational conflicts of intent and uses, monitoring specific indicators and level of patronage, projecting revenues and other economic and social benefits, query and visualization of database for decision supports. It is ideal for compiling and producing maps and other spatial information for tourists in digital and analogue maps and videos which are usually web-based; provide selective information for route planning, accommodation, natural and cultural events of special attractions. The beneficiaries are for both the tourists, the owners and managers of the tourist facilities and quality control enforcers.

A8 Climate and Climate Change

Although, climate change is now a responsibility of all, nevertheless, availability of long-term and high-quality climate records remain insufficient in many parts of the developing world. Meteorological agencies are responsible for the management of climate data for climate change analysis, impacts and mitigation decisions by respective stakeholders. However, the data quality is hampered by gaps in recordings, obsolete equipment and some general issues of attitude and behavior towards scientific and technological researches in many parts of the world.

Generation and analysis of meteorological and climatic data as well as improvement of the data using rigorous gap-filling and spatial time-series analyses remain in the realms of geography and geo-spatial technology. Drivers of climate change such as urbanization, industrial activities, deforestation, etc. are generated from remotely-sensed data to understand and predict models of the future outlook of climate and the impacts on the environment.

Awareness for climate change has increased more steadily due to free access to plethora of online spatial data and maps. Interactive climate change maps are accessible to convey contributions of pollution and greenhouse gases (GHG) data based on consumption, emission, assumption and historical rates by countries and regions to climate change. Map users can now analyze the map for rigorous statistics and have the ability to customize generated maps by varying layer information such as year of data, carbon emission values, canopy cover and other data layers. The maps can be viewed at different resolutions and scales for specific areas of jurisdiction. They can be plotted in graphs and charts and can be customized and downloaded freely using varied tools.

A9 Air Quality

Arising from climate and climate change is data collection, monitoring and prediction of air quality and pollution levels which are equally the business of metrological stations globally. Geo-spatial techniques provide free and open source data on climatic elements, greenhouse gas (GHG) emissions and carbon emissions for some parts of the globe. Satellite sensors have been able to pick reflectances of concentrations of particulate matters of up to $PM_{2.5}$ across some parts of the globe. The image-maps generated from these are used to determine averages of the particles for respective locations around pollutant sources such as power plants. It is feasible to visualize the results for locations comparatively in the global field and in time-lapse videos with zoom and pan capabilities. These can be further subjected to advanced programming interfaces in JavaScript and python for various objectives. Researchers extrapolate factors that determine climate change and their seasonality.

A10 Health and Healthcare Services

The challenge of matching supply with demand of health services has always been an issue for the profession. Amongst others, cases abound on the types of hospital and facilities to provide, frequency of medical supplies and number of health personnel to deploy to community and other geographical regions based on the specific population in care need at normal and on emergency periods. These are issues of what, where and when.

The most common areas of geo-spatial techniques in medical geography include inventory and mapping of existing health projects, resources and status, priority public health problems, populations at risk over time and space. Public health, disease transmission surveillance and progression assessments as well as environmental health and sanitation characteristics are all geographic and better understood through spatial techniques. This also applies to finding optimal locations for new ones and determining how many more to establish.

Market research of catchment area analysis of distances to residences are achievable through geometric algorithm of thiessen polygons while the analysis of potential demand for services are determined with interpolation of demographic data with that of facilities. Further, epidemiology studies for diseases risks and behaviours, history and distribution of diseases endemicity and factors, capacity for bed surge occupancies of in-patients, fluctuations of outpatients, effectiveness of preventive control measures and diagnostics/drug administration are better understood with geo-spatial technology. As such management of electronic medical records with spatial entities have become popular a health decision support system. They are being implemented using mobile GIS for health control and management.

