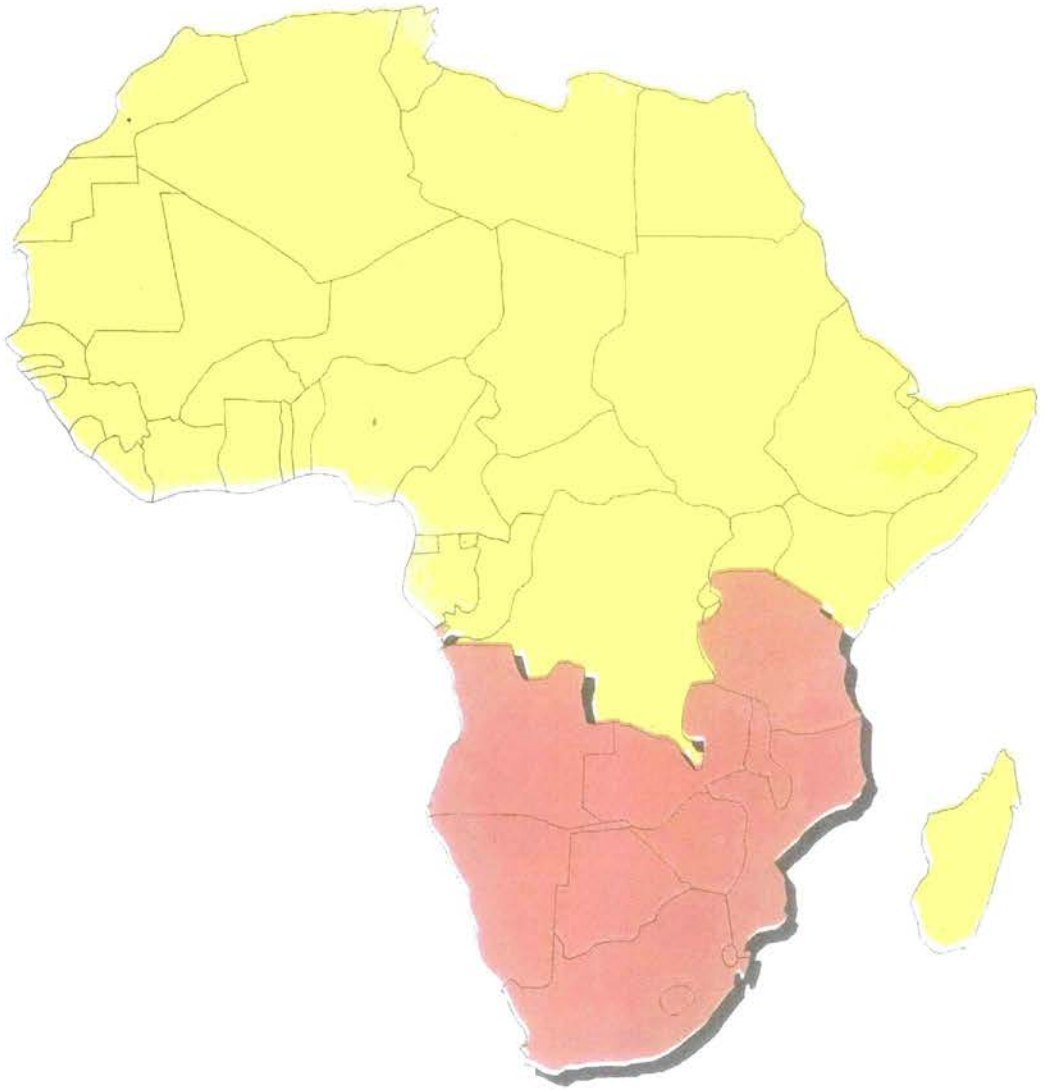
ENVIRONMENT INFORMATION SYSTEMS DEVELOPMENT IN THE SADC REGION

Third SADC Regional EIS Workshop

Gaborone, Botswana
20-23 June 1995



Organised by SADC-ELMS and the Department of Environmental Sciences, University of Botswana

Sponsored by SADC, GTZ , UNEP, WRI and USAID

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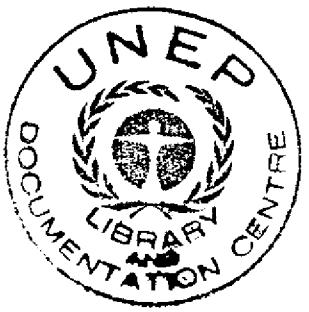

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ACRONYMS

ADS - Africa Data Sampler
DEAP - District Environmental Action Plan
DMC - Drought Monitoring Centre
DNR - Department of Natural Resources
EIS - Environmental Information Systems
ELMS - Environment and Land Management Sector
ERSI - Environment and Remote Sensing Institute
FAO - Food and Agricultural Organization
FSTAU - Food Security and Technical Administration Unit
FSTCU - Forestry Sector Technical Coordination Unit
GTZ - Deutsche Gesellschaft fur Technische Zusammenarbeit
IBM - International Business Machines
IRA - Institute of Resource Assesment
IUCN - International Union for Conservation of Nature
LIS - Land Information Systems
MEMP - Malawi Environmental Monitoring Programme
MSC - Master of Science
NamGIS - Namibian Geographical Information Systems User Group
NCRSC - National cartographic and Remote Sensing Committee
NCS - National Conservation Strategy
NCSA - National Conservation Strategy Agency
NEMC - National Environment Management Council
NRSC - National Remote Sensing Centre
RCSSMRS- Regional Centre for Services in Surveying, Mapping, and Remote Sensing
RRSP - Regional Remote Sensing Project
RS - Remote Sensing
SADC - Southern African Development Corporation
SETES - SADC/ELMS Training and Education Sub-program
UB - University of Botswana
UNAM - University of Namibia
UNEP - United Nations Environment Programme
UNSO - United Nation Sudano-Sahelian Office
USAID - United States Agency for International Development

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EXECUTIVE SUMMARY

This is a report of a workshop on: "Facilitating the Development of Environmental Information Systems (EIS) in the Southern African Development Community (SADC) Region". This workshop, which was the third in a series of regional workshops on Environmental Information Systems (EIS), was held in Gaborone, Botswana from 20th to 23rd June 1995. The Gabarone workshop was a follow up on two previous ones held in 1992 and 1994 in Harare to address strategies for promoting the development of EIS in the SADC region.

The workshop had two objectives:

i) To identify and clarify a strategy for networking in order to promote the developmentof EIS within and between the SADC member states on one hand and SADC regional programs on the other.

ii) to lay out a framework under which capacity buiding for EIS may be enhanced both in the SADC member states and at the SADC regional level.

The report presents a summary of the workshop presentations and highlights the state of EIS development in the various SADC member states and SADC regional programs represented at the workshop with respect to: goal and purpose of EIS programmes; technical set-up of the programs; training, data sources and quality; national awareness; product generation and distribution; current and expected impact of EIS programs; problems encountered and posible solutions .

An analysis of the papers presented and deliberations during the workshop shows that although most SADC counties do not have a regional view, they had made positive progress in the development of EIS. There is also a striking similarity in EIS goals and objectives within the SADC member states. The report also shows that there are a number of common problems in the development of EIS in the region. These include, but are not limited to, the following: shortage of financial resources, equipment and skills; uncertainity about institutional/ legal responsibilities leading to duplication of effort, conflicting and/or overlapping mandates and copyright issues; unharmonized training programmes; limited participation by the private sector and poor or insufficient data with unknown data gaps or standards.

Discussions after the presentations identified two key areas on which more detailed group discussions were conducted. These areas are:

i) Education and training for the development of EIS in the SADC region
ii) Networking and integration of national and regional programs;

Recommendations from the workshop were made in line with the two key areas identified above. Two sub-programs, namely Education and Training program, and Networking program , were approved as being the foundation for the development of EIS in the region.

With respect to the **Training and Education sub-program,** the workshop recommended that SADC/ELMS, UNEP and the University of Botswana (UB) should prepare a proposal for funding the development of the SADC/ELMS EIS Training and Education sub-program (SETES). The workshop further recommended that the initial work on this sub-program should start by mid-August 1995 and that the program should be ready for implementation by May/June 1996. It was also recommended that the UB in consultation with SADC/ELMS and the UNEP should create a SETES Sub-program advisory committee to guide the implementation of the sub-program.

Regarding the **Networking sub-program,** the workshop recommended that a technical contact institution for EIS be identified in each SADC member state. It was also suggested that SADC/ELMS, UNEP and the FSTAU should prepare a detailed proposal for implementing the Networking sub-program at the regional level by 15 August, 1995. Additionally, the participants implored the creation of a Networking sub-program advisory committee to advise FSTAU on setting up the Sub-program. The advisory committee, it was noted, should be made up of individuals from institutions participating in the EIS programs of SADC/ELMS.

On the relationship between the SADC EIS Program and the Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS) in Nairobi,Kenya, the delagates called for further clarification. In this regard, it was recomended that the relationship between the SADC member states and the RCRSMSC should be determined and developed as necessary by the individual member states.

In conclusion, the delegates felt that the workshop accomplished its main objectives, and agreed that there was significant information exchanged and important decisions made. On future workshops, the workshop recommended that SADC/ELMS should sponsor an annual EIS workshop to promote the collaborative development of EIS programmes in the SADC region. There was also concern expressed with regard to the method of consultation SADC/ELMS used in selecting the coordinating institutions for the two sub-programs of the SADC EIS program. The delegates, however, did not pursue this issue further but were optimistic about the progress of the program.

1. INTRODUCTION

1.1 Background

The Environment and Land Management Sector of the Southern African Development Community (SADC/ELMS) has made several attempts to promote the development of Environmental Information Systems (EIS) in the region since 1992. The first of such atempts was a SADC Regional Workshop on Geographic Information Systems (GIS) for Natural Resource Management, held in Harare, Zimbabwe, from 22 to 25 April, 1992. This conference was organized by the GEMS/GRID Africa Programme of UNEP, GTZ, IUCN, and UNITAR in collaboration with SADC/ELMS. The main aim of the workshop was to sensitize the representatives of member states and other regional programmes on the importance of GIS technology in natural resources management. The workshop recommended that the SADC/ELMS Coordinating Unit should, on behalf of SADC, take charge of the development of EIS in the region in general by:

- establishing a regional environment information network;
- developing and distributing a regional resource database;
- conducting environment information training programmes;
- building awareness of environment information systems among SADC member states.

After the Harare conference UNEP, GTZ, and SADC/ELMS formulated a mission and appointed consultants to, *inter alia*: assess the level of EIS development and networking in the SADC region, formulate a strategy for further development and draw up a project implementation strategy to develop and strengthen environment information management systems in SADC region. A second workshop entitled "Environmental Information Systems Development in the SADC Region - Assessment and Strategy for Implementing a Regional Support Program" was held, again in Harare, from 6 to 9 September, 1994. The purpose of this workshop was to review the consultants' report and agree on objectives and a final strategy to address the needs recognised therein. The workshop agreed that a SADC EIS coordination program with appropriate components should be formulated to address the needs that had been recognized. Specifically the purpose of the program would be to ensure that the products and services of the SADC EIS coordination program are consistently used by professionals and decision makers in the SADC region.

Although the September, 1994 Harare workshop recognised that the effective management of a coordination program was necessary; and that harmonization of data, provision of services

(including training), and production of the state of the environment reports were the expected results, it did not identify how the coordination program would be set up. A third SADC/ELMS workshop, the subject of this report, was called to identify and clarify a strategy for networking to promote the development of EIS within SADC member states and between SADC member states on one hamd and SADC regional programmes on the other.

1.2 Workshop Aim and Objectives

The aim of the workshop was to address those issues that were identified as requiring attention before SADC/ELMS could carry out its strategy for implementing a regional EIS program discussed at the second SADC/ELMS Workshop on EIS held in Harare in 1994.

The workshop had the following specific objectives:

a. to identify EIS program components to be conducted at the regional and national levels;

b. to clarify the responsibilities of SADC member states in the development of regional EIS programs;

c. to define a system under which EIS programs in SADC member states may receive advice on the development of their programs in order to promote compatibility in the exchange of data among countries;

d. to consider how capacity to use GIS technology may be enhanced in the region both at the member states and the SADC regional levels.

It was envisaged that by the end of the workshop SADC/ELMS would have identified methods of building a well defined framework to effect the implementation of a well defined and integrated EIS program(s). Consequently, SADC member states would also have a clear understanding of their responsibilities in the region's EIS network, and that a well formulated program for building capacity for the development of EIS would have been identified.

1.3 Organization and Format

Activities at the workshop were divided into four major sections, iteratively progressing from getting information about EIS activities in member states to making decisions on issues that were considered important to the workshop. Each of the four sections took a day to complete.

The four sections were:

a. ***Presentation of Country Reports***: On the first day, a representative from each of the SADC member states gave a brief summary of the level of development of EIS in their respective countries.

b. ***Networking proposals and examples of existing programs*:** The second section of the workshop i.e. the second day, focused on proposed networking and on providing examples of EIS-related programs at both national and regional levels.

c. ***Summary of Day 1 and Day 2 and group discussions*:** The third day marked the start of the decision-making process of the workshop. Summaries of deliberations from the first two days were made and group discussions were conducted on topics which had been identified as being important for the development of EIS in the region. Two key issues were seen to be critical. Participants were divided into two groups to discuss each in greater detail. The groups and areas of concern were:

Group 1 - Education and training for the development of EIS in the SADC region: One of the major constraints in the development of EIS in the SADC region was seen to be the unavailability of appropriate skills to use the relevant technologies for building these systems both at the national and at the regional levels. Although good programs were reported to exist or to have been planned in various ministries in the individual member states of SADC, many of the institutions of higher learning lagged behind in developing programs for education and training their nationals in the relevant technologies. Group 1 considered the specific mechanisms that would make it possible to utilize the various national and regional institutions of higher instruction and learning, and in particular the national universities, in the development of a sustainable and continuously growing capacity for using EIS. This group thus discussed measures necessary for the relisation of objective 1.2d.

Group 2 - Networking and integration of national and regional programs: The main responsibility of this group was to discuss the basic requirements for a system for exchanging information and ideas on EIS throughout the SADC region. In general this group discussed issues related to objectives 1.2a, 1.2b, and 1.2c.

d. ***Plenary session and closing ceremonies*** : The fourth and last day of the workshop was dedicated to group presentation in plenary and drawing up of recommendations and conclusions.

A detailed programme of the activities that occured at the workshop is atttached to this report as Appendix A.

1.4 Attendance

SADC/ELMS invited each of the 11 SADC member states to nominate two representatives to attend the workshop. Of the 11 SADC Member States, SADC/ELMS received official notification from 9 countries that their representatives would attend. South Africa and Angola did not respond. However, there was one participant (a facilitator) from South Africa who had wide experience and the workshop organisers took advantage of his presence to ask him to comment on the development of GIS in South Africa. Representatives from Zambia did not attend the workshop, though their names had been forwarded to SADC/ELMS two months before the workshop. Other participants came from donor agencies and other SADC programs and projects relevant to EIS development in the region. A list of all participants at the workshop is attached to this report as Appendix B.

2.0 SUMMARIES OF WORKSHOP PRESENTATIONS

2.1 Individual Country EIS Reports

2.1.1 Introduction

One representative from each of the countries represented at the workshop made a formal presentation summarizing the EIS activities in their respective countries. Specifically, the representatives had been requested to give an overview of the following issues as they related to EIS programs:

Awareness of the importance of EIS at the national level
Goal and purpose of EIS programs
Technical set up of the programs (hardware/software used, reports produced and their regularity, technical decisions at the national level etc)
Training requirements
Data sources and quality
Product generation and distribution
Current impact of EIS programs and expected impacts not yet achieved
Any outstanding problems in the development of EIS. Representatives were asked to state if there were any plans in place to try and solve these problems.

Not all representatives followed this format, and therefore some relevant information on some of the topics listed above could not be extracted from the presentations.

[*To the extent possible some of the relevant information which were lacking in the presentations but are available in the country reports have been incorporated in this chapter.*]

The papers presented are attached to this report as Appendix D.

In the following sections summaries of the papers presented at the workshop are presented.

2.1.2 Botswana

Presenter: Richard Segodi

Organization: Department of Town and Regional Planning, Ministry of Lands, Local Government and housing

National Awareness: The Government has recognized EIS as being an important tool in national development. The development of EIS is based on the Botswana National Conservation Strategy. In order to move towards the achievement of the full adoption of GIS, Botswana has undertaken a number of initiatives including awareness workshops, seminars and needs assesment studies. A countrywide consultancy assigment to assess GIS potential was completed in April 1994 and has provided the government with a clear strategy for undertaking an integrated, county-wide GIS program. The technical arrangements have just been initiated and each department is currently undertaking a detailed needs assessment and drafting of an implementation plan.

Goal and Purpose of EIS Programs: The main goal of EIS programs in Botswana has been to provide a sound basis for decision making. There has been an effort to build capabilities for collating, storing and interating environmental information to facilitate the flow of information between ministries/departments, parastatals and private organizations; and to enhance and empower organizations to undertake tasks more efficiently.

Technical Setup of Programs: The Botswana National Cartographic and Remote Sensing Committee (NCRSC) is the official body that oversees the development of EIS through its GIS Steering Sub-Committee. The NCRSC has identified the Government Computer Bureau of the Ministry of Finance and Development Planning as the coordinating body for EIS. Currently, there are many institutions that have installed GIS hardware and software such as Arc/Info, ArcCAD, IDRISI, REGIS, ILWIS, Microstation mapInfo, and AutoCAD. Several GIS installations use tape streamers. To facilitate data exchange throughout the country it was decided that PC Arc/Info should be the standard GIS package and that all other GIS software purchased by Government Departments had to compatible with PC Arc/Info.

Training: In- service training is the most commomnly used training system. In addition, vendor training has been conducted in several departments. The Department of Environmental Science, University of Botswana (UB) has played a key role in developing GIS training in the country. UB has incorporated GIS training into the undergraduate and graduate level

programs.UB has a large GIS lab and focuses its training on GIS fundamentals and student projects using country datasets.

Data Sources and Quality: Government and Non-Government Organizations have developed more than 200 GIS databases, an inventory of which is available in the GIS consultancy report stated above. The databases were compiled mainly from sources ranging in scale from 1:5000 to 1:250000. Databases compiled from large scale sources cover themes from urban and peri-urban areas while those developed from small scale sources contain information on water resources, soils, and a wide range of facilities and natural resources for the Northwest and the Central Districts. A major program on cadastral mapping is under way. Although the current quality of the data is reasonable, coordinated database management is required to ensure the proper development of the country-wide system. Currently most databases being developed are following the general standards outlined for the country in the consultancy mentioned above.

Product generation and Distribution: Botswana has not produced a State of the Environment Report but the National Conservation Strategy Agency has begun work on this and a report is expected by 1998. Current data and information exchange mechanisms between Government departments are largely informal in nature.

Impact of EIS Programs: The adoption of GIS for use in various activities has facilitated development planning and analysis , land information projects, the provision of emerengy services and network facilities management.

Problems: There are still a number of problems in developing EIS in Botswana. In particular there is duplication of effort, lack of communication, inadequate documentation of existing data, positional inaccuracy of data, inadequate data storage space and underpowered computers, incompatibility between tape back up units. Copyright issues related to electronic records and cost recovery are also of major concern.

Plans to Solve Problems: Improved communication and closer monitoring of development will reduce duplication of effort. Training programs have been intensified to enhance GIS capacity . There is a need to inventory all GIS data available and to document how these data can be accessed. Acquisition of more powerful computers through the Government Computer Bureau is also essential. A study of copyright and cost recovery issues may be necessary and may result in change of legislation and policy.

2.1.3 Lesotho

Presenter: L. V. Leotlela

Organization: Lesotho Society for Geographic Information Systems

National Awareness: The Lesotho Society for Geographical Information Systems was formed in 1992 by officers of both Government sector, Parastatals and Non-Governmental bodies to advance the the science and technique of GIS/EIS. Currently GIS is used in many government and parastatal organizations .

Goal and Purpose of EIS Programs: EIS programs are aimed at coordinating and integrating data and promoting information exchange.

Technical Setup of Programs: The following GIS sofware are curently in use: ARC/INFO, REGIS, TYDAC, SPANS, UNIGIS, and ATLAS GIS. These are used on either PC's or workstations. It has recently been decided that Infottera will serve as a national EIS exchange center.

Training: Few Basotho are currently trained in GIS/EIS at the advanced level. Since no university based training is available, in-service training is the only alternative. Overseas training costs are very high but have been considered essential.

Data Sources and Quality: EIS data has been developed from a wide range of sources including written reports, maps and data acquired from various projects. Data is mostly incomplete and their accuracy is usually questionable.

Product Generation and Distribution: Most data available for EIS comes from individual projects. There is no data exchange directory.

Impact of EIS Programs: EIS development has facilitated planning and enhanced environmental protection.

Problems: Financial constraints and lack of training are the major problems hindering the development of EIS in Lesotho. Other problems include copyright issues and lack of conformity in standards for ease of data and information exchange.

Plans to Solve Problems: Donor funding is the surest way for further development of EIS. Also expanded training programs are required.

2.1.4 Malawi

Presenter: J.A. Malunwa

Organization: Malawi Research and Environmental Monitoring Program

National Awareness: The Government recently recognized the importance of EIS and made it a major component of the Malawi Environmental Monotoring Programme.(MEMP). EIS programmes, however, are still at infancy stages and there is limited participation in EIS development by various agencies.

Goal and Purpose of EIS Programs: The goal of EIS programme is to monitor the implementation of the various policies through the analysis of spatial environmental data and to build technical and institutional capacities in the various ministries.

Technical Setup of Programs: EIS programs in Malawi are in their infancy and there is very little environmental data. The Geographic Information Systems Coordination Unit has an on-going program to conduct data collection, storage, analysis and cataloguing.

Training: In-service training is provided by Clark University. There is no other on-going training program.

Data Sources and Quality: Many thematic maps have been digitized. Rainfall data which has been collected over a long period is now ready for analysis.
Product Generation and Distribution: Data being collected will eventually be used to produce a State of the Environment Report.

Impact of EIS Programs: EIS programs provide environmental data necessary for policy making and project development in Malawi.

Problems: Lack of technical competence required for environmental monitoring has been a major hinderance to the development of EIS. Financial constraints have also made it difficult to purchase equipment.

Plans to Solve Problems: The country plans to embark on an elaborate training program for EIS. In doing this external funding will be needed.

2.1.5 Mozambique

Presenter: Abilio Inguane

Organization: Environment Information Systems Development Strategy.

National Awareness: In the past three years, there has been an increasing level of interest in the use of Geographic Information Systems (GIS) in Mozambique. This mounting interest is the result of a number of short and long term activities which have strong GIS components. These initiatives can be characterized as "on-off" exercises which generate and/or use data typically stored in a geo-referenced format.

Goal and Purpose of EIS Programs: The overall goal of EIS programs is to improve policy development and decision-making on environmental issues, and to promote monitoring and evaluation of natural resources management activities. EIS programs also aim at interlinking national, sectoral and regional databases; and strengthening institutions in spatial data management.

Technical Setup of Programs: There is no formal EIS user group. The current capacity to deal with environmental information system (including GIS) in Mozambique is quite weak. There are only a small number of operational GIS installations (12) with only experimental activities and limited information production capabilities. The capacity to absorb data and information in digital form is moderate. There is a limited number of well-trained professionals capable of generating, processing and interpreting environmental data and information in Mozambique.

Training: Considerably more effort is needed in training of local staff, design and implementation of appropriate systems and provision of adequate technical assistance.

Data Sources and Quality: There is a wide range of ARC/INFO coverages available at scales ranging from 1:250 000 to 1:1 000 000. They include river basins, game reserves, roads, irrigation suitability maps, and agro-ecological zones. Data from a few pilot projects are available at 1:10 0000. There are no data quality standards. It is therefore difficult to determine the quality of the various data sets.

Product Generation and Distribution: Mozambique has not produced a State of the Environment Report. There is no formal arrangement for distributing data. Data distribution is done on an informal basis.

Impact of EIS Programs: There is a need for environmental information and supporting materials for educational and awareness-raising purposes, and for distribution to the general public by the media or other means. It is recognized that GIS plays an increasingly important role as a tool for the integration, analysis, monitoring and presentation of environmental data and information. However, the need for traditional statistical and cartographic products does, and will for some time, persist. Since the existence of an archive of data for the country of Mozambique may be considered as very important in influencing public and private development and investment decisions, it is clearly in the general interest to encourage active orderly progress in the ways in which data on the country are collected, stored and used.

Problems: To date unrelated projects have resulted in uncoordinated efforts. This has lead to the development of data collection and storage schemes designed for exclusive purposes which render them moderately or completely incompatible.

2.1.6 Namibia

Presenter: Andre Kooiman

Organization: National Remote Sensing Center

National Awareness: Although EIS/GIS is seen as a valuable tool by a number of institutions in the country, it is not yet recognized at senior government level as being an important technology for the development of Namibia. Both policy makers and the public , however, do recognise the need for giving environmental issues the neccessary attention. The need for environmental information is high and increasing, and the role of GIS in generating this information is well appreciated and recognised. In 1991 the National Remote Sensing Center (NRSC) was established as a first step in facilitating the use of GIS and RS in Namibia at national level. Post-independence needs for improved land use and environmental planning, including urgent needs for land distribution formed the major justification for further development in several environment related departments.

Goal and Purpose of EIS Programs: The aim of EIS program is to improve policy development and decision making in environmental issues and to create an effective approach in informatiom management.

Technical Setup of Programs: A number of official bodies oversee the development of GIS/EIS. The Directorate of Environmental Affairs is responsible for the co-ordination of environmental management. The steering committe- NRSC- provides "user" input in management and priorities of NRSC activities. The Namibian GIS Users Group (namGIS) i s the informal forum for information exchange. There is a national policy but no plan of action for GIS developed by the Directorate of Data Systems of the Prime Minister's Office.

Training - The University of Namibia's (UNAM) Geography Department has planned training in GIS. Currently there are not enough opportunities in Namibia, though some short courses in GIS and RS are provided on the job.

Product Generation and Distribution: A wide range of EIS product outputs recently completed are available for distribution. These include digital maps of vegetation, and biodiversity. There are no formal arrangements for data exchange.

Impact of EIS Programs: GIS technology is appreciated and applied in studies. GIS/RS applications have made information availabe faster and cheaper to many interested parties.

Problems: Lack of digital data is a major problem. Consequently much emphasis has been put on data input (digitizing). Underestimation of effort required to set up a GIS , limited awareness and over-emphasis on technology rather than problem solving are the major factors hindering the development of EIS.

2.1.7 South Africa

Presenter: Summary written by Dave MacDevette as South African delegates did not attend the meeting. [*Note: this summary is based on the consultant's views and does not in any way represent the position of the Government of South Africa*].

Organization: CSIR

National Awareness: GIS is used actively in a number of state departments and the National Land Information System Committee has been operating for more than 5 years. There is a history of applying GIS in each of the Provinces of South Africa in a wide range of industries. In the process of change in the country and the development of new Provincial Governments, new role players have entered the government arena.

Goal and Purpose of EIS Programs: There is no formal EIS program in South Africa. Many state departments, however, have developed both GIS and EIS capacity. The National Land Information Committee coordinates Government Land Informaiton Systems . Although there is no National Environmental Action Plan or Conservation Strategy, the Reconstruction and Development Program forms the overall strategy for the development of the country. The Department of Environment Affairs is the national agency responsible for the co-ordination of environmental activities. Informal co-ordination occurs within a number of provinces through GIS working groups. There is a national information system being developed for supporting the implementation and monitoring of the RDP which may begin to play a central co-ordination role.

Technical Setup of Programs: Arc/Info and Erdas are the *de facto* standard softwares for GIS and remote sensing for the environmental management fraternity, although not all agencies use this software. ReGIS, a local GIS product is commonly used at municipal level. Government Departments and parastatals largely use Unix workstations with PC's while PC's are more common in smaller agencies in the Provinces. A wide range of GIS software including IDRISI and MapInfo are used in environmental applications. Reliable national digital networks exist between major centers and Internet access is readily available through commercial Internet suppliers.

Product Generation and Distribution: There is significant national capacity in the area of GIS but only a limited competence in EIS. GIS is used in many Government departments, provincial agencies, science councils, utilities as well as for municipal and metropolitan management and in the private sector in many fields ranging from banking to distribution. There is a significant

installed base of GIS as well as a large number of people trained in GIS. However there are still not enough experienced GIS staff for the needs.
Many provincial agencies, particularly environmental agencies recognize the need for GIS but often lack the funding for the equipment or the manpower to run the systems.

Training: Training in GIS is available from most South African Universities. The University of Cape Town (contact Mike Barry) and the University of Natal (Prof Rob Fincham) offer specific training in GIS.

Problems: There is a general lack of understanding of the nature and value of EIS. Furthermore there are no formal initiatives in this respect but attempts are being made to ensure that adequate environmental components are developed in the information systems being developed to support the RDP. There is also the problem of lack of national coordination in development of EIS. Since most of the development planning will now take place at the provincial level, attempts are being made to support coordination at that level.

Other problems facing the development of EIS in South africa are; lack of basic data required for environmental planning at the 1:50 000 scale, lack of trained staff in the provinces and limited capacity for training in EIS.

2.1.8 Swaziland

Presenter: Sabatha Qwabae

Organization: Environment Department

National Awareness: The Government supports the use of GIS, and has been willing to help relevant ministries in purchasing thenecessary systems. Government has shown its support for GIS development by proposing the formation of a GIS committee which will serve the following functions:

(1) Advise government department on the type of hardware and software to be purchased;
(2) Co-ordinate all government departments using GIS;
(3) Facilitate the exchange of data between these departments. Ministries/departments and institutions using the products of GIS greatly appreciate the system

Goal and Purpose of EIS Programs: GIS was started by FAO in 1991 as a tool for land use planning and management to help realise the country's main goal of sustainable development through the exploitation of limited natural resources.

Technical Setup of Programs: The Environment Department acts as a secretariat to the Swaziland Environment Authority which is composed of members from relevant government departments and NGO's. TheEnvironment Department is responsible for coordinating the national environmental programmes. Currently there is a National Environment Programme that forms the basis for action. The Land Use Planning Section reports to the Principal Secretary of the Ministry of Agriculture and the Geology Department. The Surveyor General's office uses UNIGIS which will form the basis for a future Land Information System (LIS). Other packages currently in use are DBMS, IDRISI, TOSCA, and IMAGE IN. IDRISI images are Raster based.

Training: GIS started with an expert from the FAO who has left. There is a major need for training of government staff, but there is no capacity for EIS or GIS training at the University of Swaziland.

Data Sources and Quality: Primary data is collected from the field on climate, land use etc. Maps are also used as a major source of data.

Product Generation and Distribution: There is a lot of climatic, land use,and agro-ecological data that has been compiled at varying temporal periods and scales. Data is exchanged at no cost among government departments, but there is no formal mechanism for the exchange of data.

Problems: Lack of funding has hampered the promotion of the use of GIS. This means that only those mininstries/ departments which have been able to raise enough funds through projects have been able to acquire the systems. The current GIS software (IDRISI) is not suitable for all the work. There is no local capacity for GIS training at the University of Swaziland. Owing to lack of sufficiently trained personel, the GIS technology is still underutilised even in those institutions having the technology.

