LAGOS LAGOON COASTAL PROFILE: INFORMATION DATABASE FOR PLANNING THEORY

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Abstract: *The conceptual framework for planning thought consists of the rationale of planning theory and the model of planning agencies. The route for planning theory aims to establish categories of laws under which particular events of planning may be summarized and explained. This gives credits for information in planning theory, especially in the area of concerns (application areas).*

This paper aims to highlight the importance of information technology in planning theory and planning practice at large. It describes the profile of Lagos lagoon, identify the issues to be considered in coastal profile, examine existing literatures on coastal profile and related issues, describe the study area in order to give an account of the coastal area and human interactions and provide an information database for planning. The paper is narrative and historical in its methodology, that is an account of existing literatures on coastal profile.

The paper provide information base for Lagos Lagoon in the light of advancing knowledge for planning decisions in planning theory and urban development.

1 INTRODUCTION

Nigeria has made significant efforts since the Rio Conference to address the core environmental and sustainable development issues, which were identified and agreed upon at the United Nations Conference on Environment and Development (UNCED). However, environmental problems are still visible twelve years after UNCED.

The unprecedented increase in population and rapid rate of urbanization have brought about significant settlement problems of housing, overcrowding, traffic congestion, environmental degradation, inadequate infrastructure and services. Recognizing these problems, the Government has not only featured in its National Rolling Plan, the National Housing Policy but also the strategies for implementing a number of programmes aimed at promoting sustainable human settlement development.

The aim of the paper is to highlight the importance of information in planning theory and planning practice at large. The objectives are to examine existing literatures on coastal profile and related issues, to describe the study area in order to give an account of the coastal area and human interactions and to provide information database for planning theory and practice. The paper is narrative and historical in its methodology that is, it gives account of existing literatures on coastal profile and identify the intellectual gaps.

This paper focused on Lagos lagoon, a water body in the heart of the metropolis. Lagos lagoon cuts across the southern part of the metropolis, linking the Atlantic Ocean (in the west and south) and Lekki lagoon (in the east) see Appendix 1. It is about 6354.708 sq.km in area and 285km in perimeter. The lagoon provides places of abode and recreation, means of livelihood and transport, dumpsite for residential and industrial discharges and a natural shock absorber to balance forces within the natural ecological system. The Lagos Lagoon consists of three main segments and they are as follows; Lagos Harbour, the Metropolitan end and Epe Division segments.

“The bottom water of the lagoon has high temperatures which were relatively constant throughout the year. The temperatures varied between 32.7ºC in December 2002 at the entrance of Ogun River near Ikorodu and 27ºC in October 2003. The temperatures fluctuated only narrowly throughout the year. The annual temperature arnge was only 7ºC. During the rains (May to November) the influx of riverine water and the heavy cloud cover in the sky resulted in a gradual fall of the temperature to a minimum of 26ºC” (Oyenekan, J. 1988).

There is differential salinity in the lagoon due to the effect of Atlantic Ocean and fluctuates both seasonal and semi-diurnally. Seasonal and diurnal salinity fluctuations are greatest in the Lagos Harbour segment of the lagoon because the influx of water from Atlantic Ocean and the Lagoon. At different time of the day and year.. This salinity decreases as distance increases from Atlantic Ocean.

The pollution level of the lagoon is greatest in the Lagos harbour segment and decreases in the metropolitan end of the lagoon, while Epe segment records the least level of pollution. Though, the actual level of pollution varies even within the segments but there

are correlations in the values recorded. A detailed pollution monitoring exercise will suffice for the purpose.

The bottom deposits ranged from coarse shelly sand around the mouth of Lagos harbour through various grades of muddy sand to mud. Sandy mud or muddy deposits occurred in the central areas with muddy sand or sand towards the shore line. The coarse sand of the harbour entrance could be attributed to the fast water currents in the area.

The sea bed of Lagos lagoon has been described phenomenom because of the nature of continuous deposits and sporadic dredging in the harbour area. The sea bed in the metropolitan area is relatively higher and increases towards Epe segment of the lagoon. The sea bed has been distorted by semi and large scale sand mining especially towards Ikorodu area of the lagoon. A detailed hydrological survey by the Nigeria Institute of Ocean and Marine Research (NIOMR) will be appreciated in this respect.

Like the Nile to Egypt and the Mississippi to America, Lagos lagoon impacts the lives of many Lagosians (inhabitants of Lagos metropolis) enormously. It provides place of abode for the Ilajes and Ijaws (stilts housing). The greater portions of two communities (Makoko and Ilaje in Bariga) with combined population of about 37,598 over an area of about 0.25sq.km live on the lagoon. Other human activities associated with the lagoon are fishing, aquaculture, sand mining, recreation activities. It also provide a good platform for inland waterways transportation which has potentialities of reducing transportation problems in Lagos metropolis.

