AN INVESTIGATION OF ENVIRONMENTAL INFORMATION SYSTEMS PRACTICES IN KENYA

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A MANAGEMENT RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE MASTER OF BUSINESS ADMINISTRATION DEGREE FROM FACULTY OF COMMERCE, UNIVERSITY OF NAIROBI

DECEMBER 2004

DECLARATION

This Management Research Project is my original work and has not been presented for a degree in any other university.

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This Management Research Project has been submitted for examination with my approval as University Supervisor.

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DEDICATION

This project is dedicated to my lovely wife, Monday Businge Ambala, our children Atuhaire Ogola Ambala and Ahura Adhiambo Ambala, my parents Barrack Odhiambo Ambala and Jemimah Odhiambo and my sisters, Pauline, Olgah and Perez Odhiambo

ACKNOWLEDGEMENTS

An undertaking of this nature is an involving process and I wish to gratefully acknowledge those wonderful people who contributed to its realization.

First and foremost, I am greatly indebted to my supervisor Nixon Muganda, of the department of Management Science without whose invaluable guidance, advice and encouragement, my dream of completing the MBA course would not have been realized. I thank him for his tireless efforts, patience, interest, and dedication in seeing me through the accomplishment of this project.

Secondly, I would like to extend my sincere gratitude to my various lecturers and classmates over the past three years for their individual advice, support and stimulating course and appreciate the role each played in shaping the outcome of my MBA.

Third, I am beholden to my family for their love and support from the start of my MBA program. To my wife, Monday, our children, Atuhaire and Ahura, my parents, Barrack and Jemimah Odhiambo, my sisters Pauline, Olgah and Perez, my in-laws, Patrick, his wife, Jennifer, Jennifer, her husband Brendon and my nephew and niece Hosea and Catherine, thank you all for the support, commitment, patience and believing in me through the years.

Fourth, to my wife, Monday Businge who has been very supportive of me, and encouraged me even during those difficult financial times. Heartfelt thanks for all the support, patience and encouragement.

Above all, I want to thank God who has made it all possible and blessed me with a job that helped me pay for my college fees.

ABSTRACT

Increasing globalization and a focus on sustainable development is forcing governments to rethink their environmental information systems that produce information for decision-making. There is thus recognition that environmental information has a role to play in decision-making on matters related to sustainable development.

In addition many donor-funded projects in Kenya require mandated institutions to start thinking about developing environmental information systems capable of producing environmental information efficiently. The objective of this study therefore was to carry out a survey on what the current environmental information systems practices are, as well as to document some of the challenges in their implementation. A judgmental sample of 60 professionals from 35 institutions, which comprised relevant government departments, semi-government institutions and non-governmental organizations, formed part of the sample.

Descriptive statistics were used in the analysis specifically to determine the frequencies, percentages and proportions in an attempt to ascertain to what extent the institutions of the sample have adopted various environmental information system variables.

The conclusions arrived at indicate that according to Nolan's model, Kenya is at the control stage of Environmental Information systems development in most of the institutions. Further, a majority of the institutions mainly focused on the Information technology aspects as opposed to other areas such as information management, capacity building and issues to do with data sources. This disproportionate focus has resulted in ineffective environmental information systems in most of these institutions.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

DEFINITIONS OF TERMS

AEIN	Africa Environment Information Network
AEO	Africa Environment Outlook
AMCEN	African Ministerial Conference on the Environment
CBD	Convention on Biological Diversity
EIS	Environmental Information System
FAO	Food and Agriculture Organisation
GEO	Global Environment Outlook
GIS	Geographic Information System
IGOs	Inter-Governmental Organisations
IT	Information Technology
LANDSAT	Land Satellite
MoU	Memorandum of Understanding
NGOs	Non-Governmental Organisations
SPOT	Satellite Pour L'Observation de la Terre
SoE	State of Environment
SoER	State of Environment Report
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WWW	World Wide Web

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Mankind must attempt to find the delicate balance between its developmental needs on the one hand and the complete preservation of the status quo, or preferably the reversal of environmental damage, on the other. While it is highly unlikely, if not entirely unrealistic, to assume that environmental management models will provide for full sustainability, every effort must be made to minimize negative human impact on the environment. It is well known that increased population and socio-economic developments such as urbanization, apply tremendous pressure on agriculture, biodiversity, climate, vegetation, wildlife, and water resources, among others (Paradzayi, 2002). Man's exploitation of these resources inevitably leads to environmental degradation in the form of soil erosion, deforestation, increased urbanization and irregular settlements (EIS Uganda, 2000).

1.1.1 Definition of Environment

In order to appreciate this study, it is necessary that we fully understand what environment in this context is. Different people have their perceptions of the environment and attitudes towards it have evolved as an integral part of the long history of human interactions with the rest of nature.

Mostafa K Tolba, The World Environment 1972-1992, 1992, describes the environment as:

> "the natural resources which surround the human and which they depend on to survive"

These includes the air they breath, the forest that surrounds them, the land they live on, the water they drink, the animals that the humans live with, atmosphere, climate etc.

The recognition that people can damage or deplete the natural resources on which they depend dates back to ancient times. Plato, in *Critias*, describes deforestation and soil erosion as the negative side of power, (McCraken, 1987). Some civilizations declined because their resource management, especially of water and soil, was not enough to maintain agricultural productivity.

The evolution of increasing self-reliant cultures, especially in Western Europe, seems to have been accompanied by an alienation from nature and hostility towards it. The worldwide concern about the environment that is so evident today is a relatively recent phenomenon, impact and the threats that this could pose. This concern has led, in turn, to demands for changes in approach, at international, national, community and individual levels. Changing human behaviour towards the environment demands the alteration of perceptions and attitudes and especially the creation of circumstances under which the new behaviour is seen to be both rational and possible. People will accept a new ethic for sustainable living when they are persuaded that it is right and necessary to do so, when they have sufficient information, and when they are enabled to obtain the required knowledge and skills (IUCN/UNEP/WWF, 1991).

According to WLIP (1991), environmental information includes information relating to topography, soil, geology, minerals, vegetation, land cover, wildlife, land use, land use controls and restrictions, jurisdictional boundaries, historic and prehistoric sites, economic projections, etc. Environmental practitioners can use Environmental Information Systems (EIS) as a management technology to determine, organize and manage, for optimal utilization, their environmental resources.

Environmental Information Systems (EIS) should therefore, include strategies, procedures and institutional frameworks, together with data management tools, that ensure access to

environmentally relevant data and allow for their analyses (Prévost and Gilruth, 1999). These systems should contain a wide range of environmental components so that environmental practitioners can develop holistic, cross-media and multi-disciplinary approaches to environmental management. The complexity of an environmental information system depends on the number of environmental components required to serve the defined management objectives. Users of EIS should be able to query these systems and derive information on fauna and flora locations, migration routes, sources of pollution, land ownership, archaeological sites, protected areas, location of endangered species, demographics, etc (NRDC, 2001).

A starting point for research on the EIS phenomenon in Kenya is to look at UNEP's Africa Environmental Information Network (AEIN) strategy on environmental management, which collaborates with various government ministries. UNEP's mandate is to report on the state of environment at regional and global level. In Africa, perhaps more than any other region of the world, a healthy and productive environment is a prerequisite for combating poverty, raising social well being, and facilitating sustained economic development. African Ministers of Environment have therefore taken a leadership role towards harnessing the knowledge and understanding of the region's environmental resources for the formulation of appropriate socio-economic policies necessary to achieve sustainable development.

At the 8th Session of the African Ministers Conference on Environment (AMCEN), held in Abuja, Nigeria in April 2000, the Ministers decided that an Africa Environment Outlook (AEO) Report should be prepared to provide a comprehensive scientific assessment of the environment, policies, and environmental management programmes. These are needs that have been identified by African geo-information professionals, and also through the on-going integrated environmental assessment and reporting processes at national and sub-regional

levels (State of Environment, SoE), regional (African Environment Outlook, AEO), and global (Global Environment Outlook, GEO).

In addition to concerted efforts by the Kenyan government to focus on environmental management and systems arising from initiatives such as above, there are also indications that public awareness on environmental issues continues to increase not only in Kenya but also in other parts of Africa. This is due to several reasons, which include (EIS-Zimbabwe, 1999):

- Evidence of environmental degradation due to desertification and erosion
- Decreasing agricultural productivity of land and water resources
- Increasing access to public media like Radio, Television, Video etc.
- Evidence of pollution of the environment
- Individual and consumer rights through NGOs
- Government Commitment to International Conventions

The existence of an integrated and co-coordinated EIS system would therefore enhance the effectiveness of environmental consciousness thrust as a source of data and information for decision-making.

Further in other studies (EIS-Mozambique, 1998; EIS-Zimbabwe, 1999; EIS-Ghana, 1999; EIS-Uganda, 2000) it was found out that the framework conditions were not yet very favourable for an open and transparent information system, nor for an EIS. Networking for their own ministry, department or personal purposes is quite common, however, sharing information in full transparency is not the main characteristic of the actual communication culture. While information has its own value, sharing information means sharing both value, and power. Thus the majority of the countries studied still lack a coherent and comprehensive environmental law framework as a solid foundation for transparency in decision-making, sustainable resource and environmental management.

In Kenya, environmental management has evolved over the years through the Ministry of Environment and Natural resources, which has worked in conjunction with other ministries and organizations. However, laws are still fragmented, uncoordinated, overlapping, difficult, expensive to administer and essentially ineffective because they rely on a criminal law approach, which addresses matters after their occurrence (Henley, 1990).

As a result there are no integrated formal installed procedures in operation producing systematic and periodical information for decision makers. Whenever information is needed for decision-making, data have to be gathered, collected and systematically interpreted in order to get information for decision-making. Environmental information is therefore normally produced on an ad hoc basis whenever needed. Thus quite often, for complex issues and studies it is common to ask consultants to gather the data needed and transform them into information needed for decision-making.

1.2 STATEMENT OF THE PROBLEM

The amount of environmental capta in Kenya is continually increasing as evidenced by the number of ministries and non-governmental bodies engaging in environmental management. For instance, within the government alone, there are at least five ministries charged with some aspect of environmental management. These Ministries include the Ministries of Environment and Natural Resources, Tourism and Information, Livestock and Fisheries, Agriculture, Water Resource Management and Development, and Energy. Each of these ministries and other non-governmental bodies receiving support from donors have some environmental information with preliminary research indicating that most of it is not accessible to interested public or institutions.

The concept of an environmental information system strongly advocates for an integrated approach of environmental management ensuring accessibility to this information (EIS-SSA-Zimbabwe, 1999; EIS-SSA-Uganda, 2000). In addition, since there are several ministries handling different aspects of environmental management, with no central co-ordinating authority, there is likelihood that they may pursue different approaches to implementation of their EIS. This may result in incompatibility in terms of the capta; data and information systems if there is need to integrate the different environmental information systems.

Thus although the amount of environmental capta is increasing at an exponential rate, it is not clear, especially in developing countries such as Kenya, how various EIS are being implemented for its proper management.

Preliminary research indicated that there is very limited co-operation and co-ordination between the ministries. The majority of institutions which have embarked on EIS are motivated by their own mission and visions but to a great extent do not subscribe to national

policy objectives. Further, existing systems serve primarily their own clientele, without regard to the needs of other potential users. This leads to duplication of efforts and sometimes inefficient use of both financial and human resources partly because of the absence of a co-coordinating body to harmonize the objectives and implementation of EIS initiatives.

It is also worth noting that there is insufficient co-ordination of donor activities and the manner in which they can support and fund EIS projects and initiatives. This is attributable to competition among the donors themselves, lack of both government EIS vision and capacity to co-ordinate donor activities.