Plans to Solve Problems: The Government is willing to help relevant ministries in purchasing the systems. The land use planning section is in the process of introducing ARC/INFO which is a better GIS tool and hopes to link the GIS system to a remote sensing facility. RS images can then be easily analysed with the IDRISI software.

2.1.9 Tanzania

Presenter: Anna T. Maembe

Organization: National Environment Management Council

National Awareness: Although EIS was started before 1990, profound coordination efforts only began in 1992. A "User Needs" survey was conducted in 1994 in order to understand what is required in terms of training, technological requirements, environmental information and management issues. Eighteen organizations are currently using GIS.

Goal and Purpose of EIS Programs: EIS programs are directed at providing simple, continuous and accessible environmental information to users (especially planners and decision makers) to support the decision making process for sustainable development.

Technical Setup of Programs: There is an EIS Technical Committee that provides advice to the National Environment Management Council (NEMC) on technical matters including GIS remote sensing, cartography, database development, statistics, documentation of systems and awareness. IBM is the most prominent hardware in use. Arc/Info and IDRISI are the most prominent software packages with SPANS, ILWIS, SYSTAN, PUMATEC, MapInfo, and AutoCAD also being used to a limited extent.

Training: There is no organized EIS training program. Most of the training occurs outside Tanzania. Some institutions, however, arrange for their employees to be trained on the job. There are very few trained cartographers as well as data analysts. The Ardhi Institute (Land Institute) has started an in-service basic GIS/data capture course. UNEP and UNITAR in collaboration with the EIS committee are organizing GIS training at the Ardhi institute.

Data Sources and Quality: A directory of organizations that have environmental information is available. The organizations are now compiling their own bibliography of in-house holdings. A documentation database is under development. Data standards have been set, e.g., forestry, soils, wildlife, etc. Abundant data is available but has not been processed. The following datasets are available in GIS format; soils [1:2000000], hydrology [scale 1:3000000], administrative boundaries [scale 1:3000000], some regional administrative boundaries, [scale 1:750,000], rainfall [scale 1:3000000], and vegetation units [scale 1:3000000].

Product Generation and Distribution: Tanzania has not produced a State of the Environment Report. Data is given out free of monetary cost. A record is kept of who gets a copy of the data. Source maps may be purchased from the Survey and Mapping Division. Efforts are underway to develop regional profiles and from these prepare a State of the Environment Report. Four (out of twenty) regions are complete.

Impact of EIS Programs: Networking and cooperation among participating government departments using EIS has increased. Demand for EIS materials even in draft form has gone up. Some donors have shown interest in funding the sub-programs after preparation of the EIS Program.

Problems: Some institutions are not open as to what they are doing and their outputs are not advertised. Use of modern technology in information management is limited and the majority of institutions tend to stick to the traditional information management skills. Conflicting and overlapping mandates of different institutions and departments make coordination and cooperation difficult. Inadequate trained personnel make it difficult to know the real information needs of various institutions. Also there is inadequate awareness and trained personnel. Exisitng information gaps make it difficult to exchange data while the lack of systems maintenance staff makes smooth running of systems impossible.

Plans to Solve Problems: There are on-going efforts to strengthen the capacity of Ardhi Institute to conduct GIS training. A GIS users group is charting out digital data exchange mechanisms. The Government is also seeking regional (SADC, UNEP, etc.) technical assistance in terms of manpower for in-house training of technicians and systems maintenance staff.

2.1.10 Zimbabwe

Presenter: Robert Mkwanda

Organization: Department of Natural Resources

National Awareness: GIS is being used by a number of government departments who have their own GIS facilities (sometimes with remote sensing facilities as well) and produce digital products. There is a commitment to the use of space sciences and the development of indigenous science and technology capacity in the management of natural resources and the environment. The Remote Sensing and GIS Sub-Committee is one of the six (6)Sub-committees of the Research Council of Zimbabwe. But although these issues are recognized formally in both policy and national structures, there is need to clearly demonstrate the cost effectiveness of GIS and related technologies to government decision makers.

Goal and Purpose of EIS Programs: The overall objective of Zimbabwe's EIS program is to coordinate all research related to environmental issues.

Technical Setup of Programs: The Ministry of Environment and Tourism, through its various agencies, has the overall responsibility for the conservation of natural resources and the development and administration of policies on environmental protection. There are also a number of other departments who actively work in the environmental arena. The Natural Resources Act gives the Ministry of Environment and Tourism, the overseer role in the management of the environment, including the development of digital environmental data. A Remote Sensing and GIS sub-committee in the Research Council of Zimbabwe spearheads the development and implementation of GIS and remote sensing technologies in the country, both from a policy and implementation point of view. Arc/Info and Erdas are the *de facto* standard software for GIS and remote sensing respectively. However many different software packages are used including INFOTERRA, MapInfo, ILWIS and IDRISI. The systems mostly run on PC's but there are a few workstations in use.

Product Generation and Distribution: Zimbabwe has a National Conservation Strategy (NCS) and District Environmental Action Plans (DEAP's) are currently being produced. In both the NCS and the DEAP's which are being implemented under the auspices of the Department of Natural resources (DNR) in the Ministry of Environment and Tourism, data requirements are being identified. DNR has recognized the need for the use of GIS for analysis and management of spatial data. Major outputs include: Digital maps which are available at a scale of 1: 1000 000, but only 12% of the country has been completed at 1:50 000 level.

DNR has developed a 1:50 000 database for the Mashonaland East province and an erosion modelling application. ERSI has also been involved in a wide range of projects.

The Surveyor General is busy developing digital standards for topocadastral mapping in the country and acquiring software and hardware for the upgrading of their facilities. These improved facilities will be used to speed up the production of digital 1:50 000 maps for the country.

Forestry vegetation mapping at a scale of 1:250 000 is being provided by the VegRis project being undertaken by the Forestry Commission. An agricultural information system capacity is being developed by Agritex to support the management and development of renewable natural resources and for monitoring of rural land use. AGRITEX is working in Gokwe district as a pilot project site. The project includes both technology and capacity development components.

The Department of Geological Survey has integrated remote sensing technologies in their operation of geological exploration and ground water identification. The output has been thematic maps. GIS technology is also being used on a project basis as an important tool in conducting environmental impact assessments.

Training: Decision makers in government departments, professional scientists, technical support staff, educational institutions and the general public are the target groups identified for EIS education and training. The University of Zimbabwe provides undergraduate programme in GIS in a number of Departments as well as a post graduate Diploma and MSC in GIS. The ERSI provides GIS and Remote sensing training on a contractual basis and has developed partnerships with ITC in order to provide a wide range of training opportunities. The Ministry of Education and Culture has introduced a satellite receiving station at one of the schools as a pilot project to test whether space technologies can form a part of the science curriculum at high school level.

Problems:

All sectors of the economy are short of professionally qualified personnel in the area of space sciences and GIS technologies. These issues are being addressed by the various initiatives reported on in the previous section.

There is a lack of thematic information on the physical environment required by planners, environmental managers etc. This includes information on soils, vegetation, hydrology and geohydrology.

Where thematic information is available it cannot easily be collated and plotted onto topographic base maps due to inherent errors in the generation of the information.

The absence of national data standards and the absence of a developed private sector industry supporting GIS and Remote Sensing technologies. These issues are being addressed in the Research Council of Zimbabwe level.

2.2 SUMMARY OF ISSUES FROM COUNTRY REPORTS

The following is a summary listing of issues and findings contained in the country reports presented during the workshop.

All SADC member states share similar goals with respect to EIS development.
All SADC member states have made positive progress in building EIS capability
There is a vast range on the development stratum
All SADC member states have instituted EIS training in some form or another, but most feel their training programs have had little impact
Most countries do not have a regional view, but realize that there would be some benefit to regional knowledge and experience
There are many common problems:

- Needed Resources
  - Training
  - Data
  - Equipment
  - Cost Recovery
- Institutional/legal
  - Conflicting/overlapping Mandates
  - Un-harmonized Training Programs
  - Duplication of Effort
  - Participation
  - Copyright
  - Cost Recovery
  - Lack of Private Sector Component
- People/human Resources
  - Lack of Qualified Professionals
  - Unskilled Staff:
  - Computer Skills

- Information Management/database
- Inability to Identify Information Needs
- Out-of-country Training
- Mobility

Technical
- Insufficient Data
- Poor Quality Data
- Lack of Standards
- Inadequate Storage Space
- Gaps in Information

Operational
- Inadequate Equipment
- Underpowered Equipment

Communication
- Inadequate
- No Exchange Standards

2.3 SUMMARIES OF REGIONAL REPORTS

2.3.1 Africa Data Sampler

Presenter: Norbert Henninger

Organization: World Resources Institute, Washington D.C.

The World Resources Institute has initiated a project - the African Data Sampler (ADS) with the aim of developing and distributing an internationally comparable set of digital maps at a scale of 1:1 million for every country in Africa. The ADS will help meet a growing demand from African organizations and donor agencies for digital and paper base maps that can be used to visualise and assess environment and development conditions of the various countries. The ADS is distributed in the ARC/INFO software format in decimal degrees. Geographical information from the ADS can therefore be used in GIS applications. The ADS contains data on drainage, topography, infrastructure, protected areas, forests, mangroves and wetlands, sub-national administrative boundaries and demographic statistics. The data will be available for all African countries and will be be released during the summer of 1995. The country diskettes - with individual country data- are available free and the CD ROM with the continental data set can be bought from the World Resources Institute. The ADS is a useful tool for education, demonstration and data viewing, and may be a good starting point for spatial analysis within SADC countries.

2.3.2 Africalink

Presenter: Dan Dworkin

Organization: US Agency for International Development, Washington D.C.

Africalink is one of a number of initiatives to assist in getting Internet into African countries. The goal of the program is to connect over 100 (but potentially hundreds of) collaborating institutions in Africa to the Internet. These connections are designed to improve networking and information sharing between African institutions, between African countries and between Africa and the rest of the world. In an earlier assessment , WRI found out that significant local electronic communication capacity already exists in Africa and that USAID, by working through local e-mail providers, can support the immediate connection of 100 collaborating institutions to the Internet at modest cost. SADC countries interested in getting Internet

connections should contact WRI to find out the status of the program in their countries and what opportunities there are for getting connected.

2.3.3 Drought Monitoring

Presenter: W. Zhakata

Organization: Drought Monitoring Center, Harare

A project on Drought Monitoring for Eastern and Southern Africa was set up with the World Meteorological Organization as the implementing agency. This project resulted in the establishment of Drought Monitoring Centers (DMC's) located in Nairobi and Harare. The DMC's are charged with the responsibility of monitoring drought in a timely manner with respect to its intensity, geographical extent, duration and impact upon agricultural production, and giving early warning for the formulation of appropriate strategies to combat its adverse effects.

Important activities include:

establishing and updating historical and near real-time regional climatological agrometeorological and hydrological data;
adapting and developing new methodologies in drought monitoring;
training member countries' personnel in drought management across the subregion;
collecting and processing of available information on the status of vegetation, crops and soil through modern facilities established at specialised center/services;
preparing and disseminating, in a regular and timely manner, relevant products and advisories on drought including its onset and cessation, its severity and extent, etc. This involves the preparation and dissemination in map form or otherwise of relevant parameters such as rainfall and temperature anomalies, drought severity indices, drought risk, moisture stress, etc; and I) identifying the trainees for short courses and attachments to DMCs, and other international institutions, e.g. Climate Analysis Center (CAC).

DMC's link to countries through the Meteorological Departments and work with a number of regional and international programs relating to climate and drought and as such will be important collaborators in the SADC EIS Program.

2.3.4 FAO/SADC R.R.S.P. in Support of Food Security

Presenter: C. van der Harten

Organization: Food Security Technical Administration Unit, Harare

This project, which is based at the Food Security Technical Administration Unit (FSTAU) in Harare, is intended to strengthen capacity in remote sensing and GIS for early warning and food security through establishment of information systems. The project has operational systems with GIS and other hardware and software and links to countries via Internet, using a server in Harare. The project provides both hardware and software as well as technical support to participating countries.

The following issues and solutions were suggested:

Training has been provided in GIS and remote sensing rather than the application of the technologies to meet the real needs. It is suggested that training programs be modified accordingly.
Few regional databases exist and where data exists it is often in incompatible formats. It is suggested that the project assist with the harmonization of data sets.
Problems of getting appropriate hardware and software. Simple, affordable and effective systems are being developed to meet country needs.
No consistent regional database for food security exists. A database will be built.

2.3.5 SADC Regional Forestry Database and proposed Information Network systems

Presenter: E. Misomali

Organization: SADC Forestry Sector Technical Coordination Unit

The mandate of the SADC Forestry Sector Technical Co-ordination Unit (SADC FSTCU) are; *inter alia* developing a data base on the region's forestry sector and facilitating the exchange of forestry information amongst SADC members. The SADC FSTCU has developed a computerised Regional Forestry Database Management System with the intent of maintaining diverse data to facilitate decision-making processes in the forestry sector in the region. The database system consists of eight data sets and represents most of the essential data requirements to facilitate region-wide planning of forestry programs, projects and activities. An information documentation center which is an integral part of the system has also been established.

In order to facilitate exchange of forestry information amongst SADC countries, SADC FSTCU has formulated a SADC-wide Forestry Information Network project. The project has two objectives; to improve the flow of information within and between SADC member countries and to provide an effective standard framework for storing, managing and reporting critical forestry information required to successfully define and implement forestry policy and programs in each SADC member state. A rim-effect networking model interconnecting the national centers with the SADC FSTCU has been chosen for the system.

2.4 ISSUES ARISING FROM THE REGIONAL PROGRAMS PRESENTATIONS

Training was identified as a major requirement in the region. In this regard it was agreed that what is needed is a broad range of training opportunities that include training for people already working and thus can only afford to be away on courses for short periods.

Regarding the WRI initiative of the African Data Sampler, it was noted that it would provide useful information to countries. However, participants felt that WRI should work more closely with the respective countries in order to generate more comprehensive data and information. Additionally, since important lessons in the production and harmonization of Africa data sets have been built up in the Data Sampler project there is need to ensure that WRI completes the compilation of information and that the information so generated is availed to African countries. Delegates also took issue with many international development agencies which had collected a lot of data sets in the region and yet such data sets are currently not available at the country level.

On networking and coordination it was reported that there are a number of initiatives designed to improve Internet access to SADC countries . In order to take full advantage of these initiatives the usefulness and cost-effectiveness of such programmes need to be clearly understood before any new similar (mostly repetitive) work is undertaken. For example, it was agreed that the SADC Food Security Program had clearly demonstrated that Internet access could be provided in the region, in the interim period, with existing facilities.Th need for better coordination within the SADC region was also echoed. Coordination, the delegates argued, could be better achieved through exisitng networks such as the Forestry Sector Networking Project.

On international linkages , the workshop participants noted that there is a need to actively link the SADC EIS program to similar programs elsewhere. These include, but are not limited to; the Program on Environmental Information Systems for Sub-Saharan Africa (the secretariat will be located in Pretoria from August 1995), the AfricaGIS initiative and the USAID/WRI EIS program, IUCN ROSA and the SARDC activities in relation to state of the environment reporting, the international core data program co-sponsored by UNEP., the Biodiversity information program hosted by the World Conservation Monitoring Center in Cambridge, the World Bank Africa Technical Department - Environment Technical Advisor and EIS team. Since a catalogue of GIS projects was produced for the AfricaGIS Conference in 1995, it would be useful to ensure that SADC countries enter their information in this database and use it to look out for opportunities for collaborative work.

The delegates also discussed issues of duplication and overlapping between EIS activities within countries and problems of donor incoordination. It was felt that issues of duplication and incoordination should be handled at regional level through and effective EIS program.

The following programs were agreed upon as being urgent and requiring regional efforts:

State of the environment reporting.
Transboundary air pollution in SADC.
Management of common water basins.
Sub-project 6 in ZAPRO 6 under the Zambezi Action Plan.

3.0. RECOMMENDATIONS

The delegates at the Third SADC/ELMS EIS Workshop agreed to the following program recommendations and executing agencies for the development of the SADC/ELMS EIS.

i) Training and Education sub-program- to be implemented by the Department of Environmental Science of the Universty of Botswana.
ii) Networking sub-program - to be implemented by the SADC Food Security and Technical Administration Unit.

In stating the recommendations, the necessary action proposals and steps emanating from the Second SADC/ELMS EIS Workshop held in Harare, 6-9 September 1994 are also elucidated.

3.1 Recommendations for the Training and Education Sub-Program

In order to establish the SADC/ELMS EIS Training and Education Sub-Program, workshop delegates make the following recommendations:

3.1.1 Training and Education recommendation 1: SADC/ELMS, UNEP and the University of Botswana to prepare a proposal for funding the development of the SADC/ELMS EIS Training and Education Sub-Program (SETES). The proposal should contain details of components, costs, and time frame for the implementation of the above sub-programs. The SADC/ELMS EIS Training and Education Sub-Program (SETES) will consist of several components.

Component 1: Assesment of training and Educational needs on all levels

This component will provide the information on what is needed, the type of programs and needs by categories with focus on training the trainers.

The needs include:

a. At Technical Level:
   - systems maintenance and networking
   - data capture skills (including documentation, library/archiving)
   - basic cartographic skills and map reading
   - data analysis
   - basic EIS/GIS/image processing skills (including data collection)
   - data quality/assurance

b. At Scientist Level
   - all of the above
   - integration and analytical capabilities
   - sector knowledge
   - database structure
   - database development
   - data management
   - output generation-design and layout for maps & reports

c. At Information Technology Specialist Level
   - Remote Sensing
   - GIS
   - EIS

d. At Decision Making Level
   - awareness raising
   - in-house demos
   - one to two days workshops

Component 2 Survey of existing Training and Educational Institutions

This component will serve to identify existing institutions and organizations providing relevant components of EIS training and education needs as identified in component 1 above.

The instituions include:

a. Colleges/ Universities/Polytechnic
b. Vendors/ Consultancies
c. Institutes
d On the job.

Other activities to be undertake are to:

a. Conduct a detailed assessment of all programs and existing capacity
b. Identify the gaps in meeting the identified needs
c. Identify resources required to fill the gaps (equipment, finance, human resources and political commitment).

Component 3 Facilitation and Design of Training and Education Programs

The University of Botswana in consultation with SADC ELMS etc.will design a program which will be reviewed by the sub-program advisory committee.
SADC ELMS would coordinate fund raising efforts.

Component 4 Evaluation and Monitoring of the Training & Education Program

This component will involve the monitoring and evaluation of the course content with modifications where appropriate, and the monitoring and evaluation of the effectiveness of the training program as a whole. The program preparation should start by mid-August 1995 and be ready for implementation by May/June 1996.

3.1.2 Training and Education recommendation 2: The University of Botswana, in consultation with SADC/ELMS and UNEP should create a Training and Education Sub-program advisory committee to advise UB in setting up the sub-program. The advisory committee should be made up of key participating training, educational and user organizations in the region.

3.2 Recommendations for the Networking Sub-Program

In order to effect the networking sub-program, the workshop delegates made the following recommendations:

3.2.1 Networking Recommendation 1: The following recommendations apply to country level initiatives:

i) Each country should identify a technical contact institution for EIS in addition to the usual SADC ELMS contact. These institutions should preferably be the institutions mandated to co-ordinate environmental activities or GIS in the country.

ii) Countries, in association with the SADC Networking Project, should develop and maintain a database of EIS/GIS contacts and activities.

iii) Countries should create either formal or informal groups relating to EIS to promote the coordination and sharing of information on EIS. These groups can provide effective mechanisms for information exchange within and between SADC countries. Informal groups in certain SADC countries have been found to be very effective in this respect.

3.2.2 Networking Recommendation 2: SADC/ELMS, UNEP, and the FSTU should prepare a detailed proposal for implementing the networking sub-program at the regional level. A proposal for funding the networking sub-program should be drafted by 15th August 1995. The proposal

should be drafted a small team chaired by SADC ELMS and consisting of representatives from UNEP, FSTAU and FSTCU. The proposal should include the following elements:

1) The need for support to countries in the establishment and maintenance of national environmental information networks.
2) A method for effectively establishing and using Internet connections for communication within and between countries.
3) Mechanisms for development and exchange of regional level databases. The databases will mostly be developed by national institutions and coordinated by the FSTAU.
4) Mechanisms for effectively working with and supporting other SADC sectors relying on environmental data.
5) Mechanisms for raising awareness of the potential use and value of EIS technologies in the development of the region.
6) Mechanisms for linking to international and global environmental and information projects in order to add value to the work of the program.

3.2.3 Networking Recommendation 3: FSTAU, in consultation with SADC/ELMS and UNEP to create a networking sub-program advisory committee to advise FSTAU in setting up the Sub-program. The advisory committee should be made up of key participating environmental institutions.

3.3 Other Workshop Recommendations

3.3.1 Other Recommendation 1: The delegates felt that the relationship between the Program and Regional Center for Services in Surveying, Mapping and Remote Sensing in Nairobi required clarification. The following recommendations were made concerning this matter.

1.1 The relationship between the countries and the Regional Center should be left to individual member states to determine.

1.2 The Regional Center is an important player in SADC and as such should be invited to the SADC EIS Workshops to actively participate in the deliberations. .

3.3.2 Other Recommendation 2: SADC/ELMS should sponsor an Annual EIS Workshop to further the collaborative development of EIS programs in the SADC region.

4.0. CONCLUSIONS

There are several ongoing EIS initiatives in the region. Most Government Departments and Universities have well-developed GIS capacity. These initiatives and existing institutional and human resource capacities should form the basis of any future work on EIS in the region. Towards this end, there is need for enhanced access to available data and information and better coordination of activities. To effect coordination, lead institutions (centres of excellence) should be identified to work with the UB and FSTAU which have been assigned the responsibility of coordinating the two program components. Capacity building will be required if the institutions so identified are to be effective.

Since most institutions lack qualified manpower to undertake EIS work, training opportunities should be explored with a view to upgrading the skills of local personnel. Local personnel who are part of on-going EIS projects need to be supported and assigned more meaningful roles. In addition they should have access and where possible they should be responsible for the safe custody of enviornmental data and information.The proposed regional sub- programs will require the continous services of advisory and technical committees drawn from lead EIS institutions and other regional programmes.

This workshop presents a useful step in the development of EIS in the SADC region. The delibarations during the workshop have served to: *inter alia* articulate the particular activities that the regional program will carry out; identify how national EIS activities will network among each other and with the regional centers and identify the most effective way to implement the EIS training and educational program.

The workshop resulted in the significant sharing of information about each SADC member state's efforts in the development of EIS in the past years. It is with great anticipation that all the stakeholders await the succcessful implementation of a coordinated EIS program in the region.

APPENDIX A

WORKSHOP PROGRAM

Tuesday June 20, 1995

0800-0900 Registration

Opening Ceremony **Chair - M. Mphati, *Ministry of Agriculture, Botswana.***

0900-0930 Opening of the workshop by Mr. R. Sebego, Deputy Minister, Ministry of Agriculture

0930-1000 Tea break

Session I - Country Reports

Morning **Chair - Bob Kakuyo, *UNEP/GEMS/PAC, Nairobi, Kenya***
Rapporteur - A. Maembe, *National Env. Council, Tanzania*

1000-1230 Country reports: Botswana, Lesotho, Malawi, Namibia

1230-1400 Lunch break

Afternoon **Chair - Bob Kakuyo, *UNEP/GEMS/PAC, Nairobi***
Rapporteur - F.M. Kalowekamo, *Ministry of Agriculture and Livestock Development, Malawi*

1400-1530 Country reports: Tanzania, Swaziland, Mozambique

1530-1545 Tea/coffee break

1545-1630 Country reports: Zimbabwe

Wednesday June 21, 1995

Session II - Examples of SADC-wide and National Programs

Morning **Chair - E. Misomali, *SADC/FSTC, Malawi***
Rapporteur I.D. Kunene, *Ministry of the Environment and Tourism, Zimbabwe.*

0830-0915	N. Henninger - AFRICA DATA SAMPLER
0915-1000	D. Dworkin - AFRICALINK
1000-1030	**Tea/coffee break**
1030-1045	W. Zhakata - The drought monitoring program
1045-1130	C. van der Harten - The Early Warning Systems/Food Security Program
1130-1215	E. Misomali - The SADC/FSTC Forestry program
1215-1400	**Lunch break**

Afternoon **Chair - C. van der Harten, *FAO/SADC Remote Sensing Program, Harare.***
Rapporteur S. Qwabe, *Ministry of Agriculture and Cooperatives, Swaziland.*

1400-1530	M. Mulalu - The GIS Program in the Ministry of Agriculture, Botswana.
1530-1545	Tea break
1545-1630	Concurrent Demonstrations on the AFRICA DATA SAMPLER, projects from the Ministry of Agriculture, Botswana, and projects from the Ministry of the Environment, Zimbabwe.

Thursday June 22, 1995

Session III - Summaries and Group Discussions

Morning **Chair, R. Segodi, *Ministry of Local Government, Lands, and Housing, Botswana***

Rapporteur, Kunene, *Ministry of the Environment and Tourism, Zimbabwe*

0830-0930 D. MacDevette, *CSIR, Pretoria* - Summary and discussion of EIS programs at the SADC national level

0930-1030 D. Healy, *Stone Environmental Inc., Burlington, Vermont* - Summary and discussion of EIS programs at the SADC regional level.

1030-1045 Tea break

1045-1230 Work Groups (about 15 people in each group).

Group discussions of major issues identified in the workshop

1230-1400 Lunch break

Afternoon **Chair - L. Thamae, *SADC/ELMS, Maseru, Lesotho***

Rapporteur R. Mkwande

1400-1530 Group reports and recommendations.

1530-1630 Tour of the University of Botswana GIS/Remote Sensing Laboratories

Friday June 23, 1995

Session IV - Conclusion

Chair - E. Misomali - *SADC/FSTU, Lilongwe, Malawi.*
Rapporteur - K. Masamvu, *FAO/SADC Remote Sensing Program, Harare.*

0900-1030	Plenary session: Discussions of summary and recommendations
1030-1100	Tea break
1100-1200	Evaluation of workshop, comments about the future, and closing ceremonies.
	D. Dworkin, *USAID/AFR/SD/PSGE, Washington D.C* - Closing remarks

APPENDIX B
LIST OF PARTICIPANTS

SADC EIS WORKSHOP, GABORONE 20 - 23 JUNE 1995 LIST OF PARTICIPANTS			
Name	**Address**	**Email**	**Telephone/fax**
Iain CLARK	Box 30170, Lilongwe, Malawi	iclark@unima.wn.apc.org	(265) 781-000/784 268
Moses CHAKANGA	Directorate of Forestry, P/Bag 13346, Windhoek, Namibia	jobs@formiu.alt.na	(061) 221478/221511 (061) 222830 fax
Raban CHANDA	University of Botswana, P/Bag 0022, Gaborone, Botswana		(267) 351151 (267) (267) 356591
Dan DWORKIN	USAID/AFR/SD/PSGE, 1111 19th St., Arlington VA 22209, USA	ddworkin@usaid.gov	(703) 235-3687 (703) 235-3805 fax
Fatima FERRAZ	GTZ, P O Box 2406, Harare, Zimbabwe		(263) 4 731049/7/5 (263 4 495628/731049 fax
David HEALY	Stone Environmental 58 East State St. Montpellier, VT 05602, USA	2007135@mcimail	802 229 4541 802 229 5417 fax
Norbert HENNINGER	World Resources Institute, 1709 New York Avenue, Washington DC 20006, USA	norbert@wri.org	202 662 2571 202 638 0036 fax
Abilio INGUANE	I.N.L.A. Maputo		

SADC EIS WORKSHOP, GABORONE 20 - 23 JUNE 1995 LIST OF PARTICIPANTS			
Name	**Address**	**Email**	**Telephone/fax**
Ruud JANSEN	IUCN, Private Bag 00300, Gaborone		
Felix M KALOWEKAMO	Box 30145, Lilongwe, Malawi		(265) 782466/782212
Faustin KALABAMU	University of Botswana, P/Bag 0022, Gaborone, Botswana		(267) 351151 (267) 356591
Bob. KAKUYO	UNEP/GEMS/PAC, Box 47074, Nairobi, Kenya	bob.kakuyo@unep.no	(254)2 623513 (254 2 623943
Peace M KENNEKAE	P O Box 502672, Gaborone, Botswana		(267) 350698
Irvin D. KUNENE	DNR CY 385 Causeway, Harare, Zimbabwe		(263) 4 705671 (263) 4 793123 fax
Andre. KOOIMAN	National Remote Testing Centre, P/BAg 13346, Windhoek, Namibia		+264 61 239047 +264 61 222830 fax
L.V. LEOTLELA	Box 7332, Maseru, Lesotho		(09266) 314324 off. (09266) 340240 res. (09266) 310060/310050 fax

SADC EIS WORKSHOP, GABORONE 20 - 23 JUNE 1995 LIST OF PARTICIPANTS			
Name	**Address**	**Email**	**Telephone/fax**
Kennedy MASAMVU	FAO/SADC Regional Remote Sensing Project, Box 3730, Harare, Zimbabwe	root@rrsp.stellar.zw	(263)4-796847/8 (263)4-795345 fax
Anna. MAEMBE	National Environment Mgt. Council, P O Box 63154, Dar-es-Salam, Tanzania		(255 051) 34603/32531 (255 051) 34603/44495
Dave MACDEVETTE	CSIR Technology for Development, P O Box 395, Pretoria 0001, RSA	dmacdev@environ.csir.co.za	(12) 8414511 (12) 8413011 fax
John A MALUNGA	MOREA, P O Box 30745, Lilongwe 3, Malawi		(265) 781111 (265) 781487
Bonsani S. MASUKU	P O Box 162, Mbabane, Swaziland		(268) 43858 (268) 44700 fax
Leonard MATLHODI	Ministry of Agriculture, P/Bag 003, Gaborone, Botswana		(267) 350675
M C MATSHEKA	Dept. of Town & Regional Planning, Ministry of Local Government & Lands, P/Bag 0042, Gaborone, Botswana	unepbot@wro.apc.org	(267) 354277/285 (267) 313280 fax
Ernest MISOMALI	SADC FSTCU, Box 30048, Lilongwe 3, Malawi	emisamali@unima.wn.apc.org	(265) 781 000 (265) 784 268 fax

SADC EIS WORKSHOP, GABORONE 20 - 23 JUNE 1995 LIST OF PARTICIPANTS			
Name	**Address**	**Email**	**Telephone/fax**
Robert MKWANDA	DNR CY 385 Causeway, Harare, Zimbabwe		(263) 4 705 671 (263) 4793123 fax
Mulalu MULALU	Ministry of Agriculture, P/BAg 003, Gaborone, Botswana		(267) 350572 (267) 356027/359934 fax
Masego MPHATHI	Ministry of Agriculture, P/Bag 003, Gaborone, Botswana		(267) 350512
Musisi NKAMBWE	Dept. of Environmental Science, University of Botswana, P/Bag 0022, Gaborone, Botswana	musisin@noka.ub.bw	(267) 351151 (267) 356591
B. OTENG	Dept. of Town & Regional Planning, Ministry of Local Government & Lands, P/Bag 0042, Gaborone, Botswana		(267) 354100
Sabatha QWABE	P O box 4253, Mbabane, Swaziland		(268) 43858 (268) 44700 fax
Reuben SEBEGO	University of Botswana, P/Bag 0022, Gaborone, Botswana	sebegorj@noka.ub.bw	(267)351151 (267) 356591 fax
Richard K. SEGODI	Department of Town & Regional Planning, Ministry of Local Government & Lands, P/BAg 0042, Gaborone, Botswana		(267) 357145 (267) 356015 fax

SADC EIS WORKSHOP, GABORONE 20 - 23 JUNE 1995 LIST OF PARTICIPANTS			
Name	**Address**	**Email**	**Telephone/fax**
R M SILITSHENA	Dept. of Environmental Science, University of Botswana, P/Bag 0022, Gaborone, Botswana		(267) 351151 (267) 356591 fax
David STIMELA	P O box 50124, Gaborone, Botswana		(267) 350698
D. TLOU	University of Botswana, P/Bag 0022, Gaborone, Botswana		(267) 351151 (267) 356591 fax
Lenka THAMAE	SADC-ELMS, P O Box 24, Maseru, Lesotho		(266) 312158 (266) 310190/310465 fax
Camille van der HARTEN	FAO/SADC Regional Remote Sensing Project, P O Box 3730, Harare, Zimbabwe	camille@fao.stellar.zw	(263)4 796847/8 (263)4 795345 fax
W. ZHAKATA	Drought Monitoring Centre (Harare), P O Box BE 150, Belvedere, Harare, Zimbabwe		(263) 4 733156 (263) 4 733156 fax

APPENDIX C

SADC NETWORK (SADNET) DESIGN

SADC Secretariat, Private Bag 0095, Gaborone, Botswana
Paper presented at the SADC Forestry Information Network Workshop, Pretoria, South Africa 16-17 May 1995

1. WHAT IS SADC NETWORK (SADCNET)?

SADCNET is an acronym for SADC Network. SADC Network is a region wide computer based network which interconnects institutions and the people of SADC. The objective of SADCNET is to provide region wide information infrastructure which will foster information exchange and ease access to existing databases in the region.

