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1 The Use of Geographical Information Systems (GIS) And International Technology Transfer by Non-Governmental Developmental Organisations in Africa

ABSTRACT

This Research work is based on the Use of Geog raphic Information system (GIS) and international technology transfer to Developing Countries (Africa) by Non -Governmental Development organisation. NGDO are involved in initiating and Implementing development projects in Developing Countries. They discove r that with the use of GIS in their projects, scarce resources could be appropriately distributed using GIS system for the intervention measures identified. The GIS Technology seen by NGDO playing a role in improving decision making and planning (Mather199 7); used the new mapping technology to assist in agricultural development throughout the third world (CIRAD 1994); seen playing a leading role in environmental assessment in the third world (World bank); GIS seen as technology that remove the 'political' f rom the decision making process and allows for an equitable and fair distribution of resources.

GIS has many problems both at the development stages and the implementation and use. Some of the problems included: Data Capture, Data access, National infrastructures, Organisational issues (such as Management acceptance, Top management involvement, GIS users participation); also funding sustainable development and appropriate technology transfer are issues of concern.

Recommendation made to overcome such probl ems included: appropriate participation at all stages of development and use by all GIS users; development of prototypes, incremental (phase) implementation.

GIS has many benefits: rational planning, Monitory of trends of disease prevalence, Integration of Data and geo-information from diverse sources (aerial photography, GPs, satellites, survey data, routine data, data from conventional maps); accurate and timely information ; Mapping of social and physical information.

GIS technology transfer should be an incremental approach: Initial phase, orientation, sensitisation programmes, developing technical capacities, training and workshops, establishing of provisional teams to ensure sharing of resources, data and information across line agencies and other gov ernment departments, establishment of national system to supported and promoted by international organisations.

DEFINITION OF TERMS

TECHNOLOGY:" A piece of equipment, technique, practical knowledge or skills for performing a particular activity".

TECHNOLOGY TRANSFER: " The broad set of processes covering the exchange of knowledge, money and goods amongst different stakeholders that lead to the spreading of technology for adapting to both for diffusion of technology and cooperation across and within countries.

DEVELOPMENT: "To expand or realise the potential of; bring gradually to a fuller, greater or better state"(New college edition of American Heritage Dictionary)

DEVELOPMENT: According to Ingham (1995) "Development is a much broader concept of human welfare, with important social, political and cultural implications."

SUSTAINABLE DEVELOPMENT: "To strike a balance in response to continually changing conditions with respect to the principal components that collectively contribute to the welfare of society, namely: the promotion of accept able forms of economic development, the fulfilment of social needs and the achievement, protection and maintenance of satisfactory environmental condition". (Pryor andChu1997)

> "Sustainable Development in a country is a process by which decisions are taken about resources use to provide for both the short and long term needs of its people. This process will allow the people to realise their full potential and provide for a healthy environment and enjoyable quality of life". (www.info.gov.hk/planning/p-study

SOCIAL INERTIA: "the resistance to change in organisations in relation to information systems" (Keen1981)

CULTURE: "An integrating system of learned behaviour patterns that are characteristic of the members of any given society. It includes everything that a group thinks, says, does and markets it customs, language, material artefacts and shared systems of attitudes and feelings " Bailey R. E. (2001)

DATABASE: "an organised, integrated collection of d ata stored so as to be capable of use by relevant applications with the data being accessed by different logical paths. Theoretically it is application -independent, but in reality it is rarely so.

DATABASE MANAGEMENT SYSTEM (DBMS): "a collection of softwar e for organising the information in a database. Typically a DBMS contains routines for data input, verification, and storage. Retrieval and combination

DATASET: "A named collection of logically related features arranged in a prescribed manner, for example, all water features. A dataset has more internal structure than a layer and is related to another dataset only by position.

DIGITISING: "The process of converting analogue maps and other sources to a computer readable form"

EPIDEMIOLOGY: " the study of th e spread of disease throughout population in particular areas"

GEOGRAPHIC INFORMATON: "Information, which can be related to a location (defined in terms of point, area or volume) on earth, particularly information on natural phenomena, cultural and human r esources special case of spatial information"

LOCATIONAL REFERENCE: "the means by which information can be related to a specific spatial positions or location"

RASTER DATA: "Data expressed as an array of pixels, with spatial position implicit in the ordering of the pixels"

REMOTE SENSING: "The technique of obtaining data about the environment and the surface of the earth from a distance, for example from aircraft or satellites"

SPATIAL INFORMATION: "Information, which includes a reference to a two or three dimensional position in space as one of its attributes.

TOPOGRAPHIC DATABASE: "a database in which data relating to the physical features and boundaries on earth's surface is held.

VECTOR DATA: "Positional data in the form of co-ordinates of the ends of line segments, points, text position etc."

DATA CAPTURE: " The encoding of data. In the context of digital mapping this includes map digitising, direct recording by electronic survey instruments, and the encoding of text and attributes by whatever means."

ATTRIBUTE: "is a property of an entity, usually used to refer to a non - spatial qualification of spatially referenced entity"

ENTITY: " something about which Data is stored in a databank or database"

GEOGRAPHIC INFORMATION SYSTEMS: "any information management system which can: *Collect, share, and retrieve information based on its spatial locations;*

Identify locations within a targeted environment, which meet specific criteria;

Explore relationships among data sets within that environment;

Analyse the related data spatially as an aid to making decisions about that environment;

Facilitate selecting and passing data to application specific analytical models capable of assessing the impact of alternatives on the chosen environment;

Display the selected environment both graphically and numerically either before or after analysis." (Francis Hanigan (1988) in Antenucci et al 1991p.7)

ACRONYMS

AT Appropriate Technology

NGDO Non-Governmental Development Organisation

ICT Information Communication Technologies

UN United Nation

GRID Global Resource Information Database

AIT Asian Institute of Technology

GIS Geographic information systems

WHO World Health Organisation

UNICEF United Nation Children Funds

IFI International Financial Institutions

UNDP United Nations Development Programme

IDRC International Research Development Centre

CIRAD Centre de Co-operation Internationale en researche agronomique pour le development

FEWS Southern Africa's Famine early warning System

PRA Participatory Rural Appraisal

DEVSIS Development Sciences Information System

USAID United states Agency for International Development

NGDO Non- Governmental Development Organisation

NGO Non-Governmental Organisation

UNEP United Nations environment Programme

GEMS Global Environmental Monitory System

FAO Food and Agriculture Organisation

DTSS U.S. Army's digital Topographic Support System

DCP Distributed Computing Platform

OO Object-Oriented Programme

OGC Open GIS Consortium

UCGIS University Consortium for Geographic Information Science

GPS Global Positioning System

RS Remote Sensing

CSE Ecological Monitory Centre

UNITAR

MapInfo Registered trademark Mapping Information System

ATLASGIS Trademark of Strategic Mapping

ARCVIEW Registered trademark of Environmental Systems Research Institute ESRI

ESRI Environmental Systems Research Institute

ARC/INFO Register Trademark of ESRI

MEMP Malawi Environmental Monitory Programme

ASAP Agricultural Sector Assistance Programme

DOF Department of Forestry

DOW Department of Water

DOM Department of Meteorology

DOS Department of Surveys

DREA Department of Research and Environmental Affairs

2 CHAPTER ONE

2.1 INTRODUCTION

2.1.1 BACKGROUND OF STUDY

According to Yapa (1991) " there is a new interest in decentralized regional planning and development in using local ly-available resources and in low cost Appropriate Technology (AT) which is part of an emerging alternative paradigm".

The concept of using local resources came into being contextually in a system of space and time co-ordinates embedded in the local region al geography. Uncovering these "local resources" is an essential part of regional development through the use of AT.

The technology of GIS was not seriously applied prior to 1980 except for few research applications and exploratory pilot projects. From the 1980 especially after 1986 was a steady expansion of the application of the GIS knowledge in developing nations to a rapid technological change in a number of related fields (Taylor 1991).

The explosions of GIS technologies in the developing nations were found to be initiated by funded or supported by international agencies and Non -governmental Development organizations (NGDO's), (Edralin 1990). These applications were mainly pilot or research projects as opposed to operational systems, which were also con trolled by outsiders, not by indigenous scientists.

GIS represent a promising generation of both traditional and new Information and Communication Technologies (ICT's) in both public and private organisations for Administration and decision -making (for example new database technologies, the Internet). Some commentators explicitly states that the development and use of GIS's is

becoming such a generic application in public administration and have been expected to contribute to a more comprehensive, technocra tic and rational mode of policy making and decision making. (Wim, Donk&Taylor 2000)

Examples of such initiatives are United Nations (UN) systems, which has been in Nairobi and Geneva, developing the Global Resource Information Database (GRID) used to support UN efforts to collect and manage environmental information for planning and decision-Making purposes (Clarke, Hasting and Kinneman 1991). The second example by Taylor (1991) the Asian Institute of Technology (AIT) in Bangkok, which was supported by UN, funds. AIT has been involved in the development and application of GIS especially in Asian region. Taylor (1991) noted that " GIS as a new Technology in developing countries and their introduction, whether in: 'Top -down' or 'bottom-up' fashion was coming mainly from the outside and so far it had been largely marginal to the solution of the development challenges of developing countries".

The steps identified by Taylor (1991) and others like, Sundaram (1987), Rada (1982) to face the challenges were:

- Indigenous scientists and decision-makers from the developing countries to gain a greater degree of knowledge and control of the technology.
- How to obtain the Socio-economic command of the developments of science and technology (Sundaram1987)
- How to master the change to the best advantage for development strategies.

When this is done would avoid mismatch between the tasks, which can be performed by GIS and the reality of the current application situation.

The development challenges facing developing countries are :

- “The effective and efficient technology transfer;

- The development of skills by the local staff in the host country; and
- The effective management of programmes that could be monitored using GIS.
- The provision of continuous funding for development project s and maintenance of the information stored so that it is kept up -to-date."(Taylor 1991)

This paper will explore the impact of GIS systems use on a number of development programmes in some developing countries in Africa with a common theme, which is the "improvement of community/Public health". Programmes with a wide geographical spread would be selected from the ones being executed or have be executed by the following organisations:

UNDP, DFID, UNICEF OR WHO

2.1.2 STATEMENT OF PROBLEM

According to Taylor (1991) " many problems of GIS Technology are common to all nations but in the developing world there are additional issues to be addressed. GIS technology is not as scientifically objective and value -driven as some authors assume. It is a product of industrial a nd post-industrial societies of the so -called "first world". The information revolution of which GIS is an integral part, taking place in these societies is imbedded in general context of Socio -economic change in society as a whole. The Socio-economic realities and priorities of the "Third world" are quite different and, if GIS is to be of use to the challenges to these realities and priorities"(Taylor, preface 1991)

2.1.2.1 APPLICATION OF GIS

According to a report of the British Computer Society's Developing Co untries Specialist Group (1991) stated, " As a management information (MIS), GIS is capable of

enhancing our understanding and management of geographical phenomena in developing countries. In particular its uses should be noted in the application areas of:

- Health
- Management of public services such as water, electricity, roads;
- Management of forests;
- Land use surveys, irrigation, soil maps, pest control;
- Fisheries;
- Discovery of natural resources such as minerals;
- As a tool for recording of geographical infor mation; and
- The forecasting of major events.

The report highlighted the benefits gain for the visual representation of information with spatial characteristics, especially while it is of a network type such as that concerning roads, pipes, cables etc. Thi s spatial representation is appropriate in helping people to think in visual terms. Also the combination offered by GIS of graphical/visual terms with a tool such as a relational database represents a great benefit. (BCS 1991)

2.1.2.2 CHARACTERISTICS OF INFORMATION FOR GIS

The key issues of concern are the both quality and the appropriateness of information collected in a GIS. For projects of geographic nature, there is a tendency to make a decision to adopt a GIS before reviewing adequately the temporal and spatial characteristics of the information, which is to be used. Some information is so time - dynamic that it is not appropriate to represent it in a GIS. Information from different areas may also very so much in terms of detail required to be meaningful th at it is not appropriate to collect it with the same precision from these different areas. (BCS1991)

2.1.2.3 NEED TO UNDERSTAND THE TECHNOLOGY ENVIRONMENT

Quoting Shirin Madon in her own research in formation systems for rural management in India; Shirin commented "the objective of the requirements analysis phase of any GIS implementation effort should be to assess the overall goals of the organization to be served by the technology".

This requires a careful understanding of the environment within which the technol ogy is to be implemented. Madon explained that while plans existed in India for the digitisation of records of village amenities in order to promote micro -level rural development planning in India, little attention was focused on the various implementation issues involved with data capture and on the social and political acceptability of the system. (BCS 1991)

2.1.2.4 CONTEXT OF MAKING POLICY DECISIONS

The concern is the seductiveness of the new technology of GIS can serve to overemphasis its importance. Some cou ntries may value GIS as a less valuable tool in development than other more conventional systems; GIS projects could also distort the development process by attracting funds to the wrong segments. It is clear that with GIS there are big potential benefits, but there is also potential for misuse either they may be inappropriate and not succeed, or where they are positively harmful in diverting resources away from other much needed projects. These issues should be understood in order to make policy decisions. (BCS1991)

2.1.3 OBJECTIVE OF THE STUDY

The objective of this dissertation is to make an assessment of the effectiveness of the International Aid Agencies - NGDO (Non-governmental development organizations

programs and initiatives to introduce Geographical Inform ation Systems technology (GIS) into development process in some developing countries in Africa.