Lagos city (estimated population was 1,274,000 in 1991), southwest of Nigeria, on the Gulf of Guinea. It comprises of the islands of Lagos and Victoria and the outer Lagos Mainland and part of Lekki Peninsula. Lagos is Nigeria's largest city, its administrative and economic center, and its chief port. Industries include railroad repair, motor vehicle assembly, food processing, and the manufacture of metal products, textiles, beverages, chemicals, pharmaceuticals, soap, and furniture. The city is a road and rail terminus and has an international airport. An old Yoruba town, Lagos, beginning in the 15th century, grew as a trade center and seaport. From the 1820s until it became a British colony, Lagos was a notorious center of the slave trade. Britain annexed the city in 1861, both to tap the trade in palm products and other goods with the interior and to suppress the slave trade. In 1906, Lagos was joined with the British protectorate of Southern Nigeria. In 1914, when Southern and Northern Nigeria were amalgamated, it became part of the small coastal colony of Nigeria. In 1954, most of the colonies were merged with the rest of Nigeria, but Lagos was made a separate federal territory. From the late 19th century to independence in 1960, Lagos was the center of Nigerian planning ideas and movement. From independence until 1991, Lagos was the capital of Nigeria. The capital was then moved to Abuja, although some governmental departments remain in Lagos. The University of Lagos (1962), the Yaba College of Technology (1948), the National Museum, and a large sports stadium are in Lagos.

2 Problem Statement

In an attempt to pursue sustainable use of coastal water and the adjacent land, the Federal Government of Nigeria put in place an Action Plan on water pollution control and biological diversity conservation in the Niger Delta area of the country. Internationally, collaborative efforts were made with the West African sub-region under the Gulf of Guinea Large Marine Ecosystem (GOGLME) Project aimed at monitoring coastal water in terms of pollution and biological diversity conservation. Apart from this project, measurements of some meteorological parameters over the Atlantic Ocean bordering the country are being taken by relevant agencies.

Nigeria has given high priority to its freshwater resources due to the growing concern at the increasing stress on water supplies caused by poor use patterns, affecting both water quality and quantity. Consequently, the Federal Government through the Ministry of Water Resources and Rural Development is undertaking a number of programmes designed to protect the quality and supply of freshwater resources in the country. Some of these include the preparation of a National Water Resources Master Plan (1995-2020), water resources assessment, promulgation of enabling decree, rehabilitation of dams and soil erosion sites, and establishment of water quality laboratories. Others include development of a National Water Supply Policy, production of the National Rural Water Supply, Sanitation Sector Strategy and Action Plan, and strengthening of national water quality monitoring networks.

The situation in Metropolitan Lagos is becoming pathetic and unbearable economic growth and urban development seems not to consider the environmental consequences of their exploits. A vivid example is the gradual disappearance of open spaces, interesting scenery, pedestrian walk-ways, public relaxation spots, trees, shrubs and flowers, grass condition is further strained by the seasonal and persistent flooding, ineffective waste management system, inadequate water and electricity supply, incessant and indiscriminate water and ambient air pollution, poor drainage system compounded by the topography, the inability of urban governance (local government councils) and general lack of information base to address the deteriorating physical urban environment. All these above, indicate great need for information about the immediate vicinity and the resources therein because the rate of euthropication of the water body has increased a great deal.

3 Theoretical Framework

This paper is conceptualized bt the typology of environmental degradation and concept of environmental Kuznets curve. Bonilla (2002), stated that “neoclassical economics focuses on the goal of efficiency – defined in Paretian terms as a situation in which no one can be made better off without someone else worse off”. He stated that the analysis of the causes and consequences of environmental degradation is discussed with these three questions: Who reap the benefits?, Who bears the costs?, Why are the winners able to impose costs on the losers?.

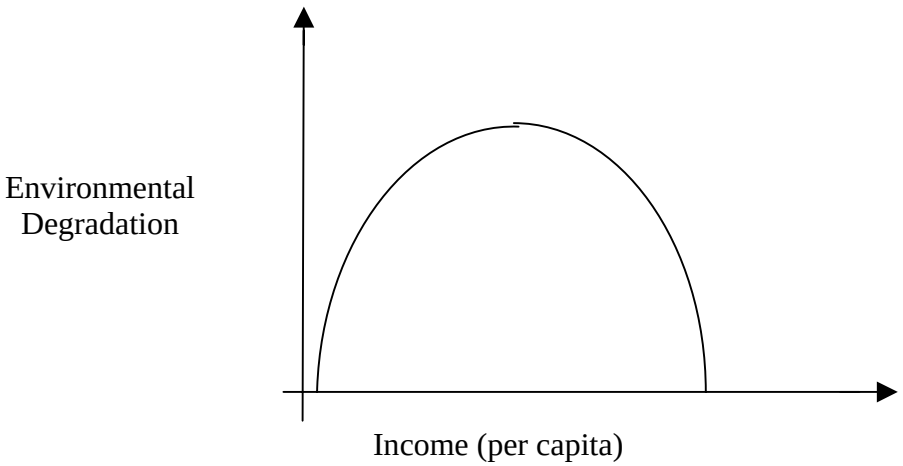
Figure 1 **A Typology of Environmental Degradation**