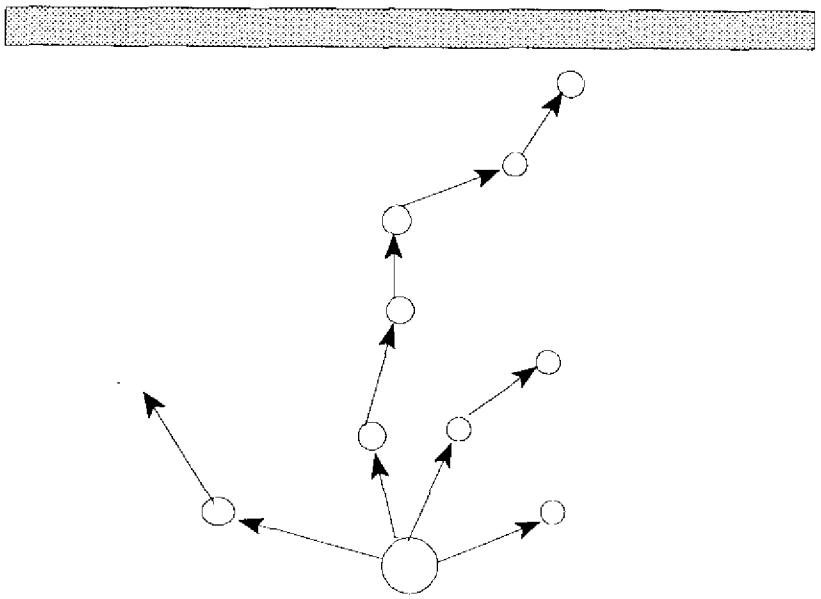
SADC principles dictate that the development of such infrastructure be sustainable and provide mutual benefit to the members of the community. The design of the SADCNET has to ensure that this principle is maintained.

2. THE DESIGN OF SADCNET

There are three levels of design for the SADCNET. These are regional, national and institutional structures. For purposes of this workshop institutional structure is called sector structure.

2.1 The Regional Structure

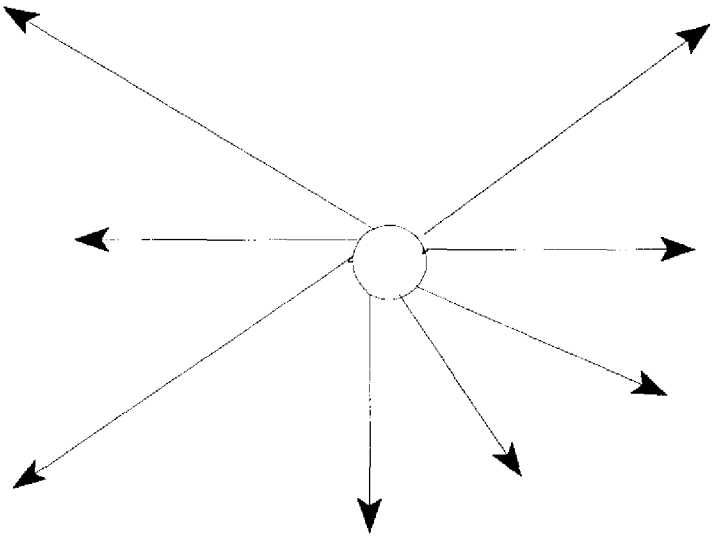
SADCNET is being developed to take advantage of existing networks in the region. Given that there exists an Internet node in South Africa, the SADCNET design may be conceived as a star topology where all Internet nodes in the rest of the SADC member states connect to South Africa. We can improve the design and include flexibilities that are possible with neighbouring countries. Depicted in Diagram 1 below is another way of looking at the Regional network topology.



2.2 The National Structure

At a National level cooperation should be sought amongst all networking enthusiasts. National Governments should take the lead or support existing private institutions and or Universities to improve the infrastructure to serve the whole country. The National plans should support or facilitate the development of a National Information Infrastructure (NII). Where such NII exist there is need to support their sustainability.

Diagram 2 below depicts National level structure.



According to geographical representation on map of Africa, Tanzania borders Malawi, Zambia and Mozambique. Tanzania could choose to connect on SADCNET through any of the three neighbouring countries.

In the diagram I assume that Tanzania connects to Malawi, Malawi to Zambia, Zambia to Zimbabwe, Zimbabwe to Botswana and Botswana to South Africa. Namibia, Swaziland and Lesotho connects directly to South Africa. Angola connects to Namibia and Mozambique connects to Swaziland.

The diagram implies that cooperation in networking can be done between two neighbouring countries depending on the cost advantages. This assumes that the neighbouring country is on Internet through other connections, for example, Angola connects to Namibia which in turn will be on Internet via South Africa.

At a national level, a national node should be selected and developed with the right infrastructure for Internet access. The national node will provide Internet service to the nation. There may be other specialised service providers should be encouraged to do so.

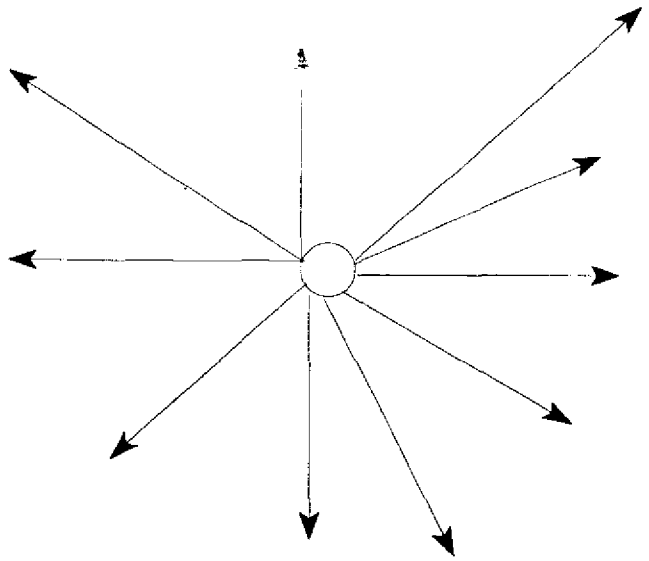
The National node shall connect all institutions, public and private, and all citizens of the country. The National node administration will devise a payment method for the service in order to sustain the national information infrastructure. Costs must not be prohibitive, but must aim at sharing the cost of the infrastructure amongst its users.

2.3 **The Sector Coordinating Unit Vs Sector Contact Point**

Every Sector Coordinating Unit is a regional body that coordinates the region in a particular sector activity, e.g. Forestry. There are 15 sectors. Some countries coordinate more than one sector. Each sector is interested in obtaining information and data from the sector contact point in each country, hence, each of the 15 sectors wishes to connect to their sector points in order to obtain the required data.

If each sector pursues its own sector networking with the SCU being central node, we will have 15 types of networks across the region resulting in unnecessary duplication of effort and unsustainable networks in the region. The advantage of cooperating at a national level is that, each country will be responsible for providing the networking and maintenance facilities. There will be enough people subscribing to the national infrastructure enabling the NII to achieve sustainable development.

Conceptually, a Sector Coordinator views its own region wide sector network as depicted in the diagram below:



Practically the SADCNET network strategy is a long term goal. Development at a National level is not going to happen at the same time. SADC Countries on the Internet Map are South Africa and Zambia. While Zambia and South Africa have Internet access the rest of the SADC member states have nodes providing E-mail facility. So what can be done in the interim as we wait for a complete SADCNET?

3. SECTOR NETWORKING

The logical representation of the Sector Networking represents the sector's view of the desired networking. In practice, though, the region can not afford to sustain sector networking. We need to converge our interest and provide affordable national facility that can serve all concerned. In this instance, the practice to be followed is for each sector to seek to connect all its sector points through the existing network node, be it for E-mail and file transfer or for on-line access to databases where possible.

The following is a list of actions we can take towards the development of national information infrastructure.

- Connect to the existing network nodes see Annex. I.
- Use E-mail to communicate information and data access the region.
- Cooperate with existing networking enthusiasts.
- Form a National Steering Committee.
- Solicit Government or Donor Support through your SADC National Information Centre (IT Contact Point) see list in Annex 2.
- Hold seminars and training workshops on networking.
- Encourage data exchange locally to develop a culture of information sharing.

4. HARDWARE AND SOFTWARE

- A machine that runs UNIX or any of the variations of UNIX Operating System. It can be a PC, a minicomputer or even a mainframe depending on the required capacity and processing power.

- The Operating System must have TCP/IP protocol for Internet access. All terminals connected to the UNIX must have a version of software running TCP/IP Protocol like Chameleon which is a commercial product. There are other free variations available.

- To have Electronic Mail you can have computers run any of the mail software like MS-Mail or cc:Mail. You need a mail server for connecting remote computers to your mail system. This solution only gives you electronic mail, text and image data file transfer facility.

5. CONCLUSIONS

SADC sees regional networking as an instrument for regional integration. It will foster collaborative research, exchange of information and access to databases will provide the necessary tools for planning and management. Information technology should provide us with a competitive advantage in management and marketing of goods and services of the region.

ANNEX 1

Directory of Some Of The Known Existing Electronic Networks in SADC Region

COUNTRY	:	Angola
ORGANISATION	:	Development Workshop
ADDRESS	:	Rua Rei Katyavala
CITY	:	Luanda
HONE	:	244-2-330-243
SYSOP	:	Allan Cain
ID	:	dwang
NODE NAME	:	angonet.gn.apc.org

COUNTRY	:	Botswana
ORGANISATION	:	University of Botswana
ADDRESS	:	ambat - acting computer -
CITY	:	Gaborone
PHONE	:	267-35-1151/35-6364
FAX	:	267-35-7573
SYSOP	:	Thula Segokgo
ID	:	segokgot
NODE NAME	:	pula.ub.bw

COUNTRY	:	Lesotho
ORGANISATION	:	National University of Lesotho
ADDRESS	:	P O Roma 180
CITY	:	Maseru
PHONE	:	266-340-610
FAX	:	340000
SYSOP	:	Lebeko Sello
ID	:	lls
NODE NAME	:	isas.nul.ls

COUNTRY	:	Malawi
ORGANISATION	:	University of Malawi
ADDRESS	:	Chancellor College
CITY	:	Zomba
PHONE	:	265-522416
SYSOP	:	Paulos Nyirenda
ID	:	Paulos Nyirenda
NODE NAME	:	fl.n7231.z5.fidonet.org

COUNTRY	:	Mozambique
ORGANISATION	:	Center Informatica, (CIUEM), University Eduardo Mondlane
ADDRESS	:	CP 257,
CITY	:	Maputo
PHONE	:	258-1-492-601/491-54
FAX	:	258-1-491-557
SYSOP	:	Venancio Massingue
ID	:	venacio
NODE NAME	:	dzowo.uem.mz
COUNTRY	:	Namibia
ORGANISATION	:	University of Namibia
ADDRESS	:	Private Bag 13301, Windhoek
TELEPHONE	:	27-61-307-2428
FAX	:	27-61-307-2286
SYSOP	:	Tim Priebe
ID	:	tim
NODE NAME	:	grumpy.unam.nl
COUNTRY	:	Swaziland
ORGANISATION	:	University of Swaziland
ADDRESS	:	P/Bag 4 Kwaluseni
CITY	:	Mbabane
PHONE	:	+268-84011 ext 211, fax: 85276
SYSOP	:	Eelco Vriezekolk
ID	:	eelco
NODE NAME	:	attic.alt.sz
COUNTRY	:	South Africa
ORGANISATION	:	SANGONET/WORKNET
ADDRESS	:	187 Bree Street, Longsbank Bldng
CITY	:	Johannesburg 2000
PHONE	:	27 11 838-6943
SYSOP	:	Simone Shall
ID	:	simone
NODE NAME	:	worknet.apc.org
COUNTRY	:	South Africa
ORGANISATION	:	UniNet
ADDRESS	:	Foundation for Research Development
CITY	:	Pretoria
PHONE	:	27 11 841 3542

FAX	:	804-2679
SYSOP	:	Vic Shaw
ID	:	vicshaw
NODE NAME	:	frd.ac.za
COUNTRY	:	Tanzania
ORGANISATION	:	COSTECH
ADDRESS	:	Council for Science and Technology, Epidemiology & Biostatistics Dept, Muhimbili Medical Centre, P O Box 65015
CITY	:	Dar es Salam
PHONE	:	255-51-26211
SYSOP	:	William Sangiwa
ID	:	bsangiwa
NODE NAME	:	hnettan.gn.apc.org
COUNTRY	:	Zambia
ORGANISATION	:	UNZA
ADDRESS	:	University of Zambia Computer Centre, Box 32379
CITY	:	Lusaka
PHONE	:	+260 1 252 507
SYSOP	:	Mark Bennett
ID	:	mbennett
NODE NAME	:	unza.gn.apc.org
COUNTRY	:	Zimbabwe
ORGANISATION	:	Mango
ADDRESS	:	PO Box 7069
CITY	:	Harare
HONE	:	+263 4 303 211 ext 1492
SYSOP	:	Rob Borland
ID	:	rborland
NODE NAME	:	mango.apc.org
COUNTRY	:	Zimbabwe
ORGANISATION	:	University of Zimbabwe
ADDRESS	:	
CITY	:	Harare
PHONE	:	+263 4 303 211 ext 1378
SYSOP	:	John Sheppard
ID	:	postmaster
NODE NAME	:	zimbix.uz.zw

Support centres for African Nodes:

GreenNet
23 Bevenden St, London, UK
PHONE +44 71-608-3040
FAX +44 71-253-0801
support @ gn.apc.org

WorkNet
13th Floor, Longsbank Building
187 Bree St. Johannesburg, SA
PHONE +27-11-838-6934
FAX +27-11-838-6310
support @ wn.apc.org

ORSTOM,
213 rue La Fayette
75010 Paris, France
PHONE +331 48037609
FAX +331 48030829
renaud @ orstom.fr

ANNEX 2

LIST OF EXISTING SADC NETWORK NODES

ANGOLA
Mr. Maria Alberto Sousa.
Director General
National Statistics Institute
CP 1215, LUANDA
Telephone: (2442) 343060 (h)
Telefax: (2442) 320430 (o)

BOTSWANA
mr. Ross Speciale
Principal Systems Analyst, Networks
Botswana Government Computer Bureau
Private bag 50, GABORONE
Telephone: (267) 351551
Telefax (267) 308646

LESOTHO
Mr. L Pamotse
Director
Bureau of Statistics
P.O. Box 455, MASERU
Telephone: (266) 323127
Telefax (266) 3100177

MALAWI
Mr. Tayemu Masiki
Controller of DP Services
Ministry of Finance
Department of Data Processing
P.O. Box 30319, Chichiri
BLANTYRE
Telephone: (265) 652441
Telefax (265) 652881

MOZAMBIQUE
Mr Venancio Mussingue
Director
Centre Informatica, University of Eduardo Mondlane
MAPUTO

Telephone: (2581) 492601
Telefax (2582) 491557

NAMIBIA
Ms N Hamutenya
Director
Information Technology management
Office of the prime Minister
P.O. Box 30819
WINDHOEK
Telephone: (26461) 2872093
Telefax

SOUTH AFRICA
** Not identified Yet **

SWAZILAND
Mr. Hlomani Mahluza
Director of Computer Services
Treasury department
P.O. Box 38
MBABANE
Telephone: (268) 45826
Telefax (268) 44240

TANZANIA
Dr. B M Mupanywa
Director of Computing Centre
University of Dar es Salaam
P.O. Box 35062
Telephone: (255-51) 43758
Telefax (255-51) 43380/43376
Telex: 41854/41561/41327

ZAMBIA
Mr Lemmy J Mukonka
Software Support Manager
Data Processing Centre
Ministry of Finance
P O Box 31998
LUSAKA
Telephone: (2601) 254162

Telefax: (2601) 250195

ZIMBABWE
Willard Chiinze
Director
Central Computing Services
Government Computer Bureau
P O Box CY704, Causeway
HARARE
Telephone: (2634) 792297
Telefax: (2634) 792820

APPENDIX D

PAPERS PRESENTED AT THE WORKSHOP

BOTSWANA COUNTRY REPORT

R. Segodi

1. INTRODUCTION

The Botswana National Conservation Strategy is the overall and comprehensive policy for the conservation of natural resources and forms a base for the development of EIS in the country. The need for EIS has been stressed in the document as a base for developing and making decisions on the environment.

Geographical Information Systems (GIS) have been given great enthusiasm since 1990 when a GIS Steering Committee was formed as a sub-committee of the National Cartographic and Remote Sensing Committee. The committee is comprised of volunteers who use GIS. Through their commitment, they have promoted the benefits gained using GIS. Also through official training programmes and individual initiatives, GIS has developed some skilled and motivated human resources.

2. GOAL AND OBJECTIVES

The overall goal of GIS is to build capabilities for collating, storing and integrating environmental information and to facilitate the flow of information between sectoral ministries/departments and parastatals and private organisations ; and to enhance and empower organisations to undertake their tasks more efficiently. Readily available information gives organisations an opportunity to plan , evaluate and make timely decision on the environment and other tasks. In order to move towards the achievement of the full adoption of GIS Botswana has undertaken a number of initiatives including awareness workshops, seminars and needs assessment studies.

3. COUNTRYWIDE GIS CONSULTANCY

Following the National GIS Workshop in 1991, the Botswana Government instituted a Nation-wide GIS Consultancy. The consultancy was instituted as a result of the recommendation of the GIS Committee and the Conference participants. The main goal of the study was to provide Government planners and decision makers with a clear understanding of the current use of GIS; its existing and potential application; the hardware, software and training requirements for establishing an integrated national GIS programme; the procedure which must be in place to address issues relating to data use, transfer, integrity, storage, accuracy and if necessary confidentiality. The underlying objective was to lay the ground work for effective implementation of an Integrated GIS programme within the Botswana government, parastatals and the private sector. The report outlines Botswana's comprehensive plan for the implementation of GIS and provides an effective stepped approach to integrating GIS components into both line ministries and parastatal organisations.

This study was carried out through a consultancy by Associates in Rural Developing Inc of Vermont, USA and was completed in April, 1994. The report made a number of recommendations including the appropriate location of a GIS coordinating agency, sectoral/departmental priorities, data development priorities, and possible GIS policies, standards and guidelines. The location of the coordination agency has been suggested and agreed as the Computer Bureau, in the Ministry of Finance and Development Planning.

The choice of Computer Bureau as compared to other departments was based on its neutrality, its experience in managing the development of Botswana Land Information System (BLIS), familiarity with information technology, computer hardware/software and data standards and as well as familiarity with legislation on information technology and information access and the mandate to network (communication) electronically and otherwise. However the Computer Bureau still faces the problem of knowledgeable manpower regarding GIS. It is believed that given the lead time it will develop the necessary capacity.

4. HARDWARE AND SOFTWARE

GIS in Botswana is currently run on Personal Computers (PC) and most of them run under MS-DOS (Microsoft Disk Operating System) with a few exceptions where the UNIX GIS system is set e.g. DTRP. Most of the computers purchased by the Computer Bureau are brand names with good technical support. Other computers purchased through other means vary considerably on quality and support.

Regarding software there is a variety of GIS and CAD software packages employed by different organisations. The common one is the CAD packages including Intergraph Microstation and Auto-CAD and . Microstation is installed at most Land Boards and Department of Surveys and Mapping. Auto CAD is also used by the utilities and most private sector surveyors. Some institution like the Botswana Power Corporation (BPC) are now using Auto-CAD for Windows which seem to be meeting their needs.

The use of PC ARC/INFO, which is used as a standard software for Botswana Geographical Information (BGIS) is gaining a wider use both at central government and local authorities. The latest version of Arc Info packages including Arc View have been installed in various locations,. Several private sector firms are also using Arc/Info in their projects.

ReGIS has been installed in several locations including the Department of Surveys and Mapping and used for the management and input of cadastral information. However Department of Surveys and Mapping is now moving towards the use of ARC/INFO.

IDRISI has been used extensively for training at the University of Botswana. It is also installed in other locations including the Department of Town and Regional Planning (DTRP), the Department of Crops and Forestry in the Ministry of Agriculture , the Department of Wildlife and National Parks (DWNP). Several pilot projects have been undertaken using IDRISI and have yielded tangible results.

MapInfo is being used at the University of Botswana for training purposes and is also installed in Wildlife Department. This particular software poses several data conversion challenges between IDRISI and PC, Arc/Info. Although these problems are easily solved at the University they may still pose problem on individual department. Prefix GIS program from France has been installed in DTRP to input data relating to Ramotswa Land Inventory Pilot Project. The experience gained from this project will be replicated in other areas by the Land Boards.

ILWIS, a raster based programme from ITC in the Netherlands is installed at the Ministry of Agriculture, in the Central District and at the University of Botswana. It is easy to learn and relatively inexpensive.

Regarding tape backup units several GIS installation use tape streamers but there is no standard for these units, thus limiting the exchange of information. However efforts in resolving this are underway but would need further assistance from those with the know-how.

The procurement of the GIS software and hardware is through two mechanisms: hte Government Computer Bureau, and through donor support. Purchasing through the Government Computer Bureau is subject to government procedures which may sometimes be laborious. The other method is through donor support which follows some more or less informal channels. These are mainly through donor funded projects, most of which remain with the host institution. This particular system can be a problem in the sense that when the technical expert leaves there may be no one to operate the system especially if proper arrangements are not made at the beginning in terms of an understudy.

5. TRAINING

Botswana considered training to be a critical component of the countrywide GIS programme at the earliest stage. Sound training could ensure confidence in personnel in conducting their work. Various training programmes have succeeded in exposing many Batswana to the concepts of GIS and its methods. Training has been advanced by many other local, regional and international programmes.
External training has covered both the short and long term training leading to higher degrees. Local training has so far focused mainly on in-service training. The University of Botswana has been very instrumental in this regard. The University has worked and continues to work in close collaboration with Government Ministries/Departments in training the employees. Another form of training is vendor training. For example, the Geographical Information Management System (GIMS) of South Africa has provided training for MLGLH staff.

The main training and research centre is the Environmental Science Department of the University of Botswana. It has incorporated GIS training in its curriculum. For example it incorporated GIS in its two year MSC programme in environmental planning. It has as a well equipped laboratory with research facilities to provide for the much needed training. The University has recently redesigned its GIS training to be more responsive to the needs of the participants. It is hoped that more people could now be trained locally at a reasonably lower costs.

Although the training progress may seem impressive there are several problems and challenges which need to be addressed. The previous and current training efforts were not well coordinated and targeted. This may be attributed to the independent nature in which GIS has evolved and lack of needs assessment before designing a programme. The net effort of all this has been that participants are sometimes sent to the not so relevant training. Duplication and repetition of courses by some participants is sometimes common due to uncoordinated curricular This duplication of courses is not only with local training courses, it is common with regional courses. Although this problem can be corrected locally, it will be important for regional institutions especially SADC to look into this matter. In addition the diverse interest of people who attend these courses is great. The training is generally open to staff with varying skilled levels, thus causing a problem to some participants who are more capable than others.

6. GIS APPLICATION

The adoption of GIS for use in various activities requires each organisation to develop a plan for the integration of GIS into its overall operation. This in most cases is never done at an early stage due to limited knowledge and procedure on how to do it. Sometimes it is better to get the knowledge and then develop the plan. Although the majority of Government Departments and a few other institutions may not have written strategies or plans, the will and enthusiasm is there. This is evident from a number of pilot projects and large scale projects that have been carried out.

The current and potential GIS activities can be classified under four major categories which include:

6.1 Development Planning and Analysis

This activity covers visual display and statistical analysis, population demographics, physical planning, economic development initiatives, health planning agricultural production and livestock management. Examples of such projects include the proposed National Atlas by Department of Surveys and Mapping. Other most important projects include The Development of Spatial Data to Store Population Statistics. The aim of the Project is to desegregate the census information into planning areas for easy use by planners. The project has just been completed and is being transferred to ArcView for easy display and use by planners. Another recently completed project is the Gaborone Central Business District (GCBG) where GIS was used to capture, analyze and display data. This project is designed as a pilot project to assist in the planning of detailed layouts for the GCBD and monitoring of the implementation of the Central Business District. It will be used as base for the future Urban Geographical Information System.

The mapping of crop production potential, an ongoing activity and part of a general land use planning project within Division of Land Utilization in the Ministry of Agriculture, is aimed at determining present land use in order to advise on improvements regarding the type of land use, efficiency of use and management systems. The result should be improved land use, the prediction of higher returns and better understanding of potential conflicts between planned land uses. Another project on Environmental Protection/Natural Resources Management includes activities such as forest inventories environmental impact assessment, mineral exploitation, species habitat determination, rainfall recording and display and water resources location and planning. Examples of project being undertaken in this area include Habitat mapping which involves the use of GIS and remote sensing technology to monitor habitat health and

change based on season, climate and utilization. Other projects include mapping of borehole locations and a National Water Master Plan in the Department of Water Affairs.

6.2 **Network Facilities Management**

This is a specialised activity that uses GIS to optimise network systems. Network activities include routing and scheduling of deliveries and smooth delivery of power, water and telecommunication services. Organisations engaged in GIS projects in this activity include the Roads Department, the Botswana Power Corporation and Water the Utilities Corporation.

6.3 **Emergency Services**

GIS technology is frequently used to help with the provision of emergency services. This relates to public safety. The Botswana Police has shown great interest in using GIS to identify areas in which there is high incidence of crime and accidents, allowing them to conduct targeted patrols.

6.4 **Land Information**

Botswana has several pilot land information projects that use GIS. Land Information forms the core GIS database used in many activities that could benefit from using GIS e.g. Land utilization, wildlife, crop production potential etc. The mapping of base features at different scales is an activity of the Department of Surveys and Mapping. The Department of Surveys and Mapping currently produces large scale, digital cadastral maps for towns and large villages.

Another important activity is land demarcation, transfer and use of rights. The DSM, DL, DTRP and Land Boards are engaged in a variety of operational experimental projects in the use of GIS. A recently completed project is the Ramotswa Land Inventory carried out by IGN Consultants of France using Prefix software. The result of the pilot project are under consideration for replication in various Land Boards throughout the country.

7. **GIS DATABASE DEVELOPMENT**

A significant amount of GIS data has been developed both by the Government and Non-Governmental Organisations. Approximately (in 1994) eight organisations developed more than 200 GIS databases. The data seem to be available for a variety of interests e.g. health, boreholes, wildlife distribution. However their utility may be limited to within the originating institutions because the standards for database development are not common to all the institutions.

Most of the GIS database development has resulted in large scale (greater than 1:5000 scale) and small scale database (1: 250 000 to 1:1 000 000 scale). Little development has been achieved in the area 1:50 000. The large scale data covers towns and large village centres. Smaller scale GIS database comprises of information on water sources, soils, wide range of utilities and natural resources and many other organisations and planning database development. These are BPC, WUC and BTC. These have a great need for detailed information on line placement, land ownership, existing buildings, road locations, contours etc.

The quality of the data is fairly reasonable especially with the base information from the Department of Surveys and Mapping. Database management is a critical step to the long term success of a country-wide GIS effort. Good coordinated database management practices and standards will allow timely access to up to date GIS data. Data management includes coordinated management procedures for GIS tiling structures and procedures for the updating of GIS data and monitoring changes over time. In the absence of formal procedures future exchange of information and updating can be very difficult. It is planned that when the coordination mechanism is in place some of these issues will be sorted out.

8. STANDARDS AND PROTOCOLS

This includes data procedures, GIS data documentation data layer naming conventions, use of projections and coordinates, feature coding schemes, security procedures etc. Several organisations have unwritten standards which they follow. The DSM, DTRP and Roads Department have some procedures and manuals that are followed. The different standards pose a problem in the exchange of information. There is a serious need for standardisation.

9. ISSUES AND CHALLENGES

Although there is a great interest in GIS, efforts are uncoordinated. This leads to duplication of efforts. The general consensus that the Government Computer Bureau should be the coordinating agency is one step in the right direction. However, a number of issues would still need to be solved.
There are issues of unknown data sources due to lack of adequate documentation which may limit users' confidence in using the data. Positional inaccuracy of much of the existing data also results from lack of quality control procedures.

For hardware and software one can make a generalization that hard disks of at least 300 MB are required for most GIS needs beyond simple desktop mapping. Many organisations already have 80486 computer which are more suitable for GIS applications. Currently the majority of the computers have 8 MB of Ram or less and are becoming inadequate where large and complex applications are required.

The lack of transferability between tape back up units severely restricts data transfer among GIS projects. There is need for a coordination in training and for each of the organizations to focus its training program to its specific needs. The University of Botswana should continue to provide both in-service and academic training.

The issue of standards and protocols is a critical one in the development of GIS. The ARD report provides a base on which common standards could be developed and agreed upon. The movement towards the use of workstation environments has profound implications on hardware and software maintenance costs, data and computer management procedures and time commitment.

One of the most important issues that seems to be overlooked in majority of cases is the issue of copyright and cost recovery. Electronic records are similar to paper records in some way and different in many others way. Copyrights will generally protect the use of government information without permission. The complication with digital data is that it is very easy to change its content and create new "original" outputs.

The creator of the original product from the digital data would now own the product, not the original owner of the data. The issue of copyrights and the creation of digital databases using government maps is a grey area. Whether individual digitizing or scanning violates government copyrights is generally unclear. The digital products that result are technically "new products".