2.1.4 AIMS OF THE STUDY

The GIS technology will be assessed using a number of criteria. These will include:

- The contribution that the technology has made to the spe cific development project;
- The extent to which the system used was an appropriate technology;
- The degree to which skills transfer as well as technology transfer has taken place;
- The trade off between low system cost and software effectiveness;
- The nature of the information processing that takes place and its relationship to the core function of the host agency or host Country;
- The efficiency and effectiveness of the solution and the scope of future development and application.
- A critical approach will be taken in order to evaluate the limitations as well as the benefits of any of the systems considered.

It is hoped that, there would be discovery on whether the GIS product use matters in the development process and what alternative GIS's are possible, who w ill be best served by the development; whether GIS is an Appropriate technology to be used in the developing countries. Also to identify if issues that affect skills and technology transfer has been addressed adequately.

Recommendation is to be made on the future perspectives of GIS in development.

2.1.5 RESEARCH METHODOLOGY

Research methodology would include literature reviews, which will involve library and Internet research.

2.1.6 LIMITATIONS OF THE STUDY

The time available for dissertation writing does not allow a comprehensive study to be carried out. Besides a study of this nature might require travel, which increase the cost. Therefore time and funds will act as serious constraints.

2.1.7 ORGANISATION OF THE STUDY

The dissertation is divided into seven (7) chapters. Chapter one would be the introduction in which there would be a brief discussion on the background of the study, statement of the problem, objectives and aims, methodology, limitations and the organization of the study. Chapter two would be about, the int ernational Aid agencies/ |Non-Governmental Development Organisations (NGDO) that is the focus of this study, example are UNICEF, WHO, and also development issues, NGDO and GIS Technology use would be looked at. Chapter three would centre on Development, Ge ographic information Systems (GIS), GIS technology Transfer and the issues on GIS products, what products and do products matter. Also in the same chapter issues on Current Advances, Critique and future Development Perspective of GIS would be mentioned. Chapter four would be the Methodology. Chapter five the analysis of the case studies selected for the research work, which are Botswana, Senegal, Morocco and Malawi. Chapter six would be the Discussion and Conclusion of the study, while chapter seven would be Recommendation.

3 CHAPTER 2

DEVELOPMENT ACTION IN PRACTICE IN NGDO

According to Fowler (1997) "there is often confusion about the overall purpose or goal of international development assistance. A sour ce of uncertainty is the mix-up between means and ends, fed by multiple agendas and institutional rivalry."

Market capitalism is now the pre-eminent global economic model. This unrivalled position has pushed the major proponents – International Financial Institutions (IFI's) like the World Bank and the International Monetary Fund – to the forefront in setting the agenda in terms of the purpose and content of international assistance. These influential institutions create the impression that efficient mar kets producing broad based growth can be equated with development itself (Fowler, 1997).

The United Nations Development Programme UNDP opposed the view of the IFI's, while competing for the acknowledged pre-eminent position in the aid system. According to Fowler (1997), UNDP has for the past few years been emphasising human well-being as the purpose of markets and development.

NGDO's would, assert to all people and their values are both the means, ends and judges of development, and those markets are in the service of human kind. That is NGDO's can and may do, take a more holistic, people-centred view, unimpeded by the "bickering made necessary by IFI's limited economic mandates".

The reasonable consensus about the overall long-term goal to be achieved by development assistance is the creation of societies without poverty and injustice, and the functional purpose of development is to nationally and internationally, foster socially just, sustainable economies with accountable, inclusive systems of governan ce (Fowler, 1997).

Figure 1.1 – Framework of development action

The figure summarises what makes up development today and how they are meant to relate to each other and how the NGDO are playing in achieving the goals, which the aid system has set itself.

Figure 1.2 expands on Figure 1.1 by bringing NGDO's into the scene and showing what actions typically impart on the micro - and macro-levels of development.

Figure 1.2 – NGDO's and development action

Fowler (1997) argues that for NGDO's to be effective in development work, the NGDO's individually, in alliances and collectively must have the capacity to among other:

Balance the knowledge, experience, motivation and values of people who are poor or marginalized, especially women and powerless minorities agai nst the expertise, links, resources and relative power of outsiders;

Balance external inputs with local mobilisation of resources and links;

Balance tangible products with human processes over time;

Balance time perspectives, interests and power relations between stakeholders while hitting them in favour of the powerless;

Balance micro-, macro- and increasingly intermediate levels of development, coupling direct actions at the grassroots with learning for leverage to gain structural change .

GIS TECHNOLOGY AND DEVELOPMENT AGENCIES/NGDO'S

Overview

According to Mather (1997) that "GIS technology is first becoming the darling of the international development community". The Canadian -based International Research Development Centre (IDRC) foresees a 'brilliant f uture, for GIS in the communities and

nations of the developing world'. The IDRC had funded a number of different development projects in Peru, Nepal, China, Cote d'Ivore and Egypt that relied heavily on the technology for improving decision making and pla nning. (Mather1997).

Also the French organisation CIRAD (centre de co -operation internationale en researche agronomique pour le development) used new mapping technologies to assist in agricultural development throughout the third world. Example is given of how (CIRAD, 1994 quoted in Mather 1997) the technologies in Burkina Faso in an attempt to maintain a sustainable balance between agricultural land use

The World Bank in its report of 1993 indicated "It sees the technology playing a leading role in environmental assessment in the third world. The technology's advantage over previous methods lies in its ability to… assess complex relationships between a variety of economic, environmental and social factors across space and time" (world Bank 1993).

South Africa sees the potential of the technology to redress the inequalities associated with apartheid social engineering. Due to the prominent role that these and other development agencies see for new mapping technologies in the Third World as recorded by Missoten et al (1994) made a basis for critical attention of researchers interested in the relationship between technology and development.

DIGITAL MAPPING AND DEVELOPMENT AGENCIES

Many reasons have been proposed as to why the GIS technology is attractive to development agencies? Mather (1997) suggested three most impotent reasons.

The first is that GIS allows planners and development workers to integrate data and geo- information from diverse sources as satellites, aerial photographs, global positioning systems, and conventional maps and surveys, into one computer system. This was previously difficult to do such as analysing data from, for example, satellites, in conjunction with surveys and field reports. Now with GIS combining remotely sensed information with data collected by humans is a relatively simple task (Jacobberger 1994 in Mather 1997). Example of the kind of Data Integration using GIS comes from southern Africa's famine early warning system (FEWS). This project goal was to allow countries in Southern Africa sufficient time to respond in the event food shortages or worse famine (Wright, 1994 in mather1997). FEWS used data from surveys climatologically information and predictions, crop prices and other information in an attempt to anticipate shortfalls in food production. Those information have been integrated with satellite images into a GIS to provide timely assessments of plenty growth on a regular basis, throughout the year. It was recorded that GIS considerably improved the ability of FEWS to predic t food shortages (Mather 1997).

The second reason is the growing appreciation within development circles of the benefits from mapping social and physical information. It is possible to map a particular area and be able to identify problems, dispel myths a nd find solutions to social and resource based problems. Example of this was given of the use of GIS in Nepal, a country that was predicted by World Bank in the 1970's that due to population pressure, Nepal would have no forests left in 15 years. However a ccording to Schmit et al, 1995, GIS planners were able to challenge the world banks dire prediction and provided a complex explanation of resource, use and change (Mather 1997).

The third reason is the GIS system's ability to assist planners in rational d ecision making. For example, Hastings and Clark (1991) noted that Africa is often perceived as a continent where rational planning of development … can contribute significantly to environmental protection as well as people's welfare… This increases the app eal to some organisations interested in implementing GIS (as "it is perceived by many donors, the failure of countries in Africa and elsewhere to develop was partially due to corruption and the use of funds to enrich individuals rather than communities and nations.")

This ability of GIS has made donor countries to be prepared to fund projects, which rely on technology that removes the 'political' from the decision -making process and allows for an equitable and fair distribution of resources.

It is noted that while these systems can be applied to almost any spatial planning problem, they are used most frequently as a tool for service provision, resource management, and for environmental assessment and management

OVERVIEW OF SOME INTERNATIONAL AID AGENCIES /NON-GOVERNMENTAL DEVELOPMENT ORGANISATIONS

UNITED NATIONS CHIDREN'S FUND (UNICEF)

UNICEF was created in 1946 to meet the emergency needs of children in post war Europe, (then called United Nations International children's Emergency Fund -UNICEF) UNICEF's initial Mandate in the 1950's was the provision of supplies, training and emergency operations to countries recovering from the world War. In 1973,UNICEF teamed up with WHO, Governments, and Non-Governmental Organisations (NGO's) in mass campaigns against childhood disease. This led to many other resolutions by the

General Assembly of the United Nation to reformulate the focus of UNICEF. Among the important resolutions include: 1975 endorsed the incorporation of "Basic services for children in Developing countries", embodied the inclusion of child health, nutrition, water supply, basic education and supporting services for women; 1984 authorised UNICEF to take advantage of developments on social and biological sciences bringing about a low costs, promoting Universal Immunisation and the use of the oral Rehydration Therapy (ORT) (this improved and recorded success in child mortality reduction in a short time),

UNICEF programme of co-operation with governments an the Civil Society are being governed by the provisions of the convention on the rights of the child (CRC) what was passed by the UN General Assembly in 1986.It incorporate and enlarge on all the previous mandates.

WORLD HEALTH ORGANSITION (WHO)

The world Health organisation (WHO) is one of the specialised agencies of the United Nation responsible for international health matters on Public Health.

In 1945, a proposal for the establishment of WHO was approved and in 1946, the constitution conference on international Organisation. The constitution came into force on 7th April 1948.

WHO OBJECTIVE

The objective of WHO is "The attainment by all peoples of the highest possible level of health".

WHO FUNCTIONS

The functions of WHO, as stipulated in the constitution include:

To act as the directing and co-ordinating authority on international health work;

To establish and maintain effective collaboration with the United Nation specialised agencies governmental health administration professional groups and such other organisation as may be deemed appropriate;

To assist Governments, upon request, in strengthening health services.

WHO'S STRATEGIC FOCUS

WHO's current strategic priorities in line with the principle of health for all are:

Communicable diseases;

Non-communicable diseases;

Sustainable development and health environment;

Health systems and community health;

Evidence and information for policy;

Health technology and pharmaceuticals;

Social change and mental health.

TECHNOLOGY TRANSFER, GIS AND DEVELOPMENT THINKING/PRACTICE

GIS experts identified the problems of transferring GIS technology to relate to a readily identifiable set of obstacles surrounding data availability and maintenance, training and institutional readiness and also the problem of participation (Mather 1997). According t o Mather (1997) two concerns arise about how GIS experts see the role of this technology in the Third World countries without consideration of the impact it might have on existing development practices;

First concern GIS is presented as a solution to under development as if no other development practices existed as illustrated by Hastings and Clark's(1991) assessment of how Africa is often viewed as a laboratory with unique opportunities to do something correctly from the beginning.

The second concern relates to the emphasis by GIS experts on rational planning. This is the feature of the technology that has made it extremely attractive to development agencies and their emphasis on the importance of participation.

Several GIS writers involved in development w ork identified participation as a factor which has contributed to the failure of technology transfer in the past, and which they think may guarantee its success in the future. From their views participation means drawing clients into the design process to ensure that the implementation of the technology is sustainable. Both these concepts that is the rational planning and the GIS view of participation sit very uneasily with current development thinking and are

incompatible when considering contemporary deve lopment thinking and practice in rural areas of the third world (Mather 1997).

According to Ferguson (1990) the mid-1990s rural development practice and thinking had no claim to objectivity and rational planning and that the experience of rural development since the late 1960's showed that 'development' is a profoundly political process. Projects were considered to fail because local leaders were not involved in the process of development interventions that promise resources and improved living standards and, as they did not perceive any personal benefits from the initiatives. Examples of such rural development initiatives that face such problems is one in Swaziland, the development initiative challenged the power of the local leaders (Sallinger-McBride and Picard 1989), the case of women who are marginalized from the new development efforts they resisted and derailed the development initiatives (Mather 1997). There are several cases like that, where the agency intervention has failed due to the inability of aid workers to predict the political implications of their intervention in rural areas of the Third World.

The development workers had to respond by acknowledging the political implications of their intervention and to devise strategies of negotiating the complex process of development (Chambers 1993) and Mather (1997).