		Winners	
		Rich	Poor
Losers	Rich	I	II
	Poor	III	IV

In Type I, environmental degradation, both winners and losers are rich. In Type II, the rich bear the costs of environmental degradation caused by the poor. In Type III, the reverse occurs: poor bear the costs of environmental degradation caused by the rich. Finally, in Type IV the poor are both winners and losers. Type III environmental degradation is more prevalent than Types I and IV, and these in turn, are more prevalent than Type II. The rich are thus better able to impose environmental costs on the poor than vice-versa.

Torras (2002) in ‘rethinking the environmental Kuznets curve', tested this proposition by examining the determinants of the international variations in air pollution, water pollution and access to clean water and sanitation facilities. In recent years, some economists have suggested that pollution and other forms of environmental degradation display an inverted U-shaped relation to per capita income: as economic development proceeds and average incomes rise, pollution at first increases but ultimately reaches a turning point after which environmental quality improves. An examination of international variations in income distribution, literacy, and political rights and civil liberties determining environmental outcomes.

Figure 2 **Environmental Kuznet’s Curve**



These views presented here give a generic opinion of the social structure (rich and poor), income distribution (per capita), environmental quality and degradation. However, these are the area of concerns for planning (substantive theory) but are not the general and basic issues in planning (procedural theory).

4 Background Knowledge

Nils Drønen, N. et al (2002) used the principles of linear stability analysis to study initial formation of rip channel systems of three-dimensional stability of a barred coastal profile. The subject of the stability analysis is to find the most unstable perturbation (of all) that can be added to the bed. The shape of this most unstable, or fastest growing, perturbation is expected to be representative for the shape that will eventually emerge as the bed develops. The starting point of the analysis is an alongshore uniform bed with a barred profile.

The modelling system adopted in this study is a non-linear numerical modelling system and consists of three separate modules, a wave module that calculates the wave transformation (refraction, shoaling and breaking), a hydrodynamic module that solves the depth integrated flow equations for the wave driven currents in two horizontal dimensions, and a sediment transport module, e.g. taking into account effects of the wave boundary layer and the wave breaking. From the calculated sediment transport field, the local rate of bed level change is found through the continuity equation for sediment.

There are opinions on the effects of climatic changes on the coastal areas. Ukeje, J. E. and Alozie, J. E. (1995), stated that “areas that are most vulnerable to disasters emanating from climate change in Nigeria include (a) the low-lying islands, (b) the mangroves, (c) the coastal wetlands and grasslands, (d) the semi-arid and arid areas, and (e) rivers, lakes. The greater and faster these vulnerable areas get impacted by climate change, the more the damages to the ecosystem, the human societies and the social cum economic developmental processes that depend on them. This is the case with the following sectors of the nation's economy namely; the coastal zone resources, agricultural and food production, water resources and energy sectors:

Coastal Resources

The Nigerian coastline forms an important base of socio-economic development of the nation. The Nigerian coastal zone lies within latitude 4º 10' to 6º 20' N and longitude 2º45' to 8º 35'E spanning about 850 km of low-lying coastline, with estimated human population of over 20 million. The zone consists of four distinct geomorphologic parts namely: (a) The Barrier-lagoon system in the west; (b) The Mahin transgressive mud coast; (c) The Niger-Delta covering about 20,000 square kilometre which is the second largest delta in the world. It spans a coastline of 450 km and has the largest mangrove swamps in Africa estimated at 1,900 square km; and (d) The Strand coast in the east.

Studies by the Nigerian Institute for Ocean and Marine Research (NIOMR) on Lagos Lagoon reveal that, the barrier lagoon coastline in the western extremity housing the high real estate at Victoria Island and Lekki in Lagos could lose well over 584 and 602 square kilometer of land from erosion, and inundation could completely submerge the entire

Lekki barrier system. Such adverse impacts will affect the residential, commercial and tourist facilities in these areas, which are valued at well over 12 billion US dollars. Already, an occurrence of 0.2 meter of sea level rise resulted to a loss of 3,400 square kilometers of landmass to flooding. This is projected to affect about 18,400 square kilometers of land with a 1m sea level rise.