The issue of cost recovery is also a rather difficult one. In the majority of cases in Botswana, cost recovery policies are applied where Government outputs are purchased. Its application to GIS data needs to be investigated. If Government prices the access or copies of digital data too high, the result will be that most likely it will prevent users from purchasing it. It is therefore necessary to carefully select a minimum cost recovery option which is not restrictive.

LESOTHO COUNTRY REPORT

L.V.Leotlela
Lesotho Society for Geographic Information Systems.

1. INTRODUCTION

The Lesotho Society for Geographical Information Systems was formed in 1992 by officers of both the Government sector, parastatals and non-governmental bodies.

The goal of the society is to develop GIS specialists and systems in the country and to advance the science and technique of GIS/EIS.

The objectives of its formation were:

to make people aware of the existence of the GIS technology
to promote GIS use
to exchange information both nationally, regionally and internationally and to share experiences and problems.
to disseminate knowledge and information through a medium of seminars, workshops, conferences, meetings, training and publications.

A recent achievement of the society is the success of the recent workshop/conference held in Maseru on June 14 to 16 1995 on **Planning and operations using GIS - with particular reference to map interpretation** .

2. THE GOAL AND PURPOSE OF EIS PROGRAMMES IN LESOTHO.

2.1 Coordination

At present individual organisations were collecting data as and when the need arose whereby there was duplication of efforts and data. The society is encouraging coordination of efforts to combat this problem. This will also ensure that standards are agreed prior to data collection.

2.2 Integration

One of the suspicions of the society is that data has not been collected in whole; Gaps will still be found which will need filling up. Acquiring data from one organisation may still lead to further field checks, further data gathering and updating.

2.3 Exchange

We advise that data should be kept in an easy format that can easily be exchanged/exported. A challenging question here is how to protect the copyright and to assure conformity of export standards.

Regular reporting is encouraged in the dissemination of information. This is one of the powerful sources of making people knowledgeable about our activities.

Regular technical evenings are held where people present their experiences with the GIS technology and its related fields.

3. TECHNICAL SET-UP OF PROGRAMMES.

The dominant software used in Lesotho are:
Arc/Info, ReGIS, Tydac Spans, UniGIS, and AtlasGIS. These are being run either on personal computers or workstations.

LSGIS has realised the need to have a national information exchange centre and have advised SADC-ELMS of INFOTERRA at the National University of Lesotho as a suitable place for this facility. At present hardly any environmental information circulates except for a few organisations that are legally bound by their contracts to do so.

Even though INFOTERRA is out of reach for others due to its attachment to the university which is outside Maseru where all government departments and parastatal bodies are situated; it has been deemed the best location due to its ongoing activities in research.

4. TRAINING REQUIREMENTS.

As evidenced by the EIS/GIS user survey in Lesotho of June 1995 (attachment 1) there are fewer than ten Basotho trained in GIS/EIS at the advanced level. LHDA has two while other organisations are either undergoing advanced training at the moment are still contemplating training and the choice of systems.

Most organisations have just learned of the systems after being sensitised by the recent LSGIS workshop and have felt the need for its use. Advice to them has been to start with the training prior to purchasing systems.

The other alternative for them is to call in specialists to conduct in-service training. Unfortunately experience has shown that some of the specialists especially from the donor countries have ties with their vendors and will only prescribe their vendor brands for purchase regardless of availability of support services.

It is quite a pity that our own university has not started a training programme for these systems. This will delay a national appreciation of the systems and hence impede progress in the use of GIS.

Training people in other countries involves large sums of money that are lacking in our country. Should the University of Lesotho wish to introduce courses in this field, they need to start with training trainers first or attract specialists from other countries. Replacement of these specialists may take quite a while.

5. DATA SOURCES AND QUALITY.

Most data already exists either in the form of written reports (alpha-numeric data), raster (aerial photographs), Linear (line maps particularly topographic and cadastral plans).

The accuracy cannot be guaranteed for completeness and they will need to be checked, annotated and interpreted and or coded.

6. PRODUCT GENERATION AND DISTRIBUTION.

Most projects are target-oriented. To give an example; Mafeteng Development Project develops only the Mafeteng district. LHDA environmentally is conscious about the areas of construction, the total catchments that drain into the reservoir basins while socially they look at the affected communities to maintain their standards of living above that pertaining prior to destruction by the project.

The distribution of the products cannot be traced with accuracy at the moment due to lack of an exchange directory.

7 IMPACTS OF EIS PROGRAMS.

7.1 Current impacts

7.1.1 Facilitation of planning.

In the case of LHWP the less expensive routes can be planned. These would be planned along areas that will not affect too many expensive town houses that will need replacement.

7.1.2 Environmental protection.

Areas of endangered rare flora and fauna can be are identified mapped and protected. The maps of these areas are classified information and not made available to the public.

7.2 Expected impacts not yet achieved

The society is not aware of these at present.

8. OUTSTANDING PROBLEMS IN THE DEVELOPMENT OF EIS

8.1 Problems

8.1.1 Financial constraints

Most institutions in Lesotho cannot at present afford the costs of both the hardware and the software. Being a new technology, people qualified in this field will ask for high salaries resulting in the exodus to the neighbouring country which affords salaries commensurate with the level of education

8.1.2 Lack of training

This is an the greatest impediment. Only a few Basotho have been trained in GIS to the advanced level. The technical cadre is not flooded yet with expertise The National University which is the highest institute of learning in Lesotho has not yet prepared a curriculum for this programme.

8.2 **Plans to Solve the Problems**

8.2.1 Financial

For some institutes/organisations proposals have already been prepared for possible donor funding.

8.2.2 Training

Most organisations are committed to training their staff before the end of 1995 at different levels of the system.

LHDA has been offering in-service training to others at no cost.

LSGIS has made quite a lot of people and organisations aware of the systems in the recent workshop/conference.

9. **SUMMARY**

Even though Lesotho still feel less developed in the GIS/EIS field our pace of development is quite promising and we estimate that by the year 2000 the systems will be fully in place and that training will be at the highest level. We also believe that data exchange will be at the regional level.

ATTACHMENT A

EIS/GIS USER SURVEY IN LESOTHO - June 1995

L.V. Leotlela. LSGIS

1. **INTRODUCTION**

The following gives a broad view of the GIS/LIS/EIS needs in Lesotho as of June 1995. The information was collected at the national GIS workshop/conference held in Maseru between 14th and 15th June 1995.

All responses were grouped for departments or institutions.

1.1 **The Ministry of Education**

In 1993 MoE, Planning unit engaged a private GIS specialist to recommend and implement a GIS and to undertake a full survey and location mapping of primary schools. The choice of systems was made between MapInfo, ReGIS and Tydac Spans. The latter was chosen for its user friendliness, stability and sophisticated modelling analyses facility. It was felt that with Lesotho's distance from support services, the system chosen should be easy to operate and stable.

The ministry has digitised constituency and enumeration areas for Lesotho in preparation for the analysis of 1986 census data. This data is not yet ready and does not allow transfer to Fox Pro (Dbase format).

It requires a contour map at 100m or less for modelling. The modelling has not yet started due to funding limitations.

The computer operator is being trained in-house for GIS operations. She lacks formal GIS training. She has digitised data for more than a year and is fairly competent in this operation.

The ministry requires information about the state of Primary School Education and the location of schools.

Annual statistical return forms are sent to officially registered schools in Lesotho. With the varying response; the ministry felt the need for a field survey to collect data.

The ministry is also aware of unregistered schools but has no idea of their numbers.

The ministry knows very little about their schools, the pupil number to the school buildings and food availability.

Data collection took 8 months with timing being constrained by the daily closing times and the term closures.

During data entry the lists were checked against the number of known schools and against their mapping and for errors. A survey was later carried out for missed data in order to complete the data base.
Shortage of and lack of trained staff restricted the timeous finish.

The ministry intends to use the census in the modelling of new schools.

The following maps have been produced from the data:
- Location of schools
- Frequency of parent/teacher meetings.

There is an intention to perform overlay and buffer operations, to analyze school locations and their causes, the student pass rates and causes of better feeding schemes.

The ministry operates a school building programme and the locations of these schools should be known.

2. The National University of Lesotho

The university has not yet installed any GIS/LIS. It has, however had one member trained in IDRISI, ATLAS DRAW/ATLAS GIS and Autocad. They intend having two members of staff trained in GIS both

for basic and advanced courses in 1995/96. The University will require the system for educational training purposes. There is no mention yet when they will acquire the system.

The university has lots of publications due to ongoing research and has a very high potential for EIS. The LSGIS has recommended that INFOTERRA at the institute of EDUCATION be earmarked for the National Information Exchange centre.

3. The Lesotho Highlands Development Authority

With the assistance of UNEP in Nairobi, the LHDA installed PC and workstation Arc/Info in 1990. Arc/View awaits installation. The system is used in Natural Resource Management and Planning.

Projects have been undertaken in water quality, biological diversity, alternative powerline routing, reservoir impacts and various LHWP mapping which include project areas to be gazetted, areas to be protected etc.

The LHDA through its GIS officer helps offer on the job training to officers of other departments at no cost to them.

Two officers have been trained at advanced level and one at the basic level. There is still a need to train four more in basics, three at intermediate and one at advanced level between 1995 and 1997.

Nine officers have been trained in Autocad to date.

Financial constraints are still experienced in financing both the human resources and the Hard/software. A project paper has been drawn and forwarded to the EEC delegate in Lesotho for strengthening of the GIS unit in LHDA both in hardware/software and staff development.

4. The Department of Roads.

The department has been using DeightonCad software since January 1995. This is still being refined.

They have felt the need to switch to Arc/Info with interfaces to Map/Info. The system is under discussion. It is intended for use on road rehabilitation, maintenance, location of borrow pits, classifications, types of roads, traffic counts, accident statistics and soil types. They would like to run the system on a mainframe computer.

The intention is to train one candidate within 1995 and nine more later.

5. Mines and Geology Department.

The department has not installed any system.
One officer has been sent for training in the Netherlands for GIS training. He is due back in November 1995. Upon return; the officer will advise on appropriate system for installation.

The system will be used for geologic and exploration mapping.

Other identified training needs are for eight trainees at basic level and four at either intermediate or advanced levels as soon as possible.

6. The Lands, Surveys and Physical Planning Department

Installed UNIGIS DROCAD in 1992 for purposes of Land Title Information/Queries and topographic mapping.

They have undertaken:

- Development of land information systems (Linkage Oracle Alpha numeric data with front-end Cadastral boundaries)
- Production of large scale digital topo data using analytical photogram.
- Lease titles in Lesotho
- Urban areas on Procad.

In the first half 1995 the department has switched over to ReGIS and intend to use it to identify areas suitable for development of sites by the physical planning section.

The department intends to train 10 officers in both intermediate and advanced levels between 1995 and 1996. Ten officers have already undergone basic training in ReGIS and UNIGIS.

7. Lesotho Telecommunications Corporation

LTC is currently making a needs assessment and evaluations. Once acquired, the system will be used initially for route planning, demarcations, mapping and management of facilities. The intention is to train five officers both at basic and intermediate level.

They have not yet undertaken any projects with GIS.

8. Urban Development Services Department

As with LSPP, they installed UNIGIS in 1992 for Cadastral Information Systems and Town Planning. They have undertaken projects in planning and management of sites and services in all the Lesotho towns including a few land rehabilitation projects.

They have also switched to ReGIS in 1995 and been trained together with LSPP staff in the first quarter of 1995.

This department will soon merge with LSPP.

Four officers are to be trained in GIS at both basic and intermediate levels in 1995.

9. **Mafeteng Development Project**

Mafeteng Development Project is a German administered project. It developed in response to the increasing challenges confronting the people of that district. These are:

- Continued environmental degradation
- Low crop and livestock productivity
- inadequate agricultural services
- Weak local institutions
- A high failure rate of small business enterprises
- Poor development planning

Atlas GIS and IDRISI have been installed in 1994. While the operator is being trained in computer appreciation and use in-service training of other staff is in progress. GIS

and image processing will be run concurrently while image processing will be used for environmental impact monitoring. No database has been established yet.

Two officers are in line for on-the-job training at all levels, dates have not been decided yet for their training.

The system will be used for planning and management of agricultural projects.

10. **The Department of Energy**

Has installed Atlas GIS for windows and is still undergoing in-service training. It has not indicated any intention for further training.

11. **Lesotho Electricity Corporation**

Has installed a Microstation in 1989. It is used for network planning of power lines and cables.

The only project undertaken to date is network planning updating.

Four staff members will be trained at advanced level anytime.

12. **The Environment Secretariat**

Has not acquired the system but will need to train five staff members and then make a needs assessment prior to establishing a GIS unit.

13. **Department of Planning and the CSIR - Maseru**

Both these wish to establish GIS and contemplate training ranging between basic and intermediate levels. No GIS/LIS have been used.

14. **Ministry of Agriculture**

(Departments of Conservation, Forestry, Range Management and Land Use Planning)
Range management use GIS for management of cattle posts and Range Management Areas (RMA) in the highlands since 1992.

Conservation staff have been exposed to Arc/Info use under close supervision of the LHDA GIS officer in digitising the soil acid map for SARCCUS.

Land Use Planning contemplate acquiring GIS for Agro-ecological zone mapping.

The anticipated training is for four officers as soon as possible.

MALAWI COUNTRY REPORT

John Armando Malunga
Malawi Research and Environment Monitoring Program

1. INTRODUCTION

An Environmental Information Systems is one of the major components of the **MALAWI ENVIRONMENTAL MONITORING PROGRAM (MEMP)** that was launched two years ago financed by USAID with a view to monitoring the effects of burley tobacco liberalization.

2. MALAWI ENVIRONMENTAL MONITORING PROGRAM

The Government of Malawi with assistance from **USAID** has created a program called **MALAWI ENVIRONMENTAL MONITORING** during the past two years within the newly created Ministry of Research and Environmental Affairs. This action was initiated by the Agricultural Sector Assistance Program.

2.1 Objectives

To strengthen the technical and institution capacities of the newly created ministry and line agencies in order to:

- answer the specific questions relating to the possible environmental impact of smallholder burley tobacco production and
- build a broader technical capacity upon which a viable national EIS can be based.

So far, MEMP has focused on the establishment of the monitoring programs in five catchment areas and an intensive training program in GIS for involved agencies. Also it provides technical assistance in erosion monitoring and farmer-based environmental monitoring.

2.2 Agencies Involved in Memp Activities

- Ministry of Agriculture and Livestock Development
- Ministry of Irrigation and Water Development
- Department of Forestry
- Department of Surveys
- Department of Meteorology

2.3 Objectives of the EIS

At present, the main objective of the EIS is to provide environmental information necessary to:

- inform policy making and
- project development in Malawi for the purpose of:
  - gathering
  - analysis and dissemination of information required by the Ministry of Research and other line ministries

* supporting the environmental monitoring unit and providing information to the Environmental Impact Assessment process as it evolves in Malawi.

With the decentralization approach, information will flow from the line agencies into the EIS from where it would be redistributed to the third parties upon request.

The **EIS** will also serve as a central point of referral for data that are not of immediate concern to MEMP which are gathered and maintained at another facility. Ultimately, it is the collecting, cataloguing and filing of books, reports and maps that forms the unglamorous but unavoidable set of tasks that builds a truly useful information system. These documents eventually may be digitized and entered in a GIS to make them easier to use.

2.4 **Structure of EIS**

To clarify functions and to relate to existing capability, the EIS could be composed of two units:-

2.4.1 Geographic Information Unit

This will be concerned with all forms of geographic information required by the country like:

- map-based reference data e.g. vegetation, soil and land use maps.
- image data from satellites and aircraft.

These will be stored in digital form to facilitate analysis and exchange among agencies.

In addition to map data, the GIU will also develop and maintain databases of pertinent geographically referenced environmental data such as rainfall, temperature, stream flow, timber production etc.

The GIU unit will also include socioeconomic data related to the country in areas of interest such as population, income, agricultural production, etc.

The data which is being collected now from the FIVE watersheds will serve as a base from which a more comprehensive unit should evolve. The relationships that have been established will serve as the beginnings of a framework for information sharing and exchange upon which the GIU will be based.

2.4.2 Documentation Unit

On top of Geographic Information, the EIS will also include traditional bibliographic information that describe Malawian Environment. This will include description of flora and fauna. More importantly it will include formal reports issued by Government of Malawi (GOM), donors and NGO's dealing with environmental issues. It will also concentrate on locating and acquiring unpublished materials (e.g. informal GOM and donor reports; reports of special studies and consultancies that have been prepared for specific areas or projects which are so important but also so hard to relocate at the termination of a project.

3. **PRESENT PROBLEMS AND PROBABLE SOLUTIONS**

- Limited number of staff, in areas of technical competence required for environmental monitoring and management.
- Lack of equipment in some line agencies involved in the MEMP activities.

Owing to the above mentioned set backs linkages among staff within GOM, colleges within the University of Malawi and outside institutions, are now in place with the intent of building technical capacity in the specific agency and training capacity in the University.

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MOZAMBIQUE COUNTRY REPORT : ENVIRONMENT INFORMATION SYSTEMS DEVELOPMENT STRATEGY

Abilio Inguane
I.N.L.A.

1. INTRODUCTION

1.1 Background

In the past three years, there has been an increasing level of interest in the use of geographic information systems (GIS) in Mozambique, driven by a number of short and long term activities. These initiatives can be characterized as "on-off" exercises which generate and/or use data typically stored in a geo-referenced format. The objectives covered by such databases are overlapping by sector, scope, levels of analysis and systems architecture. The resulting systems have typically been uncoordinated, leading to the development of data collection and storage schemes designed for exclusive purposes which render them moderately or completely incompatible. Since the existence of an archive of data for the country of Mozambique may be considered a very important influencing public and private development and investment decisions, it is clearly in the general interest to encourage active orderly progress in the ways in which data on the country are collected, stored and used.

There is a considerable demand for reliable environmental information, aggregated at the national and possibly provincial level, above-all, by institutions and individuals involved in environmental planning, development projects and the general rehabilitation of the country. There is certainly a need for environmental information and supporting materials for educational and awareness-raising purposes, and for distribution to the general public by the media or other means. It is expected that such information be provided in user-friendly, highly communicative and easily accessible format.

Once developed, the environmental database is not expected to be static, but would need to be continually refined and updated to monitor the temporal and spacial changes. It is recognized that GIS plays an increasingly important role as a tool to integrate, analyze, monitor and present environmental data and information. However, the need for traditional statistical and cartographic products does, and will for some time, persist.

Environmental information, is dispersed over various sectorial agencies, projects, reports and with individuals and has, in most cases, not been integrated to the national or even the local level. In addition, data sets are based on different classification systems, organized along different formats and are of varying accuracies.

Accessing reliable, up-to-date data and information from the scattered sources is usually a very time and resource-intensive exercise.

2. OBJECTIVES

2.1 Improve policy development and decision-making

The Environmental Information system and National Database is a very strong tool for the above mentioned objectives, as it provides ready to use information in an adequate format that enables creation of various development scenarios. This is particularly important in Mozambique where data and information are scarce and the existing is so disperse and in such incompatible formats and scales that makes it difficult to take sound decisions based on integrated knowledge of existing environmental resources. Often decisions are taken based on only one or two elements of the resource base available in individual sectors, ignoring the recurrent impacts on the global environment.

2.2 Monitoring and evaluation of natural resources

The integration of complementary data gathering techniques such as aerial survey, ground surveys and Remote Sensing brings good possibilities of monitoring the "behaviour" of the natural resources over time. The multi temporal surveys improved by the use of satellite remote sensing has given a solid ground for monitoring activities. GIS in its side uses the data so gathered to perform combinations that result in different resource evaluations. The agroclimatic, agroedaphic, agroecologic and the automated land evaluations are but a few examples implemented in Mozambique that shows the power of GIS as applied to agriculture production. Mangrove depletion was analyzed using satellite data as a tool for monitoring.

It is expected that land cover/land use, lake expansion/shrinking, soil/land degradation, erosion, and urban development would be some examples on the use of EIS for monitoring and evaluation.

2.3 Interlinking of national, sectoral and regional databases

The available data and/or information is disperse in a sectoral and regional basis. First of all it is important that a data harmonization strategy be put in place. In so doing, communication between producers and users of similar information, will be facilitated. For instance land cover maps produced by DINAGECA should be "harmonized" with those produced by INIA (The Institute of agronomic research) and the DNFFB (the National Directorate for Forestry and Wildlife). Furthermore the systems architecture including software configurations should be fairly compatible. The strategy of Regional Centres of the Ministry of Environment should enable adequate data collection, appropriate formatting and storage. These data should be addressed to the central office at the Ministry where more processing power will enable generation of information to be used in environment planning both at central level and back to the provinces and localities. True integration calls for interlinking of data bases of various environmental sectors, which means, cooperation, between Ministries and within the Ministry.

2.4 Institutional strengthening

The current capacity to deal with environmental information system (including GIS) in Mozambique is quite weak. There are only a small number of operational GIS installations with only experimental activities and limited information production capabilities. This refers, even more so, to the information users. The capacity to absorb data and information in digital form is moderate. There is a limited number

of well-trained professionals capable of generating, processing and interpreting environmental data and information in Mozambique.

Considering this, considerable effort must be put in training of local staff, design and implementation of appropriate systems and provision of adequate technical assistance.

2.5 Create and adequate approach in information management

The approach to information generation and management, should be different from that of a Surveyor General and should be problem oriented. In that way it will concisely and clearly address specific needs and thus be useful to the beneficiaries in particular to local people.

3. APPROACH AND METHODOLOGY

A number of survey and identification steps are described below as methodological approach to building an EIS strategy.

3.1 Survey of institutional framework and network relevant for georeferenced data collection and description of the type of information available or likely to be produced.

The survey shall document the different institutions that collect georeferenced data, including the collecting organization, project, purpose, technical aspects of the data and the methodologies of storing, retrieving and presenting data. The institutions should be located so to facilitate access to country disperse information and maximize the possibilities of linkages between data/information related institutions. The referred institutions should include General Surveyors (Topography, Geology, Water, Forestry...) related socio-economic departments (Population, Industry, Commerce...) to integrative departments (Environment, Physical Planning, Rural Development...). NGO's and international agencies as well as Universities shall also be considered.

Table 1: Logical framework for Environment Information System Development

Project structure	Indicators of achievement	How indicators can be quantified or assessed	Assumptions, risks and conditions
Broad objective			
initiate a network of facilities And databases to make information readily accessible improve policy development and decision making monitor and evaluate the natural resources interlink the national sectoral databases and regional integrated databases institutional strengthening create an adequate approach in information management	accessibility to information on environment availability of information to policy and decision makers functional physical unit for environmental Information System and database development service integrated databases of various environmental sectors	statistics on natural resources for policy development operationalization and utilization of the EIS reports of the EIS environmental monitoring and evaluation	Central, Provincial and local Government are committed to the project Cooperation of other Ministries and other departments within the ministry on supply of environmental information exists Political stability
Specific project objectives and activities			

Table 1: Logical framework for Environment Information System Development

Project structure	Indicators of achievement	How indicators can be quantified or assessed	Assumptions, risks and conditions
upgrade the environmental information system (EIS) unit inventory and analysis of existing information design and standardization of database structures selection and installation of hardware and software synthesis and analysis training satellite image interpretation cartographic production	an EIS is established including functional hard and software and mapping facilities a national database structure has been developed standardized formats for databases have been developed capacity of EIS to maintain and update natural resource information is increased	monitoring and evaluation of project progress availability of environmental information and databases reports, documents and maps monitoring and evaluation of pilot projects	Government is committed to the project existing assets and potentials are used optimally existing assets and potentials are used optimally adequate local staff are available adequate counterparts staff is made available

Table 1: Logical framework for Environment Information System Development

Project structure	Indicators of achievement	How indicators can be quantified or assessed	Assumptions, risks and conditions
Outputs			
environmental information system (EIS) centre with staff, capabilities and facilities and facilities for adequate environmental information management and planning a database of databases on natural resources information national database for environmental information training of a number of national counterparts in the fields of remote sensing GIS and System satellite image maps for selected operational areas	physical presence of the EIS centre natural resources databases project reports and documentation production of satellite image maps number of trained personnel production of thematic maps information materials pilot projects	reports documents databases policy and planning papers statistics satellite image maps thematic maps monitoring of progress	adequate staff is available recipient is committed to the project satisfactory conditions and services for team on site objective selection of trainee

3.2 **Identification of existing georeferenced spatial (maps) data bases and respective attribute data (tables).**

A great amount of georeferenced data already exists. Although in analog format it's good starting point. That should be organized in a data base that is accessible to relevant users. For example the Institute of Geology, DINAGECA, Forestry Directorate, INIA, the Physical Planning and its Provincial Services, are repository of a wealth of information not yet dully explored by GIS activities. Even the little existing in digital format is virtually unknown and thus unused. So an identification activity should enrich the possible "data base of data bases" and helped by appropriate networking could bring to light new possibilities.

3.3 **Survey of data bases which have been used, and which are now being constructed in Mozambique, including methodological, systems architecture and sectoral considerations.**

There is already some experience on building, using and sharing data bases. There is even a first survey done on GIS hardware, software, "transformations", outputs, and uses. It would be relevant to update these surveys and complete them with other available and relevant data bases that would feed to other information not considered at the time of the survey. The validity of the data, including dates of collection, purposes, collecting organization and estimates of current accuracy and utility should be documented.

3.4 **Survey of potential users, and uses to which the data may be utilized.**

The consultancy shall give an insight on who and how the available data base will be use.

Assuming that the data currently collected are readily available in a variety of forms, survey the potential users to identify data which are needed, or which may be needed, but which are not now collected.

3.5 **Identification of linkages between complementary geoinformation users and further identification of respective data gaps.**

Geoinformation users can be identified and classified according to data needs and information use. The consultancy should give suggestions on data sharing, appropriate data formats and institutional "proximity". This will avoid that important institutions be forced to adopt hardware/software configurations for the sake of compatibility with institutions that have only a little to do with them. Further collection of needed data should be considered.

3.6 **Development of a networking strategy connecting producers and users of complementary georeferenced data and/or information.**

Based on experience with existing methodologies for cataloguing and storing a variety of data in a number of different formats, develop a scheme to generally make the existing and forthcoming data cross-comparable, and useful to potential clients. Develop methods for identifying incompatibility of such data. Propose standardization of methods, sample frames, and data collection techniques on a per sector and per institution basis, particularly in light of the current norms and standards by respective governing institutions. Assess current and potential linkages among the systems, as well as resources available outside of the country.

3.7 **Preparation of a report on all activities, including a detailed description of the present situation as well as short, medium and long term GIS strategy.**

3.8 **Creation of a Environmental Information centre with GIS and Digital Image Processing facilities capable of handling large amounts of environment data, based on analog map as well as satellite imagery.**

4. PROJECT ACTIVITIES

4.1 Establishment of a Environmental Information System

This activity implies the selection of system architecture which includes software and adequate hardware that could respond to the needs of data input, processing and out put. This data may be in Raster, Vector or tabular format; so selection of software capable of handling such type of data is advisable.

In each regional Centre adequate computer and cartography setting is recommended.

4.2 Inventory and analysis of existing information

For the environmental data bank not all resources data is important. So careful selection should be made in order to set the proper institutional framework and relevant data sets to be drawn from the existing data bases to feed the environmental information system. This activity encompasses harmonization of data and classification systems, setting of export/import files, and compatibilization of survey/formatting methodologies.

4.3 Design and standardization of data base structure

To be useful a data base must be properly structured.

A relevant software must be used so that the data format is maintained. The standard is to be agreed by all producers and users of environment information. The regional centres should use compatible hard and software with that used at the Central Level (eg. Ministry, Department, Research Institute).

4.4 Selection and installation of hardware and software

Current GIS work in Mozambique is being done in IBM compatible PC's of different size and processing power. A recent survey showed this tendency. As for software there is also little variation, ranging from AutoCAD, ILWIS, IDRISI, and ArcInfo as the most used. Except for AutoCAD there is fairly good compatibility between the softwares which facilities Export/Import activities. It is recommended that ARCVIEW is added to the ESRI ArcInfo, and Clark IDRISI for the Environmental Information System.

This activity should take place at the beginning of the project.

4.5 Data synthesis and analysis

The existing processing power should be enough to handle data in different formats, either raster or vector and produce integrative information.

This activity is at the implementation stage where data is manipulated and converted into information ready to be used.

4.6 **Capacity building and training**

Activities on capacity building are related to equipment installation, working space, refurbishing, and training of operators. This may also include seminars and workshops.
Short-term training may be carried out abroad or in-house.

Maintenance is to be secured by local companies and at a later stage by staff.

4.7 **Satellite image interpretation**

There is in Mozambique a fairly well-established Centre for Remote Sensing (CENACARTA), responsible of commercializing Satellite data.

This is the only institution responsible of purchasing and supplying digital satellite image data and it has specialized in the production of image maps.

The Ministries should take advantage of this powerful tools and perform image interpretation (digital and visual) to capture data that will feed the GIS. Carrying out this activity means coordination with other related institutions that will support with specialized expertise and knowledge. Visual interpretation is however highly recommended.

4.8 **Cartographic production**

One of the cornerstones of the establishment of the Environmental Information Systems at the Ministry is the production of maps through different spatial manipulations made possible by GIS. Data from photo and image interpretation as well as attribute data will enable production of scenarios maps and typical environment maps such as erosion maps, environment hazard maps (flood/drought susceptibility deforestation/desertification), agroecology, sensitivity/vulnerability maps, land degradation, land cover/land use evolution and carrying capacity maps.

4.9 **Establishment of GIS units in the Regional Centres**

As part of capacity building, sizeable units can be established at the regional centres.

Basic GIS operations and image interpretation may be performed there specially for monitoring purposes and ground-truthing. There is a previous experience on forest burning monitoring in Pemba that shows the importance of local GIS set up. The area figure show how data and information flows forth and back from the specialized regional Centres. In brief, the Centres collect, format and store data that is sent by different media to the Ministry where most processing activities take place. This information is used and may feedback to the centres and local users.

5. **OUTPUT**

Main outputs are expected from the project both related to the physical installation of GIS units and their production and functionality.

5.1 **Environmental Information System Centre**

Adequate equipment and software should guarantee the production line flow of cartographic information, satellite image maps and statistical tables. The regional centres should network conveniently with the central office and make viable the exchange of data and information in time and in a usable and useful format.

5.2 **A data base of databases**

As a result of identification activities on different national institutions and international organizations a "summary" data base should be constructed that must be capable of tracking past and current information systems and surveys in Mozambique.

It is unrealistic to think on building a data base by concentrating in one place the existing data bases. The usefulness of most of the data would be difficult to assess. Hence the concept of "data base of databases" which entails permanent knowledge of availability of certain data on natural resources, population and social infrastructure.

5.3 **A National data base on environment**

This is the most significant output in terms of information generation. As opposed to the data base in b this entails an objective selection of data relevant for environment planning and monitoring. The ministry should be the repository of data useful for environmental information generation. The information stored should be supplied to development agents and other members of the user community.

5.4 **Training**

It is expected that from the project implementation a number of operators should be trained to secure the functioning of units in the regional centres. Six technicians should be trained for data input and retrieval for the regional offices. Three (3) technicians will be trained for GIS and remote sensing in the central office. Additional staff will work on systems management (1) general management of the GIS work (1) environment management specialist (1) and remote sensing specialist(1).