4 CHAPTER 3

5

5.1 DEVELOPMENT

The South Report (1990) cited in Ingham (1995) stated that, “True development has to be people-centred. It has to be directed at the fulfilment of human pot ential and improvement of social and economic well being of the people. And it has to be designed to secure what the people themselves perceive to be their social and economic interest"(the South Report (1990).

5.1.1 DEVELOPMENT LITERATURE

A development is a gradual actual act or process of changing; progressing through a number of stages towards some sort of state of expansion, improvement or completeness or a state in which the subjects true identity is revealed. This can be transitive or intransitive. It means in reference to countries it is possible for a country either to develop by itself or to be developed by outside agency (MD Anisur Rahman, 1991, p. 19).

The term development was born as part of “True man design” of 1949 in response to the emerging cold war between the two great rival ideologies (Conyers and Hills, 1984, p. 22). It was not widely used with reference to countries or groups of people until after the Second World War. Prior to that the people who had some knowledge of both developed and underdeveloped societies were aware of the significant differences between them. People in developed nations were concerned

only with changes designed either to improve their access to the natural resources of the underdeveloped world or in a few cases to introduce some of the more basic characteristics of civilisation including the provision of a few basic services and conversion to Christianity. Meanwhile, in the underdeveloped countries themselves, knowledge of the developed world was often so obscure that the potential for change was not at that time fully recognised.

After the Second World War, the notion of development began to appear the colonial powers began to accept the need for social and economic development and even the reality of political independence in their territory of occupation. This was partly the result of growing pressures for development and independence from the citizens of these countries (Conyers and Hills, 1984, p. 24).

While all societies have experienced development, it is equally true that the rate of development differed from continent to continent, and within each continent different part increased their command over nature at different rates.

Underdevelopment therefore is not absence of development, because all people have developed in one way or another and to a greater or lesser extent. Underdevelopment makes sense only as a means of comparing levels of development. It is very much tied to the fact that human social development has been uneven and from a strictly economic viewpoint some human groups have advanced further by producing more and becoming wealthier.

In Africa development was considered possibly only by emulating the ways of the "developed" countries – their aspirations, values, culture and technology. The so-called "First and second" world countries offered financial and technical assistance in patronising assumptions of superiority in the march to civilisation.

The threat of Bolshevik Revolution inspiring Third world sought to be countered by a promise of “development” and “development assistance” will help the “underdeveloped” societies catch up with the “developed” (Md. Anisur Rahman, 1991 p. 8).

The state of development to which the underdeveloped nations were assumed to aspire was more or less synonymous with the type of society, which existed in the developed nations. This society was described by Rostow (1959) an economist who was responsible for some of the earliest theories of development as “High Mass consumption society”.

In the mid 1960’s, people were beginning to question whether the concept of a high mass consumption society was really a goal to which developing countries should aspire. (Conyers and Hills, 1984, p. 24).

The new concepts of development are those concerns with the general quality of human life and the natural environment. According to Goulet, (1978) “there is no better way to achieve a total development than to develop the best model of development that stimulates any society to forge for itself on the anvil of its own spe cific conditions. (Goulet, 1978, quoted in Wilber and Jameson, 1979).

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5.1.2 DEVELOPMENT INFORMATION

Information plays the role in any meaningful development by guiding or influencing this process of development. Since development is though of as the significan t mission in today's world there are possibilities that the same technologies which allowed for the evolution of co-operative and potentially comprehensive information, could be applied

for the provision of information to the developing community as well a s Information, could indeed be one of the missing elements in the development equation. (Aiyepeku; W.O. 1989, p11-12)

One of the most credible outcomes of the United Nations Development Decade (1971 - 1980) was the establishment of the Development Informatio n System, a computerised database of references to unpublished materials written by or for the United Nations in the field of economic and social development. By far the best -known international example of the fruitful application of information to develop ment efforts is Canada's International Development Research Centre (IDRC), which was established in 1970. Thus information is recognised by IDRC as a major vehicle for promoting the development of Third World Countries where most of the centre's activities have been concentrated. By pioneering the concept of a development Sciences Information System (DEVSIS) and promoting its application to development efforts in Africa, the Caribbean and Latin America in particular - IDRC become synonymous with "development information " throughout the world (Aiyepeku 1989,p.5)

5.1.3 AN INTERNATIONAL AGENDA FOR DEVELOPMENT

The United Nations sees development in the next century as "*globalisation of prosperity side-by-side with a depressing globalisation of poverty.*"

The United Nations agenda for a new direction in development policy during the next century, a six point agenda was proposed:

A New World, social charter, to establish a framework for equality of opportunity among nations and people.

A 20:20 human development compact, to implement targets for essential human development over a ten-year period (1995-2005).

Mobilization of the peace dividend, to get concrete targets for reducing global military expenditure and for capturing the ensuring peace dividend to enhance human security.

A global human security fund to address the common threats to global human security.

A strengthened UN umbrella for human development to establish a more integrated effective and efficient UN development system.

A UN Economic Security Council to provide a decision-making forum at the highest level for global issues of human security .

With the 20:20 compact for human developed aid donors are expected to lift their aid allocation for human priority goals to 20 percent of their aid budgets. Likewise developing countries are expected to earmark at least 20 percent of their budgets for public spending to human development concerns.

Human development is argued not only to give hope to peoples, but also to advance priority goals such as protection of the environment and is expected to slow down population growth and to support non-polluting development strategies.

5.1.4

5.1.5 INFORMATION SYSTEM RELEVENT TO AFRICA'S DEVELOPMENT

Timely and reliable information is a tool for developm ent, and private economic agents need for economic policy making in the public sector and for business decisions data. While it is public knowledge that the most relevant information to development of a community is the information produced by the communit y itself. Most of Africa's primary interest in the emerging global information highways is information in support of basic development issues such as: - Eradication of hunger; eradication of Malnutrition; eradication of Illiteracy and ignorance; provision of adequate healthcare delivery and provision of affordable housing in harmonious environments.

However, Africa contributes less than 5% of the data and information currently handled by the Internet and independent service providers, the trend which sugges ts that this proportion is declining and not increasing. (Aiyepeku, 1997,p.1). This prompted several international development agencies, international and national non -governmental organisations (NGOs) and others to respond to the pressing need for strengt hening Africa's information infrastructure and human resources capacities in order to ensure sustainable development.

5.2 GEOGRAPHIC INFORMATION SYSTEMS (GIS)

5.2.1 OVERVIEW

The need to manage information from a geographic perspective is now being made aware of and accepted by societies. This acceptance has been brought about by a twenty-first-century trend towards a global community, economy and the information age. Also the other side of the negative impact of advancing technology has shown the

need for wise management of the earth's resources. The geographic information system (GIS) is emerging as a powerful means to manage the voluminous geographic data. Also to provide foundations and tools to help meet the challenges facing societies in planning and control and the use of the earth's resources (Antenucci et al 1991:3).

5.2.2 CONCEPT OF GIS

According to Heywood (1994) "GIS have been around 30 years now. The underlying concepts of GIS are relatively simple and straightforward: GIS allows an organisation to store, analyse and retrieve information according to its location on the earth's surface. Most organisations are now involved in making decisions which involve geography the approach has wide-range applicability as illustrated in Figure 1: - who is using GIS. The main application areas of GIS are a review of the types of question GIS are being used to address.

THE IMPORTANCE OF GEOGRAPHY

What makes the GIS approach different from other information technology strategy is the use of "geography" as the key variable in the organisation, retrieval, analysis and display of information. Two basic ways in which information can be tagged in a geographical reference: First method links every item of information to its location on the earth using one of the standard geographical frames of reference such as latitude or longitude, or a more local referencing system such as the Ordinance Survey's National Grid. The second, which is less direct, was surrogate spatial reference such as a postcode or property reference (this method is not as direct since

postcodes themselves must be linked to some form of spatial referencing system such as latitude and longitude before they can be plotted on a map.

GIS apart from processing map-based Information, Data from other sources such as: satellite imagery, air photographs, surveys, satellite-based global positioning systems (GPs) can all be used in a GIS framework as illustrated in fig. 2 – Data Sources.

The most important advantage of adapting GIS approach is that the technology permits the integration of many disparate data sets, which were previously impossible.

THE GIS TOOLBOX

GIS has an array of functions in which the system can perform. Many of which are now standard features; for example any true GIS will allow one to overlay and integrate data in various ways to produce new information. Figure 3 – GIS Overlay concept, summarises this overlay concept. Another standard GIS operation is the ability to calculate the area and perimeter of geographical features, as represented in the computer. Such as the area of a field and the length of its boundary, also can calculate the distance around the feature, which facilitates the targeting of objects within a given distance. In addition to the essential and standard common place tools there are also enhanced or specialist gadgets that are often unique to a specific GIS.

Figure on functionality from Goodchild

5.2.3 THE STRATEGIC ROLES OF GEOGRAPHIC INFORMATION SYSTEMS

STRATEGY AND INFORMATION TECHNOLOGY

Murphy (2001) using Ghoshal's (1987) framework for global strategy (is used to) explore how GIS technologies may contribute to strategic choices and therefore to competitive advantage.

The Ghoshal's (1987) framework for global strategy organises several streams of multi and Trans-national strategy research and helps clarify the "inherent contradictions into different sources of strategic objectives and the different sources of competitive advantage.

Three organisational goals are:

Efficiency in current activities, managing risks, and d eveloping internal learning,

Innovating aid

Adapting capabilities

Three strategic tools represent classical sources of competitive advantage:

-

Economies of scale

Economies of scope

Regional or national differences in costs of the factors of producti on.

The framework gives a means to be used to assess the issues and factors that any one operational zed strategy would generate

Insert Table 1: GIS and Strategic Goals

Insert Table 2: Geographic information technologies and Ghoshal's strategic tools.

5.3 GIS IN AFRICA

5.3.1 ORIGINS OF GIS IN AFRICA

The United Nations environment programs (UNEP) formed in the early 1970's with its headquarters in Nairobi, Kenya. Global environmental monitory system (GEMS) of UNEP's was created to develop global environmental moni tory programme of which is the global resource information database (GRID). GRID includes GIS for the production and application of spatial databases for global environmental study (Fanshawe 1985).

Apart from the UNEP's activities in its 'home' continent, several bilateral programmes have been developed between countries. Such countries as the united states of American, Germany, the Netherlands, the united kingdom, France and Sweden to help individual organization within Africa countries use GIS and relate d technology to monitor/ manage their environment (hostage and Clark, 1991)

Other organizations that become active in GIS in Africa included the food and agriculture organization (FAO), the united nation institution for training and research among other UN organizations. The UNDP also became interested in GIS and related technology, while the World Bank is gearing up in this area. (Hastings and Clark 1991)

5.3.2 DEVELOPMENT BASE ON NEEDS IN AFRICA

Many Africa countries that regained their independence embarked on protection by producing large numbers of national and regional thematic maps of resources such as topographic, geological/mineral soils, climatic, land use and forest maps, with their accompanying reports. Many of these projects were undertaken and kept w ithout proper use in storage rooms; this was due to inability to use it fully. It is now known that GIS are collection of tools designed to help overcome this problem.

5.3.3 EXAMPLE S OF SOME AFRICA'S USE OF GIS

1. DESERT RESEARCH INSTITUTE EGYPT (DRI)

MPGAP (minerals petroleum and ground water assessment programme) was conducted by the government of Egypt with the assistance of the US agency for international development (USAID). The MPGAP programme was to improve the handing of information concerning geological resources in Egypt.

The idea is that improved access to information through better libraries, spatial and tabular databases management, and compilation of information, which make it easier for these resources to be developed wisely.

It was acknowledged that remote sensing and GIS capabilities were considered important, components of this effort. (Hasting and Clark 1991). This led to DRI to acquire raster and vector systems in early 1989. Training was produced By USAID during the period of the project offici al project life.

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GLOBAL RESOURCES INFORMATION DATABASE (GRID), NAIROBI KENYA.

The UNEP /GEMS/ GRID was established in 1983 to give users access to harmonized and integrated geographical data sets of known quality (UNEP 1988).

5.3.4 FREQUENT PROBLEMS FACED BY AFRICA GIS FACILITIES

Most of the problems were GIS laboratories developed in technical environment that are not completely ready for GIS and databases development began with nothing available. An agency's skill needs for applications often exceeds the av ailable software or technical skills of the agency's staff; some technical experts is only borrowed or is available only part- time. In most cases selection of a system is based not on a

complete study of needs but on are impression from popular GIS softwa re; some system cater for beginners and experienced users alike few have a complete balance.

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5.4 GEOGRAPHICAL INFORMATION SYSTEMS AND HEALTH

GEOGRAPHY MATTERS TO HEALTH AND HUMAN SERVICES

In every problem that faces the world and health, whether they ar e environmental, economic, political, social and so on, have a geographic context and in any analysis this aspect must be considered. Understanding issues ranging from epidemiology to access to healthcare providers requires understanding the geographic con text of these issues. GIS technology is one of the fastest growing technology in health and is helping professionals in the ever more complex health industry manage their information needs to make better decisions.