The same study also shows that, with a sea level rise of 0.3 meter, about 1 to 2 million people out of the total population of 6 million in the Niger delta area of the coastal zone will be displaced and require relocation, while a sea level rise of 1 meter will affect 2 to 3 million people in the same area. The Strand coast on the eastern extremity shares the same fate, as about 400 square kilometers of its land would be lost to inundation by the year 2100.

The resources in coastal areas are diversified and complex. Data involved in those resources are manifold and complicated. A sophisticated data management tool therefore becomes critical. Geographic information system (GIS) will be employed in this study to compile, integrate, and organize these environmental resource data in coastal areas. Data will be collected by different experts coming from different disciplines such as geography, zoology, botany, biology geology, geomorphology, archaeology, sociology, climatology, and so on. These data are from different sources such as existing maps, aerial photos, satellite imagery, documents, and field survey. They are compiled and integrated by GIS technology. One to five thousand scale orthomaps are used as base maps. Everything will be relocated to these base maps either by GIS method or by manual allocation. Field survey is aided by Global positioning system (GPS). The database contains physical themes such as, geology, soil, coastline, water level, endangered animals, vegetation; human themes such as population, landuse historical relic, existing recreational spots, and environmentally sensitive themes such as wetlands, lagoons, sandbar, sand dune.

5 Lagos Lagoon Coastal Profile

Outline of the Issues to be considered

1. Study Area
   -- Lagos Lagoon and Coastal Areas (a detailed description)

2. Database Themes:
   -- Physical Themes:
   Geology, Soil, Coastline, Watertable, Geomorphology, Climatology, Hydrology

   --Human Themes:
   Land Use, Historical Relic, Demography, Industry, Hazards, Environmental Issues, Recreational Sites

   --Environmental Sensitive Themes:

Wetland, Lagoon, Sand Dune, Sand Bar

--Biological Themes:
Endangered Animals, Rare Vegetation Species

3. Methods
--Collaborative Works:
geographers, zoologists, demographers, botanists, sociologists, geologists, geomorphologists, biologists, archaeologists, climatologists, geographic information scientists

--Use GIS technology to integrate data
Domain experts → *Maps, documents, aeriphotots, satellite imagery, field survey* → *GIS*
method → *GIS database*

4. Data Sources
--Maps (digitization)

--Satellite imagery (image rectification & registration, Image classification, vectorization)

--Aeriphotots (image rectification & registration, image interpretation, digitization)

--Documents, Figures (relocate to base maps, field verification, digitization)

--Field survey (integration of GPS with GIS technologies).

6. GIS Database Implementation

The introduction and implementation of geographic information system technology by Lagos State Government (metropolitan authority) for coastal planning and management starts with a user requirement survey which is a pre-requisite. This is done in order to achieve the following; ascertain the organisational structure of the host institution; identify roles played by the Lagos State Government; ascertain the feasibility of the GIS project; examine the present modes of operation; assess the available basic input data and those needed; identify the users of the spatial information and their demand rate; identify the uses of the information; the type of information to be gathered and the data format requirements; assess the available technology and the technology needed for the optimum operation and performance of GIS technology; and identify the potential for GIS technology and the existing infrastructure.

All the issues above should be addressed in the questionnaire to be administered by competent personnel using proper sampling techniques. The structure of this questionnaire can take different format but it should address the problems facing the organisation with respect to its operations. The questionnaire above is designed to identify the problems, assess the awareness of GIS technology, the available and needed

infrastructure, the organisation status and meet the gap among many other reasons. Above all, the questionnaire is only a means to an end, that is a panacea, it is also a feasibility and viability measure for the implementation of GIS technology.

Implementation of GIS Database

In this section an attempt will be made at stating the sources of data used and the procedures followed in the implementation of GIS in the study area.

Sources of Data

The sources of data utilized for this project includes:

1. Lagos State Government - Lagos State Regional Master Plan (1:80,000)
2. Published materials from the Department of Surveying and Geoinformatics and the Faculty of Engineering library and Nigerian Institute for Ocean and Marine Research.
3. Other materials available in academic journal, conferences, relevant texts, gazettes, brochures, internet and statistical files of some government offices.
4. Field survey of Lagos lagoon and its environs using digital camera and handheld GPS (Garmin GPS Receiver, 2.0 version, 250XL, 24 channels, accuracy of +/- 6 meters). This is used to determine accurate and precise positions.

Selection of Hardware and Software

The most important components of any GIS are the hardware and software used for the project. Hardware is basically the computer system within which the software operates. It comprises the equipment needed to support the many activities ranging from data collection to data analysis. It is therefore recommended that for any GIS project an up-to-date system need to be provided.

