

LAKE TANGANYIKA BIODIVERSITY PROJECT

LTBP GIS COMPONENT - REGION VISIT 31st May to 20th June 1999

VISIT REPORT

Alan Mills, Natural Resources Institute
Central Avenue, Chatham Maritime
Chatham, Kent,
ME4 4TB
UK
+44 1634 883366
+44 1634 883232
A.P.Mills@greenwich.ac.uk

Executive Summary and Recommendations

Aims

This report details the visit of Alan Mills to the LTBP region to

- assess the current status of GIS in the region,
- demonstrate the database and GIS interface (TANGIS),
- determine the support network necessary to sustain GIS activities for the Strategic Action Plan of the LTBP once the present project is completed,
- determine the training requirements for GIS.

Overview

AM obtained a comprehensive picture of current GIS capability for the three countries visited, and sought methods for linking the LTBP GIS to national data initiatives to assist in maintaining its sustainability.

The visit was an opportunity to liaise more closely with the institutes and individuals working on the project. New datasets were collected and methods of linking the Special Study databases to the GIS were discussed in detail.

Other technical issues were discussed during the visit, including the usage and location of the LARST satellite receiving station and the transfer of the web pages to the region.

Recommendations

1. MINATE ENVIRONMENTAL INFORMATION CENTRE , Burundi should be the centre for the metadatabase and co-ordinate data flows for the strategic action plan.
2. MINATE could also co-ordinate the LTBP Web Pages
3. Four National Centres should co-ordinate the updating of the Regional Metadatabase. These should be ECZ (Zambia), TANRIC (Tanzania), the LTBP Office, Uvira (DR Congo) and IGEBU (Burundi).
4. The co-ordination of the GIS datasets should reflect the information needs of the SAP.
5. Training and implementation of the GIS will occur in November and will be in a hierarchical structure:
 - Presentations to ministers and directors
 - Training of trainers workshops of using the database and TANGIS
 - GIS theory and Application for scientific staff
 - Metadatabase maintenance training
6. Further work is needed to ensure the integration of the important pollution and biodiversity database into the GIS.
7. LTBP should link in with the existing GIS community (identified by the established GIS Contacts Database) and the fledgling Environmental Information System Strategies in place in three of the four countries.
8. A more coherent role for the LARST station should be identified, with more emphasis on its future sustainability in a larger EIS community. It would be more sustainable if it were moved to the Meteorological Training School in Kigoma.
9. Long term investigation of putting the GIS datasets and system onto the World Wide Web should continue.

Contents:

Executive Summary and Recommendations.....	1
Aims	1
Overview	1
Recommendations	2
Contents:.....	3
Background	4
Aims of visit.....	5
1. GIS Capability in Region	6
2. Identification of LTBP metadatabase centre and proposed Implementation Strategy.....	10
GIS hardware and software review and requirements	11
The proposed data network for the GIS.	12
Selection of Regional Metadatabase and National Co-ordinators	12
Recommendations for regional centre, national co-ordinator and TANGIS Installations.....	13
Proposed Timetable for routine updating of data.....	14
3. Established and developing GIS Networks.....	15
Relationship of TANGIS to regional bodies	15
Burundi.....	15
Tanzania	16
Zambia.....	17
Implications for the LTBP database, GIS and proposed SAP.....	18
4. Linkages to other project components	19
General Comments.....	19
Pollution SS.....	20
Biodiversity SS.....	20
The BLOSS Survey database	20
The BLOSS Literature database.....	20
Sedimentation SS	21
Socio-economic SS	21
Environmental Education and Training Component.....	21
Legal SS	21
Fishing Practices SS	21
5. Proposed Training Strategy.....	22
Recommendations for courses:	22
1 Demonstrations.....	22
2 Course A – Getting to know TANGIS and the LTBP Database – Training the trainers workshops	22
3 Course B – GIS theory and application.....	22
4 Course C Metadatabase Manager.....	23
TOR for Metadatabase manager	24
Duties	24
Provisional Schedule and suggested participants.....	25
Participants	25
6. LARST	26
Background	26
Operation of station.....	26
Use of system within and outside project.....	26
Location of station.....	26
7. Transfer of Sun Workstation	28
Appendix 1 - Itinerary	29
Appendix 3 - Acknowledgements	31
Appendix 5 - Remaining work programme summary.....	32

Background

NRI provide Geographical Information Systems (GIS) and remote sensing (RS) inputs for the Pollution Control and Other Measures to Protect Biodiversity of Lake Tanganyika Project (LTBP). The aims of the GIS component are to provide a structured database which integrates data from the research studies and monitoring programmes, and seek to provide timely information to the activities of the proposed Strategic Action Plan (SAP).

The specific aims of the GIS are to

- Create, maintain and provide access to spatial datasets through metadatabase and catalogues,
- Integrate spatial datasets for project using a specially created interface (TANGIS),
- Support GIS activity for project,
- Increase spatial awareness among project participants.

Mr Ian Downey (ESD) made a visit to the region in November 1995 as part of the baseline review, establishing links with GIS facilities. A "Local Applications of Remote Sensing Techniques" (LARST) satellite station was installed in Kigoma, Tanzania in November 1997 by Mr Rupert Loftie (ESD). Since 1997, ESD have sought to achieve the aims of the GIS component through the establishment of a substantial geographical database of over 400 items. Known digital and non-digital data sources held by the project and elsewhere have been catalogued in a Microsoft Access metadatabase. A simple GIS interface (TANGIS) was created using Arcview GIS software to interrogate digital datasets, and tools for linking with the important databases held by the project's Special Studies are in preparation. Although the datasets have been publicised to all involved parties through the project's web pages, GIS and web page development has been exclusively in the UK.

A programme of regional implementation was started by this visit, to ascertain a suitable resting-place for the GIS and database, discuss training priorities and sustainability. The visit provided an opportunity to update links identified by Ian Downey and find new connections. A visit to DR Congo was not possible due to the security situation, but meetings with regional project co-ordinators and facilitators means GIS activities will be extended across the whole region (Burundi, D.R. Congo, Tanzania and Zambia). Discussions with project participants also helped to clarify the connection between the Special Study databases and the GIS, and how the GIS may have a role in supporting the Strategic Action Plan.

Additionally, the visit gave an opportunity to review the utilisation of data from the LARST satellite receiving system and consider how the GIS may link with the LTBP web pages.

Aims of visit

1. To investigate the GIS capability of potential collaborators as a follow up to contacts established in 1995 by Mr Downey.
2. To identify a resting-place for the LTBP database/metadatabase and formulate a mechanism for data transfer from researchers and national co-ordinators to the metadatabase centre and on to Strategic Action Plan and regional centres of information
3. Seek and encourage the development of a GIS user network in region.
4. Discuss database priorities with key Special Study collaborators.
5. Set up training priorities for GIS installation at end 1999.
6. Discuss the long-term future of the LARST installation and its application.
7. Investigate practicalities of transferring the Sun Workstation (containing Web Pages) from NRI to Lake Tanganyika region.

1. GIS Capability in Region

The LTBP GIS is targeted towards providing a structured database and interface for LTBP activities and data but there is limited support of hardware and software. Also, if sophisticated data capture, consultancy or training are needed for project activities, LTBP must seek outside help in the region. Visits to installations helped assess regional capability in support of these activities. GIS capability throughout the region was assessed in meetings at 11 GIS centres (see Appendix 1 - Itinerary). Equipment, project work and data quantity and quality vary considerably across the region, but there are some substantial centres with varying levels of data capture (e.g. digitizing, remote sensing), consultancy (database creation), databases (e.g. National datasets) and training facilities/capabilities. Many of these centres are in institutions already strongly linked to the project.

There are several existing and planned metadatabases of geographical information or installations in the region and these institutions were asked to add the LTBP GIS to their dissemination lists. These were:

- NEMC, Tanzania.
- TANRIC, Tanzania - AM asked for TANRIC to send a copy of the digital database of contact in the region.
- ECZ, Zambia - planning to be the Environmental Information Centre for Zambia, with support from the Ministry of the Environment
- AGEF, Burundi - this will become the environmental information centre, co-ordinated by MINATE.