5.5 **Satellite image map production**

The full fledged production of satellite image maps is the attribute of CENACARTA (The National Remote Sensing Centre).

However thematic image interpretation should lead to a limited production of specific image maps useful for field studies and as sources of data to feed the GIS data base. Visual interpretation of original corrected images will still play an important role on data and information generation for the Environmental Information System.

TABLE 2: GIS SYSTEMS INVENTORY				
Institution	**Software**	**Hardware**	**GIS Users**	
BIP Polly Gaster 490200 (Information Bureau)	World Atlas	286 PC's VGA Color Monitor	Some world statistics (i.e. population, economic indicators, etc.)	Would like to make general information and statistics available to the public in GIS format
MICOAA Abilio Murima 465851 (Environment Ministry)	IDRISI 4.0	2 PC 386 w/VGA Monitors HP Plainjet IBM Proprinter	SPOT images of Pequenos Limbombos Vegetation and topo maps of project area.	Environment Analysis in Coastal Management, Urban Ecological Zoning and Land Use Changes
Cenacarta (National Remote Sensing Centre)	Multiscope Archinfo 3.4 D plus	PC Compaq 486/66 Digitizer OCE A3 Colour printer		Land use environment Cartography

TABLE 2: GIS SYSTEMS INVENTORY				
Institution	**Software**	**Hardware**	**GIS Users**	
DNA Joao Neto F. da Costa 427552 (Directorate of Water Affairs)	ArcInfo 3.3 and 3.4D	Dell 386 25 MHz w/300 meg hard drive Houston Instruments True Grid 8036 Digitizer Hewlett Packard Drafmaster AO plotter Epson FX-1000 printer	1:250000 Incomati River Basin 1:50000 Umbeluzi River Basin Coverges: Basin limits Sub-basin limits Rivers Cities Rain gauge stations Flood Gauges Roads	Monitoring of spatial and temporal changes in land use and affect on hydrology
DINAGEC A (Surveyor General)	Auto/Kn Ver 1.81 (Swedish	2 PC's Calcomp 1025 Plotter Calcomp 9500 Digitizer	Boane Pilot Project Data 1:10,000 Cadastral Map	Digital Cartography for production of topographic and thematic maps GIS Base Maps Cadastral Maps

TABLE 2: GIS SYSTEMS INVENTORY				
Institution	**Software**	**Hardware**	**GIS Users**	
CNEP Bo Yettingsen 475145 ext 242 (Directorate of Roads & Bridges)	Mapinfo		1:2,000,000CTGIS Coverage including: Cities Roads Rivers Borders Game Reserves	Prioritizing road rehabilitation projects
Geography Dept. Universidade Eduardo Mondana Ebenizario Chonguica 490081/9	Mapinfo	Mac IId, 230 meg hard drive Calcomp AI, Plotter		Examination of sedimentation rates in Pequenos Umbombos reservoir. Calculation of reservoir lifetime

TABLE 2: GIS SYSTEMS INVENTORY				
Institution	**Software**	**Hardware**	**GIS Users**	
INIAG Rherbergen or J Frankel 460097 ext 281 (Institute of Agronomic Research)	ILWIS ver 1.21	IBM PS2/ 80 Bemoulli 144 meg external drive Calcomp 9500 Digitizer Roland GRX-400 AR Plotter HP Paintjet (A4)	National coverage: 1:1 000 000 soils map 1:2 000 000 simplified soils map 1:1 000 000 District boundaries Provincial coverage (Maputo and Gaza): 1:250 000 soils map 1:1 000 000 Land and Irrigation suitability maps	Create baseline georeferenced information for land use/soil suitability planning Specific analysis on demand
Projecto SUD (Ministry of State Administration)	AutoCAD ver 10 and ver 11	386 PC's Calcomp 9100 Digitizer Calcomp 1025 Plotter Epson Printers HP Laster Jet	Thematic Atlas of Maputo Province 1: 250 000 coverages of: Lands use Hydrology Geology Communications Utilities Industries Agro-ecological zones Climate	Project planning Social infrastructure distribution

TABLE 2: GIS SYSTEMS INVENTORY				
Institution	**Software**	**Hardware**	**GIS Users**	
WFP Pablo Recacalde 491720 (World Food Program)	Auto/Cad ver 10	386 and 486 PC Digitizer	1: 250 000 Cartographi c Coverages including: Transportati on Schools Borders Hydrology	Project Planning (monitoring food distribution, etc) GIS support to other institutions
World Bank Roberto Chavez (Res. Rep) 492851	Atlas GIS, Mapinfo Mapil	386 and 486 PC's Macintosh Bernouli 90 meg external drive Scanner	1:2 000 000 CTGIS Coverages	Donor Coordinatio n Project Planning and implementat ion
UNOHAC David Zimmerly 423217 423294 ext 2372	Mapinfo	HP Scanner 386 and 486 PC's	1:2 000 000 CTGIS Coverages SHAMAN Database on humanitaria n assistance	Visualizatio n of SHAMAN data (food distribution, mine locations, etc)

TABLE 3: SOFTWARE SPECIFICATIONS					
Software	**Manufacture**	**Native File Format**	**Import File Formats**	**Import File Formats**	**Platforms**
ATLAS* GIS ATLASPRO	Strategic Mapping (San Jose, CA)	AGF	Geographic: Note: Require Atlas Import/Export Utility ASCII (.bna) Arc/Info, AUTO/CAD(DXF) DLG, Mapinfo (.mil) Attribute: Dbase, Lotus, ASCII	Note: Require Atlas Import/Export Utility ASCII(.bna) Arc/Info AUTO/CAD(DXF) MapInfo(.mil)	PC Mac (Atlas Pro only)
Arc/Info	Environmental Systems Research Institute (Redlands, CA)		Geographic ASCII, DLG, DXF Attribute: Dbase Lotus	ASCIII DLG DXF	PC
MapInfo	MapInfo Corp. (Troy, NY)	MIF	AutoCAD -dxl	AutoCAD - dxl	Mac, PC, Unix
MapII	University of Western (Ontario, Canada)				Mac
World Atlas			N/A	N/A	PC
AutoCAD	AutoDesk	DWG	ASCII, DXF	ASCII, DXF	PC
IDRISI	Clark University (Worchester, MA)				PC

ILWIS	ITC Netherlands		Idrisi Arc/Info BNA DXF Erdas	Idrisi Arc/Info BNA DXF Erdas	PC

6. REFERENCES

1. **Inguane, A.;** 1992 - Terms of reference and plan for the Information and Documentation Centre. National Environment Commission.

2. **Inguane, A.** et al. 1993 - Xai-Xai District Coastal Profile - Integrated Coastal Area Management - National Environment Commission.

3. **Inguane, A.; Karylin, A.;** 1994 - Terms of Reference and Consultancy Services for GIS Activities in Mozambique - GIS Users Group - Maputo.

4. **Inguane, A.;** 1994 - The Natural Environment of Mecufi District.

5. **Hassan, H.; Inguane, A.;** 1994 Elements of an ICZM Strategy - Coastal Zone Management Information in Mozambique - Attachment VII - World Bank Mission.

6. **Wright, J.;** 1993 - Environmental Information Systems Development Strategy - "Aide Memoire" World Bank Mission.

7. **Sayao, O.; Beam, W.; Voabil, C.;** 1994 - Coastal Erosion Investigation -Macaneta (Marracuene District), Mozambique.

8. **Chua, T.E.; Scura, L.F.;** Editors; 1992 - Integrative Framework and Methods for Coastal Area Management, ICLARM, Manila.

9. **CNA/NORAD;** 1991 - Project Document - Mecufi Coastal Zone Management.

10. **Burrough, P.A.;** 1990 - Principles of Geographical Information Systems for Resources Assessment.

NAMIBIA COUNTRY REPORT

A. Kooiman
National remote Sensing Center

1. NATIONAL AWARENESS

Environmental issues are acknowledged as crucial with policy makers as well as with general public. The need for environmental information is high and increasing. The role of GIS in generating this information is well appreciated and recognised, even though it is a quite recent development. Around 1991 the National Remote Sensing Committee, consisting of representatives from government and university, initiated the establishment of the National Remote Sensing Centre as a first step to facilitate the use of GIS and RS in Namibia at national level. Post-independence needs for improved land use and environmental planning, including urgent needs for land distribution formed the major justification.

NRSC was established in March 1993. Applications of GIS/RS have strongly increased. A number of organisations have planned or installed GIS for their own applications. As such awareness and support for GIS/RS initiatives and applications is high among both professional and policy levels.

2. NATIONAL COORDINATION

Several organisations are involved in coordinating attempts.

> Environmental issues; planning/coordination/delegation: Directorate Environmental Affairs.
> Land Use Planning; coordination, information sharing: Inter Ministerial Standing Committee Land Use Planning.
> GIS and RS for Environment Applications. National Remote Sensing Committee, started +/- 1993 (used to be forum of main players, became dormant in 1992/93 in and ex-government. Change role into "Steering Committee National Remote Sensing Centre" to provide "user" input in management and priorities of NRSC activities.
> GIS General
> NamGIS : Namibian GIS Users Group
> Informal forum for info exchange, identify common ground, improve cooperation. More push for solutions to common problems.

There is a national policy but no action plan for GIS developed by Directorate of Data Systems, Prime Minister's Office. It does not work since the Directorate of Data Systems does not coordinate "on the ground". The use of GIS/RS in environmental applications is mentioned as integral part of policies i.e. Environmental Policies and others. An LIS policy was developed by/for Survey General.

3. NATIONAL CAPACITY

Institutions involved in use and/or generation of environmental information. These are mentioned as beneficiaries of RS/GIS.

Ministry of Environment:
- Dir. Env. Affairs (DEA)
- Dir. Resource Management (MET)
- Dir. Research Etosha Ecological Institute (EEI)
- Directorate of Forestry
- National Remote Sensing Centre

Ministry of Land Resettlement & Rehabilitation (MLRR)
- Directorate Lands
- Division Surveying & Mapping

Ministry of Agriculture, Water & Rural Development (MAWRD)
- Dir. Research & Training (DRT)
- Dir. Extension & Engineering SARDEP Rangeland Management Support Program
- Dir. Planning and Cooperatives/FAO Early Warning Unit.

Ministry of Fisheries & Marine Resources
- Research Section

Desert Research Foundation of Namibia

World Wildlife Fund, Life Project

Ministry of Transport, Works & Communications
- Weather Bureau

Ministry of Mines & Energy
- Geological Survey

University Namibia
- Dept. Geography & Environment Science

4. INSTITUTES & CAPACITY (INVOLVED IN GIS/RS FOR ENVIRONMENTAL APPLICATIONS)

	Present Staff	Positions
NRSC(MET)	4 Proff.	6 Proff. 1 Tech.

EEI (MET)	2 Proff.	1 Proff.
DRT (MAWRD)	2 Part time	
	1 Proff, 1 Tech2 Part Time	
Weather Bureau	?	?
Geological Survey	4?	?
Early Warning	1?	?
UNAM Geography	1	1

5. OUTPUTS

Major outputs for various organisations using GIS/RS

5.1 Completed

NRSC:

Vegetation Mapping, Directorate of Forestry MET. Production of 204 plotted land cover maps 1:50 000/1:100 000 Northern Namibia.

Atlas for Resource Management Caprivi: Dir. Resource Management (MET) Production of frame work for resources monitoring i.e. grid cell database, visualised as atlas of 58 maps with land cover, topography and grid cells.

Development of updated topographic database, for various applications. Production of several layers 1:50 000 topographic info from old topo maps, updated from visually interpreted SPOT/Landsat hard copies; covers 900 sheets in former Ovambo, Kavango and Caprivi.

Fencing Study - University Namibia
Mapping unregistered fences in communal land of Oshikoto region scale 1:150 000 based on SPOT imagery and 8 hrs. low flight.

Pilot study settlement mapping Caprivi using SPOT for Ministry of Education Assessment and Usefulness of several types of imagery for settlement mapping.

Farms dams study Kwiseb Catchment for Desert Research Foundation DRFN. Monitoring increase of no. of farm dams and location; 1972-1989 using old maps and new Landsat data.

TABLE 1: HARDWARE, SOFTWARE FOR EIS: PRESENT			
Institution	**Hardware**	**Software**	**Peripherals**
MRSC (MET)	Axil 240 W/St. Axil 511 W/St. 4 x PC 486	Linix/solaris L4 2 x ArcInfo (Unix) Imagine 8W(Unix) PCNFS Land/Windows Nt. 2 x Erdas 1 x Unix Arcview 1 x PC Arcview 4 x ILWIS 1 x 1DA Arcscan X-Vinola	Digitizer A0 4x Digitizer A3 1x Plotter A) Inkjet Printer A3 Inkjet CD ROM Exabyte 62T.BP1 Tape Drive QCR Scanner 1000 DPI
Etosha Ecol Int. (MET)	3 x PC 486 Moss Receiver	2 x IDA 1 x IDRISI	Digitizer A1 Printer A3
Dir. Env. Affairs (MET)	1 x PC 486	1 x ILWIS	Digitizer A2
Dir. Research & Training (MAWRD)	1 PC 486	Regis	Digitizer A0 Printer A3
Fisheries Research		IDA Metnet	Printer
Early Warning Unit		IDA	?
Weather Bureau		IDRISI/IDA Metnet	Printer/Backup System
Geol. Survey	2 x SPARC w/stat. 2 x PC 486	Imagine Unix PC ArcInfo	Digitizers A1 Exabyte

UNAM	6 x PC 486	ILWIS	?

5.2 **Ongoing**

Vegetation mapping: DoF & topographic database.
Extension of Phase I (above) to cover 2 more regions. About 180 maps are being produced.
Environmental Profile Caprivi: Directorate of Environmental Affairs. Production of set of data to analyse, monitor and model environmental factors.
Fire monitoring: for various parties, collaboration EEI. Mapping areas burnt 1981 - present, using NOBA.
Biodiversity: Dir. Env. Affairs.
Production of maps and collation of relevant databases showing and analysing species distribution, areas and factors of endemism and "hot spots".

6. EDUCATION/TRAINING

UNAM Geography has planned training in GIS. Not operational at present.

NRSC provided short courses GIS/RS for "user" organisations (with MLRR)

Staff training done on the job and out of the country (ERSI, GIMS, other).

Not enough opportunities in Namibia.

7. OUTSTANDING PROBLEMS IN THE DEVELOPMENT OF EIS AND PLANS TO DEAL WITH THEM

Lack of digital data, much emphasis on data input(digitizing)
Underestimation of effort required to set up a GIS.
Limited awareness and competence in mapping. Lack of trained staff.
Information requirements for planning and management not always well defined.
Too much emphasis on GIS as a "magic black box" for solving problems.
Too little regard for the quality and accuracy of information, too much emphasis on the "wow" factor.

8. IMPACTS

Technology is appreciated and applied in studies.
GIS/RS has forced more specification of information requirements.
Local capacity building is hampered by staffing/training problems.

GIS/RS applications have made information available faster and cheaper than one thought possible.

9. RECOMMENDED SADC REGIONAL PROGRAMMES

Training/Programme

- GIS software
- Application GIS/RS for resources surveys and planning
- Remote Sensing, image processing
- System administration/management

Either delegation/sub-contracting or build capacity at a regional SADC EIS facility, tied up with one of the national EIS centres to do this.

Technical Support Programme

- Establish pool of expertise in region
- Backstopping national institutes through visits of experts (regional/outside).

Establish direct communication SADC ELMS - National EIS points of contact, not the standard routes via Ministries of Agriculture.

SWAZILAND COUNTRY REPORT

S. Qwabe
Environment Department

1. INTRODUCTION

Geographic Information System was initiated by the Food and Agricultural Organisation in 1991. Its initiation was aimed at generating land resource data for proper land and water utilization and management to achieve the country's main goal of sustainable development through exploitation of the limited land natural resources.

2. GIS CAPACITY IN SWAZILAND

Several institutions in Swaziland are using GIS, though their versions and purposes may differ from one department to another. Some of these institutions are:

2.1 Surveyor General's office (Ministry of Works)

The type of GIS used by this office is UNIGIS for Cadastral Information System, Cadastral Record Storage and retrieval.
The main objective behind the use of this type of GIS is to create a land/cadastral information system for the department and the foundation for Later Information System (LIS) for the government of Swaziland.

2.2 Land-use planning section

2.2.1 GIS hardware

Three IBM COMPATIBLE 386 computers are presently used by the section.
One accugrid digitizing table.
One HP laserjetIIIp printer.

2.2.2 GIS components

The Land use Planning Section has acquired a computerized land and water resource information system which provides tools to manipulate land and water resource information for land use planning purposes. The system includes modules to store, organize, analyze, evaluate, and present the resource information.

The system has a modular structure with three major components:

- A database management system
- A land evaluation expert system
- Geographic (spatial) analysis and map production system

The three components are interlinked as shown by Fig I.1

þ DBMS

DBMS facilitates the storage, retrieval and processing of land and water resource information. Through this system, the following data has been compiled:

- þ Climatic data with long term records.
- þ Agro-ecological Unit data (with physiography, soil characteristics, and agro-climatic characteristics of the AEU)
- þ Soil data
- þ Hydrological and hydro-geological data with discharge data of major rivers and ground water characteristics of the hydro-geological units.
- þ Range resource data with vegetation characterization and range conditions of the vegetation units.
- þ Land evaluation and potential yield data with land evaluation results for the Agro-ecological units.

þ LAND EVALUATION EXPERT SYSTEM

This system contains the evaluation models. These models are used to automatically assess the suitability and yield potentials of land units for a large number of crops under various management types. The land evaluation system was built with ales (v. 3.0), an expert system shell developed by Cornell University.

þ SPATIAL ANALYSIS AND MAP PRODUCTION

The spatial analysis and map production modules use the following software packages:

IDRISI (v. 4.1), a raster based geographic information system (GIS) package for spatial analysis and map production developed by Clark University (Eastman, 1993).

TOSCA (v.2.0), a digitizing package developed for use with idrisi by Clark University (Jones, 1993).

IMAGE IN (v. 3.10a), an image editing package (CPI, 1991). It is used to produce high quality cartographic output from idrisi image files.

In the GIS, the following basic thematic layers are presently available at a national scale:

- þ Moisture zones (rainfall, length of growing period, start of growing season, occurrence of dry periods.)
- þ Thermal zones (mean temperatures)
- þ Physiography (slope, soil characteristics)
- þ Agro-ecological units

  The agro-ecological unit layer is a combination of the moisture zones, thermal zones, and physiographic layers; and provides the basic land resource information for land evaluation and planning purposes. In this layer each agro-ecological unit represents a unique combination of the soil, terrain and agro-climatic conditions.
- þ Hydro-geology
- þ Present land use
- þ Land tenure

- Vegetation
- Administrative boundaries
- Dip tank locations
- Rivers and streams

- GIS MAPS PRESENTLY PRODUCED
- Agro-ecological Zone (AEZ) map (scales 1:500 000 and 1:250) Swaziland has been divided into six AEZ which comprise of 100 Agro-Ecological Units. Each unit has several subunits.
- Land Tenure map (scale 1:250 000)
- Agro-Climatic Characterization map of Swaziland: Thermal Zones and Moisture Zones (scale 1:500 000).
- Present Use Map of Swaziland (scale 1:250 000)
- Land Suitability Map of Swaziland (scale 1:500 000)
- Descriptive, Suitability, Proposed Plan maps have been produced for selected small areas at different scales.

4. PROBLEMS OF THE PRESENT GIS SOFTWARE PACKAGE

- Idrisi has the capability of processing images, yet all its images are raster based. Raster images are not preferable especially when the resolution is high.
- The use of an outside package for digitizing maps takes a lot of time which affects the efficiency of the present software package.

5. UPGRADING OF GIS

The presence of GIS in the Land Use Planning Section makes it be the only important centre which uses the system. It is necessary to improve the present GIS software to overcome its limitations. In an endeavour to upgrade the system, the section is in the process of introducing Arc/Info which is a better GIS tool. The use of Arc/Info will enable the section to produce vector based maps which will be of better quality than the present maps.

6. DESIGNED GIS DEVELOPMENTS

- Change the present idrisi maps to arc/info products
- Use the applications of GIS for Land Use Access & monitoring studies.

7. FUTURE GOALS OF THE LAND USE PLANNING SECTION IN GIS

It is a dream of the section to link the GIS system to a remote sensing facility. RS images can be easily analysed with the Idrisi software.

8. REMOTE SENSING DEPARTMENTS

- Early Warning unit uses RS for crop and water disaster areas.
- Meteorological Department: for weather prediction.
- University of Swaziland: for teaching purposes.
- Geology Department: for geological and ground water surveys.

9. CONCLUSION

The country is in process of improving and spreading the use of GIS and RS to various public and private sectors. We hope that such a goal can only be achieved, not by Swaziland as an independent unit, but through co-operation between the SADC countries and the world at large.

TANZANIA COUNTRY REPORT

A. Maembe
National Environment Management Council

1. BACKGROUND

The management of environmental information has been a focus of many recent discussions in Tanzania. The issues under discussion range from specific questions such as the development of standards for data capture to more general questions on the role developing a national policy for linking development and environment.

This has been a focus since it has been observed that each institution dealing with environmental information use or production worked independently despite the fact that some of the activities undertaken by these institutions were the same or complimentary. Likewise there has been no standard for data collection and formats of the products

As a result of these discussions, the idea of achieving a national consensus for information management caught the interest of institutions active in producing or using environmental information. Among these, some were research and training institutions, NGO's, Donor agencies, government departments and quasi-governmental organizations. The United Nations Sudano - Sahelian Office (UNSO) mission visited Tanzania in 1989 recommended in its mission report that there was need for institutions using or producing environmental information to sit around the table and sort out issues related to information management.

The discussions went on among various institutions and it was felt that an agreement should be reached as to:

- what role each institutions should play in information production and use
- the conditions under which access to data occurs
- compatibility between data types
- the coordination among and across sectors to avoid duplication of efforts.

2. CURRENT SITUATION

Information in our country is not adequately managed due to a number of factors. Some of these are :

- lack of the value and availability as well as institutional and financial problems which hinder free flow and exchange of environmental information.
- Information that does exist is dispersed in various offices and thus unknown
- Even when information is available, it is not easily accessible due to inadequate or lack of appropriate technology for effective access.
- Some institutions tend to withhold information and thus make it not available to users. Reasons for this is not known, it can either be for personal or political reasons.
- In some cases, information produced is often not used or is lost because it is produced in a form which is not easily usable (maps, films, paper documents etc.)
- There is no coordination as to who is doing what and which institutions collect certain type of data, thus making environmental information exchange difficult.

While some of these issues are common to almost all the institutions involved in information production, there are a few which merit further elaboration in as far as they affect information exchange practices in use. Proliferation of issues related to information management are bringing a variety of experience in the country as each sectoral programme acquires packages that are suited to serve the specific interests of the individual sectors. Whereas different institutions have the liberty to pursue this approach, this development does not follow any set guidelines and standards (since no group of institutions has set these guidelines except for data collection formats which was set in a workshop which was organised by the institute of Resource assessment and agreed upon as national).

This therefore, highlights an urgent need to set standards for hardware and software compatibility if information is to be exchanged between the various sectoral programmes. In addition, the availability of maintenance opportunities and facilities for both hardware and software is another issue of concern which needs a major consideration in drawing up guidelines for systems compatibility. At the moment maintenance of systems is done on an ad hoc basis and taken care by each institution.

Data Standards: The establishment of standards for data quality and accuracy is the most recurrent issue when discussing information exchange and is also seen as an important prerequisite to developing an effective and operational EIS network. However, matters of data quality and data base maintenance are ultimately the concern of the sector responsible for collecting the data. Pressure to improve quality is observed as a direct response to the need to enhance information exchange procedures and protocols. This has been observed in various information workshops, gathering and other venues.

Data Security: Data security in terms of security from modification or contamination, as well as security of access are important consideration in information exchange. What is more than often aired is that whatever system is in place it should endorse the principle of free access to all public sector data, whilst recognizing the fact that access should be denied where data are clearly sensitive (e.g country defence etc) or where classified in terms of national security. There should therefore be a consensus in setting policies on security and access should be set on a sectoral basis.

Networking: Networking has been a concern of various institutions when they sit together although openness to it has been a problem. Networking in terms of data exchange between sectoral information systems has been going on among institutions and, there is a general understanding and awareness that networking is an essential prerequisite to promoting the free flow and exchange of information. Sectors simply cannot collect all required data; data must be exchanged.

Coordination: So far the National Environment Management Council (NEMC) is mandated to coordinate environmental issues in the country (1983 Act establishing the Council). It has been organising training sessions, meetings, conferences and workshops to provoke dialogue for effective information exchange practices, networking activities. This institution serves as a coordinator (a hub) in spearing the establishment of standards, data exchange procedures and protocols, and also act as the contact point for other institutions as well as external organizations.

The building of an environment information system around a network of sectoral data bases and information systems would allow information to flow freely as and when and where needed.

But what we are observing is that institutions agree in principle that one institution should coordinate information management issues. But the main problem which is coming up is what should be the institutional arrangement for such coordination, and acceptance of those institutions to be coordinated. Otherwise coordination of multi-sectoral environmental issues is proving to be very cumbersome.

Looking at all these issues it was felt that there was need to organise a workshop which could serve as a venue for all key players in environmental information production and use to see how these constraints can be overcome.

2.1 **The First EIS Workshop (Morogoro October 1993)**

The workshop was organised in October 1993 and the main objective of this workshop was:

to define the need and optimal uses of environmental information in the context of Tanzania and to clarify the principles which will guide the development of an information system.

The development of EIS in Tanzania made a U-turn after the 1993 Morogoro workshop, when more than thirty institutions which deal with environmental issues met for one week to determine which principles could guide EIS development.

During the workshop four main themes were identified and recommended to form the basis of environmental information system development in Tanzania. These are:

. Development of databases related to remote sensing, GIS and Mapping

. Documentation of available environmental information

. Other databases and environmental statistics

. Raising environmental awareness.

3. PREPARATORY PHASE FOR EIS DEVELOPMENT IN TANZANIA

The preparatory phase for EIS development started in February 1994 after the Morogoro workshop and it was supposed to last for one year.

A group off experts from selected institutions met to lay down a strategy on how to put the recommendations into practical use.

Through UNSO support a one year preparatory phase was initiated in which various activities were to be undertaken.

One of these activities was to conduct an information user needs assessment to establish what is required in terms of training, technological requirements, filling in environmental information gaps and other information management issues in the country.

- þ information needs at various user levels, both sectoral and vertically from national offices to the local community level
- þ an accurate assessment of technological requirements and training needs to enhance information management capabilities.
- þ Gaps in available information which are supposed to be filled
- þ establish a documentation network.
- þ findings of this assessment lead to the preparation of a long term refined and expanded Natation EIS Programme.

It was also foreseen that improved access to information will facilitate reporting of implementation of recommendations from agenda 21 the national level.

Also some pilot projects were identified as important activities to demonstrate the relevance of documentation systems, standardised environmental vocabulary (in Kiswahili), a directory of institutions holding environmental information and a catalogue of GIS users and a matrix of software and hardware (used in the country) compatibility chart.

Through the implementation arrangements, the achievements will spread the benefits of training and equipment through a network of institutions active in information management. It will strengthen NEMC through its facilitation role in the planning and coordination of information management.

The various activities undertaken during the preparatory phase were:

3.1 **Formation of an EIS Technical Committee.**

At the national level, the Technical Committee was formed from participants of the EIS workshop this is still providing advice and counselling to NEMC for technical matters include GIS remote sensing, cartography, database, statistics, documentation systems and awareness. Sub-committees of the above technical group offer guidance at the national level in information management activities at the various institutions.

It started with formation of the Technical Committee which defined the overall objective of EIS. The main goal of EIS in Tanzania is:

"To provide simple, continuous and accessible Environmental in formation to users (especially planners and decision makers) to support decision in a king process for sustainable development".

3.2 **Information User Needs Assessment**

The second activity during the preparatory phase of EIS development was to conduct an information priority user needs assessment.

The Consultant from Uganda was identified and contracted to work with the selected technical committee members to develop modalities for information need assessment. The findings of the assessment will lead to the formation of a network of users and producers of such information although everyone is both the user and producer and finally develop an environmental system suitable for out country which will in turn enhance environmental information management and dissemination in the country.

The results from this survey will guide the players in the formulation of various activities and programs which will lead to:

- Clarification of the demand for environment information by decision makers within the government NGOs and research communities. It will also clarify information needs at various user levels both between sectors and vertically form national offices to the local communities.
- Clarification of the demand for technological improvements in the area of information processing in Tanzania which requires an accurate assessment of technological requirements and training needs to enhance information management capabilities.
- Demonstration of the relevance of environmental information technology and networking in resolving information management problems thorough pilot project activities.
- Refining the national programme document on EIS with a view to develop policies and long term objectives.

This was done and the assessment was carried out by August 1995. The Consultants and T.C reports are out and we are still working out how to reconvene institutions and scrutinize these reports and come up with the EIS Programme Documents which will be circulated to all users (researchers Donors academicians etc) and seek government opinion for its incorporation in governments plans.

3.3 **Pilot Projects**

During 1994, EIS preparatory phase various subcommittees of the technical committees were given assignments to develop pilot projects which could demonstrated the relevance of EIS which is to be develop.

3.3.1 The awareness subcommittee
This sub-committee was assigned to:

Prepare English-Swahili Environmental Dictionary. This was to help in standardising commonly used environment. Terms and translate then into Kiswahili which is used throughout the country. This has been done and the manuscript has been prepared. It is supposed to be circulated to, scientists and experts (who will be using it before it is printed and circulated to users.

Prepare Environment awareness materials (posters, leaflets, stickers, badges) which will reach as many users as possible. The materials has been prepared, but printing problems have slowed the whole activity.

3.3.2 The Documentation Systems subcommittee
This sub-committee was assigned a task of:

preparing a directory of institutions which hold/stock environmental information as the first step and then commission these institutions to develop bibliographic databases of their information holdings.

the first directory is with printers but a copy of it is available. The subcommittee was also assigned to designate pilot documentation nodes train documentalists on might of documents using modern technologies.

To date, one documentation node has been developed and its two members of staff have been trained in use of two software to develop a database of their collection (micro-CDS-ISIS-and Q & A of software). They have been given on PC and software and they have started capturing data.

3.3.3 The GIS and Remote Sensing Subcommittee
This sub-committee was assigned to:
prepare a catalogue of GIS users in the country, and the hardware/software they use and what outputs they produce. Also form a GIS/Remote sensing users Group.

A questionnaire was prepared and circulated to users of GIS with the aim of developing a catalogue as well as a hardware/software compatibility matric. This activity has been slow but we have some questioners (few) which are back but are yet to be processed.

A workshop of GIS users was organised in March this year and a number of institutions came up and demonstrated what they are doing.

At the end of the workshop a GIS User Group was formed and it is coordinated by Ardhi Institute. They have met once and they have assigned themselves tasks to accomplish before their next meeting. This GIS/Remote sensing subcommittee is also supposed to develop environment statistics databases. GIS-

Training at a technician level (basics) is at the moment being undertaken by Ardhi Institute. This is mainly for in-service training.

4. CONSTRAINTS ENCOUNTERED AND ACHIEVEMENTS

EIS/GIS activities started in the early nineties in Tanzania at institutional levels uncoordinated and sometimes at project level and when the project end all data and information is lost or neglected.