GIS potentials to benefit the health ca re industry are many, both public and private sectors are developing innovative ways to harness the data integration and spatial visualization power of GIS. GIS is seen to play a critical role to determine where and when to intervene, improving the quality of care, increasing accessibility of service, finding more cost-effective delivery modes and preserving patient confidentiality while satisfying the needs of the research community for data accessibility.

GIS: MAPPING FOR EPIDEMIOLOGICAL SURVEILLANCE

According to WHO weekly epidemiological record (199), GIS and maps are valuable in strengthening the whole process of epidemiological surveillance information management and analyses:

IN data management-GIS serves as a common platform for convergence of multidisease surveillance activities. Standardized geo -referencing of epidemiological data facilitates standardized approaches to data management, which GIS can serve as an entry point for integrating disease surveillance activities where appropriate. Also GIS facilitates the convergence of multisectoral data, including epidemiological surveillance information, population information, environmental information and health and other resources in to a common platform for analysis a illustrated in **figure I: GIS for surveillance information management and analysis** .

In data analysis- GIS provides an excellent means of visualizing and analysing epidemiological data, thus revealing trends, dependencies and interrelationships that would be more difficult to discover in o ther formats as illustrated in **Map I; GIS for epidemiological surveillance -African trypanosomiasis**

5.5 GEOGRAPHICAL INFORMATION SYSTEMS DEVELOPMENT IMPLIMENTATION AND USE

5.5.1 ORGANISATIONAL ISSUES

DeMan (1988) argued that most of the problems and hindrance s to Implementing GIS in the earlier days of this technology are rooted in organisational and not technical. Understanding the organisation within which GIS are to function is fundamental to understanding the challenges of development and implementation. (Peuquet and Bacastow 1991)

Peuquet and Bacastow (1991) examined the U.S. Army's digital topographic support systems (DTSS). The issues looked into were the organisational context, the elements of the development, history of the system, the recognition of s ome fundamental factors that had frustrated the development of DTSS. What they discovered were:

For Organisational commitment to change - effective organisation of GIS needs not only people able to employ the technology but also people willing to employ the technology. The willingness depends on both the individuals and the organisation, this to overcome the long and pervasive resistance to innovation within both government and business (Morrison1966)

Development of GIS's is a mutual efforts - Management at all levels, as well as the prospective end-user must actively be involved through all the phases of the development process. A true appropriate functional requirement can only be derived with the detailed knowledge of the organisation uniquely possessed by those within the organisation.

Sahay and Walsham (1996) identify factors and conditions under which GIS implementation is impeded or enabled, which they term as inhibiting and enabling factors respectively.

INHIBITING FACTORS

Data: This relates to its availability on appropriate scales, usability problems because of the over dependence on remotely-sensed data, quality problems due to maps being outdated, and non-standardised format of data that are not supported by standard software.

Manpower: reflects an acute shortage of trained manpower that has the ability to understand and use GIS, and the general lack of awareness of GIS, especially among the planners. The dominance of GIS technocrats contributes to organisational issues being made subservient to technical concerns during implementation.

Structure: relates to decision-making styles and the forms of developing country organisations decision-making (normal central), left to officials with inadequate knowledge about the technology and are responsible for taking critical decisions related to implementation. The sectoral form of organisation, the lack of appropriate policies to enable co-ordination, often leads to duplication of efforts.

Financial: proves constraints in acquiring and maintaining GIS systems, also restricts the development and maintenance of training and research programmes .It is discovered that finding of a GIS project often comes as a pat of an aid package and the long times involvement in implementing GIS makes it difficult to provide sustained funding.

ENABLING FACTORS

Approaches: development of approaches that provides sustenance and by developing local expertise that would take over from the expatriates.

Practices: development practices that smoothen transition of people from their existing ways of doing work to using GIS. For example enabling users to receive prior exposure to mapping systems and allowing systems development to take place in an incremental and evolving manner.

Institutional Mechanisms: appropriate policy level initiatives around GIS .For example private companies and international aid agencies to aid in establishment of national level GIS institutions that would contribute to the development of local expertise.

Sahay and Walsham (1996) basing their research of implementation of GIS in India, on the theoretical framework for their work was developed, using the concept social context of social context and processes, implementation and the linkages between context and process. Based on current thinking in IS implementation research (Walsham 1993).

The Social context refers to conditions which are antecedent or given to the process for example the national culture of the country in which the system is being implemented.

Implementation Process: this includes the adoption of decisions installation of apiece of hardware, acquisition, utilisation, acceptance or rejection of the GIS within the organisational context.

Linkage between context and process: understanding of the interaction between the two. The social context may both enable and constraint the implementation process to evolve in certain ways, which can reinforce or reshape the existing, conditions.

5.5.2 PUBLIC ACCESS TO GEOGRAPHIC DATA

In Europe, a European commission Directives of April 1990) required that all official agencies of all members states must make available all their environmental holdings of

information to the general public a t ' reasonable cost' (CEC1990). It is argued that it is not clear what constitutes environmental information, but certainly topogra phical information would seen to be a necessary part. Nor is it clear what constitutes reasonable cost except in so far as some organisation in any country should expect to Price its products in this category much more highly than other organisations in th e same country or in others within the European Community.

Geographical data and information is derived by aggregation to areas from bureaucratically compiled records pertaining to individuals, however some geographical data are not in aggregate form and t heir supply to a third party may then transgress regulations on privacy. However legislation on privacy constraints the uses to which such data may be put only when it is held in computer form.

It is accepted generally that access to some geographical dat a may not be appropriate for example data created for military purposes.

Many countries show immense differences in practice currently exist in data dissemination and policies. Many of the European countries are inclined to recoup as much as possible while U.S.A. Sees that almost free provision of federal government data as an entitlement of the citizen and as a precaution against the garnering of power by cliques through their sole access to information

It seems no one has yet found a logical basis for ch arging for the use of topographic data. The price elasticity of geographical information is limited, especially where competitive products exist and except where the use of 'official ' products is required by statute.

It is note that the development of bro kering and legal advice services for geographical data seems very probable and this is likely to flourish on a national basis.

5.5.3 NATIONAL SPATIAL DATA INFRASTRUCTURES

Government agencies are involved as main external providers of geographical information for most operational applications of GIS, they also exert a profound influence on national developments which resulted in a phenomenon, Rhind (1996,1998) called "a cocktail of laws, policies, conventions and precedents, which determines the availability an d price of spatial data (Masser 1999).

Traced back to the mid 60's the trend in which many governments throughout the world began to think more strategically about information needs, data collection, and the resources needed to deliver information to a wid er markets; the potential of computer, cased surveying and mapping systems for creating multi -user, multi-purpose databases for the public administration was recognised.

This vision was lost in the 70's and early 80's as the emphasis of 'how' as spatial information systems were implemented for a wide variety of purposes within traditional institutional frameworks. (McLaughlin 1991 cited in masser1999). Later the focus shifted back to matters of geographical information and its use in society in the late 80' s.**Tablel: the first generation of national data infrastructures.** The table shows titles of some countries national initiatives, even though the terms used very from country to country three elements are of common:

They are explicit national in nature;

Refer to geographic information, spatial data, geospatial data, or in one case, to land information;

Refer to terms such as infrastructure, system or framework, which imply the existence of some form of co-ordination mechanism for policy formulation and impl ementation purposes.

They are term the first generation of national spatial data infrastructures (NSDI)

These first generation NSDI have differences in terms of geography, levels of economic development and systems of government.

DRIVING FORCES TO ESTABLISHMENT OF INFRASTRUCTURES

Masser (1999) argues that two basic themes underlie these national spatial data infrastructures which are: growing importance of geographical information in the coming age of digital technology; and need from some form of governm ent intervention to co-ordinate data acquisition and availability, Reports of the interest of some chief executives on these themes are:

President Clinton's Executive order for the National spatial data Infrastructure:"

Geographic information is critical to promote economic development, Improve our stewardship of natural resources and to protect the environment. Modern technology now permits improved acquisition, distribution, and utilisation of geographic (or geospatial) data and Mapping … ". (Executive office of the president 1994)

In the eyes of Koran Government:

" *The National Geographic Information system (NGIS) is recognised as one of the most fundamental infrastructures required in promoting national competitiveness and productivity. Accordingly, the Korean government is exerting significant efforts to develop and improve NGIS*". (MOCT 1995,p.10)

In the mission statement of the British National Geospatial Data framework the importance of access was apparent which seeks;

"*To provide a framework to unlock geospatial information for the benefit of the citizen, business growth and good government through enabling viable, comprehensive, demand-led and easily accessed services* ". (NGDF1998p.4)

With the advent of growing globalisation of geographical informat ion activities and the changing current practices taking place in the nature of government

Many countries governments are now expected to operate in more commercial way. For example Britain ordnance Survey is approaching 100% cost recovery. In the Netherlands the Cadastre has became an independent administrative organisation within the Ministry of Housing spatial planning and environment, with now a separate company set up in April 1996 to develop a new postal address co -ordinate product for 7m postal addresses in the Netherlands (Masser1998p.41). In other countries surveying and mapping activities are being restructured in ways that substantially alter their roles. For example the subdivision of the old department of surveying and mapping agency (Land information New Zealand) and a state owned commercial enterprise (Terralink). Those have introduced new dimensions into the National spatial information strategy debate in the country (Robertson and Gortner 1997)

Coming alongside these developments is the em ergency of global that is transnational and regional initiatives in many parts of the world (Masser 199). Such as the establishment of the European umbrella organisation for Geographic Information (EUROGI) in 1993 (Burrough et al 1993); Permanent committee on GIS Infrastructure for Asia and Pacific in 1995 (Godfrey et al 1997). These developments bring new dimension to the work that is already being done as a result of established global remote sensing and mapping initiatives; such as the UNEP Global Resour ces Information Database Programme GRID) which began in 1985 and the International Geosphere Biosphere programme (IGBP) which was established in 1986 as well as the activities of the International steering committee for Global Mapping which was set up in 1994 and has secretariat at the Geographical Survey Institute in Japan (Masser1999).

5.6 WHAT GIS PRODUCTS DO PRODUCTS MATTER

Hastings and Clark (1991) identified some capabilities of GIS products that are needed especially to assist the development of an African GIS community in particular and other GIS community outside Africa at large. These capabilities include:

IMPROVEMENT IN SOFTWARE AND USER INTERFACES

The ability to integrate raster and vector data and to integrate image processing in GIS. Additional systems integration, such as substantial capabilities for conversion from tabular to spatial data, analytical handling of multiple map scales. Example is GRASS (CERL1989)

Ability to analytical handling of multiple combinations of ASCII and binary d ata as 8-bit byte, 16-bit integer and floating point real data example is IDRISI(Eastman 1989)

Ability of indexing of data to speed windowed plots such as the NOAA National Geophysical Data Centre's GeoVu (NGDU1989) can now index within NGDC's spatial data on CD-ROMs. This feature and facilities is able to reduce the frustration of users of African GIS facilities.

Ability to have a combination of menu that the user can travel up and down, or ignore altogether by entering the name of a command that provides such power and user assistance. Example is the ERDAS' system of windowing (ERDAS 1989) Or, another option is to have menu and command line versions of the user interface with an intermediate version of each function that allows one to edit parameters and f unction settings interactively such as is offered by GRASS.

Provision of less command syntaxes for memorising as like the drudgery that has been taken out by computers of repetitive processes. The lower the level of software training necessary to be productive the better for the GIS for African and other laboratories.

Ability to help protect the user from foreseeable problems. These include protection against loss of data from system malfunctions (like a disk failing to write) in the middle of a program by not overwriting the input data with the output data. Avoiding incompatible file formats that unnecessarily impede the appropriate combination of different types of data and ensuring that the output from one function produces data, which are not incompatible for input into a logical next-step function.

Ability for the user interfaces to consider linguistic differences more common words to major languages, symbols to be used.

IMPROVEMENT IN SOFTWARE DOCUMENTATION AND TRAINING MATERIALS

Software documentation to be made in an appropriate language to facilitate quick use.

GIS developers to improve on training in GIS techniques in the appropriate technical subject area.

LONG-TERM COMMITMENTS FOR TRANING

Adequately trained personnel are a fundamental requirement to the successful implementations of GIS in any area.

Organisation should be committed to long term training needs to enable a stable foundation in the technology.

CONTINUED TECHNICAL INPUT AFTER TRAINING

Availability of appropriate collection of textbooks and subscription to journals and newsletters, to enable users current knowledge update on GIS. Thes are useful to keep

readers current on developments and personalities in the field. Example of newsletters includes: ARCNews on ARC/INFO, ERDAS Monitor and GRASSCLIPPING on GRASS.

IMPROVED COLLABORATION WITH OTHER GIS FACILITIES

Local and International collaboration is vital to the continued success of many African GIS facilities. This could provide medium term technical visits a nd possibly data and technology exchange.