A research carried out in Zimbabwe (EIS-Zimbabwe, 1999) indicated that several information systems co-exist which can in effect be considered EIS sub-systems. These sub-systems primarily serve the purposes and mandates of their host organizations, which are only now beginning to co-operate and co-ordinate. The study in Zimbabwe found out that there is no shared EIS approach or vision in Zimbabwe. In addition, most respondents had different interpretations of their EIS Policy especially when it came to their views on what EIS was about. It was nevertheless encouraging that there was a unanimous perception of their country's commitment to sustainable development.

From the foregoing, it is therefore important to recognize that the build-up of an EIS requires an information management concept to ensure that the mandated organizations collect the right data at the right time and that this data is shared and processed into meaningful and timely information for decision-making.

The survey carried out for purpose of this study, has therefore been designed to address the following research issues, among others:

- Awareness of EIS and its interpretation;
- EIS existence in both the respondents' organizations and Kenya;
- Vision of EIS for both the respondents' organizations and Kenya;
- Institutions involved in environmental issues;
- Technical Issues with respect to equipment and personnel;
- Decision making processes;
- Ownership of Environmental management and EIS mandate;

It was therefore important that the survey be carried out in Kenya to determine current EIS practices in the country.

1.3 THE OBJECTIVES OF THE STUDY

The objectives of the study were:

1. To establish the current EIS practices in Kenya and;
2. To investigate the challenges facing EIS adoption in Kenya;

1.4 IMPORTANCE OF THE STUDY

1. The study will be of value to researchers as a basis for future empirical and conceptual research, which will be helpful in refining and validating findings especially when a significant number of experiences are collected and studied.
2. It will be significant to the business community, especially to business managers involved in environmental management strategy for businesses and other government

bodies. The study will be important to this group, whether they already have an environmental management policy or not.

3. The study will also be of importance to government policy makers, since an understanding of the best practices of environmental management will enable them to come up with appropriate policies that encourage appropriate environmental management.

CHAPTER TWO: LITERATURE REVIEW

2.1 WHAT IS AN ENVIRONMENTAL INFORMATION SYSTEM?

The purpose of the literature review is to understand the rationale for categorizing a certain set-up of computerized technology and data sets as an **"Environmental Information System"** and the review is based on the use of this term.

Gunter (1998) in a book titled "Environmental Information Systems" defines EIS as follows:

> " EIS are concerned with the management of soil, water, air and species in the world around us".

He further describes a framework for systems based on four phases of data processing: data capture, aggregation, storage, and analysis.

The organizing committee for the International Symposium on Environmental Software Systems (ISESS, 1997) argues that:

> "EIS are an important factor in environmental research, decision support, management and policy. EIS implementations have a number of requirements, which are hard to justify, even with the information technology today. After a period of 10 years of trial and error, of failures and successes, the study of EIS has matured. The subject is still growing in a multidisciplinary work environment which changes quickly, both in the IT and the environment sector".

The term Environmental Information System has similarities to the term Geographical Information Systems (GIS) that is generally used on digital databases containing spatially organized information. This implies that the term EIS involves digital databases organizing

environment related information. The complete EIS concept is however more than just a database. The EIS concept also contains strategies, procedures and an institutional framework to handle environment related problems, solutions and decision-making. The three main elements of the EIS may be identified as follows:

(i). The data (with emphasis on availability, compatibility, quality, etc);

(ii). The operators (namely the level of training of staff, access to appropriate resources like computers, etc);

(iii). The institutional framework (i.e. data producers and their mandates, users, networking, etc).

The term **"environment information system"** has come to be considered as the institutional and technical framework essential for improving the flow and use of information in environmental management, rather than just a technological solution. This framework includes strategies, policies, procedures, data management, and communication tools and networking mechanisms that ensure access to environmentally relevant data by a wide variety of potential users at the national, sub-regional, continental and ultimately, global levels (EIS-SSA, 2000).

The operational objective for implementing EIS is to increase the quality, efficiency, and accountability of decision-making processes through applications that systematically use environmental information. In this regard EIS development seeks to enhance the use of harmonized environmental data sets through improving data availability; facilitating access to data; ensuring that data is internally consistent; and ensuring that different data sets match each other. The concept of an EIS is a network-based institutional framework, supported by geo-information technology, within a supportive data policy setting. This allows for environmental data to be collected, integrated, shared, analyzed, and the resulting information

and products disseminated and used to support decision making at all levels, in a sustainable development environment.

An appropriate definition of an environmental information system is therefore " *a computerized system, that stores environmental information*". It can be a set of data files or a highly integrated information system; a standalone system, running on a personal computer or a sophisticated system, based on super-computers. It can rely on "proven" technology such as a database management system running on a mainframe computer(s); or based on the latest "hot" technology such as the World Wide Web (WWW). Its scale can be as wide as the globe, national, local or it might relate to any geographical scale.

The EIS should be operated in this context to provide the decision-makers and policy formulators with a substantial base for their work. Ideally, EIS databases should contain all kinds of environment related information (like soil, geology climate, land use, hydrology, ground water, bio-diversity, population, sanitation, etc). It should be operated by highly competent staff using the latest versions of relevant software and hardware instruments and operating in an institutional network with unlimited access to each other's data and analysis results. This is however far from the actual situation in most countries in Africa.

Environmental information on the other hand is *"Any available information in written, visual, aural or database form on the state of water, air, soil, fauna, land and natural site"* (UN/ECE, 1998).

The basic units that form environmental information according to Checkland and Holwell (1998) are capta, data, information and knowledge. Their definition starts from observations on reality and the world: there are myriad facts and empirical observations on the world that can be tested or refuted. The facts that can be codified and collected are data. However, we do not collect all the possible data (facts) and store them for future reference. The first step in

information processing is the selection of those facts that are relevant for us and which we want to collect. Such data will be called capta (based on the Latin *capere*, meaning 'take'). Thus, the basic tokens of environmental information are capta. Once capta are collected, it is put in a wider context and viewed as part of a larger whole. Meaning is attributed to collections of capta. By doing so, the capta is converted into information. Information can have a meaning in a cognitive, spatial or temporal context. The process of information gathering can lead to larger structures of related information with a common meaning. Such collections are usually referred to as knowledge.

2.2 THE ROLE OF ENVIRONMENTAL INFORMATION SYSTEMS

Before analyzing why institutions need to have EIS, we need to reflect on some statements that might bring some insight into the linkages between environment and sustainable living. UNEP's publication, *The World Environment 1971-1982* concluded that:

> "At the Stockholm[1] conference, 1972, it was generally assumed that the world's system on national governments, regional groupings and international agencies had the power to take effective action. ...By early 1980s there was less confidence in the capacity of national and international managerial systems to apply known principles and techniques, or in the effectiveness with which international debates lead to action...Restoration of confidence and consensus in these areas may be the greatest challenge for those seeking to improve the world environment in the 1980s' (Holdgate *et al., 1982)*

It is disturbing that the same statement is till valid today, more than twenty years later. Indeed, many of the concerns identified in the report still hold true. There are still serious gaps in our understanding of the environment, our ability to estimate the cost of repairing the damage we have done to it, and our knowledge of the cost of failing to take rapid action to halt its degradation. Indeed thirty years after Stockholm, it is still not possible to describe the state of the world environment comprehensively or to say with confidence that the governments of the world have the knowledge or the political will to deal with the global problems we already know exist.

[1] Governments at the Stockholm Conference, held in Sweden, in 1972, provided the basis for the establishment of United Nations Environment Programme (UNEP)

The most significant concerns revolve around the lack of many of the prerequisites for informed decision-making and good environmental management. In particular these are:

- The database is still of variable quality, with a shortage of data from developing countries. As result, comprehensive data on the major environmental problems cannot be compiled, with "best estimates" being all that are available;
- Despite great advances in science, remote sensing and the technical ability to monitor the world environment, these have not been generally applied, mainly because of lack of equipment and trained personnel in many countries;

We need to appreciate that without data collection, we cannot know whether the environment is being degraded or not. The statement "environmental management implies sustainable development", (UNEP Governing Council, 1975) is instinctive and there is need to embrace EIS, to support management of environmental data and information. As such, EIS are there to assist with:

- Promoting availability of, and enhancing access to, the scientific information needed by decision makers for better environmental management;
- Assessing environmental conditions and threats to alert policy makers, and to facilitate the development of impact reduction strategies;
- Assisting policy makers to devise strategies and contribute to early warning to better cope with environmental threats and;
- Identifying emerging issues.

2.3 SOFT SYSTEMS METHODOLOGY: NOLAN'S MODEL

The establishment of environmental information systems particularly in African countries such as Kenya has, in line with Nolan's model, followed the approach to information technology adoption. Nolan's model outlines the evolution of systems in four stages namely; innovation, contagion, control and integration (Yeates *et al.*, 1994). According to Lyytinen (1990) each stage of EIS development has its peculiar characteristics, which may conform to a certain extent to Nolan's Model of Information Technology adoption.

2.3.1 Innovation

During the initiation stage, computers are used for needs of very few enthusiastic individuals in the organization. As the use of computing technology gains momentum, computerization problems will inevitably arise. Typically, minimal planning done before the establishment of computing facilities further compounds these problems. At this stage, management is concerned about these problems since they are the focus of the organization's activities.

2.3.2 Contagion

Successful implementation of information technology by a few individuals often triggers a rapid increase in computing within the organization. Management realizes the great potential of this technology while expectations increase. This results in parallel developments in computing applications leading to duplication of facilities and the adoption of different specifications of hardware and software.

2.3.3 Control

At this stage, most organizations establish computing departments to coordinate the various computing initiatives in their bid to plan, control and formalize the growth of the technology.

The position of IT management in the organization is well acknowledged, often leading to controlled standardization of hardware and software configurations. The information system planning is given high priority and management controls the costs. Data processing becomes centralized, creating a single information system for the whole organization.

2.3.4 Integration

Information systems have at this stage the tendency to grow by leaps and bounds, reaching unmanageable proportions within short periods of time. As the system grows, control structures are re-evaluated, sometimes leading to the decentralization of application development. Use and application development is rationalized and coordinated. Planning is widely accepted and any centralization or decentralization of computing resources and applications is controlled through business strategies.

2.4 STATE OF ENVIRONMENTAL INFORMATION SYSTEMS DEVELOPMENT IN AFRICA

Environmental Information Systems development in Africa is going through the different stages of the Nolan's model with different countries at different stages development. The continent as a whole is arguably at the control stage and efforts are being put towards the establishment of national EIS frameworks with a view to expanding these to regional and eventually continental frameworks (Paradzayi, 2002).

Technological advances in the field of remote sensing from the early 1970s to the early 1980s led to the evolution of environmental information management. These developments, such as the launch of remote sensing satellites (LANDSAT, SPOT, etc), provided large amounts of environmental data that could be used for analysis and management. A few enthusiastic individuals championed the establishment of environmental information systems at departmental levels of various institutions concerned with environmental management. The majority of EIS related activities during this decade were exploratory or experimental in nature and confined to specific sectors with few, if any, linkages between sector efforts. Most of the environmental information systems were created to support projects funded by donors (e.g. UNEP, UNDP, FAO, etc). These projects which related to environment support and natural resources management were, as a result, supply-driven and, project as well as data-oriented. Pockets of expertise (information communities) in the fields of GIS, remote sensing and database management systems (DBMS) technology developed in most African countries during this era.

During the 1980s more and more institutions became aware of the need to establish environmental information systems due to increased pressure on natural resources from rising population levels as well as natural disasters such as floods and drought.