The following tables summarise the GIS capability in the region as assessed during this visit (1995 data are used where no updates were possible).

BURUNDI

Installation	Hardware	Software	Staff experience	Training	Database	Consultancy
Appui de la gestation de l'environnement AGEP	2 large PC's, A0 Digitizer Scanners A0 Plotter	ARCVIEW & Spatial Analyst extension NT ARCINFO	3 well-trained staff in digitizing, presentation, database organisation. <u>Learning about GIS modelling</u>		Part of proposed MINATE Environmental Information Centre (EIC)	Source du Nil project AFRICOVER Project
IGEBU	2 PC's, A0 Summagraphic digitizing tablet A4 scanner A0 Plotter A4 deskjet and dot matrix printers	Basic ARCVIEW 3.1 ESRI Data Automation Kit (for digitizing)	1 GIS expert, mainly for digitizing Others with rudimentary GIS experience		Useful Hydrological data for Burundi. Centre for geographical data. Also access to meteorological and climatological datasets.	Source du Nil Project
INECN	unspecified no. A0 Digitizer 1 unspecified plotter	Basic ARCVIEW PC ARCINFO 3.5	Some training for AFRICOVER project. 2 staff able to use GIS		Environmental datasets sought	AFRICOVER Project
LTR	1 PC	Echobase (specific software for horizontal/vertical mapping and charting of lake data)	1 person able to use database in Bujumbura.	-	LTR database. Lake hydrology and fisheries information	-
University of Bujumbura (1995 information)	1 PC	Unspecified software	??	??-	-	-

TANZANIA

Installation	Hardware	Software	Staff experience	Training	Database	Consultancy
INFOBRIDGE	Unknown	MapInfo (Tanzanian MAPINFO Distributors)		-	-	New consultancy company formed from former UCLAS students
LARST Installation, TAFIRI (Run by MTC)	2 PC's, satellite receiving station	LARST Image processing software	Staff fully trained in data acquisition	-	LARST database of images	
NEMC	1 PC 1 Scanner (not working) 1 digitiser (not specified)	Arcview 3.0 PC ARGINFO 3.4D IDRISI ILWIS	1 well trained GIS expert	-	Co-ordinators of Tanzanian Environmental Information Network strategy Holders of Pollution Abatement Database	-
Survey & Mapping Department (1995 information)	Unknown number of PC's 1 A0 Digitiser	PC ARGINFO v. 3.4	Not known	-	Reports that the programme of digitizing the country is slowly coming together, but concentrating on Urban areas (ie. not LTBP study area).	-
Sustainable Cities	2 PC 1 digitiser	2x Arcview 3.0	2 GIS experts, producing high quality maps and a well structured database for Dar es Salaam	-	Definitive Dar es Salaam database (of little use to project but demonstrates careful design and execution)	Can do digitizing if necessary
TANRIC	3 PC's 4 A1 digitisers 2 A4 scanners 1 A0 Design Jet Plotter 2 Pen Plotters	Arcview 3.1 PC Arcinfo 3.5 (x3) IDRISI Winchips	3 well trained full time staff.	Able to offer short on-job training. Also offer training courses to Geography Department at University of Dar es Salaam	Metadatabase on GIS facilities in Environmental applications in Tanzania Distributors for land cover maps for GIS AM to receive list of datasets	Various consultancies in establishing environmental databases
UCLAS	Large number of PC's (c. 30) A3 & 2x A4 Scanners HP750C Design Jet Plotter A0 HP Pen plotter many standard printers CD Writer	20x 3.0a Arcview Spatial and Network Analyst extensions 1x Mapinfo PC ARGINFO (NT) IDRISI 2.2 PCI (planned) ILWIS Cartolinx	Well trained & motivated staff through EISCAP project.	2 large training rooms, sophisticated training facilities. Run 4 weeks theory and 4 weeks application courses (can be tailored).	-	Digitizing consultancy available Also interested in project work Excellent training facilities and programmes available

ZAMBIA

Installation	Hardware	Software	Staff experience	Training	Database	Consultancy
Computo-Geological Advisory Units (@ School of Mines, University of Zambia (UNZA))	4 PC's (15Gb & fast) 1 A0 & 1A4 Digitiser	ESRI Data Automation Kit Arcview 3.1, 3D and Network Analyst Extensions PC NT ARCINFO Easy Pace Image Processing	2 well trained GIS staff & 1 technician	-	Geological data for parts of Zambia	Digitizing and project work possible.
ECZ	2 PC's 1 A0 & 1 A3 Calcomp Digitizing tablets A4 only at present, but printer coming.	PC ARCINFO 3.5 2xArcview 3.0 Dbase IV	2 well trained staff & 1 4 th year UNZA student on placement. Database manager oversees.	-	Proposed hub of Zambian Environmental Information Centre	Digitizing possible.
Mt. Mkulu Agricultural Research Institute	2 286 PC - plans for new equipment 1 A0 plotter (not working)	ATLAS (old version)	1 staff trained at ITC, Netherlands. Others with limited GIS experience		Soil maps of Zambia	
UNZA (Surveys Department)	c. 20 PC's A0 & A3 Calcomp Digitiser Aerial photographic interpretation equipment 3x A0 Colour plotters	10x Arcview 3.0 Spatial Analyst & 3d extensions 5 x PC ARCINFO 3.5 ILWIS AutoCAD Freehand digitizing Package	Several technicians, 3 lecturers in GIS	Full training facilities, provides inputs to honours courses, also can provide short courses	-	Digitizing available.
UNZA Geography Department	2 PC's A0 & A3 tablet HP DJ Printer HP 7475a Plotter	PC ARCINFO 3.4D IDRISI ILWIS	??	??	??	??
Zambian Surveys Department (1995 data)	? PC's A1 Digitising table 1 Calcomp Pen Plotter Direct Digital Stereoplotters	1x Arcview 2 ARCCAD AUTOKAM	Development programme to train school leavers		map sales department	

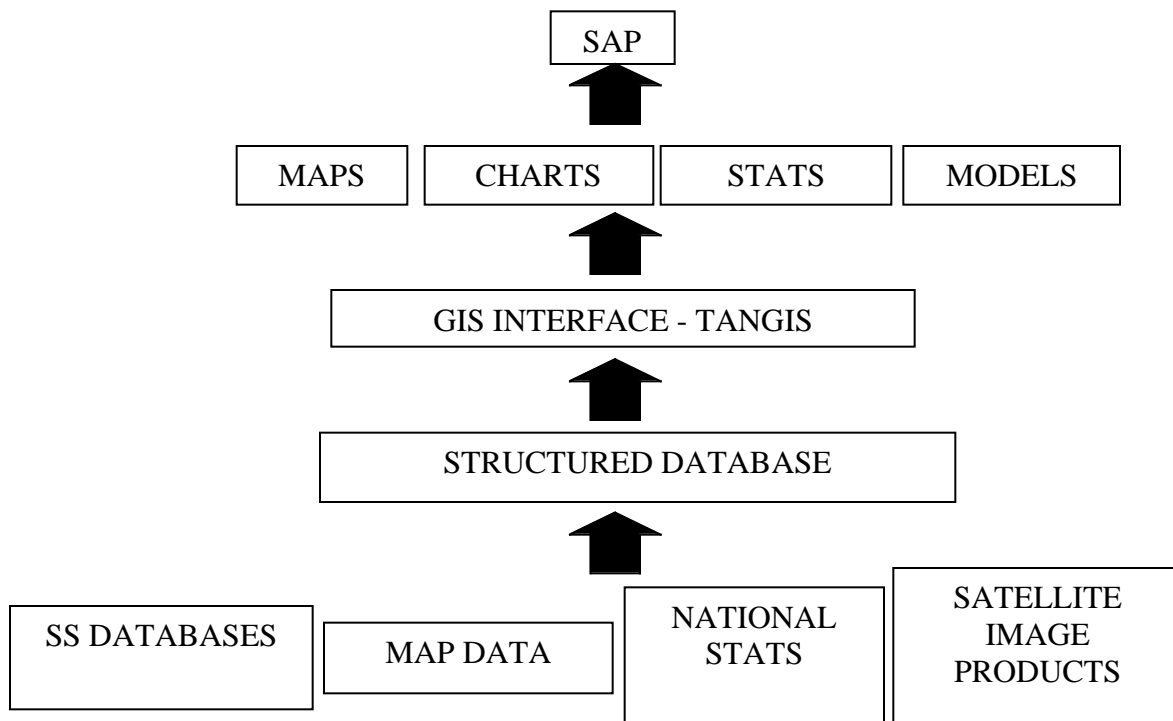
2. Identification of LTBP metadata centre and Proposed Implementation Strategy