5.7 GIS DEVELOPMENT ADVANCES AND CRITIQUE

5.7.1 INTEROPERABILITY - CORE TECHNOLOGY DEVELOPED BY OPEN GIS CONSORTIUM (OGC)

This is a core technology development in open GIS Consortium Inc (OGC's). The main aim for GIS research and development is the full integration of geospatial data and geoprocessing resources into mainstream computing and the widespread use of interoperable, commercial geoprocessing software throughout the global information infrastructure (OGC 1996). This involves the collaborative developments of interoperable geoprocessing technology.

Interoperability of GIS refer to its ability to: freely exchange all kinds of spatial information about earth and about objects and phenomena on, above and below the

earth's surface and cooperatively, over networks, run software capable of manipulating such information.

The proposed GIS by OGC was registered as open GIS and three technical issues related to open GIS are:

5.7.2 OBJECT-ORIENTATION TECHNOLOGY

Objects are the building blocks of object-oriented (OO) programs, each object is self-contained software modules includes all the commands (methods, action or function) and data (property or state) needed to do a given set of tasks. It is believed that an object approach is the ideal way to design GIS. It is discovered that in practical designing the geographic object is a very big job.

Since object technology and DCP's are still in infancy, most open GIS implementations will need not only object-oriented components, but also considerable amount of conventional structured code.

5.7.3 OPEN GIS SERVICES

The services needed include: Data management services, distributed computing platform (DCP); operating system; and hardware platform.

The technical research and development in open GIS is involved in the complex project of providing open technology for communication of geographic information between various entities which are: systems with dissimilar geo-processing software systems that employ dissimilar data format; DCP's with similar or dissimilar geo-processing systems operating in dissimilar DCP's and information communities: groups of geo-

processing software users who define geographical features in the same or different ways.

NEXT-GENERATION GIS: TECHNICAL PERSPECTIVES

The key issues identified by Goodchild (1992) important in the 1990's are: data collection and measurement, data capture, spatial statistics, data modelling and theory of spatial data, data structures, algorithms and processes, display, analytical tools , and institutional, management and ethical issues.

The next-generate GIS as acknowledged to be spatial-temporal, interoperable and intelligent to answer the scientific question that geographic information handling raises, and to pursue scientific goals us ing technology that the information system provide.

5.7.4 INTEROPERABLE GIS

The world is becoming an information society; information including geo-spatial information, is an important part of our existence, GIS can be used both, in public organizations, private companies and our daily life. Therefore the GIS of the future must adapt this need. The GIS application should be able to communicate with similar and dissimilar data structures, spatial information services and mining on multi-environment at multi-location.

It is expected interoperable GIS will shorten the spatial distance between information user and information providers, shorten the respondent time of GIS, and reduce the cost on spatial information sources.

5.7.5 FUTURE OF GIS IN HEALTHCARE

The current information society and the increasingly information -intensive environment of tomorrow's healthcare. It is argued that the role of GIS will have greater importance due to its abilities to integrate a wide range of data sources from legacy systems to image data and to make complex data more quickly and easily understood.

According to a report of GIS and health by Blom and Saavolainen - Mdntyjdrvi (Markku document Internet 2001). The possible research themes are among others:

- Environmental models and GIS for environmental epidemiology;
- Visualization, exploration and Modelling tools;
- Integration of exposure and space -time models;
- Cross-border small area epidemiological studies;
- Health potential" topography;
- Use of qualitative "soft data of perceived healt h.

EXAMPLES HAVE GIS USE IN PUBLIC HEALTH

John Snow (1854), an English Physician provided a classic example of how mapping can be used in epidemiological research. He used the mapping technology to identify the water source responsible for an outbreak of Cholera in London by locating those afflicted.

It is argued that clinical and administrative reports can be disseminated in a visual and geographical manner that can be readily understood using technologies such as ESRI Internet Map Server (IMS) technology, which enables easy accessed using an Intranet or the Internet.

It is also argued that balancing individual privacy with data accessibility has become more challenging for public health agencies.

THE BUSINESS OF HEALTH CARE GEOGRAPHICS

It is noted that private sector use of GIS has now grown substantially in the last decade. Private sector now encompasses applications in marketing and business management as well as those concerned with patient care, while taking into consideration the unique constraints u nder which the health care industry operates. Using GIS for demographic analysis to estimate the demand for various types of services is argued to benefit individual physicians. Physician specialties are more effectively marketed by locating offices near p ools of potential patients. Managed health care providers can extend this type of analysis for use.

GIS A WEALTH OF TOOLS

The new GIS technologies developed to assist in the provision of critical information for caregivers that are readily available in a v isually streamlined format, is one used by Loma Linda University Medical Centre, (one of the world's premier medical research centres) the GIS-based system called the patient location and care Environment system (PLACES), this allow caregivers see the phys ical bed location of each patient and to retrieve demographic and clinical information (ESRI 2001).

There is the BodyViewer, which is an ArcView GIS extension developed by Geo Health Incorporated, this allows users in the health care industry to analyse, v isualize, and map more than 14,000 of the International classification of Diseases Ninth Revision (ICD -9) codes that are used throughout the health care industry to index every known ailment, treatment and procedure. BodyViewer does this simple by logicall y aggregates those ICD-9 codes and display them graphically as organs and organ systems, where the

user can build a map showing where those aggregated ICD -9 codes occur geographically.

The WHO/UNICEF joint programme on health mapping (healthMap) develope d the system called HealthMapper: the system is a database management and mapping system that has been customised for public health applications at country, regional and global levels. The system contains a standardized georeferenced database of country, regional, district and subdistrict boundary maps, rivers, roads, Villages and health and social infrastructures. The system also comprises a User -friendly mapping interface and a database management interface. (WHO weekly Epidemiological Record 1999)

There also commercially available GIS products for Business Management and marketing practices for private sector healthcare companies, to improve their management practices such as: ArcView Business Analyst, BusinessMap PRO.

Systems to enhance customer service for a health care provider are available such as MapObjects IMS, which when used can show the location of services that are readily available over the web. While ArcLogistics Route improves how scheduling and optimising routes between patients deliver heal th services at home.

5.8 GEOGRAPHICAL INFORMATION SYSTEMS TECHNOLOGY TRANSFER

5.8.1 OVERVIEW

Technology transfer comes from an action taken by various stakeholders .Key stakeholders include: Developers, owners, suppliers, buyers, recipients and users of technology such as private firms state enterprises and individual consumers, financiers and donors, governments, international institutions, NGO's and community groups. Technology transfer could be between government agencies, or wholly within vertically integrated firms.

Technology flow is argues to depend on the coordination of multiple organisations such as networks, of information service providers, business consultants and financial firms. It is also argued that stakeholders need to be in partnerships am ong each other's to enable the creation of successful transfers, and Government is in position to facilitate such partnerships.

The rate of technology transfer is though to be both by motivations that includes more rapid adoption of new techniques and by b arriers that impede such transfers. These factors could be influenced by policy.

Development with modern knowledge offers many opportunities to avoid past unsustainable practices and more rapidly towards better technologies techniques and associated insist ence with developing human capacity that is knowledge, techniques and management skills; and hardware. It is expected that technology transfer, in particular from developed to developing countries, must operate on a broad front

covering those software and hardware challenges, and ideally within a framework of help in to fin new sustainable paths for economies as a whole.

Technology transfer is arguing to successfully contribute to the solution of a variety of local and global problems including environmenta l and Health. The essential elements identified for any successful technology transfer include: consumer and business awareness; access to information capacity building, investment financing, relaxation of trade barriers and a very strong regulatory framew ork. Therefore it is important t ensure that transferred technologies meet local needs and priorities.

5.8.2 ENABLING ENVIRONMENT FOR TECHNOLOGY TRANSFER

It is accepted that for successful and sustainable technologies transfer it requires a multi-facetted ena bling environment. This should include: Macroeconomic conditions, the involvement of social organisations, national institutions for technology innovation, human and institutional capacities for selecting and managing technologies, national legal institutions that reduce risk and protect intellectual property rights, codes and standards research and technology development, and the means for addressing equity issues and respecting existing property rights.

It is argued that governments can facilitate and aid in establishing an environment that promotes markets.

5.8.3 INTERNATIONAL TECHNOLOGY TRANSFER

International technology transfer has many success factors as well as problems in the process. However with a lot of planning a readiness f in the side of the supplier s and the

receivers, there should be are successful transfer. **Table 4** highlighted the success factors, success measures and the problems encountered.

5.8.4 RECOMMENDATION ON INTERNATIONAL TECHNOLOGY TRANSFER

It is important that all the parties concern that is t he suppliers; the receivers and facilitators understand the process of international transfer. This can be done by recognising the elements of the process and there effects on one another and on the outcome of transfer transactions.

Elashmawi et al (1985) recommended the following:

First step is to identify the political forces operative in the environment, they should be harnessed in favour of a technology transfer transaction to promote success.

Second step is the cultural issues that need to be identify ing to increase awareness of such factors that may help or hinder the transfer. Steps should be taken to establish effective channels of communication. Providing personnel some training in the language, behaviour and expectations of the culture to help eas e the pressures created by cultural differences could do this.

Third step is the assessment of technical issues and followed up by appropriate training, instruction and support to any party who may need it.

The supplier and receiver can then establish whet her or not the proposed transfer is in their common economic interest.

TABLE 4:

INTERNATIONAL TECHNOLOGY TRANSFER

SUCCESS FACTORS	SUCCESS MEASURES	SOURCES	PROBLI
1)The Ohio technology Transfer Organisation (OTTO) found out that a framework for strategic planning is necessary for optimal transfer. The framework helps to keep all dimensions of local or international technology transfer (ITT) activity constantly in focus	Management capabilities are available	Bailey, R. E. http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	Problems of inte technology tran into: political, c and financial
Diffusion of innovations should be within the context of communications channel, time and a social system.Five stages of innovation diffusion suggested are: awareness; persuasion, trail ; confirmation and knowledge.	The technology is state-of-the-art or a major breakthrough	Everett,M.Rogers (1983) in http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	Political barrier International Po between goverr policies &agree politics(e.g tarif Organisational I interests);Indivi interests)
Flow of information from the one who has "knowledge" to group that wishes to receive the knowledge or is targeted to receive the knowledge.	There is a definable marketable product	Everett, M. Rogers (1983);Jolly, James A., and Creighton J.W. (1977) in http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	Cultural barriers Communicating different culture vulnerability of thus miscommu form or the othe

Process of transfer model to expand paradigm in areas of infrastructure building, institutional design, and in the laws and regulations needed to facilitate targeted technology transfer at the corporate level with assistance from government.	**Government support available Available for additional development**	**Choi, Hyung Sup (1986) in bailey, R. E.http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt**	**Technical Barri sources identifi technology tran channel of trans (relevant emplo intermediaries, officials)constit & documentatic technology (Fa political and cu climate)&receiv technology(inat use technology**

SUCCESS FACTORS	SUCCESS MEASURES	SOURCES	PROBLI
Marketing function is the feedback loop essential to those involved directly with the development and final form of the technolog y - the scientists and engineers	Manufacturing is determined to be feasible	Turning R&D into real products(July 2, 1990). Fortune, pp.72-77 in http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	Financial Barrie Technology(nat &characteristic decisions on financing);Supp involved);Recei of availability a money foreign e
Early warning system be established so as to have knowledge of changes in any aspects of technology transfer before they occur	The inventor has realistic expectations for success	Rogers. M. IN Robert E. B. http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	
Establishment and maintenance of the communication links (even though can be difficult task as the technologists and non-technologists exist within the "two cultures ") this promotes optimal diffusion process.	Commercialisation skills are available	Snow, C. P.(1965) in Roberts E. B.http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	Information req become excess money and man required informa determined by i between those managing the in those using it fo
Timing is a major issue between those orchestrating the technology transfer process and those associated with the development of the technology.(especially the educational goals and strategies for shaping the human infrastructure to receive the technology must be developed for both the receiver and the sender).	The technology has immediate market uses	Roberts E. Bailey http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	Failure to carry these commerc been correlated
Costing for the transfer should be included in the cost structure and pricing analysis developed by refined marketing analysis.	There access to venture capital	Roberts E. Bailey http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	Technology eva not to be well d therefore encou of experiences transfer manag improve practic
Constant feedback after plan implementation, throughout the system very important. (as time goes on and experiences "in field" do not totally agree with the scenarios created in the final technology plan.	The inventor has realistic expectation for success	Roberts E. Bailey http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	The low succes efforts in transf , particularly fro government lab at least in large accurate predic
Product development side of the transfer process operates as a system which continually generates information that affects future action . It is necessary and advantageous that iterations on each of the stages are done.	Management capabilities are available	Roberts E. Bailey http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	No standardise evaluation of th potential of tec innovation in un federal laborato
Marketing one of the essential disciplines associated with technology transfer. Marketing process consists of four stages: analysis; planning; implementation and control. Markets a re managed in terms of: product, price, distribution policy and promotion. Seven Os describe the characteristics of markets: Occupants; Objects; Occasions, Objectives; Outlets, Organisation, and Opposition. Transfer facilitator must also keep other, uncontrollable elements in mind (culture, political, legal, technological, societal and economic environments).	The technology offers significant identifiable and quantifiable benefits		No comprehens carried out on h the technology technologies fo the so such eva
Government at both state and national levels have a growing role in quality of life, economic development and national security. Interplay between government and marketplace for technology transfer is complex and very important. Government is to balance between regulations and incentive and between the inputs of interest groups from the producer and consumer sectors of the economy.	Licensee financial support is available for development/patenting	Roberts E. Bailey http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	Technology tra significant inve country .one cri area in contem Africa is human process of tran oriented. Effect requires that re the requisite le knowledge corr of technology. W consensus indic