This period saw a phenomenal growth in the number of actors involved in EIS construction. Duplication of data and resources during this stage was inevitable due to the legacy of sectoral environmental management policies. These policies delegated different government ministries to manage different sectors of the same environment. In many countries, for example, the departments of forestry and wildlife remain separate institutions run by different ministries. The result was a multitude of EIS groups operating as an unruly collection of factions pulling in different directions, each driven by its own valid objectives (Prévost and Gilruth, 1999). In Zimbabwe, for instance, the Integrated Resources Information System (IRIS), Vegetation Resources Information System (VEGRIS) and Agricultural Land Evaluation Information System (ALEIS) initiatives had remote sensing activities but were funded by different donors and were completely uncoordinated. Further the national institute for remote sensing in Zimbabwe was not involved in the development of these information systems (EIS-Zimbabwe, 1999). This state of EIS development posed a crisis because of the lack of coordination which retarded sustainable development and promoted conflicts between the different sectors. Discussions on EIS policies to try and control the uncoordinated growth of the environmental information systems were then mooted.

Control of the development of EIS initiatives began in the mid- 1980s, as a result of the recognition that environmental information was a distinct cross-sectoral issue through the adoption of National Plans to Combat Desertification and National Conservation Strategies. The same realization came out of the National Environmental Action Plans (NEAP) processes initiated in the late 1980s, which emphasized the need for shared solutions and integrated data products. The 1992 UN Conference on Environment and Development (UNCED) in Rio de Janeiro called for the establishment of information systems that would improve access to information with environmental relevance and make it available as a basis for decision-making. This challenged the environmental information communities to

recognize their mutual interest and work towards a greater synergy of their respective efforts. EIS initiatives were propelled from a supply-driven to a demand-driven orientation.

The underlying principle is that EIS should serve a clearly specified management need, and that data should not be collected unless an end use is defined (Prévost and Gilruth, 1999). Some African governments have responded to this challenge by formulating holistic environmental management policies. The World Bank has been funding the Environmental Information Systems for Sub-Saharan Africa (EIS-SSA) Program (now EIS-AFRICA) since the early 1990s, to promote the implementation of effective environmental information systems. The Program supports African countries as they assess their priority needs in terms of environment and land information systems, and analyze the technical, institutional, legal and economic issues hampering their possibilities of meeting these needs (EIS-SSA, 2001).

Environmental management is effective if it is integrated into the decision-making process at all levels. The complex nature of the environment makes the distributed model ideal for the establishment of EIS. Here, data sets are constructed and hosted by institutions with the appropriate statutory mandates under the control and supervision of capable data custodians. The recognition and support of data custodians is crucial in controlling the development of EIS. The data custodians are encouraged to develop a culture of data sharing and to have policies that minimize duplication of resources. Countries such as Uganda, Ghana, Zambia, Eritrea and Tanzania have launched initiatives to establish national environmental information networks (EIN) (UNEP, 2002). These frameworks aim at minimizing the institutional and technical constraints to EIS development by providing horizontal and vertical structures for sharing data within the environmental information communities.

It is relatively easy to coordinate members of the EIN when their disparate data sets are being aggregated to fulfill high-level management objectives such as State of the Environment

Reports (SOERs). The Ghana - Country at A Glance (G-CAG) database was created by generalizing and synthesizing data from several custodians. It is a synoptic, inter-operable, and user-friendly geographical database designed to assist in national level environmental management and planning. The aim was to construct a versatile and inter-operable geographic database directed towards decision-makers and similar persons who need to have an overview over the country for large area planning purposes. Another aim with the data sets in the Ghana-CAG is to serve as an introduction to the detailed data sets that are available at the custodian organizations (EIS News, 1999).

EIS initiatives such as the Peace Parks Program (2002) and Lake Tanganyika Biodiversity Program (2002) have transcended national boundaries and are being used to generate valuable environmental information on shared resources.

2.5 PROBLEMS ENCOUNTERED DURING EIS EVOLUTION

In developing countries, data availability might be very limited due to various reasons. As such, the need for EIS is perhaps even more urgent on the African continent than in other parts of the world. High population increases combined with particular climatic conditions and in some areas limited resources makes environmental planning and, resource distribution and management important issues to tackle both by national and international governments and organizations (EIS-SSA, Ghana, 1999).

Data might not always be collected at all times, but inadequate storing facilities has ruined the archives. Data format is also a factor limiting access. Analogue data demands large efforts to be converted to digital format and formats might not be compatible between different software or hardware, etc. Availability of trained staff and adequate equipment might also be limiting the implementation and operation of an EIS. However, new data can be generated in

correct format and staff could be recruited or trained, software and hardware purchased thus overcoming the problems.

A more difficult issue to solve when not working correctly is the framework or climate in which the EIS is operating. The EIS requires that data flows and exchange is smooth and controlled by institutional policy and agreements. This is often not the case. Data producers tend to cling on to their information and are reluctant to release it even to other divisions of their own organization. Analysis results and secondary data produced can be traditionally considered classified information and not released due to this excuse. Another issue related to the sharing of information is the lack of appropriate copyright laws dealing with digital data in many countries. In many countries the lack of policy and strategic planning hampers the implementation of EIS. This is valid in the whole world.

To overcome this decision-makers must act to create an open-minded climate of data sharing through the implementation of a set of rules and mandates that controls both data flow and the responsibilities for each organization participating in the network. This process is ongoing but is advancing at a slow pace. One factor slowing down the process is that information needed to make a complete EIS database often depends on different ministries, which complicates the process. Intervention of high-level decision-makers is often necessary and the awareness of these and their attitude to EIS is not always favourable.

As such, the development of EIS has been fraught with numerous problems ranging from institutional barriers to technical constraints as well as limited human resources capacities (EIS-SSA, 2001). These inhibiting factors have been well documented in World Bank reports on cases in Best Practices of EIS for countries such as Zimbabwe, Ghana, Mozambique, Uganda and Senegal and are consistent with predictions of Nolan's model IT adoption during the early stages.

2.5.1 Technical Constraints

Most African governments operate under stringent financial resources and usually fund projects that have immediate political and socio-economic gains. Funding for projects with long-term gains such as EIS projects, is therefore, not readily available from central governments as they are not a priority. In some cases, the huge capital expenditure required for the new technologies is prohibitive. Donor funded projects in this sector have become norm. This results in a number of problems including proliferation of incompatible hardware and software configurations in implementing agencies. The lack of project coordination results in the adoption of different database development standards on different projects. The wide spectrum of data sources also results in data integration problems caused by different map projections and un-coordinated systems, different naming conventions, and different accuracy standards. This poses, severe data harmonization difficulties and the dissimilar sources have to be integrated into a single format.

An additional problem is that the electronic communications facilities in most African countries cannot meet the demands of the distributed nature of EIS data and facilities.

During the World-bank sponsored "Best Practices of Environmental Information Systems in Sub-Saharan Africa, (EIS-SSA, Ghana, 1999)", it was noted in Ghana, that the technical problems are most often associated with the operation of the databases rather than with data collection. This is not unexpected, since in most cases, during the data collection only one organization is involved, producing data for its own use. When operation of EIS starts, the organization is forced to co-operate and interact with related organizations. This is when the problems such as distribution costs, copyright, data format, etc become apparent. Before this stage, everything runs very smoothly.

In Zimbabwe (EIS-SSA, Zimbabwe, 1999), it was noted that, major technical obstacles to data sharing reside in the lack of application of a **national standard for spatial data**, **incompatible classification schemes** and the almost total **absence of data documentation or metadata.** Efforts to harmonize the classification schemes used in different institutions (e.g. for land use) have also failed so far. As a result, each institution organizes its data according to its own beliefs and knowledge thereby resulting in mostly incompatible data structures and classification schemes. This was also evident in Ghana and Uganda.

Data documentation is also generally poor in most Africa countries. Most do not have Metadata (*Information regarding the location, the source, the content, the relationships, the representation, the use context of data or other specifics in relation to actual data in order to find, query, analyze or present these data in existing databases).* Such information should indicate the data availability, fitness of use, accessibility, transferability, etc, which should ideally improve data exchange.

Another constraint with some set-ups is that the systems used are not always compatible and there is limited data/information exchange between the various EIS set-ups. Also, Many institutions are simply not willing to promote data exchange among themselves. This is due to institutions trying to hang on to the data they "own" to the exclusion of others or, institutions unwillingness to use data from other institutions because they do not agree with the methodology used to collect the information in the first place.

2.5.2 Institutional Barriers

Institutional barriers arise from the legacy of environmental management frameworks, which are largely sectoral. Most organizations lack a coordinated participatory approach, which is crucial for the success of EIS implementation. This can be attributed to the resistance to central coordination as some of the environmental practitioners consider this threat to their

autonomy. In some cases, environmental managers fear the exposure of their incomplete or substandard work. In most countries, there is no clear policy on environmental management. Organizations carry out their functions independent of each other and lack vertical and horizontal networking to improve data access and sharing. The legal mechanisms for inter-sectoral information exchange are virtually non-existent in most countries. The fact that copyrights to environmental data are not clearly stipulated is of major concern to most organizations with regard to data dissemination.

In Zimbabwe for instance, framework conditions are not yet very favourable for an open and transparent information system, nor are they for an EIS. **Networking for the own ministry, department or personal purposes is quite common, however, sharing information in full transparency is not the main characteristic of the actual communication culture in Zimbabwe.** While information has its own value, sharing information means sharing value, sharing power (EIS-SSA, Zimbabwe, 1999).

Institutional conflicts are also a major threat to EIS implementation. There have been too many conflicts of interest between ministries, departments and pressure groups. Allocations of findings are also another source of conflict between ministries which should ideally be working together to achieve a common goal.

EIS development and implementation is a process whose success depends on the political, managerial and cultural will to manage the shift from the current state to the future. This is still lacking in most Africa countries and there is need to mandate the EIS co-ordinating body to ensure effective monitoring of other institutions to ensure their compliance with the new environmental legislation.

2.5.3 Human Resources Limitations

During the infancy of EIS implementation, most projects depend on donor-funded expatriates from abroad due to the lack of sufficiently trained local personnel to man them. The expatriates are usually employed on contract basis and most projects are not sustainable as soon as the experts are gone.

Although a number of local personnel are trained as part of capacity building in most projects, these are often offered higher managerial posts and thus removed from the technical aspects of the EIS. This is exacerbated by the failure of African academic institutions to produce enough personnel in the field of environmental management (Ruther, 2001). The training often concentrated on environmental GIS technology rather than on environmental information management.

The ideal EIS is one in which all these constraints are minimized, enabling data integration and migration between sectors of the EIS community. The EIS community needs to continue to develop new applications that encourage several partners (*data holders or data custodians*) to share information for their mutual benefit.

2.6. BENEFITS OF ENVIRONMENTAL INFORMATION SYSTEMS

The establishment of EIS provides a focal point at which decision-makers and planners can draw authentic and viable information on environmentally related issues. The establishment of EIS initiatives compels organizations to take stock of their data inventories and update them to remove any deficiencies that might be inherent in legacy systems. This is apparent when different environmental components are being integrated into a unified system. EIS encourages interdisciplinary cooperation and networking, resulting in shared responsibilities and tackling of environmental issues in a holistic manner. This should naturally lead to the

minimization of functional duplication and efficient utilization of available resources. EIS initiatives are closely linked to capacity building within the implementing organization.

Current technologies, including latest versions of hardware and software, are acquired and staff undergoes further training courses, thus broadening the technology knowledge base in Africa. In the present information era, the implementation of EIS initiatives can induce the growth of allied disciplines such as the electronic communications sector. Information superhighways provide the backbone for the transmission of environmental information to the various users located in different sites. A significant outcome of EIS is that the state of the environment can be assessed at any point in time and this is critical for the sustainable utilization and conservation of natural resources.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 INTRODUCTION

In the implementation of an EIS, a number of professionals are normally involved. These are IT Specialists and field specialists such as soil scientists, fisheries experts, water engineers, environmental management experts, e.t.c. IT experts get involved because the records may need to be automated thus Database Management Systems may need to be used. Other field experts are involved because the various fields have their own peculiar terminologies that are only understood adequately by these experts.

Therefore, a research design that captures the perspectives offered by these parties is required. A questionnaire, attached hereto as *Appendix 2,* was administered to these parties inorder to get a broad, global perspective of the various EIS implementation issues in Kenya.