The system configuration used for the project is as follows: Workstation, AT/ATX Compatible, 528MB Random Access Memory (RAM), Pentium IV, 1700MHz Processor Speed, Compact Disc (Read Only Memory) Speed 56X, Internal Zip Drive, Compact Disc Rewriter/Recorder, Hard Disk - 80GB, 17” Colour Monitor (Digital) and Standard Windows 98 Keyboard/ Mouse. Other devices used for this project are as follows: Laser Printer (A3), Digital Camera, AO Digitizing Tablet, AO Plotter, Uninterrupted Power Supply (UPS) Device and Standby Alternative Power Supply with Stabilizer and Power Surge Regulator.

The researcher used ArcGIS 3.1 relational database for mapping as the major software. ArcGIS 3.1 is a product of ‘Environmental System Research Institute’ (ESRI). This software handles multiple tables and relates them to each other with ease. It also allows integration of CAD (example AutoCAD software) files to enhance a variety of drawing of various file formats onto the map without first converting these files. ArcGIS also allows the joining of tabular data to the features in the CAD graphics. Various manipulations and queries are possible using appropriate commands. Other qualities include the ability to visualize, explore, query and analyze data geographically.

Other software packages used are Microsoft word, Microsoft Excel and Microsoft PowerPoint. While Microsoft Word was used in the processing, editing and representation of the textual information. Microsoft PowerPoint was useful in the preparation of image slides for project presentation.

Procedure and Implementation Strategy
This project utilized ArcView 3.1 software. It was used for managing the relational database, and final data processing, while AutoCAD 2000 was used for digitizing the Lagos State Regional Master Plan. Integration of Relational Database Management System (RDBMS) with the image data was achieved using ArcView GIS 3.1.

Factors Considered for the Selection of DBMS
The selection of database software for this project is based on the following considerations: ability to carry out specific or multiple tasks as may be required; flexibility of aggregating data over a wide range of boundaries, i.e. to consolidate and summaries information to obtain statistic and make the data easier to interpret and manage and ability to avoid loss of data due to transfer, storage and conversion of data from common database.

The relational database structure was used in this project due to its numerous advantages over other models, especially in terms of structural flexibility. Such advantages include, easy manipulation (retrieval, addition, deletion, change, etc) of data or descriptive information associated with spatial data without affecting the original data tables. The basic model for vector GIS breaks down physical reality into three basic data types which includes; points, lines and polygons.

The first three data types give the cartographic location of phenomena expressed in (X, Y coordinates) associated with a geodetic grid. Attached to these is attribute information describing the characteristics of these primitive locations. However, all attributes in this project are linked to the point features.

7. Discussion of Results and Conclusion

The analysis of data presented in the relational tables in ArcView GIS shows that pollution is concentrated in Lagos Harbour and Metropolitan segment of the lagoon. This research reveals that Lagos lagoon is constantly polluted at varying degree at different points within the metropolis This is because of the level of development in the metropolis occasioned by high urbanism and industrialization see Appendix 2. However, the magnitude of pollution may be interesting to know but it is not investigated in this study.

Appendix 3 shows the query about the level of discharge and consequential effect of pollution (toxicity) in the lagoon. However, the rate of discharge and the points of discharge are concentrated more in the Lagos harbour and Lagos Metropolis segment of the lagoon. The water bed indicates ample opportunity for inland waterways. This is evident in the water level and the gentility of Lagos lagoon current. Sustainable

transportation facilities such as ferries, haulage vessels can traverse the lagoon for movement of people, goods and information and ultimate ameliorate the prevailing transportation problems in the metropolis. Lagos and Lekki lagoons are navigable for light and medium size vessels. These will be impetus for coastal and urban development in the long run.

Planning has been defined as a process for determining appropriate future action through a sequence of choices (Faludi, 1994). This means that there are determination, actions to be taken and choices to be made. There are three prepositions that are prerequisites for planning theory. The first includes the subject-matter of planning and the environment in which it takes place and reflects the world-as-it. The second describes the purpose of planning as against the uses to which it is put. The third identifies elements that in their interrelation compose the planning act and distinguish it from other forms of behaviour. Therefore, the environment surrounding planning typifies that resources are scarce and consequently output is limited and the factors of production are limited in time and supply. This is the essence of the problem of priorities. Similarly, environmental resources (commons) are limited in supply, the need to prioritize is inevitable in the wake of increasing planning problems.

The key-problem of all rational planning is that of coping with the limitations of information handling from which every conceivable subject suffers Faludi (1973, 1976). These pose the riddle of how people cope at all, let alone engage in rational planning. While describing the perennial problem of planning, as information-overload seems to conflict with an alternative view of the difficulties which planners face as evolving around how to obtain information.

The limitations for information-handling capacity are that humans (planners) have a limited channel capacity and that the human (planner) memory is also limited. More importantly, is that the same memory is differentiated into a short term memory, containing all that information which is required for solving an immediate problem, and the memory at large, from which that information can be drawn. The short-term memory, however, is very much more limited in its capacity than is the memory itself.