			effective transf "people intensiv "paper intensive
SUCCESS FACTORS	**SUCCESS MEASURES**	**SOURCES**	**PROBLI**
Culture: the study of the cultural anthropology of any targeted market is very important. The application of the basic marketing principles: know your adversary, know your audience, know your customer; is essential. Culture is constantly shaped by a set of dynamic variable language, religion, values and attitudes, technology, education and social institutions. The transfer facilitator needs both factual and interpretative knowledge.	The market is a growing one	Roberts E. Bailey http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	Culture challen effectiveness o moderated by v culture-based d receptivity to te in terms of the of the recipient failures have be different cultura
Feedback very important. Because technology transfer is indeed a highly complex process which operates with little quantitative data, considerable amounts of fuzzy subjective information and hunches, and large amount of "give and take"	The inventor is recognised and established in the field	Turning R &D into real products" (July,2, 1990). Fortune, pp. 72-77 in Roberts E. Bailey http://rclsgi.eng.ohio-state.edu/~bailey/p1-bailey.txt	Cultural arrogar by the one-size- the west. This c that African cul change. An Afri of human possil by choices, alte options
Major criteria for considering a technology are fit, fit, fit - (that is fit with the company's current markets, distribution channels, and manufacturing capability.	A positive return on investment is expected	AUTM,1994 in Heslop,L. A. McGregor and Griffith M (2001)	Argument has it some IT, such a developed coun believed that be countries were they should foc that has immed
Market research done at every stage of technology development, reducing the degree of risk in management decisions	The technology has future uses	Robertson and Weijo (1988) in Heslop,L. A. McGregor and Griffith M (2001)	
Commercialisation of a new product comprises many steps: idea generation and product definition; concept testing and diagnostic evaluation,; product development; product testing; and simulated or actual testing marketing	Royalty/licensing income expected to provide positive net present value	Dorf and Worthington,1987; Bjustrom and Smelser, 1988; Robertson and Weijo, 1988; Cooper, 1993 in Heslop,L. A. McGregor and Griffith M (2001)	In consideratio mad by some la failures. It was technology tran exception rathe
Technology sale when completed is judged by a success of technology transfer for the organisation that is the source. For the buyer success only comes after successful and profitable commercialisation and market acceptance. Today's paradigm stresses the importance of building enduring relationships with clients; the vendor should be concern with the buyer's success in order to ensure that future sales are possible.	The product/process has distinct advantages over competing products	in Heslop,L. A. McGregor and Griffith M (2001)	Using the diale inquiry system (discussed the p from the transn corporation's m transfer to deve (DC) and utilisi enthropy cycle" Jacob(1989) sh growth and stal countries deper appropriate tec
Asian countries attributed success to transfer by its ability to ensure a fit between imported technology and indigenous value systems	The technology has immediate market uses		Technology tra until the recipie corresponding t information (sol use the hardwa efficient manne
Key parameters influencing process: Awareness of existence of the appropriate technology; the format of the technology; the capacity of the user to utilise new and/or innovative ideas; the presence of informal linkers in the receiving organisation; an assessment of the reliability of the information as perceived by the receiver; and the perceived and/or actual benefit to the receiving organisation	Janis F. T. and Bibbins F. E. (1984)		Hayami and Rut distinguished a technology tran design, and cap discovered that to relocate mat technologies bu transfer capaci embodied.
To increase potential success the linker model can be use.i.e an independent third party fuctions as the linker, NGDO could be used as linkers	Janis F. T. and Bibbins F. E. (1984		African countrie necessary infra facilitate its tra its utilisation. T posited the exis technology infra

			critical element development.
SUCCESS FACTORS	**SUCCESS MEASURES**	**SOURCES**	**PROBLI**
Characteristics of successful transfer from R&D to manufacturing and receiving firms. Transfer success was accompanied by a range of people's skills and resources, including cross-functional teamwork, shared culture, intense communication, and involvement of both the scientist in the lab and management in the technology recipient organisation.	Inventor will champion as a team player	Souder and Padmanabhan (1989) and Samson and Gurdon (1993) in Heslop,L. A. McGregor and Griffith M (2001)	Sociotechnical (embodies socie facilities, and o knowledge) are the urban areas
Successful innovation requires that knowledge of all three key components of marketing, manufacturing, and R& D must be coupled.	Market readiness; Technolgy readiness; commercial readiness and Management readiness	Galbraith (1982) in Heslop,L. A. McGregor and Griffith M (2001)	Other challenge transfer to Afric rudimentary bas scientific knowl of technical ma important for na technologies ne
Personal contacts aided the technical and entrepreneurial industrial background of the founder,	The inventor is recognised and established in the field	Roberts and Hauptman (1986) in Heslop,L. A. McGregor and Griffith M (2001)	Transfer of IT r net" in the recip complex netwo proper impleme improvement of Such support is African countrie
Provision of a checklist to assess the readiness of technology for transfer	Management capabilities are available	Entingh et al. (1987) in Heslop,L. A. McGregor and Griffith M (2001)	
A checklist of "Must meet" criteria to enable in assessing whether or not to process with new products development projects	Management capabilities are available	Cooper (1993) in Heslop,L. A. McGregor and Griffith M (2001)	
Commercial readiness of technologies fall under two required measures of success: technical strength and market strength. Scientific strength includes technical framework, level of verification, and excellence of the project team. Technological strength includes commercial readiness, proprietary strength and technological durability. Commercial; strength includes market character, margin and profit potential and commercial channels.	Prospective licensees are identified; Inventor has industry contacts; The technology is state-of-art or major breakthrough; the technology is a core or platform technology.	McCullough, (1998) in Heslop,L. A. McGregor and Griffith M (2001)	
Heslop et al. Classified into four major categories the main factors that they believed affect the commercial success or failure of the new technology and its trans ferability and commercialisation: Strengths of the technology itself; market attractiveness; commercialisation avenues and management support. See attached figure of the cloverleaf Model-a technology transfer readiness assessment tool	"	Heslop,L. A. McGregor and Griffith M (2001)	
Key elements in technology evaluation for transfer should include technology effectiveness, commercial viability, supplier commitment and capability to handle the technology	Commercial skills & Management capabilities are available	Watkins (1990) in Heslop,L. A. McGregor and Griffith M (2001)	Technology trai until the recipie corresponding t information (sol use the hardwa efficient manne
Using the DMIS and influence diagramming (ID) which is a powerful device for facilitating negotiation between DC and transnational entities for technology transfer. Also used ID to illustrate how the "vicious circle" of lack of technology and underdevelopment can be transformed into a "virtuous circle" of technological development	The inventor has realistic expectations for success	Technology Atlas Team, (1987); Edoho, 1990; Georgantzas and Madu,1990; in Udo and Edoho (2000)	Hayami and Rut distinguished a technology tran design, and cap discovered that to relocate mat technologies bu transfer capaci embodied.
Given its economic vulnerability owing largely to the lack of high-level skills, the transfer of IT capacity to Africa would amount to technologically empowering the region.(benefits include shift from being mono-product economies to diversified economies; enhance the competitiveness of African countries in the	Management capabilities are available	Udo and Edoho (2000)	African countrie necessary infra facilitate its tra its utilisation. T posited the exis technology infra critical element

global economy			development.
SUCCESS FACTORS	**SUCCESS MEASURES**	**SOURCES**	**PROBLI**
Using the concept of benchmarking IT can be transferred to African countries through the joint efforts involving governments, international organisations and private sector.	Partnership and collaboration	Udo and Edoho (2000)	Sociotechnical (embodies socie facilities, and o knowledge) are the urban areas
Copying the Singapore framework. African countries should deliberately prepared itself for the new challenges posed by the Information age by developing substantial national IT capabilities	Government support	Udo and Edoho (2000)	Other challenge transfer to Afric rudimentary bas scientific knowl of technical ma important for na technologies ne
Developing countries by means of the Internet can transfer IT to remote areas by using VITA (volunteers in Technical Assistance) framework . (an effort of an NGOs which through its state-of -the-art communication systems (VITACOMM), connects people in remote locations using the Internet)	Partnership & co-operation	VITA framework (gopher://gopher.vita.org) in Udo and Edoho (2000)	Transfer of IT r net" in the recip complex netwo proper impleme improvement of Such support is African countrie

5.9 GEOGRAPHICAL INFORMATION SYSTEMS IN DEVELOPMENT PERSPECTIVE IN THE FUTURE

5.9.1 OVERVIEW

5.9.2 GIS APPLICATION RESEARCH

The quality of decision-making can be enhanced by the use of GIS in combination with technology such as the Multimedia and virtual reality. This interactive form of decision -making taps the widely recognized trend of application from an operational support system to a strategic decision support system (Crothe et al., 1994, Cornelius, 1991).

The application of GIS ranges from spatial planning of large objects to environmental health programs, with each case appearing to be unique with its various sets of underlying models and analytical tools.

5.9.3 GIS AND HEALTH RESEARCH

Research agenda proposed on GIS and Health were on methods, data and environment.

METHODS

The themes for research were automated knowledge- based surveillance system and space-time models. The first theme-knowledge based surveillance system-emphases were on the need of automated routine geographical follow-up systems for local health automation. The second theme space-time models emphasized on the need for concentration on environmental health - risk exposure models which incorporate space-time interaction factors like change of residence and daily activities for example home - to - work patterns.

Other themes suggested included modifiable-size a real clusters in accurate or missing data and confidentiality masks.

Topics proposed include among others are:

- Automated knowledge - based surveillance or monitoring system;
- Cross - fertilization between epidemiological and he alth services methodology;
- Spatially enabled analysis of masked data for public use;
- Spatial distribution of survival data, detection times;

DATA

The emphasis was on data needs, current issues of environmental and health improved methods and collaborati on issues on a basis for the research topics.

DATA NEEDS

The group identified were data needed on: Morbidity; Infections diseases; Health related behaviour; Cofounders (covariates), particularly with individual - level data; perceived health Director indicators of exposure.

Data on current issues- Identified issues included: data comparability, access constraints, and data quality and data dissemination. Data comparability has have problems with environmental factors than with Health data. Access constrai nts are centralized by confidentially factors. Data distribution dissemination included topics of Meta information provision and methods of risk communication.

International collaboration required for studies, which involve large areas, large datasets, large population sizes rare conditions and cross -border issues. Also in help

needed in the area of data harmonization and the emphasis that international projects should be carried out in a way that all partners feel involved .

Proposed research topics identified are: Comparison of environmental monitoring data; public perception of epidemiological maps; scenario studies of, for example macro economic studies and climate change; methods for dealing with uncertainty and with hard and soft variables; Relationship between accessibility, use of health services and outcomes; and health and environment decision support system.

6 CHAPTER 4

6.1 METHODS OF RESEARCH

The methods used in this Research work is by the use of secondary data retrieved from the libraries of John Rylands, IDPM, Department of Geography and also the search from the Internet.

The relevant secondary data retrieved were used in this research work.

The Topic of the Research, which is " The use of GIS and Technology Transfer by NGDO in Africa". Based on the topic, the case studies selected are based on the experiences of WHO use of GIS in development projects by the World Health Organisation in Botswana, Senegal and Morocco; and the transfer of the GIS technology to a developing Country (Malawi).

World Health Organisation (WHO) is a specialised agency of the United Nation responsible for International Health matters on Public.

This Research work intent to see how GIS is being used in development health projects in the area of community /Public health programmes.

The case studies are from countries of Senegal, Botswana, Morocco who where using GIS in their national control of tropical diseases programme. While in the case of Malawi the issue of technology Transfer was looked at.

6.2 RESEARCH METHODS USED

The methods used are the selection of relevant article from the secondary data from the library.

Retrieval of relevant articles from the Internet Search.

CHAPTER 5

6.3 CASE STUDIES I

Two case studies are considered; the cases would demonstrate the use of GIS a nd technology transfer in countries of Senegal, Botswana, Morocco and Malawi

6.3.1 GIS MANAGEMENT TOOLS FOR CONTROL OF TROPICAL DISEASES: APPLICATIONS IN BOTSWANA, SENEGAL AND MOROCCO

These are case studies of the World Health Organisation (WHO's) experiences on the use of GIS management tools with the ministries of health in Botswana, Senegal and Morocco. WHO had long integrated the geographic approach into tropical diseases control programmes (WHO 1965) while in 1989, the WHO Division of Control of Tropical Diseases in Geneva has been interested in the application of GIS (Yoon 1994) A case study on the successful use of GIS in schistosomiasis control programme on Pemba

Island (Zanzibar), alerted several health ministries to the potential use of GIS to impro ve the planning and management of control of tropical diseases (Savioli et al.1989).