3.2 RESEARCH DESIGN

This study was conducted through a cross-sectional survey of the various professionals in the relevant ministries, NGOs, IGOs, etc as given in *Appendix 3*. A cross-sectional study was adopted because the sample measurements were carried out at a single point in time.

3.3 POPULATION

The population of interest in this study are all ministries and institutions (including NGOs, IGOs etc that work with the ministries) involved in environmental management in Kenya. Currently, the ministries with that mandate are those of Environment and Natural Resources, Water Resource Management and Development, Agriculture, Livestock and Fisheries, Energy and Tourism and Information. Relevant professionals in these ministries were interviewed.

3.4 SAMPLE

A judgemental sample was carried out and a sample of 60 professionals in the ministries and institutions picked. The professionals were drawn from the broad areas of land use; ecosystems; species/genes; socio/economic and physical features. 10 experts from each broad area were interviewed. This sample was deemed adequate for this study given the time and resource constraints. The judgemental sample was adopted in order to ensure that all aspects of environmental information systems get proportionate representation starting from the technology aspect itself to the information source experts. This type of sample was also adopted to ensure that professionals in the various ministries which form part of the sample are involved in a considerable amount of environmental information systems implementation.

The unit of analysis in this study were the relevant ministries and other relevant institutions as presented through the personnel involved in EIS implementation.

3.5 DATA COLLECTION

The major method of data collection was through a self-administered questionnaire. The questionnaire attempted to gather the perceptions of a number of purportedly knowledgeable individuals, and while this is an appropriate approach in this situation, there were the usual problems of less than perfect validity, reliability and representativeness.

Content analysis of the various documents and publications was also carried out to ensure reliability, representative ness and validity of information collected.

The primary data collection instrument that was used is a questionnaire a copy of which is available in *Appendix 2,* already indicated. The questionnaire was administered to the respondents at their offices.

The questionnaire was divided into two parts (I & II). The objective of the first part was to provide a description of the relevant department, their mandate and the partnerships they have with other national, regional or global bodies while the second part of the questionnaire was related to gathering the basic data sought by the study. It had sections containing detailed questions which point to the indicators of EIS practices focusing on areas such as information management, capacity in environmental information management, computing environment and communication, external communication, data and information sources and EIS access procedures.

3.6 DATA ANALYSIS AND PRESENTATION

Descriptive statistics was used to analyze data by way of percentages, proportions and frequency distributions for all the variables in the questionnaire. Mean scores and standard deviations were evaluated and ranked to give the relative importance of the various EIS components. These analysis tools are appropriate because of the qualitative nature of the variables (see studies by Minja, 1995; Osewe, 1998; Maina, 2001; Makori, 2002). Statistical package for the social science (SPSS) for windows was used to carry out the data manipulation.

CHAPTER FOUR: DATA ANALYSIS AND FINDINGS

The data in this section from completed questionnaires has been summarized and presented using descriptive statistics. Frequency tables and percentages have been used extensively to draw conclusions. The presentation of the analysis was captured in two parts. The first part captures the general characteristics in section I of the questionnaire while the other attempts to address the earlier stated objectives of this research project.

4.1 SURVEY OF THE INSTITUTIONS INVESTIGATED

The response rate indicated that from the 60 questionnaires sent out, empirical results were obtained from 50 respondents. This rate translates to 83%, which was considered satisfactory. From table 4.1.1 below, it can be deduced that a majority of the responding institutions were from the sector comprising government ministries and semi-government institutions (36%); followed by non-governmental organizations (22%); research institutions and universities comprised 10% each; private sector was 14% while the local government institutions comprised 8%. It is worth noting that while there is adequate spread in terms of representativeness, the governmental and NGOs' comprised 58% of the respondents indicating that institutions in these sectors are largely spearheading the drive for environmental management.

Table 4.1.1: Survey of the Institutions investigated

Institutional Category	Distributed Questionnaires		Completed and Returned	
	Frequency	Percentage	Frequency	Percentage
Government	20	33%	18	36%
Local Authority	5	8%	4	8%
Research	5	8%	5	10%
Academic	5	8%	5	10%
Private Sector	12	20%	7	14%
NGOs	13	22%	11	22%
Total	60	100%	50	100%

Table 4.1.2: Mandate and Level of Operations of the Institutions

Level of Operation	Frequency	Percentage
International	4	8%
National	20	40%
Provincial	7	14%
District	3	6%
Local Government	1	2%
Regional	15	30%
Total	**50**	**100%**

In terms of the mandate and level of operations of the responding institutions, the table above shows that, the majority (40%) were institutions operating at the national level while 30% of the respondents have a mandate to operate at the regional level. The remaining institutions operated at the following levels: International (8%); provincial (14%); district (6%); and local government (2%). The corollary is that at both the national and regional levels, there is a

strong support from international initiatives such as UNEP who approach environmental management on a regional and global scale. Therefore this maybe as a result of influence of both national governments and, regional and international bodies with an interest in environmental management in an attempt to push for integration of programs in different countries.

Table: 4.1.3 Regional and International Agreements of the Institutions

Convention	Frequency	Percentage
Lusaka Agreement	4	8%
Nairobi Convention	13	25%
Abidjan Convention	4	8%
Bamako Convention	4	8%
Agenda21	16	33%
Convention on Wetlands	8	16%
Convention on Biological Diversity	13	25%
Framework convention on climatic change	8	16%
Convention to Combat Desertification	4	8%
CITES	8	16%
CPICP	4	8%
Convention on the Law of the Sea	4	8%
Habitat Agenda	4	8%
Kyoto Protocol	13	25%
Montreal Protocol	13	25%
Persistent Organic Pollutants	8	16%

In this section, the respondents were allowed more than one choice since any one institution can subscribe to more than one convention depending on whether or not there is a fit with their missions and objectives. From the table above, it is noticeable that a larger percentage of the respondents subscribed to the international conventions such as:

1) Agenda 21: 33%

2) Kyoto Protocol: 25%

3) Convention on Biological Diversity: 25%

4) CITES: 16%

This points to the fact that the push for environmental management mostly emanates from international agendas as fronted by organizations such as UNEP, CBD etc. These international conventions are normally held under the auspices of these international bodies.

4.2 INFORMATION MANAGEMENT

The variables in this section attempted to collect those **Environmental Information Systems** practices related to information management. Focus areas included environmental information management functions, users of environmental information, information strategy, data policy, access to environmental information, pricing policies applied, data availability formats, documentation and finally, information uses.

Table 4.2.1: Environmental Information Management Functions

Function	Frequency	Percentage
Data gathering	46	92%
Reporting	34	67%
Data Collation	29	58%
Data Warehousing	29	58%
Library and Archiving	34	67%
Dissemination	25	50%
Data Interpretation and Analysis	29	58%
Decision support and visualization	21	42%

Table 4.2.1 depicts some of the environmental information systems functions. The functions, as per the responses obtained ranged from activities associated with input processes such as

data gathering (92%) and data collation (67%); storage processes such as library and archiving (58%), data warehousing (58%); processing activities such as data interpretation and analysis (58%) and lastly output activities such as reporting (67%) and decision support and visualization (42%).

It is important to note that whilst higher weightings were achieved in a majority of the functions, input activities achieved higher scores, an indication that the institutions may not be giving proper attention to the processing, storage and output activities of the EIS they have implemented.

Table 4.2.2: Main users of Environmental Information

Users	**Frequency**	**Percentage**
Internal user	7	14%
National government	8	16%
International Agencies	10	20%
Private Sector	8	16%
Provincial/District Administration	9	18%
NGOs	8	16%
Total	**50**	**100%**

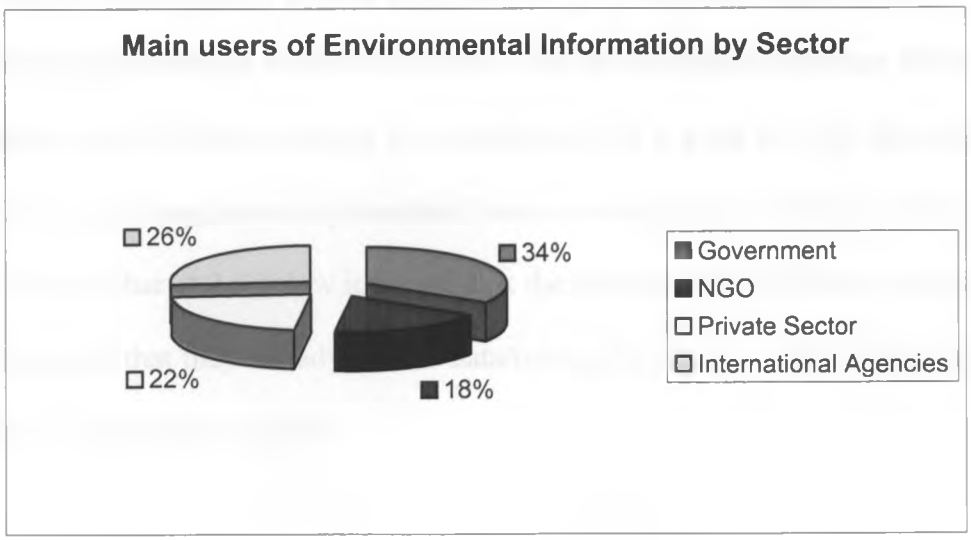
From table 4.2.2 above, it is noticeable that the major users of information from the various EIS are international agencies (20%); provincial and district administration (18%); national government (16%); private sector (16%); NGOs (16%) and internal users (14%). The implication from the above results is that the EIS implemented should mostly be geared towards external users, which account for 86% of the total users. This may require integration of the various internal networks.

Table 4.2.3: Main users of Environmental Information by Sector

Sector	Frequency	Percentage
Government	17	34%
NGO	9	18%
Private Sector	11	22%
International Agencies	13	26%
Total	**50**	**100%**

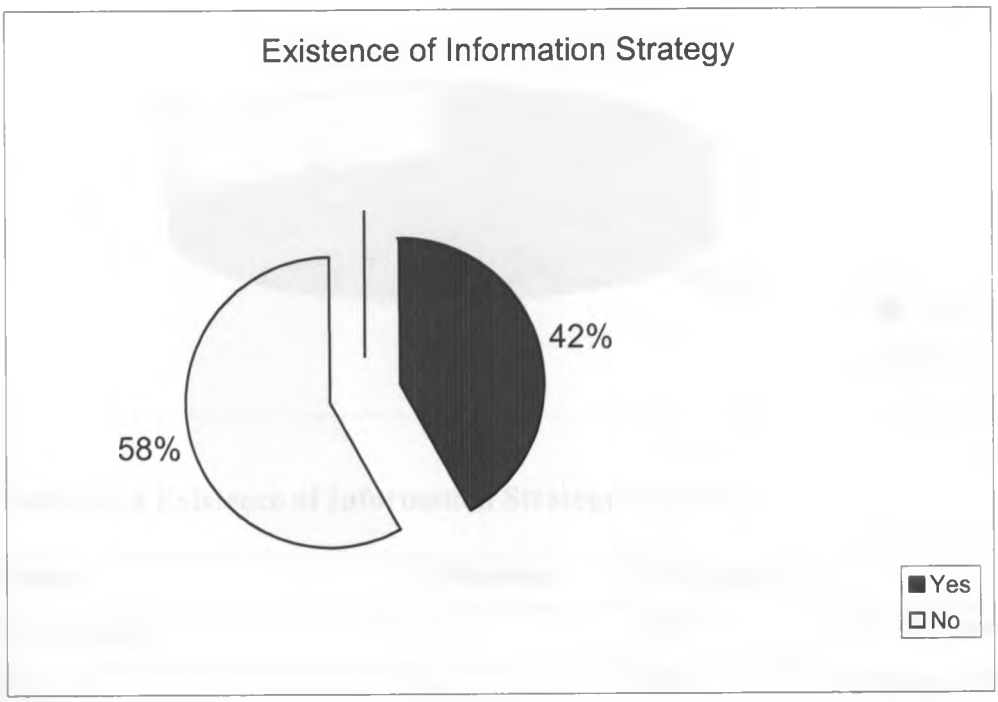
From table 4.2.3 and pie chart 4.2.1, below, the feedback from the different sectors indicates that government serves the highest number of users (34%). This observation is in-line with the mandate of the government or government institution which are expected to provide the public with information that can be used for sensitization and public awareness on environmental issues. It is interesting to note that the information from the NGOs is the least used (18%).