The proposed strategy for implementing the GIS database, interface, and metadata attempts to address the issue of how timely data from the Special Studies can be passed up to the relevant bodies making management decisions for the Strategic Action Plan. The digital database and TANGIS GIS interface is not a static system and so cannot be installed in the region without supporting facilities, commitment and staff.

While the GIS may not have a role in every proposed data promotion pathway in the Strategic Action Plan, it will be a vital component in many of the activities. The advantages of the GIS are that it:

- Integrates data from disparate sources by virtue of their shared locations
- Demonstrates the jurisdiction of the data - the sheer size of the lake and its diversity cannot all be surveyed routinely. The GIS will demonstrate the extent to which the lake is being monitored.

The diagram below demonstrates the proposed role of the GIS and database in supporting the Strategic Action Plan. Spatial data for the project; from the Special Studies Databases, maps collected by the GIS component, National Statistics and census that may be available and satellite imagery, are all catalogued in a structured database. Using the TANGIS GIS Interface, timely and relevant maps, charts, statistics and models can be made that support project activities, and provide monitoring data for the Strategic Action Plan. It is hoped that in the months following this visit report, the details of the Strategic Action Plan will specifically highlight which areas the GIS can support.



The diverse nature of the institutes involved in the project and their geographical spread precludes the complete centralisation of GIS activity in one location. Therefore, a network needs to be established containing data providers, cataloguers and users. Additionally, clear protocols need to be established to maintain this network, defining responsibilities for routine data collection, agreements to pass data between institutions and for maintaining the metadatabase and catalogues. There has to be agreed data promotion pathways up to the activities of the Strategic Action Plan, as well as horizontal links to other scientific and implementing agencies so they have access to complete datasets.

While we are encouraging widespread use of the GIS, and a devolved system for data storage and usage, centralising the mechanism for cataloguing metadata is the only workable schema to integrate all activity. It is planned that the 2 GIS PC's currently at NRI will be installed at one regional base, to which all new datasets (or their metadata) for the project will be sent. In choosing the installation, an assessment of the capabilities, roles and enthusiasm of institutions was made. The tables in section 1 summarise the capabilities from which this assessment was made.

GIS hardware and software review and requirements

The decision to make Arcview the project's standard GIS package has been borne out during this visit, since all key institutes have this software. Other software packages are only present sporadically, and where MapInfo and IDRISI are available, often Arcview is used in preference. Regrettably, not all installations support Spatial Analyst software that allows for manipulation of raster data (e.g. satellite data and digital elevation models). It was recommended that AM produce a "cut-down" version of TANGIS that will allow it to be used in the standard Arcview package. This will allow image data and other raster data to be viewed as background, but proper representation and manipulation will not be possible.

The current data sizes of TANGIS are:

- Total = 806 Mb (2689 files)
- The GIS application TANGIS.apr takes up 788 kb
- Data = 735 Mb (2223 files) of which Images is only 36.8 Mb.
- The digital manual is around 2Kb.
- The metadatabase is 2042 Kb. (this is only for use in the regional centre).
- A "cut down" metadatabase that would be sent to the GIS installations around the region need only be 500 Kb at present.

Obviously these sizes will increase as more data are put into the system. Most systems should have at least 2 Gb of space, or should make allowances that satellite imagery will not be stored on the hard drive. NRI can support the management strategies of data for these institutions, but they will have to be done on a case by case basis as all GIS systems are different.

The size of the TANGIS database and the need to update the information routinely means that TANGIS must be stored on the hard drive and not run from CD.

The proposed data network for the GIS.

1. **Data providers** – these are institutes currently involved in the Special Studies who are routinely monitoring facets of the lake (e.g. biodiversity, pollution, sediments). Responsibility is clearly stated in the SAP for those responsible to routinely update data for SAP activities.
2. **National GIS data co-ordinator** - On a routine basis (e.g. once every three months), a national data co-ordinator is sent the updated datasets from the data providers. If the data are not with the national data co-ordinator by an agreed date, then it is up to this national co-ordinator to follow up with the data providers.
3. **Regional Metadatabase co-ordinator** -At an agreed time these datasets are sent to the regional metadatabase manager, who catalogues the updated databases and all new datasets. This centre produces new metadata catalogues, publishes through web pages, archives new datasets and makes CD's for distribution.
4. **GIS users** – These are recognised GIS centres that routinely receive updates to the TANGIS database and should be open to all project counterparts to use TANGIS. These installations should have.
 1. Arcview (3.0 or better) already installed or proposed
 2. MS Access (Office 97 or better) to store databases created by Special Studies.
 3. 2 Gb of hard disk available to store TANGIS datasets.Full integration of TANGIS including use of satellite and raster based data can be achieved if the users have access to the Arcview Spatial Analyst Extension.

Selection of Regional Metadatabase and National Co-ordinators

Proposed Regional Metadatabase site should have:

1. Adequate GIS facilities (extra copies of Arcview, ARCINFO (particularly to provide reprojection support), A0 printing facilities)
2. Steady supply of electricity
3. Understanding of the importance of Archiving (integrated with an established environmental information centre)
4. Purpose for updating information with lake focus (e.g. be working in the area of biodiversity, environment or pollution)
5. Good National and Regional Links to ensure updating of databases occurs (e.g. good email and postal facilities).
6. Staff with a working knowledge of Arcview
7. Staff with broad knowledge of geographical skills (particularly projection, scale, spatial and attribute accuracy, overlay and cartographic representation).
8. Additional GIS facilities to support activities not covered by TANGIS. For example, PC ARCINFO is needed to reproject data between latitude/longitude geographic projection data with UTM Zone 35 (most national standard projection), or others.

At present the status of the Strategic Action Plan precludes finalisation of which datasets are routinely required for monitoring the lake, how they are to be integrated spatially and how the correct data promotion pathways can be achieved.

Based on these criteria and the capabilities listed in Section 1, the logical choice for the database is the AGEP EIC in Burundi. They have suitable basic GIS facilities, together with supporting hardware and software. They are directly involved with the LTBP and have a vested interest in storing and managing environmental data. The staff have good, relevant skills.

Recommendations for regional centre, national co-ordinator and TANGIS Installations

Regional Centre for LTBP database, metadatabase, web pages and 2 GIS machines.

It is recommended that MINATE's proposed Environmental Information Centre in Bujumbura be the location.

National Centres for data co-ordination

4 national co-ordinators will collate data in each country.

ECZ in Zambia,

IGEBU in Burundi

TANRIC in Tanzania. (An alternative in Tanzania may be NEMC).

LTBP office in Uvira in DR Congo since there are no other lakeshore GIS facilities

TANGIS Installations

Recommended institutions to hold copies of TANGIS interface and to receive regular updates of the digital database, including national and regional co-ordinators.

Burundi

INECN, Gitega

IGEBU, Gitega

University of Bujumbura (if facilities are available)

LTBP – Bujumbura project Office (a copy of Arcview would need to be purchased)

AGEP, Bujumbura – where the full TANGIS and full metadatabase will be kept.