A11 Hydrology and Water Resources Management

Hydrological stations are established to characterize flows and discharges which are required for making decisions on the entire components of a typical hydrological cycle. Amongst others, the data collected are meant for understanding, design and/or management of watersheds, aquifers, reservoirs, water supply schemes, runoffs and characteristics, drainage channels, sediment loads and movement, floods and other maritime hazards, marine transport, navigation aids and irrigation programmes.

Hydrological studies have developed from traditional field measurements and calibration to the use of digital techniques of sensing radiation and energy reflectance from waterbodies to determine the parameters directly or using surrogates. Modern day hydrology uses geo-spatial techniques to experiment for wave characteristics, marine and floodplain ecology, aquaculture and bathymetry. These and other basic characteristics such as temperature, relief, bottom sediments, turbidity and pollution levels are being modelled and produced in maps in numerous computer-based packages for researches and management decisions.

A12 Crime and Policing

Profiles of safety and crime importance are spatial in nature and for which geo-spatial techniques are designed to address. They include characteristics of the living environment, population and peoples' attitudes and behaviour, demographic attributes of occupation, literacy and income,

opportunities and access to social amenities and sophistication of livelihood. Geo-spatial technology is ideal for creating databases on the human-based geographical profiles and linking them with crimes statistics such as the types, numbers, seasonality and resilience (e.g. community policing) by communities.

The technology is significant for evaluating vulnerability threats of regions, determining strategic positions, jurisdictions and functionalities of crime fighting institutions and operational facilities, access by crack teams to crime spots, track offenders and post-attack appraisal for further action formulation and implementation. These account for why it is a paradigm shift towards effective policing through training and retraining of personnel as well as funding in related science and information technology.

A13 Security and Modern Warfare

Breakthroughs in military navigation and communications have improved tremendously since the launch of a first reconnaissance satellites by the USA and Russia at the close of the 1950s. Civil and military satellites are now designed to carry payloads which generate large volume of data that are automated with relevant collateral information from maps, ground reconnaissance, internet sites and administrative records using geo-spatial techniques for tactical decisions during war and peace alike. War missions require good judgments of the terrain. They have been enhanced by ground-breaking geo-spatial technology for tactical positioning and repositioning of camps, routes, bridges and covers for battlefields maneuvering of troops and circumvent obstacles, supplies of equipment, ammunitions and other amenities to personnel, evaluating the capabilities, positions and routes of enemies as well as for tactical withdrawal and evacuation.

Information in military databases are employed to appraise advances of operations, monitor post-operations/ post-attacks for reconstruction and map historical battlefields for mines and enemy traps. Singhal (2004) has opined that the future in battlefield scenarios is vastly different from its traditional version as technological superiority, weapon effectiveness and force mixes for rapid response and precision strike in the military will be more important than conventional numerical superiority. Emergent fuller control of the spatial data with high resolution space imaging is teaching the world to expect the skies to be more and more open and with better and better technology to penetrate attempts at avoidance of war and use of camouflage and other deception.

A14 The Environment

Geo-spatial techniques afford users the ability to have access to environmental data from different sources and in varied models thereby encouraging systematic approaches and reducing overall costs and

institutional overlaps in information collection and management. It enhances comparability and compatibility of diverse data sets and encourages spatial analysis in environmental studies which would have otherwise been easily ignored due to quantification phobia and cost. Until recently, the use in environmental studies has been reserved for evaluating very large and geographically expansive projects such as hydroelectric power and large-scale urban development where high values of lands justify the expenditures on elaborate data from mapping and remotely-sensed satellite data..