Pie Chart 4.2.1 Main users of Environmental Information by Sector



4.2.1 Information Strategy

Pie Chart 4.2.2 Existence of Information Strategy



The pie chart above (4.2.1) shows that of the 50 respondents interviewed, 42% had an information strategy while 58% did not have an information strategy. Since a comprehensive Information Systems strategy is a prerequisite for a good EIS, the indication is that most of these institutions have implemented these systems poorly. However, while the above maybe true, pie chart 4.2.2 below indicates that the majority (67%) of these institutions inverviewed indicated that they already have a data/information policy; while the remaining 33% do not have a data policy in place.

Pie Chart 4.2.3: Data Policy

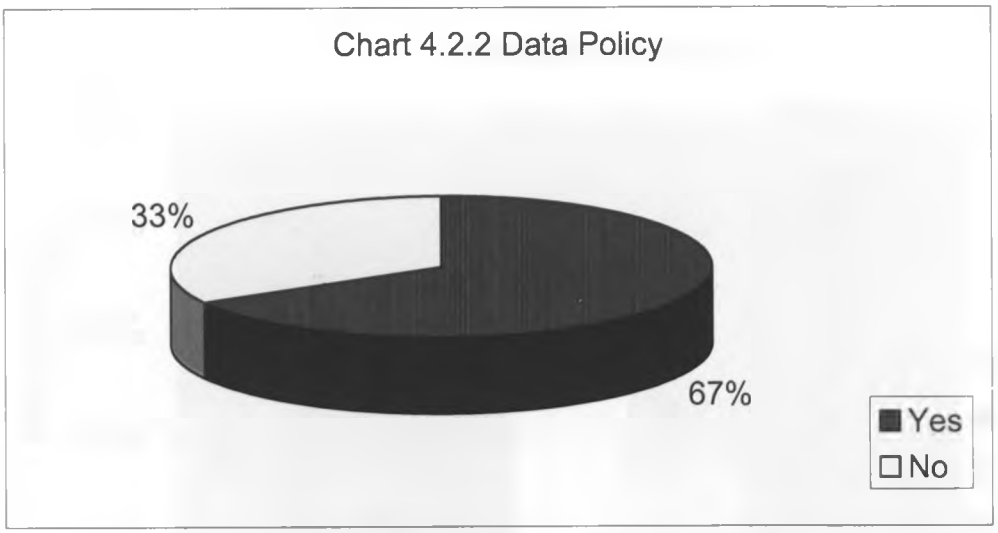
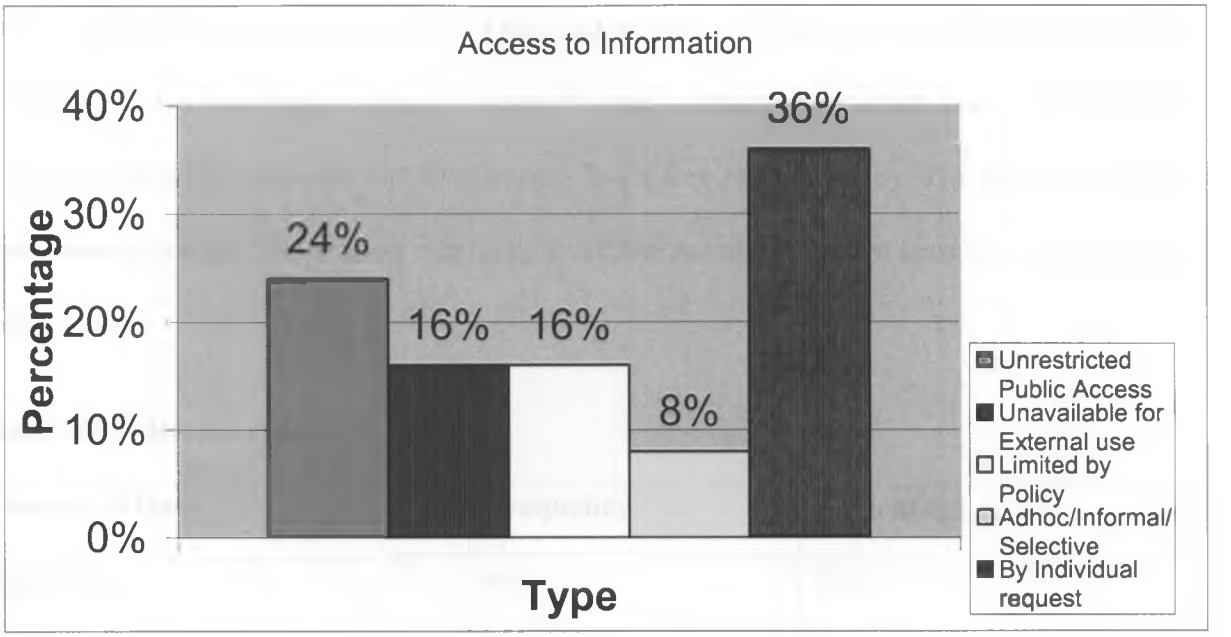


Table 4.2.4 Existence of Information Strategy by sector

Sector	**Frequency**	**Percentage**	
Government	19	38%	Do not have information strategy (58%)
NGO	10	20%	
Private Sector	4	8%	Have information strategy (42%)
International Agencies	17	34%	
Total	**50**	**100%**	**100%**

Bar Chart 4.2.4 Type of access to Environmental Information



The bar chart above shows that 36% of the interviewees indicated that access to information was mainly granted by individual request, 24% indicated that they provided unrestricted access to the public, 16% provided access but mainly limited by certain policies they put in place, 16% provided access for internal use only while 8% allowed for informal or selective access to the environmental information they held.

Table 4.2.5 Information Pricing Policies

Policy	**Frequency**	**Percentage**
Charged at Market Value	5	10%
Charged at full cost recovery basis	5	10%
Charged at cost of media	0	0%
Ad Hoc	0	0%
Free to Most	4	8%
Free to All	36	72%
Total	**50**	**100%**

72% of those interviewed indicated that their institutions did not charge for access to the environmental information they had. They had a free to all policy. 10% indicated that they charged for this information either at market value or charged on a full cost recovery basis. The remaining 8% indicated that they mostly had a free pricing policy. The implication from the above is that the information is largely available, accessible and at least free (80%) for the users.

Table 4.2.6 Data Availability Formats

Format of Data	**Frequency**	**Percentage**
Hard Copy	46	92%
Floppy Disk	25	50%
CD ROM	29	58%
Email	21	42%
Internet (FTP)	21	42%
Magnetic Tape	1	8%
DAT	1	8%
Private Network (Intranet)	2	17%
Total	**50**	

From the table above, 92% indicated that preferred data formats were hard copies, 58% indicated that preference for was data to be on CD ROMS, while 50% indicated preference was for data to be on floppy disks. The other preferred formats with their weightings are as follows:

1) Email format - 42%

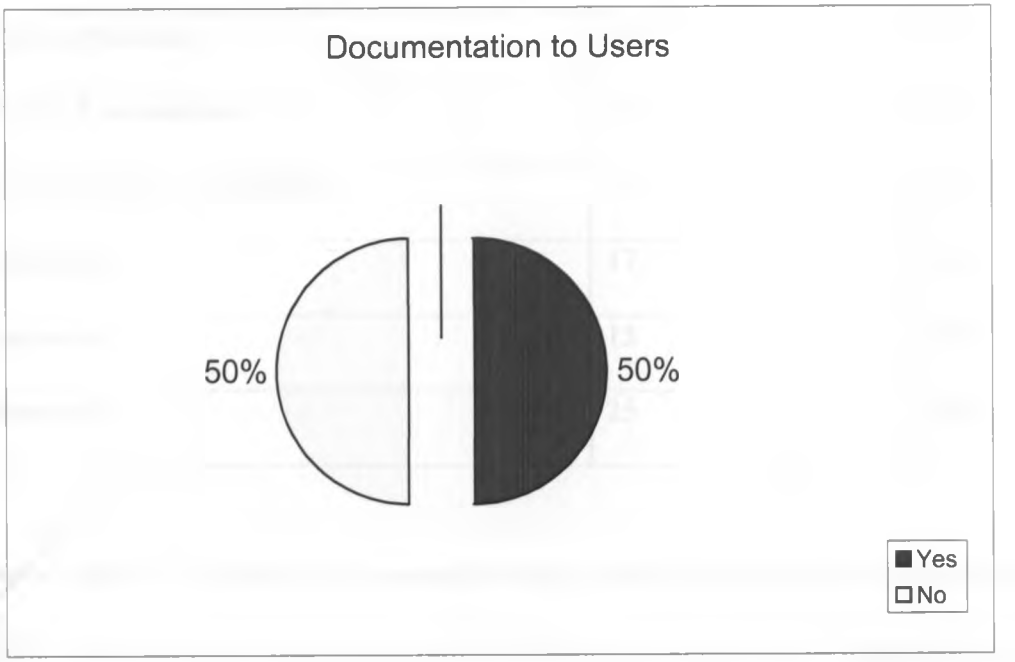
2) Internet (FTP) format - 42%

3) Private Network Access - 17%

4) Magnetic Tape format - 8%

5) DAT format - 8%

Pie Chart 4.2.5: Documentation to external users



As indicated further in the pie chart above, 50% of respondents indicated that they provided full documentation to their external users especially since the amount of environmental information is laced with alot of technical jargon. The documentation is intended to assist users to clearly understand the meanings as used. The other 50% indicated that they do not provide any documentation to their external customers/users.

Table 4.2.7 Main uses of Environmental Information

Use	Frequency	Percentage
Decision Support	25	50%
Management purposes	29	58%
Monitoring compliance	17	33%
Planning/Zoning	17	33%
Policy Formulation	34	67%
Enforcement of regulations	13	25%
Operations	17	33%
Licensing	13	25%
Research	25	50%

From table 4.2.5 above, the respondents were allowed more than one choice and we can see from it that the main uses of environmetal information in order of importance are as follows:

1) Policy formulation: 67%

2) Management: 58%

3) Decision Support: 50%

4) Licensing: 25%

5) Research: 50%

6) Monitoring compliance: 33%

7) Planning/zoning: 33%

8) Enforcement of regulations: 25%

4.3 CAPACITY IN ENVIRONMENTAL INFORMATION SYSTEMS IMPLEMETATION

The variables in this section of the questionnaire were used to further analyse the state of EIS implementation with regard to current information infrastructures of the institutions under strudy.

Table 4.3.1 Technical Skills Portfolio

Skills type	Frequency	Percentage
Data collection/Monitoring	17	33%
Data entry/quality assurance	9	17%
Data Analysis	9	17%
Technical writing	25	50%
Graphics design/Publishing	4	8%
Communications	13	25%
MIS	0	0%
Geagraphic Information Systems	0	0%
Remote sensing	0	0%
Database Development	13	25%
Systems Management	9	17%
Internet access/Website development	9	17%
Other Technical support	9	17%

Table 4.3.1 shows the results of the survey of some of the skills sets required for effective implementation of an environmental information system. From the table, only technical writing skill obtained a score of 50%. The results of the other skills were as follows:

1) Data collection and monitoring:	33%
2) Data entry and quality assurance:	17%
3) Data Analysis:	17%
4) Graphics design/Publishing	8%
5) Communications	25%
6) MIS	0%
7) Geographic Information Systems:	0%
8) Remote sensing:	0%
9)Database Development:	25%
10) Systems Management:	17%
11) Internet/Website development:	17%
12) Other Technical Support:	17%

The implication of the above is that a majority of these institutions are ill equiped interms of manpower skills to effectively implement EIS. It also needs to be remembered that despite the low scores, the level of training of staff is also low with a majority of staff being trained at diploma level or below. In addition, it is also noticeable from the table that, whilst recognizing the low scores in all areas; the skills areas with higher percentages are largely those required for input acitivites such as data collection, monitoring and data entry.