DR Congo

LTBP Uvira Office (a copy of Arcview would need to be purchased)

Tanzania

NEMC, Dar es Salaam

UCLAS?

TANRIC

TAFIRI, Kigoma (a copy of Arcview would need to be purchased)

Zambia

UNZA Surveys or Geography Department

Fisheries Department (a copy of Arcview would need to be purchased)

ECZ

LTBP Mpulungu Project Office (a copy of Arcview would need to be purchased)

The proposal calls for a further 5 copies of Arcview @ UK£1750 per copy. There may be special deals available to be arranged in discussion with ESRI.

The normal Arcview version will allow viewing but not the interrogation of satellite imagery and other raster data. A copy of Spatial Analyst is necessary for this, which would cost a further UK£2950.

Proposed Timetable for routine updating of data

There should be a cycle of data transfer for the GIS, (which may need to fit into any strategy for the SAP). Below is an example strategy to ensure timely outputs. It is based on a quarterly update of the system.

Week	Job	Responsibility
1	Required database updates sent to National Co-ordinator (or to report no new data)	Database managers (National Co-ordinator to follow up if not sent by certain date)
2		
3	Full set of databases sent to MINATE	National Co-ordinators (MINATE to follow up if not sent by certain date).
4		
5	Database catalogued by MINATE	MINATE
6		
7	Newsletter and Web Pages Produced	MINATE
8		
9	Strategic Inputs sent to SAP co-ordinators	MINATE (Responsible parties of SAP to follow up if not sent by certain date)
10	TANGIS datasets available to all identified sites	MINATE (National co-ordinators to check with GIS sites and follow up if not complete by certain date).
11		
12		
13		

The details of the datasets required for routine updating needs to be finalised by the Special Studies. It should also be the responsibility of the Special Study Teams to decide whether national databases for each Special Study are required, or whether there is a regional requirement for maintaining the databases. The GIS strategy can cope with either option. If there is a national co-ordinating strategy, then the above timetable could be used as a template. If there is regional co-ordination at the Special Study scale, then an additional tier can be put in place, that passes data directly to MINATE. Again, this needs to be carefully co-ordinated with other project activities.

During this period, new scientific datasets, or more general datasets can also be sourced by MINATE or other collaborators and sent to the regional metadatabase. For the best co-ordination of the distribution of the updated CD's, it is advisable that new datasets be collated by week 5 of the cycle.

Protocols for data transfer, web page update and language translation already exist either within the Access database used to catalogue the data, or in the written manual for the use for the metadatabase. They will form part of the training programme for the metadatabase managers.

3. Established and developing GIS Networks

Mr Downey was in the LTBP region in November 1995. Facilities and GIS experience in the region has expanded considerably since this visit, and many institutions are taking advantage of new software and hardware to utilise GIS more readily. However, some projects have become near moribund after donor funding has finished, and institutes with good intentions of cataloguing or maintaining datasets and systems are finding themselves left without necessary resources. Several new projects now exist, including the FAO AGEF and UCLAS EISCAP projects. Both are well established, equipped and motivated, but concern over their future sustainability needs to be a key factor in any collaboration LTBP initiates.

See appendix 6 for a list of the GIS contacts and facilities available in the region.

Relationship of TANGIS to regional bodies

TANGIS is intended as a tool for managers and researchers to query available data from the project and other useful sources for the lake management through the SAP. The GIS does not have capabilities for extensive spatial data capture through digitizing, scanning or remote sensing (except from the LARST station). The level of support within the project for GIS update and expertise is severely limited by budget and staff. If other requirements for GIS are needed, LTBP should seek national capacity.

AM established an Access database listing hardware, software, training and consultancy facilities of GIS installations in the region before his visit (based on ID's visit report, 1995). This was updated during the visit (see Appendix 6) and linked to the GIS. Many organisations have informally agreed to assist in providing training/consultancy GIS if needed. KW and AMe should formalise these if thought necessary, particularly in the field of data exchange.

To achieve the aim of integrating LTBP GIS activities and data with national systems, AM actively sought existing initiatives to build GIS communities or protocols for data exchange, standards and metadata.

Burundi

Discussion is starting between some key GIS players (AGEF, IGEBU, INECN) to set up a GIS community able to set standards. It appears that despite their GIS inexperience, IGEBU will play a central role, as they already co-ordinate many geographical/cartographic activities. However, the MINATE Environmental Information Centre (EIC), currently under construction in Bujumbura, combines GIS experience with environmental knowledge. This FAO funded project aims to integrate all environmental information for Burundi.

A very constructive meeting with Danny Vandenbrouke (a GIS consultant for MINATE) demonstrated his current thinking. He would like the institutes in Burundi

to work together on setting data standards (i.e. a standard projection), responsibilities and standardising software. He would like to see an institute such as IGEBU quality control the information.

This is the ideal. Realistically, decision-makers need to make do with the best information they have access to. The TANGIS philosophy is to have a database that accepts data of any quality but tries to catalogue that quality. It is then up to the user of the information to determine whether it is of suitable quality for their intended purpose. For many, a 1:1 Million scale map of soils is better than no map at all.

AM attended the UNDP sponsored 1st Symposium on the Environment. Vandembrouke gave a demonstration here, showing the use of GIS but also of the necessary steps needed to maintain the databases and use the information effectively. During the symposium, which contained papers on Biodiversity, Agriculture, Energy consumption, biodiversity as well as GIS, a Strategie Nationale pour L'environnement au Burundi (SNEB) was established, which will integrate the recommendations from the conference. It is hoped that data issues will be addressed in this strategy.

Tanzania

In Tanzania, a national data strategy was funded by UNDP/UNSO and co-ordinated by NEMC. Tanzania had already prepared a National Conservation Strategy for Sustainable Development (NCSSD) in 1988. Various meetings since 1992 have discussed the need for an Environment Information System (EIS) as part of the whole process of sustainable development. This was followed by the preparation of a National Environmental Action Plan (NEAP) in 1994. A series of initiatives and programmes are at various stages of implementation. The main one is the National Environmental Information Management Framework (NEIMF).

Both the NCSSD and the NEAP emphasise the need for "information about the detailed state of natural resources and the environment".

There are two major constraints to proper management of environmental information that have been identified from this work; a lack of a policy framework and poor data management, exchange or publicity. Guidance should be given to standardise the software packages used, to ensure cross institute collaboration and data sharing. Data standards need to be set. Issues of data security have to be addressed; highlighting the principle of free access while understanding that some data are clearly sensitive. It is thought that access to information should be set on a sectoral basis.

Networking in terms of data exchange between sectoral information systems is still at an early stage in most Tanzanian government departments but good lines of communication between sectors, research institutions and the public are planned to improve information flow. Constraints relating to networks occur vertically (for example data are often passed to centralised bodies but not back down again) and horizontally (where institutional barriers are in place to control data). Unnecessary

costs and duplication are a habitual problem in this environment, as well as lack of dataset ownership.

The NEIMF strategy allows end users to understand better, and use more efficiently, information generated from various sources and support initiatives underway to integrate EIS in decision making. These may include national strategic planning frameworks such as the NCSSD, resource specific action plans, resource related initiatives, encourage networking of producers and users of environmental information at the national level and providing opportunities for linkages to other regional and global environmental information programmes (SADC, UNEP/GRID). It also supports technical training at all levels and assists decision-makers on how best to use available environmental information

The EIS Programme implementation strategy will focus on six elements:

1. Strengthen institutional data and information management capacity
2. Strengthen co-ordination and facilitate collaboration among partner institutions
3. Create awareness and inform the EIS Community within the country
4. Enhance and promote the use of existing data resources
5. Identify gaps and improve data infrastructure
6. Develop decision-support applications.

Many of the planned activities fit well within the overall philosophy of data sharing and promotion pathways of LTBP. It also provides some framework and support for necessary GIS activities that LTBP cannot support directly.