The development and implementation of this spatial-planning information database is an attempt to address the problems of dearth of information and low information handling capacity. Therefore, in order to solve the problems of low information-handling capacity, usage of the large memory for long term problem solving and create availability of adequate information for collection, storage, manipulation (analysis and management) and retrieval and usage, there is need for conscious effort to be made to provide adequate planning information. This can be made easier to develop planning information database and manage it with the launch of the Nigerian satellite in orbit for real-time information and updates.

The following information policy statements can be elaborated for effective planning practice and theory. The establishment of several national committees on planning theory, climate and environmental related issues eg the Lagos Spatial-Planning

Information Database and Management Committee, Ecological committee, the national committee on Climate change, the national committee on sustainability Science, the technical committee on erosion and flood control and the Niger Delta Development Commission.

The creation of the Federal Environmental Protection Agency (FEPA) in 1988 (now in the Federal Ministry of Environment) to inter-alia maintain and improve the quality of the unique environment resource endowment and physical characteristics of the coastal areas and prepare ecological master plans to guide the use of coastal areas for diverse and often conflicting individual and social activities for the continuous viability of all aspects of the ecosystem.

Nigeria is also actively engaged in global and international efforts to ensure sustainable development in a bid to mitigate these planning information problems, information anxiety and adverse impacts of climate change. She became party to the 1958 Geneva Convention of territorial Sea and Continent Shelf on 10 October 1964, and 28 May 1971 respectively. The United Nations Law of the Sea was signed on 10 December 1982 and ratified on 14 August 1986.

In conclusion, this exposition on planning theory and coastal management tries to wield the dichotomy in planning theory (procedural and substantive). Having agreed with the relevance of procedural theory to planners than substantive theory, the fusion of planning theory and coastal management describe the relevance of substantive theory (area of concern – coastal management) to procedural theory in planning practice.