WORLD HEALTH ORGANISATION (WHO) APPROACH TO GIS IMPLEMENTATION

The strategy adopted by WHO for the implementation of GIS in the developing countries is focused on the opt imal use of resources already existing within a country; its process for implementing GIS for health follows six main units:

Identification of the needs and definition of the project are;

Identification of the nation GIS resources;

Identification of the participants of the GIS project;

Choice of the hardware and software;

Definition of the required data; and

Training

After identifying the available resources the role of WHO assisted by IDRC was to support the initiatives in progress, both financially and through institutional.

THE NEEDS OF GEOGRAPHIC INFORMATION

In the health care system there is the challenge of accessing data from different sources at all levels of the system. Routine data or survey dat a are normally in large quantity. These data are often presented in the form of tables or isolated figures, reading them is usually laborious easy use for decision making (Sandiford 1992).

Specific needs for health services information vary according to t he level of decision-making. The key partners of the National disease Control services who are normally the district medical officers, the regional medical office and the officers in the central level. They must have capacity to express the needs of thei r districts and to determine its

health priorities. They are responsible for reliable data to be communicated by the clinics. Therefore these medical officers have specific needs with regard to training, increased awareness and motivation of the local heal th personnel for data collection. These needs could be categorised as: Technical skills, Marketing acceptance and Management acceptances.

The regional medical officers would need accurate and reliable data for planning, something's, the are normally consid ered as the chief co-ordinators of research project carried out by foreign institutions, providing the link between research and action. Epidemiological surveillance is considered to be an essential need for tropical diseases control programmes (Malaria, Schistosomiasis, Onchocerciasis and so on). Thes programmes must have the capacity of consistently producing updated information that should be useful in guiding field operations, that is when and where to intervene, which would be the most-effective interv entions, whether an intervention is with the limited resources available, an so on.

At the control level, the statistics and epidemiology department have responsibility for determining long-term trends, assessing specific factors and integrating data that are not directly supplied by the health services to support planning and management. It is very important that reliable and understandable information should be available to decision-makers.

THE TOOL: GIS

A GIS is a combination of hardware (computers, dig itising table, scanner, GPS (global positioning system), plotters and so on and specific software. The GIS input and output are determined by the available databases and the technical skills of the staff operating the system.

According to Nuttall et al. (2001) "the GIS is often misperceived as a sophisticated technology, requiring satellite imagery that is often inaccessible to developing countries. In reality, GIS enclose a wide range of hardware and software covering a span of affordable and technical pe rformance. This technological diversity offers great flexibility so that it can be implemented in most developing countries according to their needs.

6.3.2 IMPLIMENTATION OF GIS FOR THE CONTROL OF TROPICAL DISEASES: APPLICATIONS IN BOTSWANA, SENEGAL AND MOROCCO

It has been recorded that since, 1989, the WHO Division of control of tropical diseases in Geneva has been interested in the application of GIS (Yoon 1994). Since early 1994, GIS for health are being implemented in Botswana and Senegal with support from I DRC and a feasibility study conducted in Morocco.

6.3.3 THE CASE OF SCHISTOSOMIASIS CONTROL IN BOTSWANA

THE PROBLEM

The first infection of Schistosoma Haematobium in Botswana occurred in 1930 and transmission spread by 1978 S. Haematobium infection was prevale nt throughout the country at rates ranging from 0.6% to 14%. By 1983, a survey of primary school children in Maun revealed an 80.3% prevalence of S. Mansoni and 1.4% of S. Haematobium.
In recognition of the public health importance of Schistosomiasis, a co ntrol programme was established in 1985 in Ngamiland District with two main objectives.

To develop a public health schistosomiasis Control programme through a combined approach of mobile teams and the primary healthcare system.

To control S. Mansoni infection by reducing prevalence by at least 75% and reducing heavy infection (>100eggs/gram of faeces) by at least 90% among school children by January 1988.

The control programme was co-ordinated by a multidisciplinary National Taskforce with the involvement of multi-sector expertise to ensure sustained commitment to the goal. The Terms of reference for the taskforce were:

To develop a national plan of action for Schistosomiasis control;

To prepare a final project document for Ngamiland Schistosomiasis control; and

To carryout an annual review of operational and administrative aspects of the control programme

6.3.3.1 REASON FOR GIS USE IN BOTSWANA

Simplified data collection and analysis procedures were used. School Survey results and community survey results were collected. They were able to identify and treat adults and children. It was noticed that the prevalence of infection in all villages in Ngamiland was much lower than in the schools. However, the crucial issue, which remains to be addressed, is monitoring the trend in prevalence rate reduction in relation to changing environmental factors. GIS was seen as a tool to assist the study.

INTEGRATION OF ENVIRONMENT AND HEALTH DATA WITH GIS IN SENEGAL

In trying to control drought in Senegal, two dams were built, these dams led to ecological changes which were responsible for a severe outbreak of schistosomiasis in Richard Toll 1988.

Schistosomiasis prevalence is estimated at 60 -90% in Senegal, varying by region and all age groups equally affected. A study carried out in 1993 in the district demonstrated that the disease was spreading outward into other regions in spite of the preliminary control, which were undertaken.

6.3.4 REASON FOR GIS USE IN SENEGAL

THE MINISTRY OF Health recognised that it needed adequate control and therefore requires a deep and precise understanding of the distribution of disease according to environmental data. This focus justified the use of GIS.

The Ministry of Health project had two main objectives:

At the local level, to develop a better understanding of and policy to combat the proliferation of Schistosomiasis infection through the use of GIS;

At the national level, to utilise GIS as a tool for the integration of overall collected data (agricultural, environmental, Health and so on) and to facilitate decision - making about resources allocation

Health data were being collected in five regional districts near St. Louis and an initial training course on GIS was conducted for the releva nt staff.

6.3.5 COUNTRIES NEED FOR GIS

SENEGAL: a severe epidemic of intestinal Schistosomiasis due to Schistosoma Mansoni (Talla 1990, which occurred in the Senegal valley as a result of the Diama dam. This identified the need for monitory the course of this disease and others in space and their relationship to both environmental changes and health infrastructure.

The Ecological Monitory Centre (CSE) is the principal partner of the ministry of health. The CSE is a centre of excellence initially supported by i nternational agencies and is now independent. It is responsible to supply reference data on national resources, the monitory of indicators of environmental status, and the management of a database integrated in a GIS and the dissemination of information on the environment to planners and decision makers. Within the GIS, health project for the river valley, it is responsible for integrating the database of the ministry of Water Resources (SIGRES project: Geographic Information System for the management of wa ter Resources n Senegal) with all the other available data and transferring them to MapInfo format for Macintosh.

BOTSWANA: The development of national priorities for environmental protection identified the need to integrate the monitory of tropical diseas es within a national GIS, based on the expression of a specific need for Schistosomiasis control.

Has a national committee for mapping and remote sensing supported by a GIS users group. The group recommended that for each GIS project set up in Botswana dat a should be compatible with the ARC/INFO format (Nkambwe 1994)

The central government designated the department of surveys and land to produce a digitised map of the country at a scale of 1:250,000. The map was to comply with the defined standards and woul d be available and used by all the ministries concerned.

Training of the health staff involved in GIS was based on collaboration between the department of environmental sciences of the University of Botswana and a consultant of the ESRI, who was responsib le for a conservation programme attached with a private.

MOROCCO: the epidemiological surveillance system needs to be improved in order to facilitate the elimination of Schistosomiasis (Ministry of public Health, kingdom of Morocco 1993). Two national comm ittees were established to work in the field of GIS, which are the National Committee on Mapping and the National Committee on remote

sensing. Their task is to co-ordinate activities between the two areas of study. There is collaboration with others ministries to facilitate sustainable development in the other ministries (e.g. Ministry of Mines and Geology, Water and Forestry, Water Resources, the state Under-secretary for the Environment, the Ministry of the Interior, the Royal Police Force) In order to cope with the demand for basic data, the department of Land Conservation, Land Registry and Cartography were entrusted with the task of digitising all maps at a scale of 1:250,000. While the Royal Centre for spatial Remote Sensing, a public body working primarily in the field of remote sensing serves as the national reference centre. It is particularly well endowed with regards to equipment and it also provides training.

To ensure that the utilisation of GIS was quickly undertaken, the systems were initially confined to a limited geographic area related to priority disease/ problem in the country Some international agencies such as: UNITAR, UNDP, UNEP, FAO, World Bank has helped to set up centres of excellence in GIS, cartography and remote sensing. It is noted that these centres have trained staff and geographic databases (automated maps). These countries have formed nucleus of the national network of GIS users (Sahel and Sahara observatory 1991.

TOP MANAGEMENT INVOLVEMENT

To ensure national commitment, the initiative to set up a GIS must be taken at the higher levels of the ministry of Health (Nuttall et al. 2001). This motivates the decision-makers to swiftly perceive the potential benefits of GIS and can participate in setting up the network of collaborators, which is one of the cornerstones for the success of the projects.

In the three countries the members of the Top Management that were involved were: the permanent Secretary of the Ministry of Health in Botswana, the Director of the Health Programme in Morocco, and the Director of public Health in Senegal; they fully participated in the projects on GIS for health in their respective countries.

PRACTICAL IMPLEMENTATION AND MONITORING OF PROJECT

CENTRES OFEXCELLENCE

In the respective countries, GIS taskfor ce were entrusted with the implementation and monitoring of the project. The members belong to he division of statistics or epidemiology: epidemiologists, statisticians, computer scientists and geographers taking account of the available local manpower.

In Botswana the core group was built around the unit of epidemiology, in Senegal the leadership was taken by the director of health statistics, while in Morocco, the team was driven by geographers.

These taskforces were the preferred contact points of the na tional GIS centres of excellence. The local health services, in particular the district chief medical officers are the first suppliers of data to the system and first users. The system was designed to be implemented in phases with the initial phase in Bots wana two districts while in Senegal five districts.

CHIOCE OF HARDWARE AND SOFTWARE

Several considerations were taken into account in choosing the hardware and software to be used within the GIS projects. The first important step was that collaboration wa s emphasised to the use of GIS for health in general and for tropical diseases in particular. It was also emphasised that the GIS must remain a means of analysing information and

of making good use of what is available and preference be given in the initia l stages to equipment for visualising information rather than equipment for data input.

In these reference case study projects; three elements had been taken into account for the choice of software:

The specific needs expressed by the health sect ors;

The degree of progress reached by the country (other sectors) in GIS and the expertise of the potential partners; and

The compatibility of the software selected with other software on the market

. According to Nuttall et al. (20001), a "combination of these three criteria will often lead to a choice of software such as MapInfo (a registered trademark of Mapping Information Systems, troy, NY, USA), AtlasGIS (a trademark of strategic Mapping, Inc.), or ArcView (a registered trademark of Environmental Systems Research Institute (ESRI), Inc, Redlands, CA, USA). These software packages are discovered to permit simple mapping of the existing data and offer good compatibility with other software"

In Botswana, the ARC/INFO format was fixed a s standard for the government's GIS data. It was noticed that using the PC ARC/INFO was complex this led to the utilisation of Arc View which was discovered to be simpler. The Arc View can be used for visualising geographic data direct in the ARC/INFO form at and for attaching specific information to them. Standardisation ensures uniformity of working with the same tools by the different departments and various participants and users. Also it offers the possibility, if necessary, of switching to more powerfu l software and collaborating with research laboratories, which may wish to supplement the analysis with studies integrating satellite imagery.

DATA USED

The project in Botswana was initiated using data from exhaustive school surveys carried out by the Schistosomiasis control programme between 1986 and 1991.Simplified data collection and analysis procedures were used. The data collection forms designed according to the objectives of the programme and stored in DBF with aid of private NGO. The country uses the ARC/INFO format and has a centre of excellence with automatic maps geographic databases

In Senegal, routine data collected from health posts served as a basis for the analysis. While the Ecological Monitory Centre (CSE) supply the reference data.

While in Morocco, surveillance data from the Schistosomiasis control programme were integrated.

TRAINING

In utilising the GIS, the ability to ensure appropriate training is a key components.

In Botswana and Senegal training was provided for everyone involve d in a GIS project and adjustable to the subsequent responsibilities of each person. A large part of the training was devoted, to the practical use of the tools. Decision -makers were given shorter training, consisting of a general presentation of the con cept of GIS and of the data to be incorporated.

The potential and limitations of GIS for decision -making was emphasised, to enable them appreciate its usefulness and its limitations. Joint training for district medical officers and for members of the GIS task force ensured that everybody has the same basic knowledge.

The training were normally carried out through national centres of excellence, using geographic and epidemiological data from the area of study for the initial training external consultant were invited later, the members of the GIS taskforce take over the training.