Zambia

In Zambia, similar strategies for co-ordinating environmental information are under development. The Zambian Government is funding a proposal to establish ECZ as the centre for environmental information. Victor Mbumwae (seconded from Surveys department in UNZA) co-ordinates the Environmental Information Network for the Environmental Support Programme (ESP) for the Ministry of Environment and Natural Resources. He outlined the strategy in Zambia. At present, although it is intended as a National Strategy, pilot programmes have been set up. There are several strands to the ESP:

- Environmental Education and Public awareness.
- Community and environmental programme.
- Environmental Fund.
- Environmental Information Networking and Monitoring System.

This final strand integrates data from five specific areas:

- Deforestation
- Water and Sanitation
- Land degradation
- Air Pollution (particularly in the Copper Belt)

- **Wildlife**

The environmental information network expects to involve data providers, users and the general public. The pilot project is due to end in 2004.

In summary, national initiatives to organise and disseminate environmental information are already in development in each of the three countries visited, but at various different stages. In Tanzania, where most development has gone on so far, the impetus to continue the strategy is flagging (particularly since UNDP have stopped funding the initiative). While LTBP cannot steer these initiatives on, we should give as much support to them as possible as they are crucial to the sustainability of the GIS component.

Implications for the LTBP database, GIS and proposed SAP.

LTBP has not the resources to implement a separate strategy for co-ordinating environmental information. Nor should it create a new infrastructure when many of the collaborating institutes are already working towards that aim. Instead, LTBP should link in to these programmes and assist where it has the necessary remit. LTBP should seek to have responsibility for maintaining the national databases on biodiversity and pollution in the lake itself. It also has some remit in the catchment, perhaps as providing erosion, sediment flow and pollution data. These roles can be better defined as the activities of the Strategic Action Plan become clearer.

Complete integration into the National Strategies for Environmental Information is not possible, as LTBP is a regional project. Trans-boundary integration is also necessary, and hence the proposed implementation strategy in Section 2 defines an independent structure that ensures national centres collect the information before passing to the regional centre for timely inputs into the SAP. The National strategies provide the fora for sharing GIS hardware and software, as well as a local pool of GIS experts for analysis /research, and aspiring to data standards.

Regrettably, most of these national strategies break down by not narrowing the gap between the current situation on the ground and the proposed ideal. Most GIS users understand the problems with integration of datasets, the costs of digitizing, the lack of standards or recognised data promotion pathways, but have not been able to conquer these problems with practical alternatives.

The open structure of the LTBP database, the acceptance that all data should be documented no matter the quality (with replacement with better data as and when they exist) provides a bridging between the ideal situation and the reality. Despite this, it needs some investment and commitments by the participating organisations to ensure data are kept up to date and provide timely inputs into the SAP.

4. Linkages to other project components

Time was spent with each of the Special Studies in all the countries visited. The aims of these meetings were to:

- Introduce the concept of the GIS, database and metadatabase to SS workers
- Get an update of SS activities, particularly the locations of the monitoring work
- Understand the use of the Special Study databases and how they may integrate with the GIS.

Meetings were held with the following Special Studies collaborators:

	Bujumbura
2/6	SSS - Brief meeting with Gerard Ntungumuranye (IGEBU) SSS - INECN staff.
3/6-4/6	PSS - Gabriel Hakizimana (INECN) Burundi National Co-ordinator - Brief meeting with Prof. Ntakimaze
4/6	BIOSS Literature database Robert Kimanduka BIOSS Survey database - not able to meet with Felix LTBP Scientific liaison, Kelly West on current status of GIS, integration of SS databases and LARST station.
6/6	LTBP Scientific liaison Kelly West to discuss training, implementation and SAP process.
7/6	Kigoma BIOSS survey database - Robert Kayanda & Bakaei Mnaya
8/6	BIOSS regional facilitator Richard Paley PSS - Dr Chada not available - spoke to first mate on boat about locations of work FPSS - obtained copy of reports.
10/6	Dar es Salaam LTBP Project Leader - Dr Menz
15/6	Tanzanian National Co-ordinator of LTBP (unavailable) LTBP Project Leader - Dr Menz
16/6	Lusaka Zambian National Co-ordinator & Director of ECZ; Mr Phiri SESS & Assistant National Co-ordinator; Mr Chitalu.
17/6	EE & training Kwali Mifuni & (ECZ - EE component) & Ngula Mubonda (Training) FPSS - Mr Zulu & Colleagues, Fisheries Department, Chilanga
18/6	SSS - Dr Henry Sichingabula (Geography Department) PSS - Maureen C. Nsomi (NISIR)

General Comments

Data now exist in all the Special Studies but this not all are being sent to the GIS component effectively. Although many of the datasets are incomplete, it would still be useful for the GIS component to have these data to test how they can integrate into the GIS. Also, many databases will continue to be adapted over time, so can never be treated as complete. The best use of these data is to pass it routinely to the central database and have programmes in the GIS to query them.

The GIS group at NRI has spent considerable time developing simple tools to query the metadatabase through Web Pages and CD. It is evident people are not using these enough (as I have also noticed with other parts of the Web Pages), probably because of inexperience with Internet software. Because of this, some unnecessary duplication of digitisation may be occurring. For reports, most base maps now exist, and SS should concentrate on developing large scale maps or conversion of their specialist data into GIS compatible format (guidelines given on the web). NRI can produce maps at little cost to the project and to SS specifications.

Special Studies have not often passed co-ordinates of where they are working to the GIS component. These data can produce useful management maps giving a real

indication of the extent and concentration of efforts across the lake and catchment. While on the visit, AM managed to glean some information from Special Studies. Special Study Leaders or co-ordinators in each country should regularly update these datasets. Now this information is available, AM can produce maps to give all project participants an overview of activities around the study region.

Pollution SS

Meetings with Kelly West established that no formal recording of datasets in an agreed structured database is yet available for the project. KW has addressed this by starting to develop databases for an inventory of regular pollution sources (sewage systems, industrial units etc) and an integrated monitoring/survey database. AM also suggested that a “hotspot” pollution database be developed. In the SAP, a mechanism can be set up to report sightings of pollution events. The GIS could be used to produce monthly summaries of these data. KW agreed to this and will develop, co-ordinating with AM to ensure that the data are GIS compatible.

Biodiversity SS

The BIOSS Survey database

This excellent facility is now installed in each country and data are actively being entered. There are a few minor errors, but it is a superb facility for comprehensively recording biodiversity survey data of many types. Although the final version is not ready, AM took a copy of the data in Kigoma; the first chance to see how real data were being entered. It was quickly integrated inside the GIS, and a catalogue item in the metadatabase allowed it to be quickly loaded into the TANGIS interface. Maps of the Mahale National Park Surveys were created with Mr Paley.

The potential for showing data from the Survey database is almost limitless. However, programmes or GIS functions should be limited to those activities that are most important. AM needs to contact Eddie Allison (UEA) about the proposed uses of the BIOSS Survey database and how it integrates within the Strategic Action Plan. The main activity will be to join the tables in the Survey database using Access Queries, so that the data can directly be integrated into the GIS. Here there are some problems, including the fact that some surveys have a start and end position, some surveys have multiple data at single points (e.g. a list of fish species at each survey location). All these problems can be overcome if the priorities are clearly defined.

BIOSS is determining whether the Survey databases are to remain separate or have some mechanism for integration. BIOSS team members should take note of the proposed GIS data transfer model and see whether allows integration of BIOSS survey databases. TANGIS and the metadatabase catalogue entries can be adapted to suit either the BIOSS Survey databases remaining separate in each country or routinely integrated.

The BIOSS Literature database

The BIOSS Literature database is now in use in the region, and records are being entered in at least three countries, namely Burundi, Tanzania and D.R. Congo. The

strategy for how the databases can be integrated needs to be settled by the BIOSS team. The Literature database should link directly in with the GIS, as it can be used to quickly map where species of fish have been located by historical studies around the lake (and compared with mapped species from the survey database).