However, important skills sets required for the development and implementation of integrated Environmental Information Systems such as MIS, Geographic information systems, remote sensing and database development are either non existent or have minimal scores. The

implication is that there is gross inadequacy and capability of staff to be able to implement and manage these environmenal information systems.

4.4 COMPUTING ENVIRONMENT AND COMMUNICATIONS INFRASTRUCTURE

The variables in this section of the questionnaire are intended to capture what information and communications technology infrastructure is in place in these institutions that are necessary for implementation of an effective and responsive Environmental Information System.

Table 4.4.1 Basic Telecommunications and Networks

Service	Frequency	Percentage
Telephone	45	90%
Fax	45	90%
Email	44	88%
Internet Access Points	42	84%

From the above table with regard to telecommunications services available, a majority of the respondents indicated that atleast they had the following services in place:

1) Telephone: 90%

2) Fax: 90%

3) Email: 88%

4) Internet points 84%

The indication therefore is that most firms already have in place the basic telecommunications infrastructure in place which can aid in communications.

Table 4.4.2 Internet Access and Bandwidth

Service	Frequency	Percentage
Dial-up	20	40%
Satellite	16	32%
Microwave/Radio Link	0	0%
Leased line Connections (Digital or Analogue)	33	66%
Fibre Optic Networks	0	0%

Internet services and bandwidth requirements are considered necessary for EIS due to increased use of the Internet for information dissemination. The speed requirement in terms of bandwidth invariably becomes an important issue due to high network and Internet traffic for information needs. From table 4.4.2, the infrastructure for Internet dial-up services is available in 40% of the responding institutions; leased line connections (analogue or digital) necessary for providing higher speeds with multipple access points is present in 66% of the institutions while another 32% already have satellite connections. None of the institutions have radio links and fibre optic networks for higher speeds. The implication then is that the institutions have in place basic Internet services, but with an obvious need to upgrade infrastructure to handle increased information loads.

Table 4.4.3 Data Input/Output Facilities

Facility	Frequency	Percentage
Digitising Tables	33	66%
Scanners	43	86%
Plotters	40	80%
Laser Printers	45	90%
Colour Printers	44	88%

The focus of this section was to determine the facilities available for input/output capable of handling and ensuring quality document management services. From the table above, interms of input/output technologies, the indications were that the institutions had the necessary facilities in place as shown below:

1) Digitising Tables: 66%

2) Scanners: 86%

3) Plotters: 80%

4) Laser Printers: 90%

5) Colour Printers: 88%

The implication from the above is that a big percentage of these institutions already have input/output equipment in place necessary for implementation of an EIS.

Table 4.4.4 Applications Software Infrastructure

Software	Frequency	Percentage
Desktop Publishing	16	32%
Graphics/Presentation	37	74%
HTML Editing	37	74%
Internet client	43	86%
Web Server	42	84%
Statistical/Modelling	43	86%
Office Applications	33	66%

Table 4.4.4 above depicts high ratings for some of the applications software needed in an EIS. The following were the various responses interms of percentages.

Graphics/presentation software received a weighting of 74% indicating that a majority of these institutions have already invested in this application necessary for manipulation of mainly graphics information. This is in recognition of the fact that information from EIS is not necessarily in form of text only, but can also be in image, video and voice forms. HTML Editing(74%), Internet client (86%) and web server (84%) applications are necessary because the domain of Internet and other virtual Internet sites are becoming increasingly important, especially for database-driven applications such as EIS. Statistical and Modelling applications received a score of 86% due to the fact that information from the database of an EIS may require extensive and complex analysis. This requires statistical and modelling tools to accomplish. Lastly office applications received a score of 66% which are mainly geared towards increasing productivity in this environment.

Table 4.4.5 Communications Software/Groupware capabilities

Capabilities	Frequency	Percentage
Directory Services	38	76%
Shared Calendar	30	60%
News	38	76%
Lists with Publications, projects, reports and datasets	8	16%

Table 4.4.5 summarises the capabilities of communications/groupware software that the institutions have in place. 76% of those interviewed indicated that these softwares have directory services, 60% have shared calenders, 76% also have the capability to share news. However, very few (16%) of the communication software have the capability to list publications, projects , reports or datasets.

4.4.1 Data/Information Sources

All the respondents (100%) indicated that they used a mixture of data sources as shown in the pie chart below. However, 76% relied on primary research; 76% carried out routine data collections; 66% relied on data from other organizations while only 24% depended on data from the public domain.

The implication therefore is that since a majority of these institutions rely on a mixture of various information sources, there may be need to develop integrated systems to enable these institutions to tap into existing networks for data.

Pie Chart 4.4.1 Data Sources

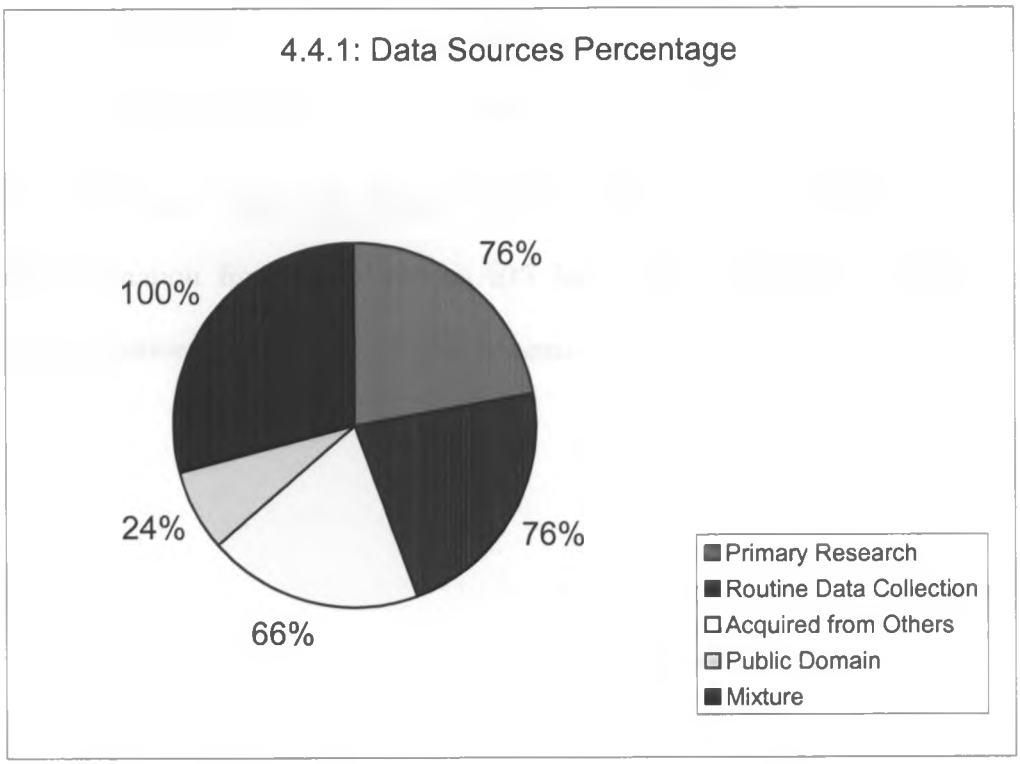


Table 4.5.6 Limitations of data for EIS

Limitation	Frequency	Percentage
Age of Data Set	33	66%
Scale	16	32%
Resolution	4	8%
Completeness	21	42%
Quality/Accuracy	29	58%

The above table depicts responses obtained with regard to the limitations of the data/information they currently have in their EIS. The scores are as follows:

- Age of Data set: 66%
- Scale: 32%

- Resolution: 8%
- Completeness: 42%
- Quality/Accuracy: 58%

The implication from the above results is that there is already recognition that the data/information from these various EIS have some limitations and focus should be on implementation of better and reliable systems.

CHAPTER FIVE: SUMMARY AND CONCLUSIONS

The broad objective of this study was to investigate the current environmental information systems practices in Kenya as well as to document some of the challenges in EIS adoption. As a concept, Environmental Information Systems was considered as a sub-system of the overall Information Systems discipline, as well as being dependent on different disciplines of Environmental management.

The literature review focused mainly on the diverse viewpoints of EIS, which was necessary in order to set a proper context for this study. Weight was also given to the various empirical researches on the state of EIS adoption in Africa in order to get a broad global view of its implementation in Africa.

Other supporting literature indicated that the development of the technology either at the micro-level within firms or at the macro-level, can be explained using Nolan's Model, a soft systems methodological approach. The literature also enumerated problems and benefits expected from EIS implementation.

5.1 Discussions

From the research findings as presented in chapter four of the study, several conclusions can be drawn in support of the adopted framework. These are discussed in light of the objectives of the study.

5.1.1 General Remarks

Kenya does not yet have a comprehensive national EIS strategy and that the process of developing one has just started. At the moment only individual EIS sub-systems exist in various relevant ministries and other semi-government institutions assisting government in environmental issues. These sub-systems have a strong emphasis on data collection as was earlier seen in the previous chapter. Further, existing EIS sub-systems in Kenya are neither institutionally nor technically linked in most cases, therefore we cannot talk of any comprehensive EIS in Kenya. The state of EIS development in Kenya, if viewed in light of Nolan's stages of Information systems development, can be placed in phase three, namely, control. The basis for this argument rests solely on the evaluation of the indicators of EIS at the institutions studied compared with the stage characteristics of Nolan's model. The focus of this stage is control, where the key characteristics of EIS is emphasis on establishment of Information Systems organizations charged with planning, control and formalization of EIS in these institutions. This is evidenced by most of these institutions already having recognized centralized Information Systems departments with clear mandates for IS development. However, the lack of an established EIS co-coordinating body may be one of the reasons for the currently fragmented EIS set-up, with no shared national approach to EIS. Thus individual institutions still form the core of EIS activities in Kenya. This is consistent with findings in Zimbabwe, where most of the organizations engaged in EIS development were found to be mostly data custodians or sources of specific environmental data/information with their own distinct EISs.

This fragmented setup results in serious duplication in the activities and set-ups within the institutions, as they attempt to setup a comprehensive EIS, but there is very little flow of information among the institutions.

5.1.2 Networking and Partnerships

The following discussion emerges from the results of the analysis of section one of the questionnaire. This section focused on mainly the institutional aspects of an EIS.

5.1.2.1 Institutional Aspects of EIS

In making observations about institutional aspects of EIS, one invariably looks at the networks and partnership of the various institutions involved in environmental management. Focus areas include, but are not limited to institutional description, mandate and more importantly the conventions that they have subscribed to. The institutional description provides an understanding of the type of organizations currently taking the lead in developing EIS in Kenya. As per the research undertaken, the government through various departments and semi-government institutions take the lead, accounting for 36% of all respondents with the NGO sector next (22%). The assumption would be that since the government and the NGO sector are in the lead, there should be more public participation. However, this is not so, owing to the fact that there is heavy donor participation in these environmental activities.