On impacts assessments of programmes, the technology supports mapping and description of baseline characteristics of natural resources at different levels of magnitude, resolution, aggregation and evaluation of environmental stress. Because it is useful for integrating diverse information, it is employed for assessment of the actual response of the environment to stresses and evaluation of the probability and magnitude of risks consequent upon new exposure to the proposed project activities feasible alternatives. The data provided are useful for monitoring and evaluation of the ever dynamic components of the environment and view of scenarios in map models thereby presenting decision makers with better information for feasible options. Assessment reports, maps and statistical summaries are created with ease for technical analysis and public briefings thereby increasing transparency and broadened scope of public participation in project implementation. Some packages generate maps for visual comparison of bio-capacity to ecological footprint which are sound basis for deciding project impacts and management

A15 Forestry and Ecosystem Services

The broad scale of ecosystems services from mangroves, forests and grasslands range from provisions of food and shelter to supply of fresh water and fuel, vis-à-vis the cultural benefits of recreation, aesthetic, inspiration and education. The parameters for effective management which are geo-based and are supported by geo-spatial techniques include forestry cover inventory as well as evaluation and monitoring changes in species, taxonomies, families and diversities. Geo-spatial techniques are good for monitoring deforestation, climate change impacts, afforestation programmes, stock / yield assessment and carbon evaluation. In the area of forestry resources management are the design and monitoring of plots, operators' compliance to regulation as well as the businesses of production, marketing and supply/value chains.

Geo-spatial techniques are also useful for vulnerability assessment and management of ecosystem hazards, ecosystem damages resulting from impacts of bush fire, pests infestation and natural resources exploration including solid minerals, oil and gas. Palaeobotanists now study chemical composition of gasses extracted from ice and wetland cores to construct

models on climates of the past. It is in these perspectives that the products of geo-spatial techniques are in mapboxes and OpenStreetMaps for understanding ecosystems destruction and effects on mammals, birds, and amphibians as well as other habitats, survival migration and in-motion displays. These allow extrapolation of such factors of climate change and their seasonality to understand erratic weather behaviours.

A16 Disasters/Hazards Risks and Humanitarian Services

Even though cases of large-scale natural disasters are few in Nigeria, volcanic disasters such as earthquakes, volcanoes and landslides are few in Nigeria, cases of technological and human-induced categories are persistent ranging from accidents of all known modes of transportation, explosion of oil and gas exploration facilities, buildings collapse, industrial accidents, fire outbreaks, ethno-religious and communal clashes. Incidences of some natural extreme events such as floods, erosion, submergence, disease outbreaks and tremors are also increasing.

Disasters are triggered spatially and often associated with development. The key aspects of geo-spatial techniques application in pre-disasters preparedness and management are modelling and forecasting potentials for, mapping level of risks and exposure of locations and regions, evaluating boundaries of risks and degree of vulnerability as well as establishing areas and population groups at risks for requisite management decisions. Spatial-based applications are becoming fundamental in plotting and predicting weather conditions and hazards of floods, droughts, hurricanes, and unusually high or low temperatures.

During disasters, the techniques are used for executing humanitarian services and logistics, establishing emergency points and response facilities, determining areas for evacuation, defining the routes of access and communicating disaster information within and between organizations and the general public on internet, extranet and intranet. For post-disaster periods, geo-spatial technology assists in are assessment of causes and damages at respective locations, and for designing and implementing resettlement and recovery programmes. The techniques are in use for estimating magnitude and severity of impacts and valuation of disaster elements for the insurance industry because they are predominantly spatial-dependent.

A17 Population Census

Mr. Vice Chancellor Sir. Nigeria has never achieved reliable and acceptable population figures for its administrative units officially due to insufficient attention to geo-spatial techniques for the planning and implementation of censuses activities at desirable disaggregation levels of households and enumeration / supervisory areas and community. Yet, the appropriateness for the country have been demonstrated by Adeniyi

(1987) for FESTAC Town, Olorunfemi (1984, 2007) for Ilorin, Eze (2009) for Enugu and Ukor, Okeke, Alaga and Rakiat (2016) for Ile Ife. Aiyedun and Olusaga (2012) experimented the techniques for dog census in Ilorin and Ohojeghuo (2015) for primate wildlife population in Calabar.