It was noted that the Burundian inputter is recording the location of references using names only. AM suggests that NRI develops a gazetteer of place names (including variations on spellings) that can be linked directly with the BIOSS database. This gazetteer will be in both latitude/longitude and UTM Zone 35 co-ordinate systems. AM also needs to link with John Pearce at MRAG to ascertain new literature database's structure, and how best to show the information. During demonstrations, it was useful to use the GIS to show a single map where the present surveys were being conducted with the historical data from the literature database. This could be done for the entire database or for individual species.

Sedimentation SS

The GIS component has already received some of the data from the core samples taken during cruises. However, sedimentation monitoring is now carried out in many rivers of the catchment, NRI need to know where these are located. Additionally, Martin Wooster at King's College London is integrating several datasets into a model of erosion. It needs to be specified how this will integrate in to the SAP and whether fuller integration into TANGIS is deemed necessary. GP is planning an SSS SAP workshop later this year where these issues should be addressed.

Socio-economic SS

Since activity on the Socio-economic study is just starting, no integration of potential SESS data in the GIS has occurred. However, SESS leaders should make note that data held at ward, district, province or village could be linked easily into the GIS.

Environmental Education and Training Component

While there are no datasets or specific roles for EE in the GIS, the role of GIS outputs in presenting information should not be underestimated. I demonstrated the GIS philosophy to the Zambian EE co-ordinator. Maps, images and other data outputs should be considered as ways of feeding back LTBP information to the local level.

Legal SS

No identified roles for the GIS component in the LSS exist.

Fishing Practices SS

Some data on fishing practices were found on the project machine at Kigoma. This contained useful data that could be mapped, but regrettably, the data are written as a report rather than a table, so a good deal of rewriting would be necessary before it could be utilised effectively. AM is willing to assist future FPSS activities in design of databases that could integrate more readily into the GIS and support the SAP.

5. Proposed Training Strategy

It is proposed to support the implementation of the GIS database, interface and metadata system in the region through a series of training courses. These will range from simple demonstrations to heighten awareness through to training in the maintenance of the entire system.

The following training strategy is suggested together with a list of recommended participants. There should be 4 types of demonstration or courses:

1. Top level demonstrations
2. Training of trainers workshops giving an overview of the TANGIS system and available datasets
3. GIS theory and application in LTBP for scientific staff
4. Detailed metadatabase training.

Recommendations for courses:

1 Demonstrations

Target participants

Ministers, heads of Institutes or agencies and National Co-ordinators of LTBP.

Outline

These are top level presentation of the GIS component. It will include a Power Point demonstration of the background to the need for metadatabases, the mechanisms for data collection, updating and cataloguing, and an overview of using the TANGIS interface.

2 Course A – Getting to know TANGIS and the LTBP Database – Training the trainers workshops

Requirements of participants

Need to know how to access datasets, understand potential promotion pathways to SAP, have small scientific but major management need for data access.

Target participants

Key co-ordinators (particularly scientific co-ordinators) of LTBP, people with GIS training capability (not necessarily part of LTBP), input from training co-ordinators may be useful

Outline of course

The concept of GIS in LTBP

The LTBP digital database

TANGIS interface

Overview of Arcview – particularly Views/Tables/Charts and Layouts; scale and projections

How to search for datasets (making use of the web pages, GIS contacts database)

Adding data to make views

Symbolising information

Using the TANGIS tools

Outputting data – maps, charts and statistics

Teaching TANGIS to others

3 Course B – GIS theory and application

Requirements of participants:

Need to use GIS in both research and management fields, require training in the potential of spatial mapping to LTBP and more general work.

Target participants

Scientific staff working on Special Studies, GIS users who need top up/specialist training in LTBP GIS related activities

Outline of course

The concept of GIS in LTBP

The LTBP digital database

Overview of TANGIS

Introduction to GIS – Vector and raster data models, scale , projection, inputting data

Making views and symbolising data

Outputting maps, charts and tables

Using GIS in Special Studies

Querying your data

Modelling with data

The modelling process

Making datasets dynamic. How to structure a GIS database and make it temporal.

4 Course C Metadatabase Manager

Possible Candidates

Someone from the recommended institute for the metadatabase, with back up provided from nearby institution.

Requirements

There are certain restrictions on candidates for this. My recommendation is that someone from the EIC in Bujumbura is assigned the task, and a second is trained as a back up. See the TOR's below.

Outline of course

Part One: Overview of TANGIS system

The concept of GIS in LTBP

The LTBP digital database

TANGIS interface

How to search for datasets

Adding data to make views

Symbolising information

Using the TANGIS tools

Outputting data – maps, charts and statistics

Part Two: Background software training

Overview of Arcview –Views/Tables/Charts/ Layouts; scale and projections

Access

Part Three: Detailed structure of system

Understanding the structure of the TANGIS database and facilities

Computer maintenance

Part 4 – The metadatabase

Introduction to the Metadatabase

Adding digital and non-digital datasets to database

Checking consistency in TANGIS

Translation issues

Making catalogues &Transferring the catalogues to the Web Pages

Part 5 – Support Services

Archiving, storage, backup and categorisation of datasets

The SS databases

Data transfer process (co-ordination with national centres)

Handling data requests

Reprojection and export of data

Newsletter writing

Training requirements

TOR for Metadatabase manager

Skills

1. Ability to use MS Access and knowledge of databases.
2. Understanding of GIS theory and experience in at least one GIS package (preferably Arcview). Some skills in geographical concepts (understanding particularly concepts of scale, projection, resolution, map-making and visualisation).
3. Good communication skills.
4. Some knowledge of Internet use and HTML would be an advantage.
5. French and English speaking and written skills.

Duties

1. Ensure the upkeep of the digital metadatabase. To actively seek relevant sources of data to support the data needs of the Strategic Action Plan. To liaise regularly with known data providers (e.g. to get updates of Survey databases every three months, liaise with National GIS data co-ordinators).
2. To update the catalogue web pages every three months and publicise the new datasets through a newsletter.
3. To liaise with or co-ordinate the GIS user group in the region and to assist in sourcing personnel with suitable technological, practical or theoretical solutions to GIS, data or spatial issues in the SAP.
4. To assist non-GIS users in the production of maps, charts and statistics to support SAP or research activity on the lake and in the catchment.

Provisional Schedule and suggested participants

No of days	Item	Trainer	Location	Participants
2	<i>Installation of TANGIS and Web Page computer at AGEP</i>	VO	AGEP, Bujumbura	AGEP employees
5	Training of Metadatabase Managers	AM/VO	AGEP, Bujumbura	Aloys Rurantije (IGEBU) & Rosemarie or Appolinaire @ AGEP
2	GIS theory and Application for LTBP (French)	VO	AGEP, Bujumbura	Gabriel Hakizimana Mr Benoit, INECN Aloys Rurantije (IGEBU) Robert Kimanduka
1	<i>Installation of GIS at UCLAS</i>	AM	UCLAS, Dar es Salaam	-
2	GIS Theory and Application for LTBP (English)	AM	UCLAS, Dar es Salaam	Robert Kayanda H Sichingabula Maureen Nsomi (PSS) Howa Sekel Mshama
2	Trainers of Trainers workshop in TANGIS interface and Database (Tanzania)	AM	UCLAS, Dar es Salaam	Robert Kayanda (TAFIRI) Richard Paley (BIOSS facilitator) Simon Mwansasu (TANRIC @ IRA) UCLAS EISCAP representative Ms Malisa (NEMC) Deborah Kahatano? UNDP
2	Trainers of Trainers workshop in TANGIS Interface and Database (Burundi and DR Congo)	VO	AGEP Bujumbura	Kelly West (Scientific liaison) LTR Representative? IGEBU representative Appolinaire or Rosemarie @ AGEP
2	Trainers of Trainers workshop in TANGIS Interface and Database (Zambia)	AM	UNZA Surveys Department, Lusaka	Olivier Drieu – SSS facilitator G Chitalu (ECZ) Ngula Mubonda (training) Sangu Khuwa (ECZ) F. Ngulube (ECZ) Mr Daka? UNZA representative
1	Demonstrations of TANGIS to MINATE /IGEBU/ INECN	VO	AGEP/LTBP Office?	Minister of Environment National Co-ordinator: Mr. J.-B. Manirakiza (INECN) (University of Bujumbura) Etienne Kayengyeng (MINATE) M. Amule? DR Congo National Co-ordinator? Jean Prosper Koyo (AGEP) Mr Moundabe (UNDP) Invited guests from relevant Institutes
1	Demonstrations of TANGIS to NEMC/ TANRIC/VP's Office	AM	???, Dar es Salaam	Mr Sisila (UNDP) Mr Msonde/Mr Ntambe (Dar Sustainable Cities) Dr Menz National Co-ordinator - Mr. R. Yonazi Minister? Anna Maembe or senior NEMC Invited guests
1	Demonstration of TANGIS to ECZ	AM	ECZ Lusaka	Mr Daka (ECZ) Mr Mbumwae (UNZA) Mr Phiri (ECZ & National Co-ordinator) UNZA gusts Mt Mkulu Research Station Invited guests