Various research institutions had used GIS in environment monitoring activities, eg Serengeti Wildlife Research and the Institute of Resource Assessment (IRA).

Since the beginning of the preparatory phase, all participating institutions expressed the need for coordination and networking among them. This enabled some of the set tasks to be accomplished in time. But there were some constraints which hindered smooth implementation of these activities.

4.1 Constraints

- Some institutions are not open as to what they are doing and their outputs.
- Use of modern technology in information management is limited so, majority of institutions tend to stick to the traditional information management skills.
- Institutional Arrangements (and their conflicting/overlapping mandates) make coordination difficult. (Conflicting mandates make some institutions not willing to cooperate)
- Inadequate trained personnel make it difficult to know the real information needs of various institutions.
- Inadequate awareness on information available make institution repeat activities done by other institutions. Also formats and gaps of available information hinder smooth exchange of such information.
- Awareness at the level of decision making as to what are the capabilities of these modern technologies in terms of timely environment information provision.

4.2 Achievements

- Networking and cooperation among participating members has increased. This can be seen in terms of data exchange and visits, invitation to seminars and conferences.

- Since the technical committee worked as a team and passed the message to other users as to which materials has been produced the demand for these materials even in draft form has gone up.

- Some donors have shown interest in funding the sub- programmes after preparation of the EIS Investment Programme.

GIS USERS IN TANZANIA		
NAME	HARDWARE USED	SOFTWARE
National Environment Management Council	IBM	Arc/info IDRISI
Tanzania Fisheries Research Institute	IBM	IDRISI
Tanzania Wildlife Research Institute	IBM	IDRISI Arc/info
Ruaha National Park	IBM	Arc/info
Institute of Resource Assessment	IBM IBM Compatibles	Arc/info Spans IDRISI
UDSM - Zoology Department	IBM	IDRISI Map/info
Ardhi Institute	IBM	ILWIS IDRISI
RIPPS - Lindi	IBM	IDRISI
Soil Service Unit	IBM	SYSTAN Arc/info
Mineral Data Base Dodoma	IBM	AutoCAD
Marine Institute, Zanzibar	IBM	IDRISI

GIS USERS IN TANZANIA		
NAME	HARDWARE USED	SOFTWARE
Survey & Mapping Division	-	PUMATEC
Habitat Project, Dar	-	Ordering Arc/info
Tanzania Electricity Supply Company (TANESCO)	IBM	AutoCAD
Sokoine University, Forestry Dept.	IBM	IDRISI
Hydrology Dept.	IBM	IDRISI
Meteorology Dept.	IBM	-
Ministry of Agriculture - Early Warning System	IBM	-

For digital data outputs available - see the summary from D. Healy.

- The preparatory phase have given a working team a clue as to which institutions are prepared to cooperate.

We expect that after writing a long term investment programme for EIS some of the problems (if not all) will be taken care of and also try to see how the achievements can be maintained and doubled if possible.

5. CONCLUSION

The overall objective of Environmental Information Systems (EIS) is to support the decision making process for sustainable development in Tanzania.

Modern Technologies play a vital role in information management. They improve processing and access of information. But supply and demand for information is a two way process (there should be a dialogue between users and producers of information). Information produced should be simple and user demand driven.

In this process of data gathering and information production, available technologies are limitedly used to enhance the whole process of information management and dissemination.

EIS development should take care of local existing conditions and thus should be country or regional specific and for this reason I am convinced there is no blue print for EIS development for all countries. But the

essence of EIS development is to lead to data and information exchange among all interested parties and that such information facilitates timely planning and decision making process for sustainable development.

EIS development involves technical and institution structures through which information is produced and used. And since environment issues are complex multi-displinary and cross-sectoral then all interested parties must be involved in EIS development. I would like to quote chapter 40 of Agenda 21 which asserts that,

"The need for information arise at all levels from that of senor decision making at national level and international levels to grass-roots and individual levels. .... two programme areas need to be implemented to ensure that decisions are based on sound information:
(a) bridging the data gap
(b) improving information availability".

This has been seen in our preparatory phase as there are institutions which are really eager to see to it that a network of information users delivers the expected goods to its clients.

ZIMBABWE COUNTRY REPORT

I. Kunene and R. Mkwanda
Department of Natural Resources

ABSTRACT

Zimbabwe is a country with a population of 10 401 767 million (1992, Census) and has an area of about 396 000 square kilometres. This suggests a theoretical population density of about 25 persons per square kilometre. However in reality this is higher as about 30% of the country is considered inhabitable.

The country is endowed with natural resources that include good agricultural soils, minerals, hydrocarbons, water and forests. Further there is a good industrial base particularly in the manufacturing sector and agro-based industry. Tourist industry is also well developed and continues to grow.

The environmental field of the country is a complex arena which embraces the natural resources endowment, socio-economic and demographic processes and land use patterns which impinge on the environment. Its administration include issues of policy and the legal and institutional aspects of environmental management and sustainability.

The Ministry of Environment and Tourism(MET) through its various agencies and departments has the overall mandate of the conservation of natural resources, developing and administering the policies on environmental protection. Some of these tasks are carried out by the Department of Natural Resources(DNR), the Environmental Planning Co-ordination Unit(EPCU) within MET , Forestry Commission and the Department of Parks and Wildlife Management.

Apart from the MET, other institutions have environmentally active departments. These include the Ministry of Lands, Agriculture and Water Development, Ministry of Health and Child Welfare, Ministry of Local Government, Urban Development and Rural Resettlement, National Planning Agency and the University of Zimbabwe.

Rational management of natural resources and of the environment depends not only on the wisdom of decision makers but particularly upon the availability to them of the necessary, timely and relevant information and data. Traditional methods of gathering information and data have not been able to provide that. In the case where these have achieved, that there has been a lot money invested in the process. This is not cost effective.

Though Zimbabwe is covered by topographic maps at a scale of 1:50000 and smaller, the maps are not up to date. This is due largely to the cumbersome orthodox field survey process of gathering information/data and the manually production of the maps.

Furthermore there is lack of total coverage of the country on thematic information such as soils, vegetation cover, geology, hydrology and geohydrology. Where the thematic information exists it cannot be easily plotted onto the topographic base. Manual plotting of this information often leads to inaccuracies, inconsistencies between different organisations who attempt to plot the same information.

Earth-observing packages and spacecraft and advanced image processing technologies provide powerful tools for producing and analysing timely, up to date spatial, spectral and temporal information. Geographical Information Systems (GISs) technologies on the other hand provide a tool for effective and efficient storage and manipulation of remotely sensed
information/data and other non-spatial data/information types. These technologies together with the traditional methods give decision makers, environmental managers and researchers tools to sustainably manage the natural resources.

In Zimbabwe it is recognised though that the development of a comprehensive GIS system for resources and the environment of a country represents an enormous task which could absorb large sums of money and many hundreds of man years. Such an undertaking will only be worthwhile if there is high quality of data to be entered, and if there is a very carefully thought out plan of controlling data quality and the precision of co-ordinates which is needed. Most important it will require well-trained personnel and a committed support from the decision and policy makers especially in the form of the needed resources. Obviously it is an undertaking that can be achieved in partnership with the developed countries.

This is also equally true for the space technologies. Developed programmes in the adoption of remote sensing and GIS technologies are being undertaken by various government organisations in Zimbabwe. Some of these are outlined below.

The Zimbabwe Natural Resources Management Programme(ZNRMP) is a joint programme between the governments of Zimbabwe and Canada. The active participants in the programme are the Canadian International Development Agency (CIDA) through the Ontario Ministry of Natural Resources and the Zimbabwe Ministry of Environment and Tourism (MET). The programme supports two projects. The first project is housed under the Environmental Planning and Co-ordination Unit (EPCU)in MET. The second project is under the Research and Technical Branch (RTB) Project. One of the component of the RTB is to establish an Integrated Resource Information Systems (IRIS) Technology. The main objective of IRIS is to use GIS and related technologies in the sustainable management of natural and the environment. IRIS uses GIS software (namely ARC/INFO)to manage information/data and produce products such as maps and reports with it. Satellite imagery and GPS are some tools being used for data collection.

The ZNRMP is fundamental to the Ministry of Environment and Tourism(MET) as it gives it the necessary infrastructure, technologies and human resources to carry out its mandate on reporting on the state of the natural resources and the environment.

The Environment and Remote Sensing Institute(ERSI) programme is undertaken jointly between the Zimbabwe and Germany governments. The NRSF project goals are:

a) establish an operational remote sensing facility fully equipped with image processing, and GIS hardware and software, production photo-laboratory and a specialised printing press.

b) train Zimbabweans and nationals of the SADC region in remote sensing and GIS technologies.

c) offer services in remote sensing and GIS technologies.

The ERSI has developed to the extent that it is now fulfilling its objectives.

The Regional Early Warning Unit and The Drought Monitoring Centre are projects that are jointly undertaken by the WMO, Japan, FAO and ODA. It aims to provide information on agrometerology to the various national early warning units within the SADC region. Fundamentally it trains local personnel in the gathering, analysis and interpretation of data from meteorological and land observation satellites as well as data/information from other sources.

The National Vegetation Mapping will be undertaken jointly by the Governments of Zimbabwe and Germany. This programme will provide baseline information on the vegetation cover of Zimbabwe based on remote sensing and GIS technologies and field observations. The information will be plotted onto the 1: 50000 topographic base.

1. ADOPTED AND DECLARED POLICY ON SPACE TECHNOLOGY APPLICATIONS

Zimbabwe is richly endowed with natural resources which should be rationally exploited to the benefit of all its present and future generations. The judicious application of science and technology to the inventory, exploitation and management of these natural resources is fundamental to the development strategy and the efficient utilisation of the resources in ways which do not harm the environment. It is Government's position that the vast potential of space science and technology must be brought urgently to bear on the most pressing problems facing the country particularly in the rural areas. Government also believes that there is an enormous amount of scientific knowledge and technology outside the country that can be adopted to our environment and particular needs. Already in the Zimbabwe **FIRST FIVE YEAR DEVELOPMENT PLAN(1986-1990)** the Government committed itself to, inter alia, "... develop and strengthen an indigenous scientific and technological capability in terms of human resources, institutions, information collection and dissemination. The indigenous scientific and technological capability will constitute the basis for attainment of long term development objectives of science and technology."

2. NATIONAL INFRASTRUCTURES

Zimbabwe has a well developed scientific, research and development infrastructure that is co-ordinated by the **RESEARCH COUNCIL OF ZIMBABWE,** which is in the Cabinet and the President's Office. To ensure that the Council absorbs as much information on the needs of the country the following National Standing Committees have been established:

- Agricultural Sciences
- Natural resources and Environmental Sciences
- Industrial Development
- Mineral Resources and Earth Sciences
- Health Sciences
- Remote Sensing and Geographic Information Systems Sciences
- Social Sciences
- Informatics

Representation on these committees is from a wide spectrum across the country and includes people from the private and public sectors, parastatal organisations and non-governmental organisations.

The Research Council apart from co-ordinating the research activities in the country is also mandated to advise government on all science and technology policy issues, organise and fund national symposia on Science and Technology and other activities that may be initiated by any of the standing committees. Perhaps the most ambitious programme the Council has undertaken is the "Establishment of the Scientific, Industrial, Research and Development Centre (SIRDC). The SIRDC is the technology unpacking centre for the country and works in conjunction with the private and public sector and the universities. Under the SIRDC there will be about sixteen (16) institutes, among them the Environment and Remote Sensing Institute (ERSI).

Further to the activities of the RCZ other infrastructure that are conducive to the adaptation of the space science technologies and GIS as well as the environmental management have been put in place.

The Ministry of Environment and Tourism (MET) has the overall mandate for the inventory, management and monitoring of natural resources in the country as well as administering policies on environmental protection. These tasks are carried out notably by the **Environmental Planning and Co-ordination Unit (EPCU), the Department of Natural Resources (DNR), the Forestry commission and the Department of National Parks and Wildlife Management.**

The ministries of Lands and Water development, Agriculture, Health and Child Welfare, Local Government, Urban and Rural Development, and the three universities have environmentally active units/departments.

3. DEVELOPED PROGRAMMES

Careful efforts have been made to adapt the space science and geographical information technologies in the operations of the various institutions.

3.1 The Zimbabwe Natural Resources Management Programme(ZNRMP)

ZNRMP is appropriately located in the Ministry of Environment and Tourism is aimed at institution building with the support of funding from the Canadian Government. This programme has two main components: the **Environment Planning and Co-ordination Unit (EPCU) and the Research and Technical Branch**

(RTB). The RTB project comprises of Environmental Impact Assessment (EIA), IRIS and Documentation and Communication Centre (DCC) components.

The EPCU project will put in place the necessary machinery and regulations that will govern the appropriate protection of the environment in all the developmental programmes in Zimbabwe. It will further enhance the capabilities and capacities of the MET and its working partners in defining the economic and sustainable exploitation of the resources in Zimbabwe.

The IRIS project reinforces and improve the operations of the Department of Natural Resources. This programme has introduced into the department the necessary tools and technologies for it to be able to scientifically collect, inventories, analyse the natural resources of Zimbabwe. The project uses mainly a topographic base to do the following:

- þ implement and enforce regulations on environmental concerns. e.g. stream bank cultivation, gold panning, deforestation, industrial pollution etc.
- þ make a thematic inventory on the land use, agricultural classification, soil types etc.
- þ make an inventory of environmental interests, e.g. forest reserves, wetlands, fragile/marginal lands etc.

The creation of such a data base requires that the DNR works closely with its partners from various organisations as it is the later that generate the bulk of the information that is needed.

Further the DNR is using such technologies as image processing, GIS, GPS's, aerial photography etc. to create this database.

Once the data base has been created it can be queried at any level to give a report on the **"State of the Environment and Natural Resources in Zimbabwe."** This then allows for informed decisions to be taken on any follow-up.

At the same time the DNR is pioneering in the development of such systems in Zimbabwe. Regional co-operation is welcome. Through various links the department has made its doors open for those interested in the systems to approach them for consultations and discussions.

The same system is also linked to the INFOTERRA and the department is therefore able to provide and receive information that is related to the INFOTERRA activities on the environment and natural resources.

3.2 The Environment and Remote Sensing Institute (ERSI) formerly the National Remote Sensing Facility (NRSF).

ERSI is another indication of the determination of the Zimbabwe Government to adapt and make use of the space science technologies. The ERSI was established in 1987 with assistance from the then Federal Republic of Germany. Upon government's recognition of the significance of this facility a decision was reached that the ERSI should be transferred from its original host, the Ministry of Mines to the Research Council of Zimbabwe as one of the Institutes under the SIRDC referred to above. This moves gives the ERSI the degree of autonomy it needs and accessibility by the users without any prejudices on the part of the users. The

government of Zimbabwe believes that this is a necessary prerequisite for the success of the adaptation of the new technologies.

This programme is mandated to:

- þ establish a complete remote sensing facility in Zimbabwe
- þ b e the technology unpackaging centre for all remote sensing and GIS technologies
- þ provide services to users in remote sensing and GIS
- þ provide training in remote sensing and GIS in the Southern African Region.

This facility is fully equipped with image processing and GIS hardware and software, a fully functional photolaboratory with film writing facilities, training facilities as well as research facilities.

To date its major users are from government organisations, mining companies, agricultural organisations and international donor organisations. Its clients particularly in the field of training and consultancy services have come from Botswana, Lesotho, Namibia, Mozambique, Zambia and Zimbabwe.

It has worked equally well in co-operation with the FAO, UNDP, UNITAR/GEMS and the Southern African Development Community (SADC).

The above programmes give the basis on which other organisations develop their own discipline specific programmes. These organisations include the Agriculture and Extension Services (AGRITEX), the Forestry Commission, the SADC Early Warning Unit for food security, etc. These organisations have either commenced or have planned programmes that will use space science technologies.

4. APPLICATIONS OF SPACE TECHNOLOGIES AND GIS TO MANAGE NATURAL RESOURCES AND MONITOR THE ENVIRONMENT

Rational management of natural resources and of the environment depends not only on the wisdom of the decision makers but particularly upon the availability to them of the necessary, timely and relevant data and information. The traditional methods of gathering data and information have not been able to provide this. In the case where these have been achieved it has not been cost effective.

Zimbabwe is therefore developing systems and mechanism that would be cost-effective in information gathering for natural resources and the environment. Up to date the country has been covered with 1:50 000 or small scale maps.

However due to the rapid developments since independence it has been difficult to keep up to date records of the changes on the natural resources and the environment. Further it is not so simple to even plan for the future without due damage to the environment and the unnecessary depletion of the natural resources.

Currently there is lack of thematic information on the physical environment as it would be required by planners and decision makers. This includes information on soils, vegetation, hydrology, geology/geohydrology etc. Yet this information is a prerequisite for any meaningful developmental planning.

Where this information is available it cannot be easily collated and plotted onto topographic bases because of the inherent errors in the generation of the information. Manual plotting has in most cases been used for the plotting of this information and inconsistencies between different organisations who attempt to plot the same information.

To a large extent earth-observation packages and spacecraft and advanced image processing technologies provide powerful tools for producing and analysing timely, up to date spatial, spectral and temporal information. GIS's on the other hand provide tools for effective and efficient storage and manipulation of remotely sensed data, spatial information and other non-spatial information datasets. These technologies together with traditional methods give decision makers , environmental managers and researchers tools that can be used to sustainably mange the natural resources and the environment.

Zimbabwe recognises that the development and use of these technologies require massive investments in financial and human resources. Such an undertaking would only be worthwhile if there is high quality data to be used, and if there is a well thought out plan for quality control and the precision of co-ordinates which are needed. Most importantly it will require well trained personnel and a committed support from the decision and policy makers especially in the form of the needed resources. Obviously it is an undertaking that can be achieved in partnership with developed countries.

The following therefore summarises the efforts that have been undertaken by the Zimbabwe government.

4.1 Map Production

Topographic and topocadastral maps are produced primarily from aerial photographs. Zimbabwe is covered with blanket photography on a five year cycle at a scale of 1: 25 000 to 1: 30 000. this photography is used to update the 1: 50 000 and smaller scale maps. Further orthophoto maps have been prepared at scales of 1: 50 000. Basically satellite data has not been used for the up dating of maps largely because of the poor resolution for the scales that the maps would be required as well as the cost and accessibility of the satellite data. Further there has been not adequate facilities that are needed to implement these. It is government commitment now that the Office of the Surveyor General should be provided with the necessary resources to up date its facilities.
Already this department is exploring the ways of providing digital data, use of Global Positioning Systems as well as investigating the use satellite data for up dating maps.

It is the intention of the Surveyor General that it will eventually provide digital data to the various users in the country. The Surveyor General has also initiated the implementation of standards on the data/information that is produced in the country.

4.2 Thematic Map Production

Aerial photography has been used for mapping and assessment of the natural resources of Zimbabwe in various disciplines. These include: forestry and vegetation inventories, soil surveys, geology and mineral exploration, underground water development and land use planning. The provision of the information and maps for these disciplines is an essential prerequisite for development planning. The last ten years has seen

the gradual integration of satellite data and aerial photography for the production of the thematic maps. It is clear that the current thought in Zimbabwe is to integrate these various sources of data and to work in a multi-discipline environment.

Some of the major programmes are mentioned below.

þ Forestry/Vegetation mapping

The Forestry Commission is preparing a comprehensive inventory of the conditions and distribution of vegetation in the country in order to provide the planners with information that they can use. This exercise will provide a baseline data that can be used for monitoring the conditions of vegetation in the country. Further information will be made available on the forest resources that are available for exploitation,. However more significantly there will be built in monitoring mechanisms using space technologies to ensure sustainable management of the resources.

þ Agriculture/Agrometeorology

This programme is designed to establish the basis in terms of facilities and training of personnel as well as methodological approaches for fulfilling the long term objective of remotely sensed based information system to support the management and development of renewable natural resources and for the monitoring of rural land use. Further it contributes strongly to the monitoring of natural disasters such as droughts. The information provided also assists planners and decision makers on providing means of assessing the food security of the country.

þ Geology/Mineral Exploration and Underground Water Development

Currently space science technology is being integrated with geophysical and geochemical technologies for mineral exploration. The usefulness of these approaches is clearly demonstrated by the significant mineral discoveries that have been made in Zimbabwe during the last ten years. It is also shown by the demand that is made by earth scientists requiring training in these technologies from the ERSI.

Space science technology made a significant contribution in the development of the water resources especially during the last major drought that affected the whole of Southern Africa.

In so doing at the same time significant systems are being created that will have the necessary databases for monitoring the effect of these developments on the environment.

þ Environmental Impact Assessment on Development

As part of the IRIS programme the DNR is designing systems that will be used to monitor the impact developmental programmes will have on the environment. These systems incorporate the space science technologies and GIS . Up to date significant progress has been made on the impact of tourism on the Victoria Falls area using both aerial photography, satellite data and GIS. Equally so the technologies are being used to create databases on all major development projects in the country.

þ **GIS National Committee**

As for the users in Zimbabwe they have a national committee on GIS. The mandate of the committee is to ensure data standardisation, data sharing and data exchange are discussed at the national level. The meeting also acts as the fora for sensitisation of the use of GIS to potential users through organising national seminars and workshops.

5. TRAINING AND EDUCATION

As Zimbabwe moves into the operational use of space science and GIS technologies it is necessary to develop a solid training and education programme in the technologies.

It is important to note that all sectors of the economy are short of professionally qualified personnel and space science and GIS technologies will face even greater challenges in this area. It is important to have personnel with the scientific and technological know-how, particularly those that can manage and sustain the programmes that have been discussed above. Education and training Zimbabwe plays an important role in the context of the interaction between technology and society. This is especially more significant in that the country has only been exposed to these technological advances since 1980. It is hoped that education and training will contribute to adequate technology assessment capabilities. Some of this infrastructure includes the RCZ and the SIRDC already mentioned above.

Education and training requirements are for the following groups of people:

þ **Category 1**

Decision and policy makers who are responsible for making the resources for the acquisition of these technologies available.

þ **Category 2**

The professional scientists who carry out the various duties using the space science and GIS technologies

þ **Category 3**

It is important to create a pool of technical support staff, such as engineers and technicians who are responsible for the maintenance and serving of the hardware and software that invariably come with these technologies.

þ **Category 4**

It is equally important to train the trainers and educators at the various level of the education systems. These people are basically the first to interact with the future professionals etc.

þ **Category 5**

Finally the population in general needs exposure to these new technologies and perhaps the best way to reach them is through the media and communal gatherings etc.

In all these processes the important point is the education and training should be adapted to the level of the audience that it is aimed at. It is essential that in all our approaches it has been important to demystify the complexity of the technologies.

A significant step has been made for instance with the co-operation of the Ministry of Education and Culture to introduce a fairly sophisticated satellite receiving station at one of the schools in Zimbabwe. This station is run by the school pupils themselves. It receives data from the geo-stationary and polar orbiting satellites. The school has been provided with initial training for the teachers (five days duration) and the necessary software for the analysis of the data received. The data received is of use to pupils of biology, geography, maths, physics etc. At this early stage the pupils already start understanding the concepts and they can perceive the applications of these technologies.

The University of Zimbabwe's Surveying Department has started teaching a Diploma/Masters programme in GIS. The course accommodates all the disciplines.

6. CONCLUSION

The above describes in very brief terms the significant steps that Zimbabwe is making in adapting the space science and GIS technologies as a basis for the inventory, management and monitoring of its natural resources and the environment. Quite clearly Zimbabwe will not go it alone but will always seek partners in implementing these programmes. To date Zimbabwe is most grateful to those of its partners that have been open and willing to effect technology transfer to Zimbabwe.

Activities of the FAO/SADC Regional Remote Sensing Project in support of Food Security in the SADC Region*

C.A.J van der Harten, G. Farmer, K. Masamvu and D. Marikura
FAO/SADC Regional Remote Sensing Project, Harare Zimbabwe

1. Introduction

The FAO/SADC Regional Remote Sensing Project started its operations in June 1988 with funding from the Government of Japan. The funding terminated in 1992, after which the project continued its operational activities with financial support from the FAO Technical Cooperation Programme. The second phase of the project started in early 1994 with financial support from the Government of the Netherlands for a duration of three years. The project is the remote sensing component of the FAO/SADC Regional Early Warning System (REWS) and covers all eleven SADC countries. The main objective of the project is to strengthen national and regional capabilities in the area of remote sensing and GIS for early warning and food security through the establishment of an operational information system. The Meteorological Services Departments in the SADC region are the principal contact points of the project and through them information is channelled to the National Early Warning Units (NEWUs). Since its start, the project has been housed at the Meteorological Services Department in Harare, but moved to the SADC FSTAU building in Harare in June 1995. In this building also other components of FSTAU are housed, i.e. t he FAO assisted Regional Early Warning Unit (REWU) and Household Food Security (HFS) project, the European Union assisted Food Security Training project and the GTZ assisted Small-Scale Seed Production project.

At present the satellite data are processed by the project, and the information products are sent to the contact points and a number of users in the SADC region using mail courier services. Besides a continuation and further sustaining of the operational activities established under phase one of the project, during phase two specific attention will be given to the transfer of the processing technology to the principal contact points in the countries. To support this, electronic mail (e-mail) links are being established between the project, REWU and the Meteorological Services and NEWUs in the SADC countries. GIS technology will be used to further improve the information products and the analytical capabilities of the Regional and National Early Warning Systems. Finally, the project will establish a low-cost integrated satellite data acquisition system for NOAA and Meteosat data in Harare.

2. Project activities and set-up

2.1 Operational project activities

* Paper prepared for the SADC Regional Environmental Information Systems Conference in Gaborone - Botswana (19-23 June 1995).

Satellite data are acquired during the crop growing season (September to April) from Meteosat and NOAA, through FAO/ARTEMIS in Rome and NASA-USAID/FEWS in Washington. Satellite image products at a resolution of 7.6 km are processed every 10 days, i.e.current and long term cumulative Cold Cloud Duration (CCD) images and current, long term average and difference Normalized Difference Vegetation Index (NDVI) images. Examples of a current CCD and NDVI images are given in figure 1 and 2. In addition to the images, curves with CCD and NDVI time-series are produced for specific areas, see below. The products are distributed on a 10-day basis, together with ad-hoc information sheets, in digital and hardcopy format to a wide range of users in Government offices, donor agencies, embassies and national and international organizations working in support of food security and environmental monitoring. Finally, a monthly bulletin is distributed to all users.

2.2 Satellite image archive

The project has built up a Meteosat and NOAA satellite image archive covering the whole SADC region. At present this archive consist of NOAA NDVI images from 1981 to present, and Meteosat CCD and Number of Rainfall Days (NRFD) images from August 1988 to present. The image archive is in IDA format using the Hammer-Aitoff projection at a resolution of 7.6 km. At the moment the project is in the process of setting-up a new archive. For both NOAA and Meteosat data, similar image windows will be processed and the images will be converted from the 7.6 km Hammer-Aitoff projection into a Latitude-Longitude Platte-Carré projection with a grid size of 5 km. This projection and grid size will facilitate the use of the satellite images in low-end GIS systems, see below.

2.3 Hardware and software

For the processing of the satellite images the Image Display and Analysis (IDA) programme is used. IDA has been developed over the years with contributions from USAID/FEWS, USGS and FAO/ARTEMIS. It is a programme specifically designed for use on low-end PCS with low resolution satellite imagery. For hardcopy outputs, the screen capture programme Pizazz is used. To automate the processing routines a number of batch and command files are used. The project operates on a PC basis using the Windows 3.11 operating environment and has one 486/50, three 486/66, two P5/66 and one P5/90 PC's connected in a Local Area Network (LAN). The project LAN is part of the computer network in the SADC FSTAU building. In this network the different floors of the building are connected through a thin ethernet "backbone", which is connected on each floor to a "hub". The offices on each floor are connected through a twisted pair network to the hub. Through this system all floors and offices are connected, thus the different units and projects. Different workgroups are being set-up along the organizational structure of FSTAU. In the project LAN a P5/90 PC is used as the server, and has a hard disk capacity of 2 Gigabyte. The total hard disk capacity of the project is approximately 6 Gigabyte. For data backup, datatape streamers are used. As peripherals, the project has three HP Deskjets, two HP Paintjets, two HP Laser printers, and a small A3 size digitizer.

In addition to IDA, the project uses a variety of software programmes for GIS applications. IDRISI and Atlas*GIS are the two main programmes. For thematic mapping MapViewer from Strategic Mapping is used. In addition the project has supported the development of IDA GIS Tools (IGT). This is a flexible GIS "tool box" which can be used in combination with IDA and was developed during the first phase of the project. At present some enhancements are being made to the programme and a manual and tutorial are being prepared. The programme has an option to interpolate point data with a raster image as reference background. This technique is very useful to interpolate for example rainfall between rainfall stations with a CCD image as background reference.
Another function in IGT is a logical operator function (ImageCalc), which can be used to calculate new images based on an unlimited number of input images and a user-defined formula.

Since the project is using the Windows operating environment, it is planned to use Windows based software programmes. However, the DOS based IDA/Pizazz processing routines work very well under the Windows 3.11 operating environment. At the moment a Windows version of the IDA programme is being finalized. This programme, WinDisp, is being developed with financial support from the FAO Global and Information Early Warning System (GIEWS). This programme may replace the IDA/Pizazz processing software in the future. GIEWS, as part of the GIEWS Workstation development, has also supported the development of a number of user-friendly tools to manage and analyse spatial data. One of these programmes, GEOFILE, will be evaluated as a possible interface for the proposed SADC Food Security Information System (see 4.5. For the GIS programmes such as IDRISI a change will be made to the Windows versions as well.

3. Capacity building in the SADC Region

3.1 Training and Workshops

In addition to the operational activities, the objective of the project is to strengthen the analytical and processing skills of the principal contact points in the countries. For this purpose, the project organized a first Regional Workshop in October 1994, involving representatives of the Meteorological Services and NEWUs of the SADC countries. In addition, back-stopping missions were conducted to all SADC countries. During the remainder of the project it is planned to organize one or two more Regional Workshops, but for the training activities the project would like to concentrate on on-site training in the countries or in-service training in Harare. Through this, more specific guidance and training can be provided.

3.2 Technology and "processing" transfer

At present all processing is done in Harare. The information products are being prepared and send to the countries. One of the main problems is the timing. Since mail courier services are used, it takes several working days to sent the information products to the users in the countries.
Also, digital data are sent to the countries, and are used by the Meteorological Departments and NEWU's for more specific analysis. However, to be effective the satellite data should be received earlier than at present in the SADC countries. In order to improve this, the project is now receiving the data through electronic mail

(e-mail) from Rome and Washington. Furthermore, for the 1995/96 growing season it is planned to transfer the processing and preparation of the information products to the countries, by sending country windows of the NOAA and Meteosat images to the countries by e-mail and providing them with the capability to process the data and prepare the information products. Besides timing, additional advantages of the transfer of the processing technology to the countries is that the cost for mail courier services will be reduced considerably, and more country specific products can be prepared. Building of an independent capacity within each SADC country allows for national scale processing activity supported by regional level backstopping, coordination and networking.

3.3 Communication and equipment for the countries

In order to achieve a successful transfer of technology and processing of the products to the countries the project has taken a number of steps.