The specific areas of suitability identified for census activities include demarcation of enumeration and supervisory areas, field components of logistics planning and assigment of tasks, and the actual field enumeration and trail supervision for completeness monitoring. The supports for post-enumeration activities are records processing including collation, geocoding and networking of field records, geo-statistical analysis, visualization in varied cartographic formats and dissemination of results. It is used for creating databases on address matching and geo-refencing, web deployment, records maintenance, storage and revision of population records. Both census and off-census exercises of vital statistics registration are spatial and the challenges of accuracy, credibility, completeness and integrity can hardly be resolved with openness outside the geo-spatial technology domain.

A18 Election and Electoral Matters

Geo-spatial techniques is applied to a multitude of spatial management activities which are required for election planning, logistics, registration, results and processes. The technology is a key tool for redistricting which is the delimitation of boundaries and redistribution of electoral units. It is ideal for optimal location of sites electoral materials and results collation, determining the number, locating and geo-coding registration/polling units objectively based on the number of voters to be assigned, determining accessibility by voters to polling station, correcting errors in demarcation and production of geo-coded and geo-referenced stations digitally for election logistics and management. It is utilized for planning logistics and monitoring effectiveness of political mobilization and information, distribution of voting materials, personnel and security apparatus for electorate registration as well as for returning results of voting.

Geo-spatial technology aid politicians in their database management system for monitoring registration, election performances in terms of voting numbers and patterns as well as effectiveness of party activities. One of the post-election uses was to create electoral atlas that includes demographic analyses of elections results. Web-enabled spatial data are utilized for analysis and disseminations of results, predictions regarding the likely political impacts of electoral decisions, performances by parties and candidates, areas with impediments and the factors. Satellite systems mounted on vehicles and at collation centers to record and transmit video information of all events during election periods are for identifying culprits of election malpractices.

Appendix 2: Names of the Departments of Geography and their Domiciles in some renowned Universities

	University	*Name of Department*	*Domiciliation*
Australia	University of New England	Dept. of Geography & Environmental Science	School of Geography
	Australian National University	Dept. of Geography & Human Ecology	School of Resource Management & Environmental Science
	Monash University	Dept. of Geography & Environmental Science	Faculty of Arts
	University of Tasmania	Dept. of Geography & Environmental Studies	Faculty of Science
South Africa	University of Pretoria	Dept. of Geography, Geoinformatics & Meteorology	Faculty of Natural and Agricultural Sciences
	University of South Africa	Dept. of Geography	School of Environmental Sciences
	University of the Western Cape	Dept. of Geography & Environmental Magt.	Faculty of Arts
	University of the Witwatersrand	Dept. of Geography	School of Geography, Archaeology and Environmental Studies
	Walter Sisulu University	Dept. of Geography	School of Science, and Engineering
United Kingdom	University of St. Andrews	Dept. of Geography & Geosciences	School of Geography and Geosciences
	University of Aberdeen	Dept. of Geography & Environment	School of Geosciences
	University of Glasgow	Dept. of Geographical & Earth Sciences	Faculty of Physical Sciences
Canada	University of Toronto	Dept. of Geography	Faculty of Arts and Sciences
	Wilfred Laurier University	Dept. of Geography & Environmental Studies	Faculty of Arts
	Carleton University	Dept. of Geography	Faculty of Environmental Studies
USA	University of Wyoming	Dept. of Geography & Recreation	College of Arts and Sciences
	San Francisco State University	Dept. of Geography & Human Environmental Studies	College of Behavioral Science
	University of Texas (Austin)	Dept. of Geography & the Environment	College of Liberal Arts
	Western Kentucky University	Dept. of Geography & Geology	College of Science and Engineering
	Northern Arizona University	Dept. of Geography & Public Planning	Faculty of Geography, Planning & Recreation

	University	*Name of Department*	*Domiciliation*
	Eastern Michigan University	Dept. of Geography & Geology	Faculty of Geology and Earth Sciences
	University of Louisville	Dept. of Geography & Geosciences	School of Arts and Sciences
	John Hopkins University	Dept. of Geography & Environmental Engineering	School of Engineering