JUSTICATION FOR GIS AS AN APPROPRIATE TOOL

Information feedback is identified to be the very key to the success of surveillance systems and it is noted to be facilitated by the util isation of Information Technology (Frerichs 1991). GIS is accepted to meet the need for feedback to the district level by enabling routinely collected data to be presented easily and attractively.

GIS is seen to provide an advantage, inasmuch as it facilit ates what Sandiford called the "ritualisation" of the interpretation of routine data (Sandiford et al 1992).

In Senegal, the GIS makes it possible to analyse routine information thus, strengthening the management information system. The lack of quality of the data in action-led information systems is noticed to be often due to their underutilisation. Thus as soon as the information is used, the errors and anomalies are rapidly corrected and improved through the feedback process, which GIS facilitates.

From the cases presented it indicates that GIS should form an integrated part of surveillance systems, as it is one of the few tools meeting the need of monitoring the distribution of a disease in space.

It is also recorded that the uses of GIS in surveillance of tropical diseases have been mentioned. For example, in Israel in 1992, the surveillance of imported malaria cases and identification of anopheles breeding sites led to the precise identification of intervention areas and thus enabled malaria transmissio n to be kept within bounds (kitron 1994). Also in South Africa (LeSueur personal Communication) the cartographic representation of geographically referenced databases of malaria control programme makes it possible to locate the high-risk areas in space and in time. While GIS was used in Guatemala to Identified communities at risk and as tools for assisting in Ivemectin distribution (Richards 1993).

CONSTRAINTS/ LIMITATION OF GIS USE

The over simplification of the handing of GIS was observed to conceal the importance of the data, and furthermore the significance and limitations of mapping. Experience has shown that the basic epidemiological concepts such as prevalence tend to be forgotten when mapping is carried out.

It is noted that the greatest risk when analysing superimposed data is the deduction of causal relationships from mapping. It is to be stressed that the simple visualisation of data under no circumstances permits the conclusion of a cause - and - effect relationship between the various phenomen a observed.

GIS makes it possible to demonstrate spatial relationships that might lead to subsequent in-depth epidemiological research (Scholten et al. 1991)

GIS in respective of its limitations, still has as an important role to play in the management of control of tropical diseases as it meets a real need in decision -making. With the GIS epidemiologists now have a means of presenting rapid and readily understandable results to the administrators (Frerichs 1991)

The decision makers needs can now be met by the very basis of the GIS to remove obstacles such as: Comparisons of the level of aggregation of data and the difficulty of sharing the information.

6.4 CASE STUDY II

6.4.1 Sustainable technology transfer under the Malawi environmental monitoring programme

The Malawi Environmental Monitory programme (MEMP) was an initiative to monitor the potential environmental impacts of increased smallholder production of burley tobacco brought about as result of the Agricultural sector Assistance Programme (ASAP) policy reforms supported by the United States Agency for International Development (USAID)

6.4.2 TECHNOLOGY TRANSFER UNDER MEMP

The technology transfer programme in Malawi followed an incremental approach for the transfer, of tools such as GIS and remote sensing. The initi al phase of the technology transfer process was technology orientation. The objectives of this were two -fold:

To establish a baseline level of technical capability that can be used to evaluate the technology.

To increase general awareness regar ding the technology and it's potential at the decision making level.

In collaboration and co-operation, a high trained technical staff and the decision makers within each of the agencies involved from the beginning to fulfil the mandates for MEMP.

Developing the technical capacities, include the exposure of a small representative group from each of the line agencies to the technology by training and workshops. As the technology has potential that are both positive and negative to ensure an informed evaluating a cadre of technicians were trained to initially assess those potentials.

The introductory training was largely analytical, conveying the principles, capabilities and limitation of the GIS and related technologies. The trainee initially developed a minimum-purpose, analytical system that assesses a specific problem within their respective agencies in contribution to MEMP.

The example would be the department of forestry (DOF) to fully georeference and automate its inventory capacity with an analytical ap plication directed toward forest biomass modelling in relation to burley production, current and future. The approached encouraged the development of local capacities and demonstrated the use of the technology for solving relevant problems. This initial fo cus of the training facilitates: a quick and useful in-house demonstration project with limited data collection; and quick development of an in-house GIS capability.

Organisational issues surrounding the GIS technology transfer were also emphasised during the training process, to make it clear that GIS as a decision support tool rather than a technical black box; this was facilitated by sensitisation programme like site visits to ensure organisational sensitising especially with the decision makers.

Provisional teams were established across the agencies that will be instrumental in fulfilling these requirements. The teams were to ensure the sharing of resources, data and information across line agencies and other government departments. They were able to assess benefits and limitations of the technologies. identify additional needs and enlist support from other interested parties. The teams were to provide the following information among others:

The operational GIS procedures needed to analyse data;

The reliability, costs and availability of the data;

The information products required by decision -makers in relation to MEMP;

The frequency these products are needed for each agency and DREA (department of Research and Environmental Affairs).

Initial training comprised of those directly participating in the training, later those teams became the basis for a broader user group committee, including decision makers.

The establishment of a national system was supported and promoted by international organisations. In keeping with the bottom-up MEMP methodology and building on its decentralised base. The proposal was to broaden and deepen the capabilities within key ministries that will allow them to routinely assess environmental conditions at the national level. The specific goals were:

Establish a national level committee to assess the use of information technologies for environmental monitoring;

Establish work groups from within line agencies that can be assign specific fact finding tasks related to establishing a na tional information system;

Broaden the decision making process that incorporates and utilises information products from the system.

To be ongoing activities are the training programme, application development and institutionalising of information technolog ies within each agency over the life of the project.

There should be continuing evolving of the system working after the initial implementation to meet changing objectives and human skills. Thus the need for continual monitoring, evaluation and support.

7 CHAPTER 6

7.1 ANALYSIS OF THE CASES

7.1.1 THE CASE OF TECHNOLOGY TRANSFER IN THE THREE CASES OF BOTSWANA, SENEGAL AND MOROCCO

In evaluating the case studies of the use of GIS in Botswana, Senegal and Morocco and the case study of MEMP.

The key success factors that were highlighted in the cases were:

Development of strategic plans for the projects;

Establishment of appropriate communication channels, time and a social system by the putting in place appropriate taskforces and committees at differen t levels.

Adequate flow of information between partners and users of GIS.

Feedback loop facilitated by the use of data and information and GIS assisted in correcting mistakes and abnormalities discovered when used.

All the cases had basic National infrast ructures for example donors already in place and training from expert contracted centres of excellence;

Appropriate support from international development agencies such as WHO, IDRC;

Adequate network activities put in place with line agencies and partners as in the case of MEMP with these departments DOF, DOW, DOM, DOS and DREA;

Government support and Top Management involvement, these enable improvement in the quality of life, economic development and National security; while management accepted and support the projects by the direct involvement of Permanent Secretary, directors etc;

Cultural gap was bridged by the use of acceptable language and the involvement and participation of staff from the line agencies;

Appropriate training was provided for all the u sers and partners for example the top management, decision-makers at various levels of operations were trained, sensitised and awareness created;

Good working relationships that is appropriate relationship management was put in place.

7.1.2 PROBLEMS /CONTRIANTS ENCOUNTERED

Not much was said about the problems encountered in the use and transfer of the GIS technology. It is observed that as WHO has been involved in many development projects they aware of the need for basic infrastructures. They insisted the benefiting country should have some basic infrastructure in place and were able to identify the appropriate partners such as the suppliers of the technology, the involvement of government officials, the appropriate training and addressing the cultural issues of language.

The limitations of GIS noticed was the over simplification of the handling of GIS which conceal the importance of data and mapping and that of greatest risk of deduction of causal relationships for mapping.

7.1.3 FUNCTIONAL STATUS OF GIS IN EPIDEMIOLOGICAL SURVEILLANCE

GIS can help perform the functions:

"Generate "thematic' maps (ranged colour maps or proportional symbol maps to denote the intensity of a mapped variable;

Allow for overlaying of different pieces of information;

Create buffer area around selected features (for example a radius of 10km around a health centre to denote a catchments area or 1km around a water point or school;

Carry out specific calculations (the proportion of the population falling within a certain radius f a health facility, school, dam etc.);

Calculate distances (for example the distance of a community to a health facility) as illustrated in ***Map 2: location of some guinea-worm endemic villages and health facilities, Mali.***

Permit a dynamic link between databases and ma ps so that updates are automatically reflected on the maps;

Permit interactive queries of information contained within the map, table or graph;

Process images such as aerial or satellite images to allow information such as temperature, rainfall, soil type s and land use to be easily integrated and spatial correlation between potential risk factors and the occurrence of disease to be determined;

Provide a range of extrapolation techniques (for example, extrapolating sentinel site surveillance to unsampled ar eas)."

USE OF GIS IN PUBLIC HEALTH

Many public health administrators, now using GIS and mapping technologies such officers include policy makers, national programme managers, statisticians, epidemiologists, regional and district medical officers . Some sample GIS applications in the public health: Determining geographical distribution and variation of diseases (prevalence, incidence); analysing spatial and longitudinal trends; mapping populations at risk. Also stratifying risk factors; assessing resource a llocation (health services, schools, water points; planning and targeting interventions; forecasting interventions; forecasting epidemics; monitoring diseases and interventions over time; researches to organize and link datasets.

7.2 CONCLUSION

It is realised that projects can fail or success due to the politics in an institution or host Country. Political leaders should involve actively from the beginning of development projects as was successfully done in the case of Senegal, Botswana, and Morocco. Digital Mapping Technology and its use in the Third World reinforce Top -down planning, while it attempts to brush aside politics of development. It is also seen as unable to

represent the diversity of knowledge and experience that is so important to current development initiatives. GIS should be seen as playing an emancipatory role (Mather19970.

An incremental approach for the establishing a GIS is expected to be useful and effective. The gradual expansion of the system gives users enough time to evaluate and accept the idea of transferring to a computerised Information System and to use such whenever they feel that they are ready to do so (Al -Ankary 1991).

GIS technology transfer should be a holistic approach which consist of measures and guidelines that improve data availability and quality, allowance to be made for better and more sustained training and guarantee the participation of local clients (Mather 19970

8 Chapter 7

8.1 RECOMMENDATION ON THE USE OF GIS IN AFRICA

8.1.1 DEVELOPMENT OF AFRICA GIS LABORATORIE

Hastings and Clark (1991) suggested the following help the development of Africa GIS Laboratories: -

Improvement in software and user interfaces -software should be user friendly but not at the expense of speedy operation.

Long-term commitments for training materials.

Continued technical input after training.

Improved collaboration with other GIS facilities .

8.1.2 PROPOSED STRATEGY FOR ORGANISATIONAL GIS SUCCESS

To minimise the "social inertia' (Keen 1981) in an organisation, it was suggested that project management technique and a development team needs to be bond together with the entire effort to develop GIS. The development of GIS needs a development strategy that allows the organisation and the people in it to adapt and evolve in parallel with the other components of the development team that is designed to maximise the effectiveness of that strategy. They went further to suggest that the best development strategy for this situation is iterative prototyping as illustrated in **Figure 4:Evolutionary systems development using prototyping and pilot systems approach [after Eason (1988)]**

8.1.3 DEVELOPMENT ORGANISATION

To implement a successful GIS in an institution, Mable (1990) identified the critical actors and summarised as follows:

System Sponsors: A high ranking institutional 'parent' of the system that by position assumes the burden of risk and political responsibility, which include: pursue of the GIS related capabilities to the goals of the organisation, provision of funds, format direction and organisational legitimacy.

Systems Analyst: Technically trained person who is an 'agent for action; to chart the course of system development and implementation: guides details of project to completion, champions users' needs, balances the technical opportunities with organisational requirements and is a skilled politician.

System Users: The organisation and individuals who use GIS to support decisions.

System Operators: the organisation that deals with daily operation and maintenance of the system and ensures continuous function.

Suppliers: the organisation responsible for the development and implementation of system. Could be private company that supplies a commercially marketed system.

Data Supplier: the organisation(s) that supplies (supply) data to the system.

An additional actor identified by Peuquet and Bacastow is:

System Mentor: to be a powerful individual (or group) outside prescribed development channels who provides guidelines concerning the organisational implication of GIS technology

8.1.4 PRACTICE OF GIS IMPLEMENTATION

The research findings tended to reinforce the Taylor's (1991) claim of the visible benefits of GIS in developing countries being marginal. Sahay and Walsham provided three specific sets of implications for the practice of GIS implementation for the future GIS projects. Which are: finding a better balance between the technical and social aspects of the project; providing continuity in project management; and the development of more comprehensive data management strategies.

8.1.5 PARTICIPATION

For the successful development, implementation and use of GIS, the typology of participation developed by Pretty (1994) could be adopted which is a “participation that ranges from passive participation at one end of the scale to the interactive participation and self-mobilisation at the other end”

8.1.6 CULTURE

An appropriate balance

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