6. LARST

The LARST installation at Kigoma was discussed at length with KW, AMe and RP, particularly concerning its use within and outside of the project, its operation and location.

Background

A station was installed at a TAFIRI Site near the LTBP Kigoma office, with the intention that the TAFIRI staff would man it. In the end, four lecturers from the Meteorological Training Centre (MTC) in Kigoma were trained, headed by Mr Shayo. They have been routinely archiving NOAA AVHRR 1km data for the region since November 1997, and have built up a substantial archive through MO disks. A list of available imagery is given through the project web pages.

Operation of station

A visit to the installation showed that the Meteorological Training Centre (MTC) staff under Mr Shayo meticulously collect and archive data, sending comprehensive reports back to Rupert Loftie (RL) at NRI. However, significant money has been spent on its maintenance, particularly using the project vehicle to ferry the MTC staff to the site and back (c. 8km round trip).

Use of system within and outside project

At present, little data have been used for the project. There has only been one research application and no management pathways identified for the installation. Dr West and Dr Menz are particularly concerned that the station has not been integrated into the other activities of the project. Mr Mills agreed that the outputs possible from LARST had not been identified or exploited well enough so far. The data from November 1997 to present has potential as a resource but this has not been identified as yet by any of the SS.

Since the visit, SSS have identified that the vegetation data from LARST vital in the erosion model. It is recommended that the SSS define clearly to both the GIS component and to the project leader how the data will be used.

There is some scope for the station to have a wider remit than just LTBP. If the National Meteorological Training Centre took more ownership of the station, it could be used as a source of meteorological data for Tanzania. There is also scope for it to provide inputs to Lake Victoria GEF project, or for routine monitoring of vegetation status of National Parks in all four countries. AMe should consider whether to support wider use of the data to assist its sustainability after the project.

Location of station

The satellite data receiving installation is too remote from the MTC to be practically sustained once the project leaves. AM visited MTC and identified some potential sites with similar standards to the current TAFIRI site.

The requirements for a suitable site for the receiving station are:

1. Relatively flat area
2. A good horizon (lack of trees / high buildings in region)
3. No plans to build high buildings
4. No microwave radio stations in vicinity
5. Good steady electricity supply

I would not advocate a move to Bujumbura, partly because of the cost involved. The original shipment was in three wooden crates, 100x103x64, 115x83x57 and 104x130x73 cm and weighed 365 kg (source BURS, Yorkshire, UK). It would be costly to determine a new site elsewhere in the region, move the equipment, train new personnel and set up new protocols for data in a new location. However, a move to the MTC would remove some of the obstacles to sustaining the receiving station in the region beyond the project's lifetime.



Plate 1: Suggested location for LARST station at MTC.

7. Transfer of Sun Workstation

LTBP maintain a web site on a Sun Workstation at NRI in Chatham, as a virtual office of project activities. The workstation needs to be transferred to the region before the end of the project. The workstation has been easy to maintain at NRI and AM sees no problem with installing it in a regional centre that has experience with computing facilities. Brief discussions with JC also highlighted some advantages with connecting the GIS and Sun Workstations, and the main issue will be having a sustainable electricity supply. AM will support JC in any decision on timing and implementation of the Web site computer, but recommends that it be located alongside the GIS units.

The virtual office facility provided by the Web could provide the long-term solution for integrating all spatial data for the Strategic Action Plan. GIS can now be accessed on the Internet but there are several stages of sophistication.

- 1) Publication of the dataset catalogues. This is already achieved within the LTBP
- 2) Printing of key maps and statistics from the system on the Internet (these could include well defined outputs, such as identified pollution sources in past three months, vegetation status maps, intensity of fire activity detected by LARST station, Special Study/monitoring activity over a period. The data could be collected in the same way as shown in the strategy for implementation and then the metadatabase managers could also be responsible for putting together this information and publicising as bitmap images (GIF/JPEG) on selected web pages. Managers could then have direct access to static maps showing the current situation. This strategy could be implemented at relatively low cost to the project, as long as they were clear guidelines for the intended outputs from the SAP.
- 3) A simple interactive GIS system. Several free software packages are available through the Internet that allow this to happen. JC and AM investigated one during the visit; ForNet (www.gis.unm.edu/fornet/docs/Mapserver/overview.html)
- 4) ESRI produce an Internet Map Server (IMS) software package, which allows for implementation of most Arcview functionality onto the Web. It costs UK£11,995 for development software and each subsequent year costs UK£1995. It would allow for the full GIS system to be loaded onto the web and any user could interrogate the data.

The current GIS works from a Microsoft NT platform while the Web Page is a Unix based system. JC needs to do further investigation but believes that a Samba server installation software could allow NT to be mimicked effectively on the Unix Workstation to allow the system to be used through the web. I believe this to be an unnecessary expense at this stage and the GIS has more pressing needs.

In the immediate term, the network of institutes with direct access to the web is too small to justify high priority development. However, AM and JC should keep abreast of technological developments in the field and address the issue if the access to the Internet improves in the region. If more funding was available in a second phase, this strategy should be developed in line with the sustainability of the Web page virtual office.