At present in some SADC countries direct Internet connections are available, but in most countries only secondary e-mail services are available or none at all. The availability of national Internet connections in the countries is mainly a matter of time, given that funds are available and in some countries legal problems are solved. While the project recognizes this development, it has started the implementation of an e-mail network in the SADC region, mainly for the transfer of digital satellite images, in order to start sending the image at the beginning of the 1995/96 growing season. In collaboration with a local company in Harare, the project has started the installation of high speed modems at the Meteorological Departments and NEWU's in the countries. These modems enable the users in the countries to be connected to a dedicated host in Harare and make it not only possible to communicate between countries in the Region, but also with Internet points elsewhere. A disadvantage is that the countries have to make international telephone calls to Harare, however the average connection time, even when collecting a satellite image, is less than 30 seconds, which is less than sending one page by fax. The system and software used is "Internet" compatible, and the users can be connected to a local Internet connection as soon as this comes available.

For the preparation of the information products, the Meteorological Departments will be provided with the necessary software, processing routines and colour printers. The project is looking as well into an upgrade of the computer hardware and it is planned to provide all Meteorological Departments with similar equipment. This will make technical backstopping and possible maintenance and troubleshooting easier.

3.4 Data acquisition equipment

As discussed above, satellite data are received through USAID/FEWS in Washington and FAO/ARTEMIS in Rome. At the moment data acquisition stations, i.e. Primary Data User Stations (PDUS) for Meteosat data and HRPT stations for NOAA data, are available at reasonable prices and the software and technology is PC based. Moreover, in a number of SADC countries such data receiving equipment have already been installed. These provide the opportunity for real-time products, produced within the SADC region, serving aspects of

timeliness, security of supply and, in the case of NDVI, higher resolution. The project is planning to install a PDUS and HRPT receiving station at the project/SADC site in Harare in combination with software which will enable processing database management of the images. A first outline of the system has been prepared and with the assistance of a consultant to most applicable equipment will be selected. It is planned to have the system operational during the second half of 1995.

4 GIS activities

4.1 Use of GIS technology in early warning systems

It has been recognized that the use of GIS technology is indispensable for the development of a number of analytical routines to better use and interpret satellite images for early warning for food security. Especially with NOAA/LAC data coming available in the SADC region, more specific routines have to be developed. The most used technique is a vector to raster overlay to extract satellite point or area average data for time-series. A good example are the cumulated CCD curves which were introduced by the project during the 1994/95 season. Average CCD values are extracted for selected areas from CCD images for all dekads during the growing season for a number of years using IDA.
The selected areas are available in vector format and used as overlays for the extraction of the CCD values. The CCD values are imported in Lotus 123, where the final curves are prepared. Two examples are shown in figure 3.

Another use of a GIS technique is the presentation of data on a map, i.e. the thematic mapping component. The curves, as presented in figure 3, can also be presented on a map, for example as the percentage shortfall in Cold Cloud Duration or rainfall, or more qualitatively, as a description compared with other areas. An example is presented in figure 4. The areas on this map represent, more or less, the main maize producing areas. First those areas were used to extract data, and secondly they are use for the data presentation.

GIS technology can also be used for more complicated analytical procedures. Good examples are raster map overlay procedures, especially to overlay different indicators. A logical operator function, such as the ImageCalc function in IGT and the Algebra function in IDA, can be very useful. IDRISI has in its latest version the possibility to do a multi criteria evaluation (MCE) and different weights can be assigned to these indicators. Another option in this programme is to evaluate areas in more detail and try to find similarities through a principal component analysis. The project is evaluating the use of this option to define uniform areas in order to combine CCD and NDVI.

Finally, GIS technology will be used in support of the development and further improvement of the data base systems for food security information at regional and national level in the SADC region. The basic principle behind this is that data will be organized according to a geo-referenced framework, and that data can be queried not only by, for example, type or date, but also by geographic location.

A basic requirement for the development of the applications and the geo-referenced database is a database with layers such as, for example, administrative boundaries, roads, rivers, lakes, land use and crop zones, which is uniform in scale and format for the whole SADC region.

4.2 Problems encountered in the introduction and use of GIS technology

GIS technology is being used increasingly to capture, store, manipulate and display geographic data. During the last fifteen years or so, a number of GIS software programmes have been developed or improved and have been introduced during training workshops. A lot of "GIS" training has been provided, some with the objective to train participants in specific applications, and some for training in the use of specific programmes. While more people have started to use GIS technology, not much attention has been given to the coordination and harmonization of data bases developed for the specific GIS applications. As a result many users have developed their own data bases and duplication of work has occurred. Moreover, the data sets developed are not always interchangeable, because of the specific format dictated by the GIS software used or because the origin, scale, and for maps, the projection has not been documented. Especially for vector maps this has created a problem. A vector map can be considered as the spatial representation of selected features, such as national and sub-national boundaries, roads and rivers, of which the coordinates of the lines can be digitized.
If the lines enclose a map unit, such as a province, district, lake or crop zone this is called a polygon. A vector map can be considered as one of the basic requirements in a GIS approach. Amongst others, as discussed before, the map is being used to relate data in a georeferenced order.

It may appear that a wide range of vector maps are available in digital format. This is true. However, the problem is the incompatibility of the maps. This not only happens between countries, but also within one country, for example when the first level and second level administrative boundaries have been developed by different parties, using different projections, scales and base maps. What will happen is that the vector lines do not fit to each other, thus it is difficult to merge the two layers. More specifically the problem is that the different data sets, both at regional and national level, are available: (i) at different scales and projections, which in most cases has not been documented; and (ii) in different, sometimes incompatible, digital formats. If information is available on the above mentioned problems it is possible to use a GIS programme to convert one layer to the other. However, it is often the case that this is not available and the only solution is then to manually correct the layers, which can be a very time consuming and expensive exercise.

4.3 Need for data harmonization and the development of an uniform, standard vector data base for the SADC region

The encoding of maps is the most costly step in applying GIS technology. This has been recognized by different organizations and institutions who are using GIS technology in their work, and most of them have expressed the need to collaborate in the establishment of standards for data exchange. The need for digital maps may be different, but the establishment of standards will make it possible to exchange these maps, and thus reduce the cost for the digital encoding of maps. In general, an uniform standard vector data set for the SADC countries will contribute to the development of more specific routines to interpret and analyse satellite information and will serve as a standard geo-referencing system for the proposed SADC food security information data base.

A large number of vector data bases are available in the SADC region, each developed for a specific purpose or application. The project will initiate a number of activities in order to develop an uniform regional standard vector data set for SADC, based on the Digital Chart of the World (DCW), through merging and enhancing the DCW with existing data sets. In collaboration with the Office of Arid Land Studies of the University of Arizona the data base will be developed and will contain the following coverages:

1. Administrative and natural boundaries (national, second and third level sub-national boundary, coastal islands, land cover features and built-up areas);
2. Infrastructure (roads, railroads, utilities, road and railroad bridges, airports);
3. Hydrology (perennenial water, drainage, dams and rapids, small lakes and islands);
4. Topography (contours, spot elevations, supplemental contours);
5. Forest, wetlands and protected areas;
6. GIEWS main crop zones;
7. Zimbabwe communal lands, natural regions and farming areas;
8. Swaziland agri-ecological zones;
9. Malawi RDP and ADD layers.

These data layers are expected to be available by June 1995 and will be available in the Atlas*GIS ASCII export file format, in short BNA format, while the master copy will be held in Arc/Info export format. The resolution is 1:1 million and the layers will be in the Latitude-Longitude Platte-Carré projection. The rationale behind the BNA format is a "working" format, in that this format is used by a wide range of popular programmes such as IDA, IGT, GEOFILE and WinDisp and that it can be imported directly into low cost GIS programmes such as Atlas*GIS, IDRISI and ILWIS. The master copy is in Arc/Info format in order to enable "maintenance" and updates of the vector data set using the more powerful Arc/Info programme.

4.5 Application development and GIS training

The project is looking for close collaboration with other groups and institutions working in the field of GIS and remote sensing. One of the objectives is to build regional capacity to maintain and further develop the SADC vector data set. Another objective is to develop applications tailored to specific needs in a particular country. In this respect the project will not concentrate on GIS software training, but training will focus on

assistance in the development of applications, through national training sessions or in-service training in Harare.

For the maintenance and update of the SADC vector data set a host organization at regional level will need to be identified. Also at national level, where possible, a host institute will be selected. These institutes will be asked to take the responsibility for the vector data set and technical personnel will be trained in the above mentioned tasks.

Application development will mainly concentrate on a better use and understanding of the satellite information, for example by looking at the data for specific areas, such as the natural regions in Zimbabwe (see figure 5).

Another important aspect will be the Food Security Information System (FSIS) for SADC. For this data base development the REWU, in close collaboration with the RRSP, and with the assistance of two consultants prepared a detailed report. Based on this report a proposal, to seek funding from the FAO Technical Cooperation Programme (TCP), was prepared for the development and implementation of the FSIS. At the moment this proposal is being evaluated by FAO in Rome and is expected to start in the second half of 1995.

As mentioned before, the design of the FSIS will be based on the food security workstation developed for the Global Information and Early Warning System (GIEWS) in Rome, also called the GIEWS Workstation. This workstation is built-up from different components of which the workstation interface programme GEOFILE is the most important one. GEOFILE allows the organization of data files, in its original format, in a georeferenced frame and the use of these files in the software programme they have been created. For example, a WordPerfect file in WordPerfect, an IDA image in IDA, etc. Other modules are a programme for the display of satellite data together with thematic information, WinDisp; an interface menu for the Lotus Crop Cereal Balance Sheets; an Internet mail facility; and a news agencies interface for Reuters and Agence France Press.

In the FSIS these modules will be adjusted for use in SADC. The objective is to implement the data base system first at a regional level in Harare and then transfer the design and technology to the countries. The long term objective is that through this system a uniform standard will be established in the SADC region not only for the maps and the thematic data, but also for data base structure and the format of the data.

5. References

Demissie, B and N. Freeland (1994) Improvement of Database Systems for SADC Food Security Information. Report on Preparatory Activities. Consultancy report for FAO and SADC prepared in December 1994.

Marsh, S.E., C.F Hutchinson, E. Pfirman, S. Des Rosiers and C.A.J van der Harten (1994)

Development of a Computer Workstation for Famine Early Warning and Food Security. *Disasters*, 2, 117-129.

AFRICALINK
D. Dworkin

1. Why get connected to the Internet?

1.1 Opportunity

We can, at relatively low cost, communicate in near realtime to over 20 million users world wide.

This global community of users can help solve our day to day problems.

We can also communicate instantly with colleagues across town or across the street.

We therefore become more efficient and more effective in our work.

1.2 Obligation

Getting connected to the Internet is a measure of our commitment to stay in contact, and continue to learn from each other, between meetings.

We gain confidence and credibility.

2. Goal and Purpose

þ Goal

To connect over 100 - but potentially 100's - of collaborating institutions in Africa to the Internet.

þ Purpose

To improve networking and information sharing between African institutions, between African institutions, between African countries, and between Africa and the rest of the world.

The day of the $10 fax is over

3. Assessment

WRI was asked by USAID to assess the local technical capacity in Africa to implement these connections as soon as possible.

To promote long term sustainability, USAID will work through existing email service providers, and other entrepreneurs, to establish and maintain these connections.

> *USAID money is welcome, but only if delivered in a manner that promotes self-sufficiency in communications and doesn't put small business people out of business.*

To assess this capacity, WRI requested cost estimates from email service providers to connect their local collaborating institutions to the Internet. 50 email service providers in 40 countries were contacted by email. Cost estimates were received from 15 email service providers.

The results of this assessment have been published as a draft report.

þ **Findings**

Significant local electronic communications capacity already exists in Africa.

By working through local email service providers, USAID can support the immediate connection of 100 collaborating institutions to the Internet at modest cost:

$500 for a modem, software and training

$1000 per annum operating costs

USAID can build incrementally on existing capacity in collaboration with other organizations that support electronic networking in Africa: IDRC, UNECA/PADIS, ORSTOM/RIO, OSS/UNITAR, AGRHYMET Regional Center in Niamey.

4. INCREASING INTERNET CONNECTIVITY IN SUB-SAHARAN AFRICA ISSUES, OPTIONS AND THE WORLD BANK ROLE MARCH 29 1995

- þ Fast vs. slow countries.
- þ Donor effort limited to small incremental changes.
- þ More proactive and deliberate policy required focusing on:

4.1 Proposed actions

4.1.1 Reforming obsolete regulatory frameworks

e.g. in Zimbabwe each modem has to be licensed @ $60/month.

- þ Initiate an intense policy dialogue with African Governments.
- þ Support deregulation, privatization, and competition.
- þ Capitalize on greed and fear.

4.1.2 Building self-sustaining networks

- þ Stimulate the demand for African IPs (see AFRICALINK report).
- þ Avoid creating parallel private networks.
- þ Support fee-paying users.

þ Support training.
þ Focus on strengthening within-country communications.
þ Quality of existing networks not a serious obstacle, even in Kinshasa.

5. STATEMENT BY AFRICAN ELECTRONIC SERVICE PROVIDERS

Statement made at the closing session of the Addis Ababa Conference on Telematics for Development in Africa. Addis Ababa, April 7, 1995

þ*It is with great pleasure that we have seen the importance of African telematics raised during this meeting. We hope that the result of the symposium will be to raise the profile of Africa in global communications and to get more of Africa on-line*þ

This statement is signed by service providers who speak on behalf of their 10,000 electronic mail users in Sub-Saharan Africa.

þ Donors and member states should recognize the key contribution of existing service providers and it is strongly advised that they consult and support these systems in the implementation of new initiatives.

þ These functioning local initiatives should be recognized both as independent systems as well as examples of successful donor projects.

þ All new initiatives should take in a sub-regional perspective.

þ New initiatives should be made with a view to providing a transitional path between existing levels of service such as dial-up store and forward systems to full IP connectivity.

6. LIST OF SADC COUNTRY OPERATORS

Silvio Almada	Angola	silvio@ridsang.gh.apc.org
Mike Jensen	South Africa	mikej@wn.apc.org
Venancio Massingue	Mozambique	postmaster@dzwo.uem.mz
Theophilus Mlaki	Tanzania	mlaki@hnettan.gn.apc.org
Erik Rowberg	Tanzania	erowberg@marie.gn.apc.org
Bill Sangiwa	Tanzania	wsangiwa@hnettan.gn.apc.org

7. WHAT INFORMATION DO WE EXCHANGE DAILY?

- Technical support.
- Listserv(ESRI-L, etc.)
- Requests for documents, maps, databases, etc.
- Monthly highlights.
- Product announcements.
- Reports.
- Meeting minutes.
- Data.

8. GETTING CONNECTED TO THE INTERNET

To send and receive text email over the Internet, you will need:

- A communications program that will allow you to receive, edit and send email.
- A PC to run the communications program.
- A modem to convert the analogue signal transmitted over the telephone line to a digital signal that the PC can understand and vice versa. The speed of a modem is measured by the number of bits per second (baud) it can transmit. A 2400 baud modem is sufficient for most purposes.
- A telephone line to connect the modem to the outside world.

If you need help buying a modem or communications program, installing the hardware and software, or if you have the necessary equipment and want to get connected, you should contact your local email service provider (SP). You will send email to, and received email from, your SP. Your SP will connect daily to an Internet gateway to exchange international email. Most countries have more than one SP. Some have no known SP.

It costs about $500 to buy a modem and communications program, and pay your SP to open and email account, install the hardware and software, and provide initial training. You will have to pay for your telephone calls to the SP, and for the email you send to, or receive from, the Internet gateway. Most SPs charge about $0.40 (200 CFA) per 1024 characters sent or received. This is equivalent to about $0.25 (125 CFA) per email message.

For further information, please contact:

Adam Lishan, PADIS/UNECA P.O. Box 3001, Addis Ababa, Ethiopia +251 1 51 11 67 +251 1 51 44 16 FAX lishan@padis.gn.apc.org	Pascal Renaud, ORSTOM, 231 rue La Fayette 75010 Paris France +33 1 48 03 76 09 +33 1 48 03 08 29 renaud@orstom.fr

Prepared by Jake Brunner, World Resources Institute & Koffi Koaukou, World Bank.

AFRICAGIS'95, Abidjan, Cote d'Ivoire, March 6-10 1995.

AFRICA DATA SAMPLER

N. Henninger

1. BACKGROUND

The World Resources Institute has initiated a project to develop and distribute an internationally comparable set of digital maps at a scale of 1:1 million for every country in Africa. The Africa Data Sampler (ADS) will help meet a growing demand from African organizations and donor agencies for digital and paper base maps that can be used to visualize and assess environment and development conditions for the whole country. The ADS will be based on the Digital Chart of the World (DCW) which contains data on drainage, topography, and infrastructure. Additional data on protected areas, forests, mangroves, and wetlands will come from the World Conservation Monitoring Centre (WCMC). Sub-national administrative boundaries with corresponding selected demographic statistics will be provided by the National Center for Geographic Information and Analysis (NCGIA).

These data will be introduced through a series of Guided Tours and Views. The data sets will be stored in geographic-referenced map features with descriptive tabular data. The Guided Tours will use a Windows-based map viewing and query software and are accompanied by descriptive text in a User's Guide. The digital format will allow users equipped with readily available hardware and software to view, query, print, and distribute maps.

Data Samplers will be available for all African countries. Maps from different countries can be easily combined to create regional, watershed, and other transborder maps (albeit with varying data quality within and among countries). Data Samplers for each African country will be distributed on diskette and for the continent as a whole on CD-ROM.

With the release of this prototype Africa Data Sampler, the World Resources Institute and its collaborators, the World Conservation Monitoring Centre and Planning and Development Collaborative International, Inc. (PADCO), are hoping to increase the availability of international digital maps and data, bring spatial information into the policy planning and decision making process, and provide a tool for high quality presentation of environmental information. The distribution and use of the ADS should ultimately work as a catalyst to invest in the construction of more up-to-date and accurate georeferenced databases, especially at the national and local level.

2. USERS AND USES OF THE AFRICA DATA SAMPLER

The data and structure of the ADS can support three broad levels of expertise and use:

- The Guided Tours and Views in the ADS can be used by non-GIS experts who are interested in reading and analyzing maps. The Tours provide these users with an overview of the data, introduce them to major tools and applications of the map viewing and query software, ArcView, and allow

them to prepare simple maps of national parks and forest areas, roads and cities, population densities, and other features which can then be incorporated in reports and presentations.

þ Policy analysts can integrate the ADS's internationally comparable data sets (assuming the data quality is judged as adequate) into their own digital maps.

Those familiar with spreadsheet programs and ArcView can add and modify attribute data. For example, the data can be used to assess growing stress on critical habitat or cropland. Policy analysts can also use these data to assess national conditions and compare them to conditions in neighbouring countries and regions. The ADS can be used in training students to prepare and analyze their own maps.

þ Because the ADS is distributed in the ARC/INFO software format in decimal degrees, geographic information from the ADS can be used in GIS applications. GIS experts can either use all or parts of these data in ARC/INFO software or import the data to other widely-available GIS and mapping programs (e.g., Atlas*GIS, MapInfo, Idrisi). These programs can then be used to edit the data, produce quality cartographic output, or add geographic information. For example, location of projects and project information can be added to the ADS. This information can then be used to help program planners in locating projects in areas of need and assist in project management.

3. WHAT THE AFRICA DATA SAMPLER IS NOT

The Africa Data Sampler is not an official national base map for any country. The digital data sets are not comprehensive. They are rather a sample of international digital information made available at a country level. Because of the limitations in scale, compatibility, and data quality inherent in the ADS, it cannot be used in its present form as an analytical tool for a country's planning and decision making in areas such as infrastructure management, environmental impact assessments, forestry concession, or agricultural extension.

4. HOW TO OBTAIN THE AFRICA DATA SAMPLER

Country diskettes and the CD-ROM with the continental data set are expected to be released in summer 1995. The CD-ROM will be available for purchase from WRI.

WRI will provide key African institutions such as national environmental in-formation centers, resource planning departments, national NGOs, and universities with a complementary copy of the country specific diskette version and accompanying User's Guide. You can request a data sampler by contacting us directly, indicating briefly the intended use and that you have the necessary hardware and software to run the data sampler. We recommend an IBM or compatible PC with an 80486 or higher processor, a minimum of 8 Megabytes of RAM, and PC ArcView 1 for Windows to run the Guided Tours.

For further information contact:
Africa Data Sampler Project

World Resources Institute
1709 New York Avenue, NW
Washington, D.C. 20006
USA

fax +1 (202) 638-0036
internet nhenninger@wri.org

Presented on the next page is a list of the principal geographic layers in the data sampler.

LIST OF PRINCIPAL GEOGRAPHIC LAYERS

Layer	Feature	Description	Source
BOUNDARIES/BUILT-UP AREAS			
Country boundary	Polygon/Line	Political boundary	DCW
Coastal islands	Point	Islands (part of national territory)	DCW
Land cover features	Polygon	Selected surface features	DCW
Cultural landmarks	Point	Mines, power stations, ruins, etc.	DCW
Urban areas	Polygon	Built-up areas (general shape & name)	DCW
Settlements	Point	Location and name	DCW
INFRASTRUCTURE			
Roads	Line	Primary, secondary roads, and trails	DCW
Railroads	Line	Railroad lines	DCW
Utilities	Line	Power transmission lines & pipelines	DCW
Transport. structures	Line/Point	Bridges, tunnels, etc.	DCW
Airports	Point	Airports	DCW
HYDROLOGY			
Perennial water	Polygon	Lakes and large rivers	DCW
Drainage	Line	Drainage network	DCW
Drainage	Point	Dams, rapids, wells, etc.	DCW
Small lakes/islands	Point	Small lakes and islands	DCW
TOPOGRAPHY			
Contours	Polygon/Line	Elevation contours	DCW
Spot elevations	Point	Points with recorded elevation	

DROUGHT MONITORING IN SOUTHERN AFRICA

B.J. Garanganga (Co-ordinator) and W. Zhakata (Meteorologist)

1. INTRODUCTION

Due to the perennial droughts of the 1980's across the Horn of Africa and elsewhere on the continent there were many meetings by various African governments and specialised agencies of the United Nations and other sub-regional institutions. These meetings led to the conceiving of a Project on Drought Monitoring for Eastern and Southern Africa (RAF/88/044) funded by the United Nations Development Programme (UNDP) with the World Meteorological Organization as the Executing Agency. This resulted in the establishment of the Drought Monitoring Centres, one located in Nairobi (Kenya) and the other in Harare (Zimbabwe).

The Drought Monitoring Centres (DMC's) are charged with the responsibility of monitoring drought in a timely manner with respect to its intensity, geographical extent, duration and impact upon agricultural production and giving early warning for the formulation of appropriate strategies to combat its adverse effects. The preparation and dissemination of the drought related products, commenced in March 1991.

2. ACTIVITIES BY AND OUTPUTS FROM THE DMC's

The following is a sample of the range of activities from the centres:

- þ establishing and updating historical and near real-time regional climatological agrometeorological and hydrological data;
- þ adapting and developing new methodologies in drought monitoring;
- þ training member countries' personnel in drought management across the subregion;
- þ technical backstopping missions to participating countries;
- þ participating in international fora on climatological and environmental issues;
- þ establishing linkages with the existing food security Early Warning Systems in the subregion to ensure the use of common facilities and the joint development and management of data banks;
- þ collecting and processing of available information on the status of vegetation, crops and soil through modern facilities established as specialised centre/services;
- þ preparing and disseminating in a regular and timely manner, relevant products and advisories on drought including its onset and cessation, its severity and extent, etc. This involves the preparation and dissemination in map form or otherwise of relevant parameters such as rainfall and temperature anomalies, drought severity indices, drought risk, moisture stress, etc; and I) identifying the trainees for short courses and attachments to DMCs, and other international institutions, e.g. Climate Analysis Centre (CAC).

The DMC (Harare) is currently handling near real-time (daily and ten day) data (rainfall and temperature) from a total of 180 stations and climatological records for at least 300 stations from the SADC group of countries. The period covered by the daily records ranges from about 1910 to 1993 for the region. However, the lengths of the records vary quite significantly from country to country.

The main output from the DMC's is the assessments of environmental and climatic conditions in the region to allow early and timely monitoring of the possible incidents of drought and other adverse weather conditions through publication and dissemination of products. For southern Africa, the SADC Ten Day Drought Watch and the Seasonal Drought Watch have been major publications. These contain:

- Dekadal climatological summary and drought severity
- Dekadal Agrometeorological conditions and its impacts, and
- Dekadal synoptic review and weather outlook in the subregion.

The information provided to users by the DMC's gives them the necessary tools with which to provide early warning and to formulate appropriate strategies to combat the adverse impacts of drought in a timely manner. A questionnaire designed to evaluate the impact of the bulletin showed that virtually all the recipients of the ten day bulletin regarded it highly.

In addition to the above products, the DMC continues to embark on an exercise to develop new products in liaison with the participating countries and other users. The new products already or being developed include, probabilistic drought risk assessment, progressive rainfall season analysis to give agronomically useful results and extreme value analysis. Eventually, drought and other climatological indices will be generated and put on map.

Other products under development include, a documentation of the region's climatology in relation to drought, namely drought frequency, cyclone tracks in relation to the region's rainfall pattern and ITCZ's climatological positions also the updating of Southern African droughts and their association with El Nino/Southern Oscillation and other regional climatic anomalies is an on-going process at the centre.

3. DATA ARCHIVING AND PROCESSING

The huge amount of data involved in accomplishing the objectives of the DMC has given rise to the need to implement new ways of information presentation on maps using computers. As from November 1993, map contouring and shading for the bulletin were computerized, a development which made the DMC bulletins acquire a more professional look.

The use of computer systems for the storage, analysis and display of spatially related natural resources data is at an experimental stage at the DMC. These systems, commonly known as Geographic Information Systems (GIS's) are invaluable in addressing many resource management concerns. The idea of creating a computerised data bank has been realised by the introduction of GIS's which have made it much easier to store present, historical and near real-time regional climatological, agroclimatological and hydrological data.

The DMC, being one of the consumers of data derived from space technology as well as ground observations for environmental monitoring has resorted to computerising its activities, considering the volume of data to be dealt with for the entire region (Eastern and Southern Africa). Transference of tabular data from existing computer files is in progress whilst digitisation of maps is still at an infant stage.

The Drought Monitoring Centre uses data derived from two series of meteorological satellites, METEOSAT and NOAA. METEOSAT data are used to indicate areas with the high likelihood of rainfall having occurred, and to some extend the amount of rainfall. These satellite schemes assist in addressing the problem of ground based data sparsity.
However, to have more accurate interpretation more work is required to calibrate the remotely sensed data against ground data. The NOAA satellites provide the Normalized Difference Vegetation Index (NDVI) data. This gives an indication of the vigour of the vegetation, and from there an indication of vegetation season progress.

NDVI data covering Africa with a spatial resolution of about 7.4km date back to mid-1981. This data archive is based on a number of satellites in the NOAA series. Due to problems encountered in the operations of some of the NOAA satellites, leading to cessation of operations in some cases,f the user is bound to be careful to cross check the satellite data and any interprctation with other satellitc data, eg. Meteosat, and ground truthing.

Partly in response to the problems of loss of NDVI data, the Drought Monitoring Centre pays particular attention to the extraction of information from Cold Cloud Duration (CCD) data. CCD which expresses the presence of the convective clouds and the potential for rain by their duration below a particular threshold temperature, is one of the important factors considered when looking at the rainfall situation over the subregion.

Plans are in progress to fully utilize GIS's as storage media for manipulation and updating of environmental data acquired from multiple sources, including remotely sensed data. However, for the DMC to strengthen the capacity of using GISs technology, this can be achieved through training courses at Remote Sensing/GIS specialised institutions. The training should be aimed at enlightening those to be or already involved in GIS to perform nine general functions; managing GIS applications, GIS analysis, data base management, processing, cartography, digitizer/key operating systems, computer systems administration, programming and the final product analysis.

The planned launch of a series of satellites in space over the next decade will generate volumes of data some of which is of direct interest to the DMC, for the purpose of environmental monitoring and assessment. Hence, GISs will assume a more prominent role in the operational activities of the centre.

4. DMCs PERFORMANCE

The DMCs have already made a big impact in the region and many users have publicly acclaimed the services and products being of utmost importance to their operations. Perhaps it is pertinent at this juncture just to emphasize that the major target groups that benefit directly from DMCs services are National Meteorological Services, farmers, planners, decision makers and relevant regional and international institutions. For example the DMCs have consistently issued timely information to these target groups pertaining to the behaviour of the rains in Eastern and Southern Africa region during the 1991/92 drought and the subsequent rainy seasons.In particular, the DMCs had advised all relevant countries as early as March 1991 the possibility of an ENSO episode during 1991/92 period. They further cautioned on the anomalous weather pattern that would follow the onset of this episode in the region. In particular deficient rainfall in Southern Africa countries during December-February and in Eastern during March-May were predicted well ahead of time by the DMCs and advisory issued to this effect to countries and relevant Regional and International Institutions.

During the 1994-95 austral summer season, the DMC also issued warning of below normal rains for many of the SADC countries before the season actually commenced. The season behaved as the DMC had projected. Consequently, more requests were always pouring in at the centre for information related to the progress of the season.

5. INSTITUTIONAL LINKAGES

Institutional linkage so far established and/or strengthened include those with USAID's Famine Early Warning System (FEWS), SADC Regional Early Warning Unit (REWU), Norwegian and Swedish International Development Agencies and SADC-FAO Remote Sensing Unit. The links with FEWS have enabled the DMC to receive El Nino-Southern Oscillation (ENSO) advisories in operationally good time. In some cases, such advisories have been received within 5 days of the date of issue. SADC-REWU is one of the main users of the SADC DMC-ten day bulletin and technical exchange meetings between the two bodies are regularly conducted. Remote sensing products both on magnetic media and hard copy have been readily available for use at DMC from the Remote Sensing team. The remote sensing products have been very useful in complementing the DMCs rainfall data which in many cases is spatially inadequate. Other institutional linkages were beneficial in our product development efforts. Donor and volunteer agencies have from time to time visited the centre with special requests for information and products.

During the 1992-93 rainy season for Southern Africa, the DMC addressed a lot of such requests for up-to-date information on the prospects for that season, from both government departments, non-governmental organizations (NGOs) and other institutions. Such coordination is necessary in order to improve the quality of the range of products from the DMCs. Latterly the DMC has established another mutually advantageous partnership with CAC. There is also a fruitful partnership with ACMAD.

Strong links with large scientific bodies, particularly, the Climate Analysis Centre in USA, Australian and UK Meteorological Offices and the International Centre for Theoretical Physics in Italy are being established or strengthened. At the moment, arrangements are in place to get ENSO and other products from CAC

immediately they are processed. This facilitated timely advisories on the important state of the global atmospheric circulation and oceanic indices situation.

6. PLANNING FOR DROUGHT

There are many lessons learned from the past terrible droughts. The important message is that drought being part and parcel of the atmospheric circulation variability will continue to rear its ugly head from time to time. In fact, from the records going back to the turn of the century there are many instances of drought occurrences in the subregion. Thus, it is imperative to have in place institutions with a capacity to cope with any drought eventuality, to the extent that its effects are greatly reduced.

In order to effectively plan for drought and combat its negative impacts, strategies and policies must be developed and implementing machineries instituted.