In terms of the mandates and levels of operation of these institutions, most (70%) have either a national or regional mandate. The national mandate is recognized especially considering that there is a Ministry of Environment and Natural Resources, charged with crafting Kenya's environmental policy. Although this ministry is assumed to be the co-ordinating institution of environmental issues, it is not properly mandated to exercise that role since there are other ministries that handle environmental issues as already discussed. Further, networking for individual ministry, department or personal information is quite common, but sharing information in full transparency is not the main characteristic of the actual communication culture among departments and institutions charged with environmental information management. Communication is rather linked to hierarchy and authority. Since the success of

an EIS is to a large extent based on cross-sectoral networking and free access to information, the inherent organizational "communication culture" is impeding the build-up of an efficient national EIS. In addition, most of the systems have been initiated by donors to meet their objectives, not necessarily paying attention to the requirements and capacities of the host organizations. The way donors exert their influence is very much a reaction to the legal situation and the distribution of power within government, ministries and administrative units. There is also insufficient co-ordination of donor activities and the manner in which they can support and fund some EIS projects and initiatives. This is due to competition among the donors themselves, the lack of government EIS vision and capacity to co-ordinate donor activities.

Another aspect of the research concerns the conventions/agreements they have signed up to. These conventions determine to a large extent the organizational setup in terms of their ethos, missions and visions and in the end influences the role of resulting information from this EIS on decision-making. Results indicate that a majority of them have ratified either regional or international conventions, implying that the objectives of the institutions and departments of government have to be in tandem with the provisions of these agreements. Most of these conventions are mainly donor funded which then influence the output of whatever system is developed. For instance, Agenda 21 which is a programme of implementation of the Rio Declaration, calling for governments to re-examine the process of environmental decision-making has the highest subscription at 33%. As decisions impacting on the environment are made in various sectors of society, mechanisms for the formal sharing of decisions must be put into place. In fact, there are demands calling for the decentralization of the management of resources upon which local communities depend particularly relating to giving these communities effective decision making powers over the use of these resources.

As a result of the influence of donors, the build-up of an EIS in Kenya has mainly adopted a sectoral approach, since every institution has to respect or adopt the requirements of a particular convention (and/or lead donor). This has resulted in EIS playing a marginal role in decision-making in Kenya. Thus there are varying attempts and efforts to build, strengthen and promote EIS but to date purely sectoral approaches have been made. The sectoral EIS are not coordinated, not linked and, due to lack of standards are hardly able to exchange data.

5.1.3 Information Management

One of the key areas of any EIS is the area of information management. This is in recognition of the fact that any information system (EIS included), has its output as information, which is itself for decision-making. From the data analysis of this section, various observations can be made which all stem from the fact that the majority (58%) of the respondents indicated they do not have an Information Strategy in place. Given the lack of this overall information management approach whose intent is to define the information flows from data collection to the information products, the approach adopted by most of the respondent institutions is questionable since the build-up of an EIS requires an information management concept to make sure the mandated organizations collect the right data at the right time and that this data is shared and processed into meaningful and timely information for decision makers.

It is interesting to note that government serves the highest number of users (34%) yet it does not have an information strategy. Government needs to take the lead in this area so that it can give direction to other players in the sector. It is only with this approach that other actors such as NGOs, private sector and international agencies can see the benefit of working closely with government institutions in terms of information sharing.

This lack of a comprehensive overall information strategy for the institution may be further explained by the other attributes, firstly, that a majority (92%) of the institutions interviewed focused mainly on the data gathering function, which is largely an input process activity, with less attention being focused, for instance on output processes such as decision support and visualization (42%). This imbalance in information management functions allotted to the various EIS facets of input, output, storage and processing activities goes contrary to the theory and practice of development of any Information systems which requires that for it to be effective, there should be adequate focus in each of these other areas as well.

Secondly while there was indication that the institutions have data policies in place, the fact that a significant percentage (33%) did not have data policies points to a situation where EIS build in the current is not driven by a uniform approach as would have been the case if there had been a central coordinating body to ensure that Kenya has a national EIS system geared towards data sharing. This is because data sharing requires common standards for data transfer, storage and quality as well as the harmonization of classification schemes. The senior management of all concerned institutions should as a priority, consider conforming to internationally development standards. This concern is also further compounded by the fact that 50% of respondents did not consider data documentation an issue despite the fact that awareness for copyright issues is rising globally. Data documentation is necessary, as the amount of environmental capta has continually been increasing from diverse fields. Documentation aids in clarifying meaning in specific contexts.

Thirdly, is the fact that 92% provided data as hard copies to their users. Data dissemination as part of the overall EIS design should take into consideration efficient means of distribution. In the global Internet age, more efficient storage media such as CD ROMs, FTP and Email should be less costly and viable alternatives. Focusing then on an inefficient mode of dissemination points to a poor design, again pointing to lack of a comprehensive information strategy either at the micro or macro level.

Another aspect of information management concerns access policies with regard to pricing. Many (80%) of the institutions suggested that they provided information gratis to the users. This is not necessarily a bad policy especially if public access is to be encouraged. However, this needs to be looked at in conjunction with other aspects, which determine quality. For instance, if there is no documentation, whatever the volume of use of this information, if the

quality of decision-making is in dispute as a result of different interpretations, then again the concept of poorly designed and implemented EIS cannot be ignored.

An assessment of the users and uses of EIS information is also important to understand its practice in Kenya. A majority of the users were mainly international agencies (20%) and the provincial/district administration (18%). The spread presents a paradox since the information from these EIS should be for the benefit of the country. However, this may point to the fact that for many decades now, donors have largely influenced the environmental management practice in developing countries through international agencies. Our institutions then, in terms of setup, are geared towards meeting the donors' objectives.

Lastly, environmental information management also encompasses an assessment of the uses of this information. Evidence from the earlier analysis points to areas with slightly high ratings such as:

- Policy formulation
- Management purposes
- Decision support and
- Research

It may be observed that in terms of use, these are not necessarily poor uses of this information, since they can be considered to be in the domain of strategic use of environmental information.

5.1.4 Capacity in Environmental Information Management

An important area of EIS is staff skills with regard to EIS development or implementation. The focus of this is in capacity development; which should be a prime concern of senior management of all institutions involved in environmental management systems. It includes

the theoretical issues and the practical hands-on capabilities to implement projects and programs regarding EIS. This issue of building local capacity will continue to be a major constraint to the success of EIS systems in Kenya as seen from the results of chapter Four. The issue of capacity is probably one of the most glaringly evident weakness as resulting in the lack of a comprehensive national EIS policy in Kenya. The technical infrastructure, with regard to skills necessary for design, development and analysis of EIS in Kenya is obviously lacking as enunciated in the previous chapter. As already discussed, whilst knowledge and training in Management Information Systems (MIS), Geographic Information Systems, and remote sensing are a bare minimum in EIS implementation, none of the institutions under study had anyone trained in these skills. Further, while recognizing that some of these institutions had skills in database development (25%); Internet access/website training (17%) and systems management (17%), these scores are insignificant in light of the sample being judgmental in nature. The indication then is that even core broad requirements such as skills in database development are inadequate in the Kenyan context with regard to EIS. This is despite the fact that the guiding principles and ethos of most of these respondents support the role of environmental information in decision making as illustrated earlier. The presupposition is that senior management appears to be supportive of EIS initiatives. However, it maybe concluded that they do not consider EIS an institutional or national priority that requires allocation of substantial funds.

It may therefore be appropriate to conclude that necessary human resource skills are grossly lacking in EIS development in Kenya. Thus capacity development should be a prime concern of senior management of institutions involved in EIS development and should include the theoretical issues and the practical hands-on capabilities to implement projects and programs. This issue of building local capacity will continue to be a major constraint to the success of EIS systems in Kenya.

5.1.5 Computing Environment and Communications

From the analysis in Chapter Four, this area of EIS information infrastructure, mainly geared towards the Information Technology aspects received largely favourable ratings. Indications from the analysis were that a majority of the respondent institutions had a basic infrastructure for EIS in place. Infrastructure issues looked at were services such as:

- Telecommunications and networking to assess organizational capability to handle both internal and external communications, remembering that a majority of the information users were external in nature.
- Internet access and bandwidth services, since the global trend for information sharing is becoming more and more Internet driven as opposed to being locally based in Internal networks.
- Focus on data input/output facilities, to encompass capabilities in data capture and reporting.
- Applications software capabilities, since EIS processes of input, output, storage, output and supporting activities are managed by applications software and lastly,
- Communications software for messaging.

From the above analysis, the presupposition is that most of these EIS tend to emphasize information technology rather than information management. There is no comprehensive data and information management concept linking data production and management with the production of information products such as maps, reports or indicators (information technology dominates information management).

5.1.6 Data Sources

Input processes require that the sources of data need to be assessed. The analysis revealed that 76% of the respondents relied on primary sources of data and another 76% relied on routine data collection on an ad hoc basis. This may point to the fact that there are no formal procedures in operation that regularly produce information for decision makers. Whenever information is required, data has to be gathered and processed. Further, for complex issues and studies it is common to hire consultants to produce the required information. Therefore, the institution does not acquire data processing know-how nor can it evaluate the quality of the information. This practice of carrying out primary research or ad hoc data collection negates the fundamental advantage of data re-usability as espoused in database systems theory and practice handled elsewhere.

5.2 Challenges to EIS Implementation

Some of the major factors considered as impediments to successful implementation of EIS systems in Kenya include the following:

The development of the EIS from the current state towards the desired goal of sustainable development faces a series of threats and difficulties as follows:

- Lack of a shared EIS vision;
- Lack of co-operation between Sub-EIS units;
- Lack of co-ordination at donor and government levels;
- The existing "communication culture" in public administration not favouring information sharing;
- Perfectionism in systems implementation;
- Lack of standards;

- Lack of a mandated co-ordination body;
- Low sustainability;

5.3 Recommendations

5.3.1 EIS Co-ordinating body

There is need for a formal EIS co-ordinating body with a clear mandate. Data sharing requires comprehensive Meta-data development. The EIS coordinating body seems to be best suited to carry out such a task. Attention should also be given to regional and international co-ordination and co-operation. A close co-ordination and co-operation in developing EIS between countries would considerably improve efficiency for the benefit of all local EIS in the region.

5.3.2 Decentralization of Decision Making

There is need to change the communications culture in government departments which has mainly been hierarchical in nature to a more decentralized one to enhance efficiency. Efficiency is important since there has been an increased need for environmental information due to conventions, public awareness or enactment of environmental policy.

5.3.3 Environmental Legislation Reform

Legislation for environmental protection should continually be reviewed to recognize the importance of the global influence on national laws as well as to recognize that the movement is towards a shared approach to EIS build-up. Legislation therefore should consider issues such as standardization schemes for data, EIS policies, access policies, etc.

5.3.4 Relevance of EIS to Policy Level Decision Makers

The New Partnership for Africa's Development (NEPAD) is an agenda based on national and continental priorities, and serves as a long-term vision of an African-owned and African-led development programme. In the context of the information-driven economy of today, the successful implementation of NEPAD will be linked, among others factors, to the extent to which the importance and economic value of information on Africa's environmental assets are leveraged on the global market. Value will not be derived from the resources *per se*, but more importantly from the strategic use of information about assets. Therefore, environmental and natural resources need to be characterized and quantified in such a manner as to optimize their value in the context of harnessing information-driven assets. There is therefore a need for a strong information foundation to support the assessment of different scenarios, and to suggest options for environmentally sustainable development and Kenya is no exception to this.

The value of information derives from its impact on decision-making and there has not been a sustained support for the building of underlying data foundation and developing a "market" for information. Thus the ultimate justification for investing in EIS is to provide information that responds to policy makers' in order to respond to information thirst related to their policy objectives. This leads to improved environmental management, which in turn results in improved environmental conditions, and ultimately sustainable development. Implementation of policy objectives requires that available resources are known and can be quantified so that we can ensure efficient and effective use to achieve the set objectives. As such, the use of good quality environmental information at all levels (operational to policy) is necessary within institutions with responsibility for managing a nation's environmental assets and must become part of the "organizational culture" in Kenya.