Appendix 1 - Itinerary

31/5	Travel to Bujumbura
1/6	Meeting with Jean Prosper Koyo & D. Vandenbrouke, FAO AGEP at proposed MINATE Environmental Information Centre
2/6	Meeting with Director General of the Ministry of the Environment Etienne Kayengyeng Travel clearance sought at UN Security Cell. Travel to Gitega to meet with IGEBU & INECN inc. National Co-ordinator: Mr. J.-B. Manirakiza (INECN)
3/6-4/6	Meeting with George Hanek: LTR centre. Attended two-day conference "Premier Symposium sur L'Environnement au Burundi. Met with: <ul style="list-style-type: none"> • Gabriel Hakizimana (PSS pollution national co-ordinator) • Appui de le gestation de l'environnement project demonstration - Danny Vandenbrouke and others • Mr Benoit, GIS expert & botanist for INECN
4/6	Meeting with Robert Kimanduka (BIOSS Literature database) Discussions with Kelly West on current status of GIS, integration of SS databases and LARST station.
5/6	a.m. Attendance at World Environment Day Event, Gitaza. p.m. working on new datasets (Project offices and GIS contacts database)
6/6	Meeting with Jerod Clabaugh to discuss options for integrating simple GIS onto web. Meeting with Kelly West to discuss training, implementation and SAP process.
7/6	Travel to Kigoma Meeting with Robert Kayanda & Bakaei Mnaya (BIOSS survey database)
8/6	Meeting with Richard Paley to discuss GIS use/linking with BIOSS Survey databases. Meeting with Mr Shayo & LARST team at TAFIRI satellite data receiving installation
9/6	Consolidation of FPSS and BIOSS data for GIS Meeting with Mr Shayo at Meteorological Training Centre
10/6	Travel to Dar Introductory meeting with Dr Menz (LTBP Project Leader)
11/6	Meeting with Drs E.G. Mtalo (Project Director) & T. Lorain (ITC project supervisor), EISCAP project, Geoinformation centre, University College of Lands and Architectural Studies (UCLAS) Meeting with Simon Mwansasu, TANRIC
14/6	Meeting with Anna Maembe (Assistant Director General) & Ms Malisa (GIS Specialist) National Environment Management Council (NEMC)
15/6	Mr Sisila @ UNDP & Deborah Kahatano - Tanzanian National UNDP co-ordinator Mr Msonde & Mr Ntambe, GIS Unit UNDP Sustainable Cities Project. National Co-ordinator of LTBP (unavailable) Wrap up meeting with Dr Menz
16/6	Travel to Lusaka Meetings with LTBP National Co-ordinator & Director of the ECZ; Mr Phiri, & Assistant National Co-ordinator; Mr Chitalu; GIS manager, Mr Daka, Sangu Nkhuwa & Mrs F. Ngulube (GIS technicians) @ ECZ
17/6	Meeting with Kwali Mifuni & (ECZ - EE component) & Ngula Mubonda (Training) Meeting with Mr Msoni & Mr Damaseke, GIS Unit Department of Agriculture, Mt Mkulu Research Station, Chilanga Meeting with Mr Daka, Mr Mbumwae (Environmental Support Programme), & Aubrey Mulenga (UNZA Surveys student) at ECZ GIS - demonstration of GIS for LTBP Meeting with Mr Zulu & Colleagues, Fisheries Department, Chilanga
18/6	Meeting with Prof. Bujakiewkz (Ex Head, Surveys Department, UNZA) Meeting with Bert de Waele (CGA Unit) Meeting with Dr Henry Sichingabula (Geography Department & LTBP SSS) Meeting with Maureen C. Nsomi (NISIR) - PSS
19/6	Travel to Chatham via Nairobi

Appendix 2 - Abbreviations:

AGEP - Appui de la gestion de l'environnement project, Bujumbura, Burundi
AM Alan Mills - GIS Co-ordinator LTBP
AMe Andy Menz, LTBP Project Leader
AVHRR - Advanced Very High Resolution Radiometer
BIOSS - LTBP Biodiversity Special Study
BURS - Bradford University Remote Sensing Limited (suppliers of Satellite receiving station at Kigoma)
CGA - Compu-to-Geological Advisory Unit - UNZA Geology Department, Zambia.
ECZ - Environmental Council of Zambia
EE - Environmental Education component of LTBP.
EISCAP - Environmental Information Systems Capability Project, UCLAS, Dar es Salaam, Tanzania
ESP - Environmental Support Programme, Zambia
FAO - Food and Agricultural Organisation
FPSS - LTBP Fishing Practices Special Study
GIS - Geographical Information System
ID - Ian Downey (NRI)
IGEBU - Institut pour Geographie au Burundi
INECN - Institut National Pour l'Environnement et la Conservation de la Nature, Gitega, Burundi
IRA - Institute of Resource Assessment (UDS), Tanzania
JC - Jerod Clabaugh (LTBP IT consultant)
KW Kelly West (LTBP Scientific Co-ordinator)
LARST - Local Application of Remote Sensing Techniques
LTBP - Lake Tanganyika Effects of Pollution on Biodiversity Project
LTR - Lake Tanganyika Research Project (FINNIDA Funded)
MINATE - Ministry of Environment, Burundi (Ministère de L'Amenagement du Territoire et de L'environnement)
MRAG - Marine Resource Assessment Group, London, UK
MTC - Tanzanian Meteorological Training Centre (Kigoma)
NEAP - National Environment Action Plan (Tanzania)
NEIMF - National Environmental Information Management Framework, Tanzania
NEMC - National Environment Management Council, Tanzania
NISIR - Zambian National Institute for Scientific and Industrial Research (PSS involvement)
NOAA - National Oceanic and Atmospheric Administration - and polar orbiting satellites with the AVHRR sensor aboard.
NRI Natural Resources Institute, UK
NSSD - National Conservation Strategy for Sustainable Development (Tanzania)
PSS - LTBP Pollution Special Study
RL - Rupert Loftie (NRI)
RP - Richard Paley (LTBP BIOSS Regional Facilitator)
SAP - LTBP Strategic Action Plan
SESS - LTBP Socio-economic Special Study
SS - Special Studies.
SSS - LTBP Sedimentation Special Study
TAFIRI - Tanzania Fisheries Research Institute, Kigoma
TANGIS - LTBP GIS interface and database
TANRIC - Tanzanian Natural Resource Information Centre (@IRA)
TDA - LTBP Transboundary Diagnostic Analysis process
UCLAS - University College of Lands and Architectural Studies (formerly ARI - ARDHI Research Institute), Dar es Salaam, Tanzania
UDS University of Dar es Salaam, Tanzania
UEA - University of East Anglia, UK
UTM - Universal Transverse Mercator Projection (Project standard projection).
VO - Valerie Obsomer (NRI)

Appendix 3 - Acknowledgements

I'd like to thank the assistance of all the project staff met during the visit, particularly the administration staff in Bujumbura, Kigoma and Dar who eased passage in a notorious transport network, and Howa Sekela (Tanzanian Assistant National Co-ordinator) in Dar. Also to Kelly West and Jerod Clabaugh in Bujumbura, Richard Paley in Kigoma and Andy Menz in Dar for their generous hospitality.

Appendix 4 - Data sources:

In priority order by country.

Burundi:

IGEBU have the following useful datasets for the project.

- IGEBU are trying to digitize the background datasets for the country at a scale of 1:50 000 in UTM Clarke - roads, rivers, administrative boundaries.
- INECN - land use datasets, environmental survey databases are being collected.
- BLOSS Survey group - the literature database
- A list of all hydrological (both measured and graphed stations) for Burundi, with comprehensive monitoring. There are at least ten stations in the Lake catchment.
- Climate and weather data are being entered by IGEBU in Dbase IV and SPSS formats. Looking at database, it appears that the data are stored in one table but every hour's data is held in a separate column. Not sure how easy this would be to transfer into GIS.
- AFRICOVER PROJECT used SPOT image data for whole of Burundi. This is held in Nairobi by the AFRICOVER project.

Tanzania

- TANRIC hold a digital metadatabase of GIS facilities in Tanzania. They also keep the Land cover dataset, which LTBP purchased a few months ago.
- NEMC have the pollution abatement database. Understandably, they do not give out the exact locations of pollution sources, however, they are summarised into towns/districts. There seems to be no direct use of this data in the GIS.
- UCLAS have no datasets, but offer digitizing of the topographical maps (e.g. 1:50 000) at c. Tsch 80 000 per layer (roads, rivers, contours). Prices are negotiable and quantity will produce a substantial discount. Quality appears to be high.

Zambia

- 1:1 Million Geology Map from CGA Unit, UNZA, Lusaka
- 1:1 Million scale soils data from Mt Mkulu Agricultural Research Station, Chilanga
- Meteorological data from the Zambian Met Service.

DR Congo

No datasets identified.

Appendix 5 - Remaining work programme summary

The following work needs doing before project end:

1. Consolidation of Special Study location and GIS Contacts databases
2. Integration of pollution and biodiversity databases into system
3. Training programme approved and costed
4. Creation of cut down version of TANGIS for distribution to selected sites
5. Training program established and materials written
6. Transfer of GIS and web page system to region
7. Training of metadatabase manager
8. Presentations of system to key personnel
9. Training of TANGIS interface and database use
10. Training of Scientific staff in GIS theory and application in LTBP activities.
11. Movement of LARST system to MTC (*possible*)
12. Integration of GIS into SAP activities
13. Follow up support of metadatabase manager and TANGIS use in region.