There is a real potential to transform the DMCs into the centres of excellence in climate analysis and prediction with particular emphasis to the extremes across the subregion. This will be achieved by acquiring computer hardware (high speed) and developing regional expertise in climate diagnosis and prediction. The centres will then have a capability to:

- þ receive, analyze, and achieve global atmospheric and oceanic data to improve the scope and accuracy of the forecasts;
- þ accelerate applied research focused on climate predictability on seasonal to inter-annual time scales in order to systematically produce useful climate forecasts on regional scale for months to years;
- þ conduct systematic experimental forecasts on such climate variability and provide these to the appropriate agencies in participating countries;
- þ assist participating countries in effectively using these experimental forecasts to meet their particular social and economic needs; and
- þ shape and augment these forecasts by incorporating additional physical, agricultural, economic and other appropriate data, to the explicit socio-economic benefit of the region.

This will immensely benefit users of climate services in the region, i.e. institutions from both public and private sectors. Compared to the potential impact on the regional economy, the cost of maintaining the DMC is negligible.

These climate assessments will then be used by other scientists to construct national assessments of other physical variables which would then be used to predict other quantities of agricultural, industrial (i.e. fisheries) or other economic value.

7. CONCLUDING REMARKS

From the foregoing it can be seen that the DMCs play a key role in drought management for many users including policy makers, farmers, etc. While a great deal has been achieved by the DMCs in informing end-users of impending drought or other climate patterns within the region. But all these achievements of the

DMCs require consolidation and strengthening. The strengthening will lead to developing more and better schemes that will give users particularly planners, decision makers and farmers longer lead times in long-range weather forecasts. The longer lead time the better and more effective the preparedness.

SADC REGIONAL FORESTRY DATA BASE AND PROPOSED INFORMATION NETWORK SYSTEM

Ernest D. Misomali

1. INTRODUCTION

The mandate of the SADC Forestry Sector Technical Co-ordination Unit (SADC FSTCU) includes, among others, developing a data base on the region's forestry sector and facilitating the exchange of forestry information amongst SADC members. The SADC FSTCU has for that purpose developed a computerised Regional Forestry Database Management System with the intent of maintaining diverse data to facilitate decision-making processes in the forestry sector in the region..The data base system consist of eight data sets and represents most of the essential data requirements to facilitate region-wide planning of forestry programmes, projects and activities. An information documentation centre is an integral part of the system.

In order to facilitate exchange of forestry information amongst SADC countries, SADC FSTCU has also formulated a SADC-wide Forestry Information Network project. The project has two objectives, to improve the flow of information within and between SADC member countries and to provide an effective standard framework for storing, managing and reporting critical forestry information required to successfully define and implement forestry policy and programme in each SADC member state. A rim-effect networking model interconnecting the national centres with the SADC FSTCU has been chosen for the system.

This paper briefly describes the SADC Regional Forestry Database Management System and the proposed SADC Regional Forestry Information Network System. The need to include forestry information as a key component of the SADC Regional Environmental Information Systems Programme is advocated.

2. SADC REGIONAL FORESTRY DATABASE MANAGEMENT SYSTEM

2.1 The SADC Regional Forestry Database Management System (FDMS) provides most of the essential data requirements for region-wide planning, implementation and management. System development started in 1991 and it contains eight data sets, as follows:

- Human Resources, Education and Training Institutions
- Research (covering institutions, projects and publications)
- Forest Resources (covering indigenous and planted forests)
- Forest Management
- Forest Utilization, products and industries
- Forest Environment
- Forest Economics, and
- Basic Data, Donor Agencies and NGOs.

Attachment 1, provides a schema of the SADC Regional Forestry Database Management System.

2.2 **Hardware and software**

The system hardware and software comprise the following:

þ **Hardware:**

Compaq Prolinea 486 DX2 66 mHz, 8 Meg RAM, 240 Meg Hard disk

Backup system: compaq Prolinea 486 DX 33 mHz

Further backup on 3.5. inch HD Floppy disks.

QMS Post Script 420-2 Laser Printer and Panasonic KX-P1624 Wide Carriage Dot matrix printer

þ **Software**:

Lotus 123 version 4.01 for Windows

PC-File version 7.0 for DOS (currently beta testing PC-File version 8.0 for Windows)

WordPerfect version 6.0a for Windows

Lotus spreadsheets are utilized for data sets which have fewer than 30 records. Each record has its own spreadsheet and file name. The spreadsheet for data collection is the same for on screen data entry and usage. Statistics tables are linked to the Basic Data tables and thus automatically updated when data is entered in the Basic Data tables.

For data categories exceeding 30 records, the data base programme PC-File is used. PC-File reads and writes Dbase files (.DBF) and has a simpler interface than other more advanced programmes. Table 1 shows the data bases listed by Type.

Initially, information for the FDMS was being collected from the member states through structured questionnaires but the response rate tended to be generally varied and rather low and the quality of the data poor. The diversity of the information required and the need for credible nation-wide data has compelled the Unit to give same priority to data collection as to data management. Hence, national data collection is now done using national consultants.

Information is currently distributed at no cost to users which include policy decision-makers, researchers and planners in the SADC countries and SADC Forestry co-operating partners and interested organisations and individuals both within and outside the region.

An information and documentation centre located in the SADC FSTCU forms an integral part of the FDMS.

Table 1: Data Bases Listed by Type

Type of Data Base	**Data Base***
Human Resources Statistics	1-2-3-/O
Professional Human Resources Directory	PC-File
Education & Training Institutions	1-2-3/O
Research Institutions	1-2-3/O
Research projects	PC-File
Research Publications	PC-File
Forest Resources	1-2-3/C
Plantations	1-2-3/O
Growth & Yield	1-2-3/C
Forest Management	1-2-3/C
Forestry Publications	PC-File
Forestry Projects	PC-File
Forest Products	1-2-3/C
Forest Industries	PC-File
Forest Environment	PC-File
Forest Economics	1-2-3/C
Basic Data & Economic Indicators	1-2-3/C
Statistical Summary	1-2-3/C
Donor agencies	1-2-3/O
Non-Governmental Organisations	PC-File

* 1-2-3/O Data collected, stored and reported by ORGANISATIONS in Lotus 1-2-3 spreadsheets.
1-2-3/C Data collected, stored and reported by COUNTRY in Lotus 1-2-3 spreadsheets.
PC-File Data stored as records in PC-File databases

3. Proposed SADC Regional Forestry Information Network System

SADC FSTCU has formulated a SADC regional project to establish a Regional Forestry Information Network and National Forestry Information Systems. The establishment of the SADC Regional Forestry Information Network would seek to improve the flow of information within and between SADC member countries. The establishment of National Forestry Information System would seek to provide an effective standard framework for storing, managing and reporting critical forestry information required to successfully define and implement national forestry policy and programmes.

An electronic network for both formal and informal data exchange will be established with a regional node in the SADC FSTCU interconnected to national nodes located in the Forestry Department in each of the SADC member states. To facilitate data exchange and compatibility, a standard national database of National Forestry Information System will be established.

Nelson and Farrington in their book *Information Exchange Networking for Agriculture Development* define an Information Exchange Network (IEN) as *a group of individuals or institutions linked together on a voluntary basis with the primary objective of exchanging information on themes of professional interest in cost-effective ways*. The Regional Forestry Information Network System will be established with a similar objective, to facilitate exchange of forestry information for the mutual benefit of all SADC member states.

Figure 1 is a SADC region-wide schema of a rim-effect networking model interconnecting the national centres with the SADC FSTCU.

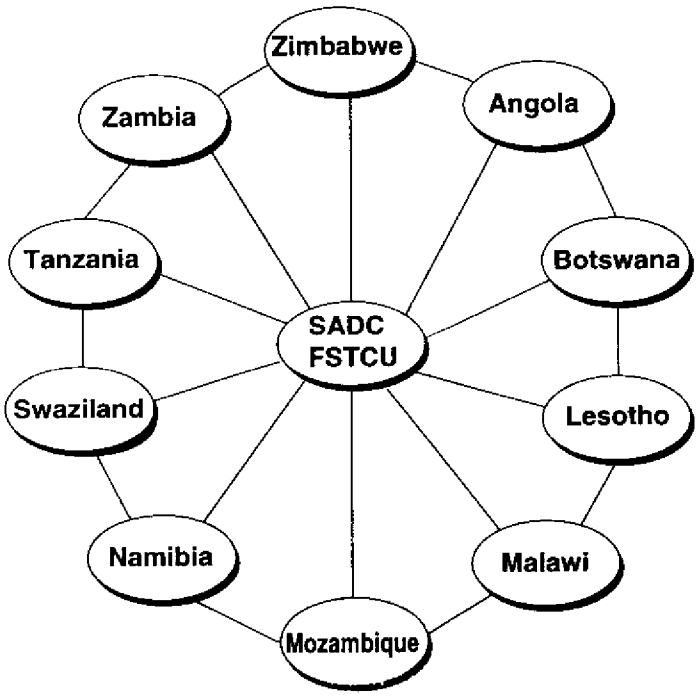


Figure 1 - The SADC Regional Information Network

The SADC Regional Forestry Information Network would provide benefits such as the following:

- þ provide a platform for the dissemination of SADC-wide forestry resource information
- þ increasing informal peer to peer communications and reducing the cost of such communications through an Email system
- þ enabling the generation of localised newsletters and bulletins by using standardised desktop publication environments extracting information electronically circulated
- þ providing a reliable electronic path for delivering formalised reports for forestry management in common formats both nationally and regionally; and
- þ provide a communication infrastructure for the establishment of as yet unidentified areas of potential information exchange both formally and informally defined.

Figure 2 illustrates an abstraction of data flow required at the regional and national levels to support the cycle of policy/programme definition, programme delivery, project delivery, activity/results logging, management reporting, programme assessment and policy/programme redefinition.

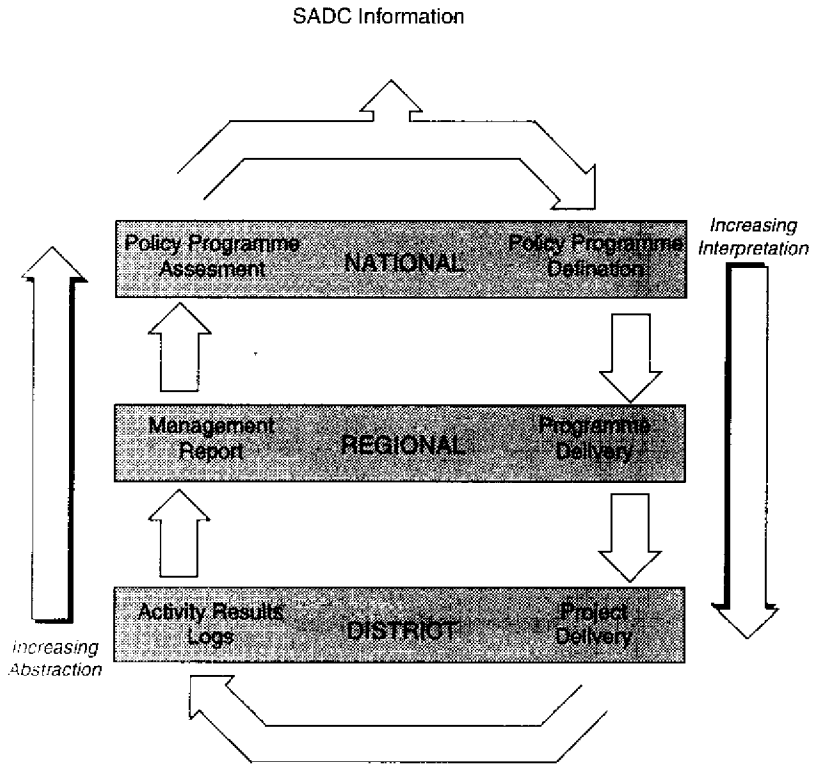


Figure 2 - Data Flow at the Regional and National Levels

The information flow from policy to project delivery (the implementation flow) is characterised by increasing latitude for interpretation (and hence for misinterpretation)

The information flow from activities/results logging to policy/programme assessment (the control flow) is characterised by increasing degree of abstraction (and hence for misinterpretation).

Interpretation error is reduced by greater, and more timely, access to the details.

IIn the case of the implementation flow, greater access to peers' successes and failures as well as guidance from management acts as a check to misinterpretation of programmes.

In the case of the control flow, greater access to comparative analyses of similar projects and readier access to the programme implementors acts as a check to misinterpretation of results. In SADC these checks are usually sought in the form of field visits, workshops, et cetera. This approach has the highest cost. As a result, information required to assess policy/programme success to correctly interpret /implement policy, programme objectives is frequently inadequate or absent.

A focus on an electronic network holds out the promise of at least partially correcting this weakness provided the network can be extended to at least the provinces in each country.

Figure 3 provides a generalised national schema of a rim-effect networking model interconnecting the key forestry centres with the national forestry centre (with provision for an interconnecting bridge to SADC FSTCU).

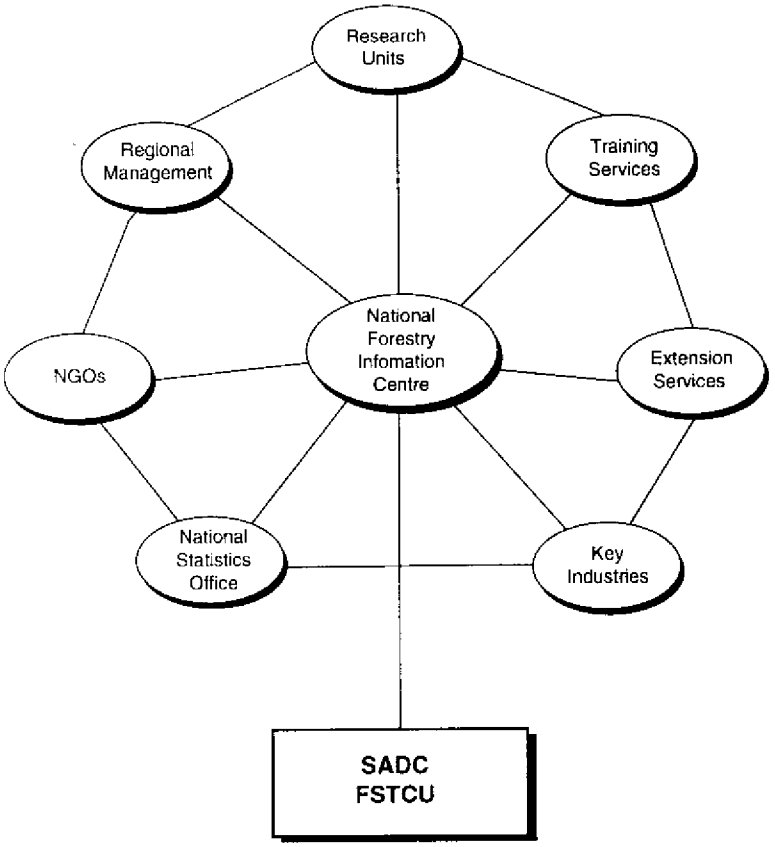


Figure 3 - A Generalized National Information System

The National Forestry Information System would have the following general design features:

- capable of storing national forest inventory databases for both indigenous and plantation forest: key fields for forest province and district; information on primary species, planting year, dbh and height.
- capable of storing soil, climate and environmental information keyed by province, district (plantation, forest/game reserve, national park, village etc).
- capable of storing utilisation (feulwood/charcoal, poles and other domestic products) statistics including quantities, source and destination keyed by province, district, or area.
- capable of storing silviculture (both indigenous and plantation), extension and protection activities at district level; and capable of aggregating these to province and national level.

- capable of storing industry and marketing statistics obtained by direct surveys at district, provincial and national levels.
- capable of storing and reporting on lists of funded projects.
- capable of storing lists of professional and technical staff at the national level including levels of training and current posting.
- capable of storing lists of educational/research institutes, NGOs and publications relevant to the forestry sector.
- capable of supporting customizable reports on individual or multiple databases to address particular national requirements.
- capable of supporting ad hoc queries across multiple databases.

The implementation of the system across the SADC region would introduce a de facto standard facilitating data exchange between SADC FSTCU and the member states and between member states themselves.

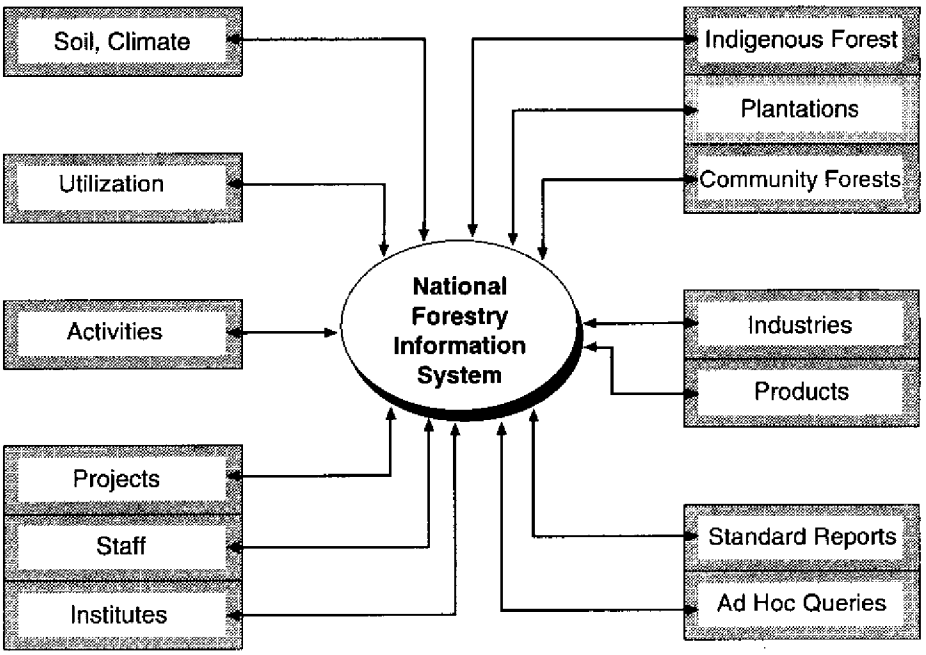


Figure 4 - National Forestry Information Systems and their Linkages

Figure 4 illustrates the various databanks of the National Forestry Information System and their linkages.

A SADC Regional workshop convened to discuss the SADC Regional Forestry Information Network System held in Pretoria South Africa in May, 1995 recommended setting up of task forces to develop the following:

- SADC Forestry Information Standards
- SADC Forestry Information protocol/agreement
- Technology Specifications

The SADC Forestry Sector has thus already initiated an Information Systems Programme and is ready and keen to play an active role in the development of the SADC-wide Regional Environmental Information Systems Programme. If adequate funding can be secured and the member states are committed, implementation of the proposed information systems programme could be guaranteed to succeed.

Finally, it is important to strengthen the institutional capabilities in the SADC Region. In Chapter 40 "Information for Decision-Making" of UNCED Agenda - 21, one of the important objectives referred to is:

"To strengthen local, provincial, national and international capacity to collect and use multisectoral information in decision-making processes and to enhance capacities to collect and analyse data and information for decision-making, particularly in developing countries."

REFERENCES

Environmental Assessment Sub-Programme, Global Resource Information Database - Proceedings of UNEP and IUFRO International Workshop in cooperation with FAO on developing large environmental Data bases for sustainable development. United Nations Avenue, Nairobi, Kenya. 14-16 July, 1994.

Government of the Republic of Malawi CIDA SADC Forestry Technical Services Fund Project, Feasibility Study: Development of a Forestry Information Management Network in the SADC Region, March 1995.

Nelson, J., and J, Farrington (1994) Information Exchange Networking for Agricultural Development, A Review of Concepts and Practices.

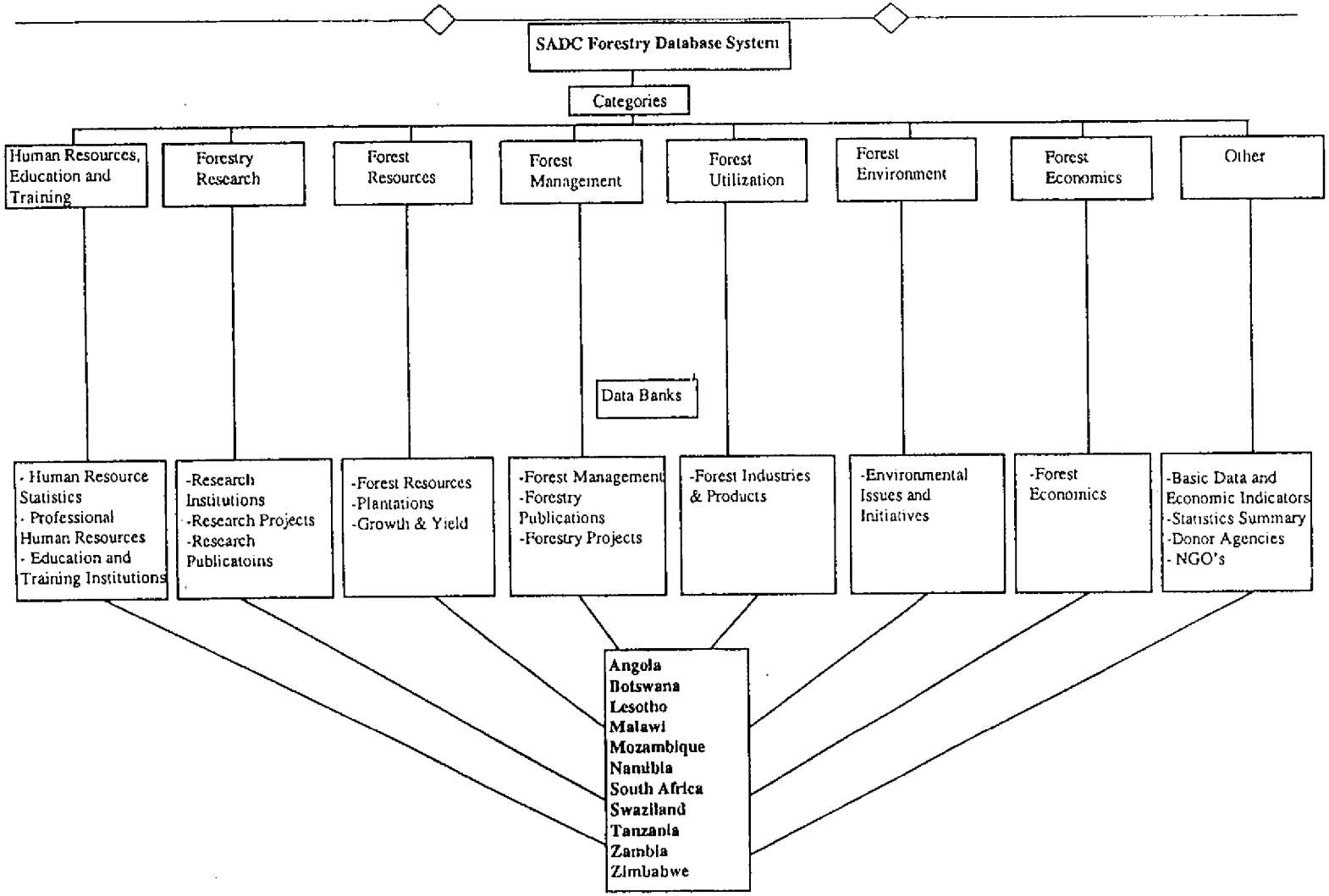
Misomali, E.D. (1994) Developing Large Environmental Data bases for Sustainable Development, The Forestry Chronicle Volume 70, No.2, March/April 1994: 128-129.

SADC Forestry Sector Technical Co-ordination Unit Malawi Institute of Management, Report on SADC Workshop on Establishment of Forestry Information Network.

Southern African Development Community (SADC, Management Information System - Report of Proceedings of Workshop, Regional and National Standards and Guiding Policies for Development of Information Systems and Networking Infrastructure in SADC, Lilongwe Malawi, 23-27 May, 1994.

ATTECHMENT 1

SADC Regional Forestry Database System



APPENDIX E

WORKSHOP EVALUATIONS

On the last day all delegates were asked to prepare a brief written assessment of the workshop. In particular, they were asked to comment on whether the workshop met the stated objectives and to make suggestions on improvements. The participant comments are as follows.

1 The objectives of the workshop were partially fulfilled. The following remarks are however to be considered:

- The absence of some delegations may be difficult on the necessary subscription of the recommendations.

- The lack of a coordinating body/person at SADC/ELMS for EIS issues is a major problem on the follow-up and enforcement of the major recommendations of the workshop.

Proposals: I expected this workshop to be a þlook forwardþ after the Harare meeting. So I propose that the following meetings be devoted to concrete aspects of EIS development in member countries to a regional perspective. Much attention must be given to:

strategy for data harmonization
concrete steps on networking
live examples on EIS use - Success stories
development perspectives.

2 What can I say? I walked into this unprepared and compounding the problem I found out there were two previous sessions.
OK, so I must say I will come away from here a lot more knowledgeable on GIS system and software than before. In effect that was the basic objective for my coming here, so I can say that I feel my trip was useful.

The future of EIS? What else is there to say but should the money keep flowing there a good chance that most objections can be met. However, in þthese timesþ there should be one or two contingency plans for anticipated funding shortfalls.

3
The objectives of the workshop were clearly followed and attained.

Actually the recommendations pertaining to network education and training were well brought up. They will help to enhance and bring to realisation objectives of the SADC/ELMS EIS goals.

I will be glad if the reports of the third workshop can be delivered in time unlike those of the second workshop.

Thank you.

4 Observations:

- No clear continuity between 1994 and 1995 Workshop
- Organizational components needed to be improved, e.g., per diem
- Organisation of the workshop itself, delegates, not informed on time.
- The program of activities unclear, posted version and version handed out at the workshop were different.
- No communication in between workshops (Harare & Gaborone)
- SADC/ELMS obviously understaffed.

Possible Solutions

- Timely arrangements
- SADC/ELMS could use E-mail services to improve their image

5 Many participants appear to expected answers on questions and problems etc. from the chair. There was little exchange across the room among participants.

Recommendation:

- Use a facilitator instead of a chair (especially for small group discussions)
- Very little spirit or initiative among participants, e.g., þLet's try something newþ or þ We would like to contribute x, y, z.þ
- Invite more participants who are in a position to make such contributions.

6.

- Proceedings from the Harare workshop were not delivered to the countries for participants to prepare themselves for the workshop.
- Too much time was devoted to country reports instead of the objectives of the meeting.
- However, good progress was made during group discussions and relevant issues were raised and deliberated on.
- The workshop facilitators were good and they were instrumental in getting issues of relevance discussed thoroughly, but not thrown aside.
- From the workshop clear recommendations and guidelines to SADC/ELMS were made and the way they are, it would be easier in the next workshop to know who failed to do what.
- It is important that a follow-up workshop be organised next year as a follow-up to the workshop recommendations.

7

- Most of the objectives were met, but concrete decisions were not taken because of the lack of the presence of Senior Officers from SADC/ELMS to discuss decisions concerning the role of SADC/ELMS EIS Sub-programme units.
- Recommendations and the report from the Harare Workshop were not communicated to member states. Besides, there was no report back on the follow-up activities coming out of the Harare Workshop by SADC/ELMS. As such it made participation difficult in the sense that the participants did not have up-to-date information on the status of the regional EIS.

Future Recommendations

- Reports and any other related information should be communicated to member states before another workshop is held.
- SADC/ELMS should arrange these workshops so that they are able to attend. Member states are not happy if SADC/ELMS fails to attend these crucial workshops.

8 Organisation -- OK, but subsistence came in late.

Objectives:
- All tasks of the workshop were discussed fully reaching at good recommendations.

Future:
- Organises to be at the workshop before participants.
- Money issues should be sorted out well in advance --before participants come in.
- Reports on previous workshops if connected to the intended one should be circulated before the first day of workshop.

9
- The objectives of the workshop were met and that full participation of the member states contributed a lot to the proceedings. There has been cooperation among member states.
- Proceedings of the previous meeting held in Zimbabwe were not distributed on time to member states for evaluation and to give an idea to those who did not participate. I implore that this should not be the case with this meeting. Member states should receive the proceedings as soon as possible.
- Organization on the part of reception: some participants were not welcomed at the airport which created some inconvenience to some delegates. Hopeful in the next workshop this arrangement will be done properly in an orderly manner.

10
- The objectives of the workshop were met. And there was full participation from the member states.
- The workshop was somehow disorganized, e.g.,
  - Some of the delegates were not welcome at the airport.
  - Invitation letters were sent late.
  - The per diem was given late which inconvenienced the participants.
  - Unreliable transport
  - Delegates were not given choice of accommodations. And therefore had to settle for the expensive accommodation.

Recommend:
- Next workshop invite people on time
- Give people choice of accommodation

11 Training and Education:
- The recommendations made by this workshop were all encompassing in covering all cadres. However we have not assessed the needs for training of TRAINERS, but I guess those needs at all the four levels should apply equally to this. In effect the training of trainers should take longer than any of the rest.

Networking of National Activities:

- This is very essential. Without it, I do not see how we can as a region achieve some of the objectives. Recommendations made are good.

For Future Improvements:

- Can we have the invitations (final letters of notification) sent out to prospective participants at least four weeks prior to the workshop?
- I have observed that some decisions made do not reach us at all. This aspect should be improved.
- Proceedings of workshops should be prepared at most two months after each workshop and distributed to delegates. This will facilitate implementation and assist in convincing our bosses of further participation at subsequent workshops.
- A focus is very important at these workshops. The chair style here has been very good as it provided clear direction. I wish to congratulate all who chaired sessions.

12

- The workshop objectives have been achieved satisfactorily.
- The resource persons were very helpful in directing discussions.
- The quality of presentation shows marked improvement compared to the past.

Suggestions:

- SADC/ELMS should send the proceedings of the report on-line. Letters and materials should express the issues to be discussed.
- One or two technical presentations should be included in the future.

#13

- Delay in circulating the 1994 Harare Workshop Proceedings made this workshop start at a slow pace, otherwise during the 2nd and 3rd day most of the things were ironed out.
- The workshop has been successful in achieving the objectives, despite that SADC/ELMS officials were not here from the first day.

14

- First and foremost, the conference proceedings were well coordinated and structure leading to open discussions which outline the course of future activities in the field of EIS/GIS.
- The recommendations which were submitted by the working groups lay the foundation for future activities. The nomination/suggestions of UB to deal with training are acceptable.
- The FAO is the best candidate for coordination considering that they have an infrastructure already in place and well linked to all SADC countries.

15

- For countries hosting the workshops, invitations should be broadened to ensure that relevant institutions participate.

16

- Poor flow of information about the workshop between SADC/ELMS - UB and some participants
- Lack of consultation by SADC/ELMS on decisions since the last workshop, e.g., choice of UB and FSTA as centers.
- Late payment of DSAs

- Absence of the report of the last workshop is regrettable
- However, the meetings were well organised
- The role of facilitators effective and very useful
- Country regional profiles well presented.
- Issues well covered - a good meeting

17 Organisation:

- Well done.
- All practical matters ran smooth

Effectiveness:

- Strong doubts if this the most effective way to get EIS off the ground in SADC context;
  - report of 1994 only distributed almost one year after 1994 Workshop
  - action items identified '94 were repeated in '95.
  -Apparently little action taken since last year
  - no mechanisms for monitoring/follow-up of action issues appear in place
- As platform for sharing info from SADC countries it works