We should therefore take advantage of initiatives such as the African Environment Information Network (AEIN), which is an AMCEN initiative to which Kenya is a subscriber. This initiative is aimed at responding to political aspirations as well as technical needs aimed at strengthening capacities in environment information management, interpretation and dissemination to support management of Africa's environmental assets, and contributing to the continent's progress towards sustainable development.

5.4 Limitations of the Study

The study had the following limitations:

- Time and resource constraints were a major limitation. It was not possible to visit and interview all institutions within Kenya nor was it possible to handle all the issues with regard to EIS. Nevertheless it is hoped that an accurate and correct overall picture of the actual "landscape of EIS" in Kenya has been presented. Due to resources, the study was limited to departments and institutions within Nairobi.
- Some of the respondents did not have enough knowledge in information systems and therefore could not understand some of the technical information technology terms in the questionnaire. This resulted in some resistance, especially from government departments in filling the questionnaire. In addition, EIS is also a relatively new concept in Kenya, and therefore some of the issues may not have been captured well by the questionnaire.
- In addition, the research design used a judgmental sample with its inherent weaknesses. A large sample would have been preferable taking into account the type of design adopted.

5.5 Suggestions for Further Research

A more empirical survey with a larger sample should be considered since this study used a judgmental sample in its sampling design in order to make the study more general.

This study can also be extended to an in depth study of the challenges or the barriers to EIS development, as well as one focused on design of a model to assist in development and implementation of EIS in a developing country such as Kenya.

However, despite the limitations, given the increasing evidence of the need for environmental information and its impact on decision-making, this study should be considered as a first step in understanding the state of EIS development in Kenya. It therefore sets the basis for future contribution that will enable academicians; government and private sector to better understand the new domain of EIS to help them fuse these systems with their other business and institutional systems.

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APPENDICES

APPENDIX 1: ***Letter of Introduction***

UNIVERSITY OF NAIROBI

FACULTY OF COMMERCE

MBA PROGRAM – LOWER KABETE CAMPUS

Telephone 732160 Ext. 208
Telegrams "Varsity", Nairobi
Telex 22095 Varsity

P O Box 30197
Nairobi, Kenya

DATE...14 AUGUST 2003.....

TO WHOM IT MAY CONCERN

The bearer of this letter ..CHRISTOPHER .OCHIENG.....

Registration No: . ....D/61/P/7823/99.....

is a Master of Business Administration (MBA) student of the University of Nairobi.

He/she is required to submit as part of his/her coursework assessment a research project report on some management problem. We would like the students to do their projects on real problems affecting firms in Kenya. We would, therefore, appreciate if you assist him/her by allowing him/her to collect data in your organization for the research.

The results of the report will be used solely for academic purposes and a copy of the same will be availed to the interviewed organizations on request.

Thank you

M. B. A. OFFICE * P.O. Box 30197, NAIROBI * FACULTY OF COMMERCE

JACKSON MAALU

CO-ORDINATOR, MBA PROGRAM

APPENDIX 2: ***Questionnaire***

PART I

Section 1: Contact Details

1. ***Name of person completing questionnaire:***
2. ***Name of organisation:***
3. ***Head of organisation:(Prof./Dr./Mr./Mrs./Ms.)***
4. ***Designation:***

Section 1.1: Networking and Partnerships

1. ***Which of the following best describes your organisation (tick all that may apply)?***

☐ Governmental ☐ Local authority

☐ Semi-governmental ☐ Private

☐ Academic ☐ Research

☐ Non-governmental ☐ Non-profit

☐ Other (please specify):

2. ***At what levels does your organisation operate (tick all that may apply)?***

☐ International ☐ Sub-regional ☐ National

☐ State (or similar) ☐ Provincial (or similar) ☐ District (or similar)

☐ Local government (City) ☐ Other (please specify):

3. ***Regional/sub-regional agreements and International Conventions:***

☐ Lusaka Agreement ☐ Nairobi Convention

☐ Abidjan Convention ☐ Bamako Convention

☐ Algiers Convention ☐ Agenda 21

☐ Convention on Wetlands ☐ Convention on Biological Diversity

☐ Framework Convention on Climate Change ☐ Convention to Combat Desertification

☐ Migratory Species of Wild Animals ☐ CITES[2]

☐ International Tropical Timber Agreement ☐ Convention on the Prior Informed Consent Procedure

☐ Convention on the Law of the Sea ☐ Habitat Agenda

☐ Kyoto Protocol ☐ Montreal Protocol

☐ Persistent Organic Pollutants ☐ Other (please specify)

PART II

Section 2.1: Information Management

1. ***What are your organisation's/unit's core environmental information management functions (please tick all that may apply)?***

☐ Data gathering ☐ Reporting

☐ Data collation ☐ Data warehousing

☐ Library and archiving ☐ Dissemination

☐ Data interpretation and analysis ☐ Visualisation/Decision-Support

☐ Other (please specify)

2. ***Who are the major users of your environmental information (please tick all that may apply)?***

☐ My organisation (internal) ☐ National government

☐ International agencies ☐ Private sector

☐ Provincial/district administration ☐ Non-governmental organisations

☐ Other (please specify)

3. ***Does your organisation have a comprehensive information strategy?*** ☐ yes ☐ no

4. ***Does your organisation have a data policy or mechanism, including data exchange?*** ☐ yes ☐ no

5. ***How does your organisation grant access to environmental information?***

☐ Unrestricted public access ☐ Unavailable for external use

☐ Limited by policy ☐ Adhoc/informal/selective

☐ By individual request ☐ Other (please specify) .....

6. ***Where access is granted what policy applies (tick one)?***

☐ Charged at market value ☐ Charged on full cost-recovery basis

☐ Charged at cost of media ☐ Adhoc

☐ Free to most ☐ Free to all

☐ Other (please specify)

7. ***Where access is granted, in what formats are the data available (please tick all that may apply)?***

☐ Hardcopy ☐ Floppy disk ☐ CD-ROM ☐ Email

☐ Internet (FTP) ☐ Magnetic tape ☐ DAT ☐ Private network

☐ Other (please specify):

8. ***Has the information/data been fully documented to assist external users?*** ☐ yes ☐ no

9. ***What are the main uses of the data/information you provide?***

☐ Decision support ☐ Planning/zoning ☐ Operations

☐ Management ☐ Policy formulation ☐ Licensing

☐ Monitoring compliance ☐ Enforcement of regulations ☐ Research

Section 2.2: Capacity in Environmental Information Management

1. ***How many staff members in your organisation/unit are trained in the following areas at the levels indicated?***

	Post graduate	**Graduate**	**Diploma**	**Short course**	**Total**
a) Data collection/monitoring					
b) Data entry/quality-assurance					
c) Data analysis					
d) Technical writing					
e) Graphic design/publishing					
f) Communications					

g) Management information systems					
h) Geographic information systems					
i) Remote sensing					
j) Database development					
k) Systems management					
l) Internet access/web-site					
m) Other technical assistance					

Section 2.3: Computing Environment and Communication

This section should be completed by your systems administrator or IT Officer

Indicate what facilities/services your organisation owns or has access to — in good working order. (Please tick all that may apply):

1. Telecommunication and networking

Telephone ☐ yes ☐ no

Fax ☐ yes ☐ no total:

Do staff members have individual e-mail accounts ☐ yes ☐ no total:

Internet access points ☐ yes ☐ no total:

2. Internet access and bandwidth

Dial-up (normal phone line)	☐ yes	☐ no	Max. Speed:
Dial-up (ISDN)	☐ yes	☐ no	
Dial-up (DSL)	☐ yes	☐ no	Type:
Direct access (leased line)	☐ yes	☐ no	Type:
Fibre optic network	☐ yes	☐ no	
Microwave/Radio link	☐ yes	☐ no	
Satellite link	☐ yes	☐ no	

3. Data input/output

Digitising tables	☐ yes	☐ no	total/size:
Scanners	☐ yes	☐ no	total/size:
Plotters	☐ yes	☐ no	total/size:

Laser printers ☐ yes ☐ no total/size:
Colour printers ☐ yes ☐ no total:
Other (please specify): _____

_____

4. ***Applications software*** Office productivity ☐ yes ☐ no
type/version:
Desktop publishing ☐ yes ☐ no users:
Graphics/presentation ☐ yes ☐ no
HTML editing ☐ yes ☐ no type:
Internet client ☐ yes ☐ no type/version:
Web server ☐ yes ☐ no type/version:
Statistical/modelling ☐ yes ☐ no users:

5. ***Communication/Groupware***

Directory services (shared address book, staff lists etc.) ☐ yes ☐ no users:
name/version:

Shared calendar (meeting schedules, events etc.) ☐ yes ☐ no users:
name/version:

News ☐ yes ☐ no users: name/version:

Lists with publications, projects, reports, datasets etc. ☐ yes ☐ no users:
name/version:

Other (please specify): _____

Section 2.4: Data/Information Sources and Data Quality

1. ***What is the source of data/information (tick all that may apply):***

☐ Primary research ☐ Routine data collection
☐ Acquired from other organisations ☐ Public domain
☐ Mixture ☐ Other (please specify):

2. ***What do you consider to be the limitations of your data/information for environmental management and sustainable development planning? (Tick all that may apply):***

☐ Age of data set ☐ Scale ☐ Resolution
☐ Completeness ☐ Quality/Accuracy

Section 2.5: Please list some of the challenges experienced in EIS implementation:

Thank you for taking time to complete this questionnaire.

APPENDIX 3: *List of the Respondent Institutions*

Government bodies			
Designation	**Institution**	**Telephone No**	**E-mail**
	Forest Department, Ministry of Environment and Natural Resources	764295	fd_hqs@nbnet.co.ke
	Ministry of Water Resources Management and Development	716106	
	Ministry of Agriculture and Rural Development	719013	
	Fisheries Department, Ministry of livestock and fisheries	744530	samaki@africaonline.co.ke
	Ministry of Energy	330048	
	Mines and Geology Department		
	Ministry of Tourism and Information	313010	
	Attorney General Chambers	40112/227461	
	Kenya Forestry Research Institute (KEFRI)	0154-32891/2/3/32949	kefri@arcc.or.ke
	Kenya Wildlife Service (KWS)	501081	research@kws.org
	East African Wildlife Society (EAWLS)		
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Non-Governmental Organizations (NGOs)			
	Forest Action Network	891035/350139	fan@fanworld.org
	Department of Resource Surveys and Remote sensing		
	National Environment Secretariat (NES)	609013/608999	
	Indigenous Information Network (IIN)	723958	iin@iin.co.ke
	National Museums of Kenya (NMK)	743513	plants@africaonline.co.ke
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	IUCN-EARO	890605-12	asi@iucnearo.org
	IUCN	890605-12	wps@iucnearo.org
	Intermediate Technology Development Group (ITDG-EA)	713540	
	Kenya Industrial Property Institute (KIPO)	602210/1	kpip@swiftkenya.com

Governmental Bodies	
Designation	**Institution**
Head/ Director of Department or Institution	Forest Department, Ministry of environment natural resources
	Ministry of Water resources Management and Development
	Ministry of Agriculture and Rural Development
	Fisheries Department, Ministry of livestock and fisheries
	Department of Fisheries
	Ministry of Energy
	Mines and Geology Department
	Ministry of Tourism and Information
	Attorney General Chambers
	Kenya Forestry Research Institute (KEFRI)
	Kenya Wildlife Service (KWS)
	East African Wildlife Society (EAWLS)
Non-Governmental Organizations (NGOs)	
Head/ Director of Department or Institution	Forest Action Network
	Department of Resource Surveys and Remote sensing
	National Environment Secretariat (NES)
	Indigeneas Information Network (IIN)
	National Museums of Kenya (NMK)
	Department of Resource Surveys and Remote sensing (DRSRS)
	Nature Kenya
	IUCN-EARO
	IUCN
	Intermediate Technology Development Group (ITDG-EA)
	Kenya Industrial Property Institute (KIPO)