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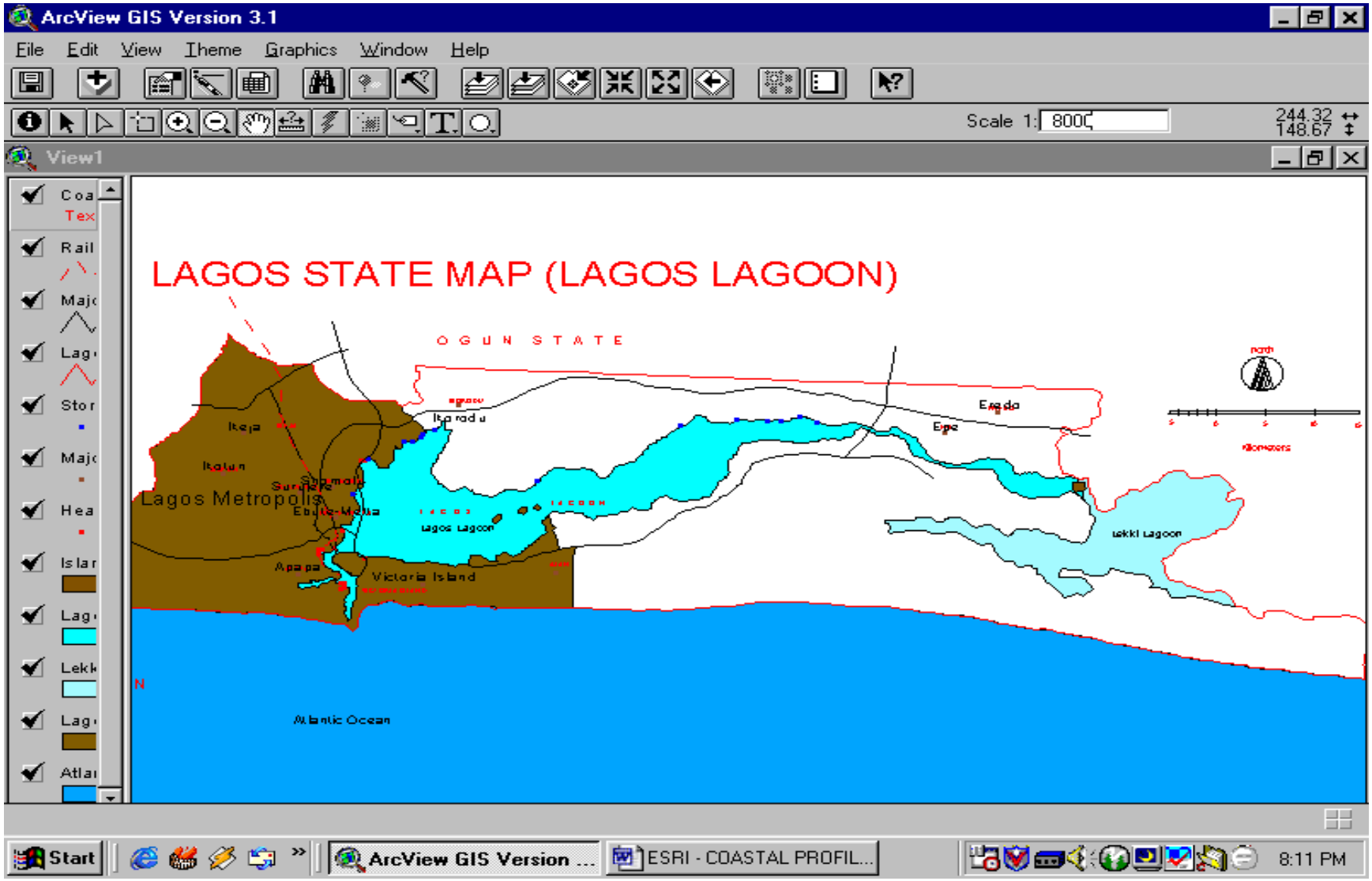
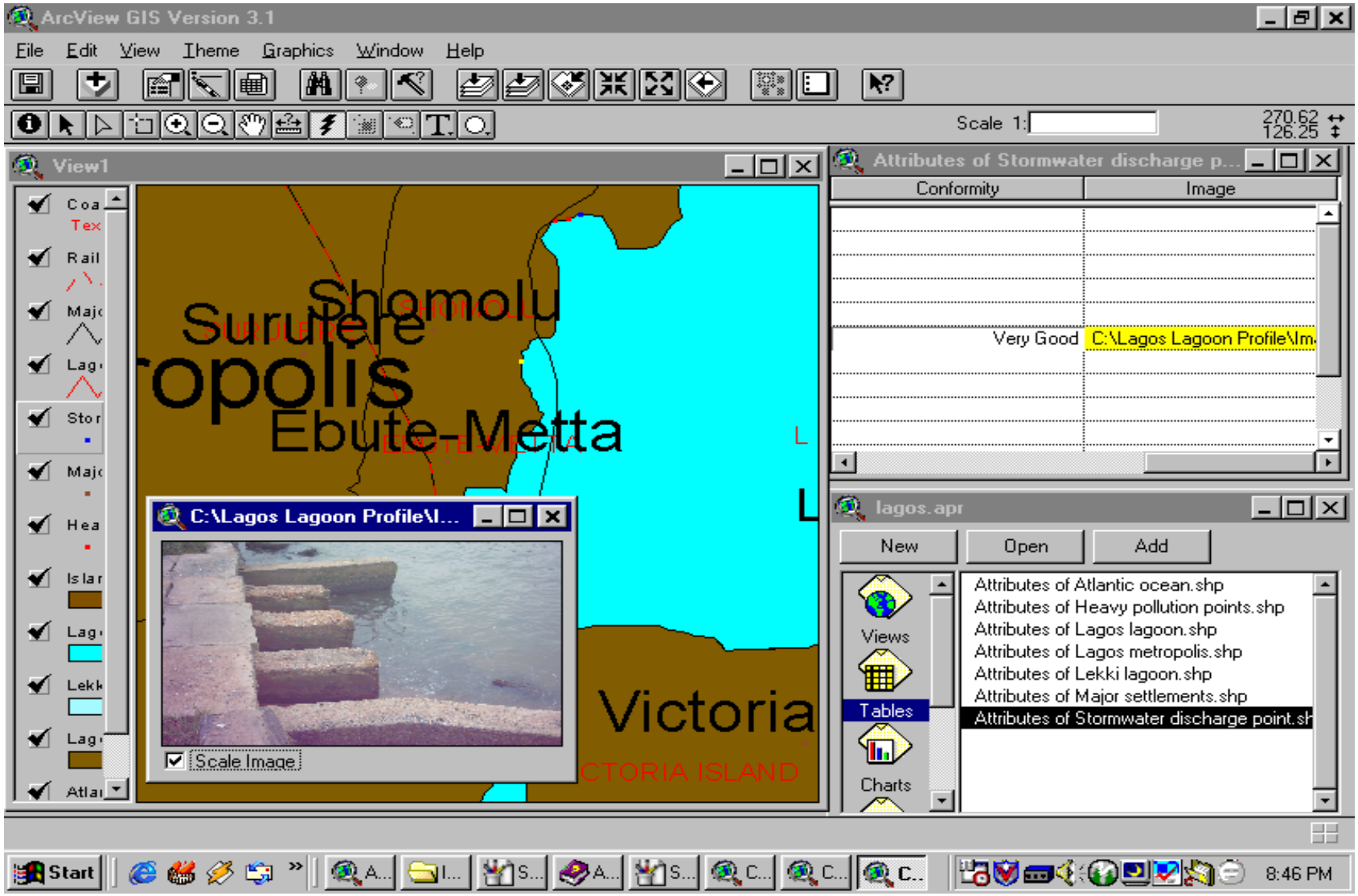
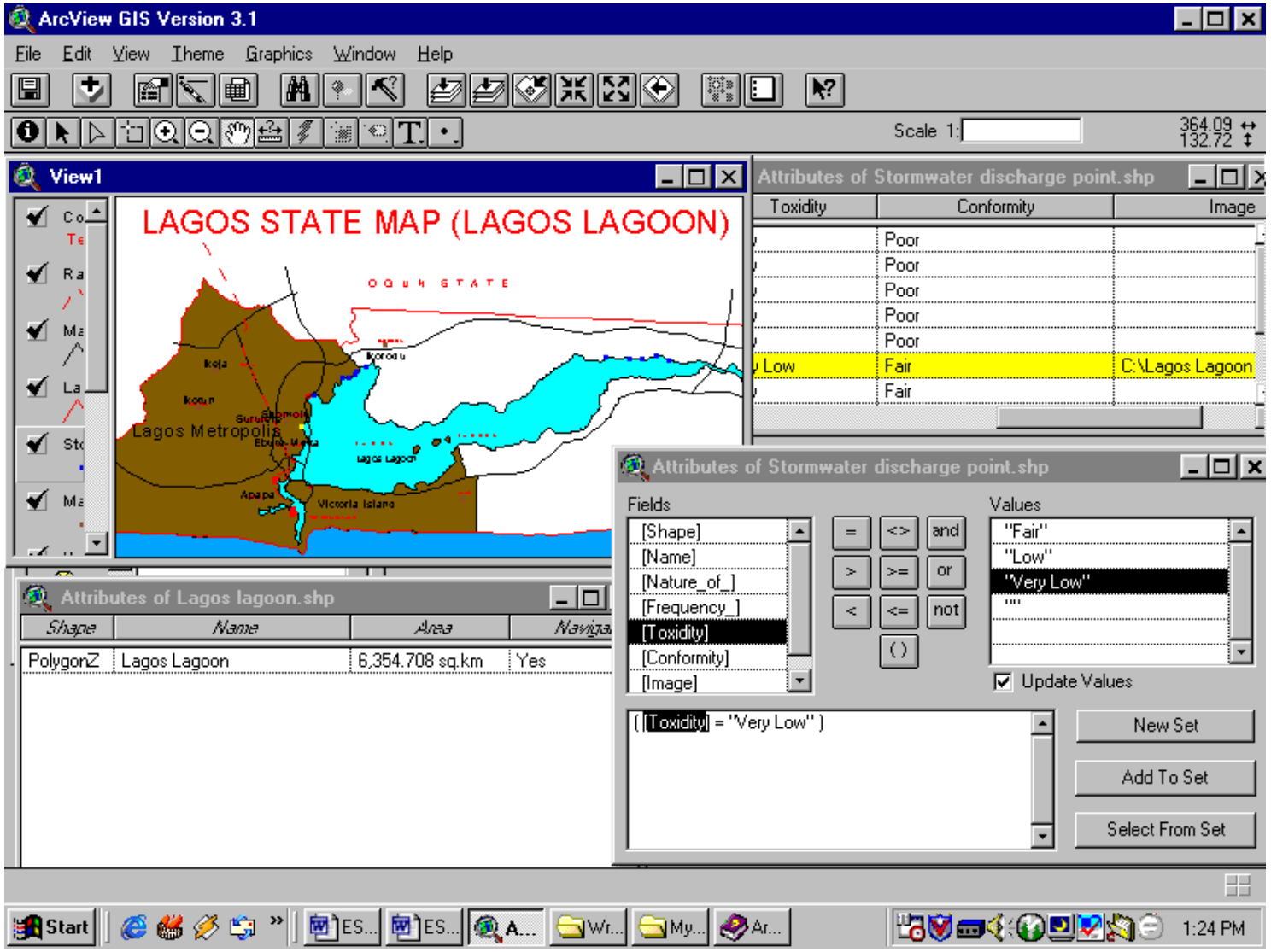
Appendix 1 **LAGOS STATE MAP (LAGOS LAGOON)**



Appendix 2 **Stormwater Discharge into Lagos Lagoon**



Appendix 3 Query and Result of Query of Stormwater Discharge



End Notes

The existence of innovations and inventions in science and technology have had tremendous impacts on mankind and have also made living worthwhile. These have brought knowledge about mankind and other activities around in a view to make live more comfortable (livability). However, the application of these knowledge is the act of wisdom because to be “informed” is to be “transformed”, while to be “misinformed” is to be “deformed”. There has been a deluge of moving from the carnage of information anxiety.

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