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COUNTRY REPORTS

PROBLEMS AND EXPERIENCE IN SURVEYING AND MAPPING

Submitted by Malawi **

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COUNTRY REPORT

MALAWI

PROBLEMS AND EXPERIENCE IN SURVEYING AND MAPPING

INTRODUCTION

Malawi as a developing nation has experienced problems in the development and implementation of Surveying and mapping. The first surveying and mapping was done by the British who were the colonial masters of then Nyasaland (Malawi). The Surveying exercise was mainly for cadastre purpose in the cities and urban centers. Hence we find that most of the early surveys were for urban centres like Blantyre, Zomba, Lilongwe and Mzuzu. These cadastre Surveys were carried out using the chain and compass survey methods.

Trigonometric surveys were carried out to establish surveys controls as demand for demarcated parcels increased. This led to the densification of controls in the 1st and 2nd order to allow for the expansion of surveys to some of the district centers. In the early days surveys were conducted for mainly the white communities who needed to lease pieces of land for different purposes. Many hectares of land were surveyed for agriculture purpose. These included mainly areas in tea growing districts of Thyolo and Mulanje.

The mapping was limited to some selected are areas. Most of these maps were produced by hand drawing methods. It was until the early 1960s when the British government through the Director of Overseas Surveys (DOS) started producing maps using photogrammetric methods. This was a step forward in producing maps for the country. Under this new method maps were produced in 1:50000, 1:250000 and 1:1m scale. Malawi was then one of the first countries to have full coverage of mapping of the basic map series in this part of Africa.

The fast growing technology in the use of computers in the surveying and mapping sector have made many countries to lag behind in terms of adopting the new mapping technology. In Malawi the advent of new technology in Mapping have affected the mapping industry in many ways. The different fields of surveying and mapping are affected differently. The different fields are given bellow the way they have been affected:

Cartography

The definition of cartography has been given as the art and science of producing maps. Science has been a dynamic aspect in most of the arts today and cartography is one of them. The production of maps in Malawi has been heavily affected by the

changing technology. For many the development of cartography and other mapping sciences have been static. The main cartographic tools were designed to last for many years. These tools included the following

Tripods
Scribing tools
Light tables
Peels coats
Duffing fluid
Set squares and many other drafting equipment which were used in the production of maps.

Gradually we experienced a drift from the dominant traditional methods to the more dynamic computerized system, which is a total shift from the traditional system to the new mapping methods. These changes have brought new different approaches to the mapping system. With the changing new system we have seen the following changes:

The introduction of computers
Many cartographers could not accept the change from the old system to the new system as a result they voluntary retired or lost their jobs. The change could not be easily accepted in many organizations as a result there have been misunderstanding between the two groups of people, those advocating the change and those against. Some management of change procedures were put in place in order to a smooth transition.

Obsolete of materials
The adoption of the new technology has rendered some of the materials, which were used in map production obsolete. This has led to the scarcity of the materials in turn making map production impossible. In this regard the cartographers have been forced to learn the new technology. This in other cases has led to redundancy of staff that could not cope with the new technology.

Shortage of training
The adoption of new mapping technology means people have to be trained in the new skills in cartography. This has not been very possible due the lack of training institutions in Malawi. On the other hand efforts have been put in place to provide on the job training for those who are willing to accept the change. Many technical colleges do not provide the surveying and mapping courses in Malawi as a result there is a cute shortage of skilled personnel in mapping technology.

Hydrography
Malawi has been affected by the technology revolution in terms of adopting the new hydrographic methods. Three quarters of Malawi is covered by lake Malawi. There is need to have the charts for the lake to enable the management of the lake resources and navigation. The mapping of the lake involves the production of lake charts to enable the safe navigation of the lake. Record in Malawi shows that the charts were made some 20 years ago therefore these existing charts do not represents the true navigation information of the lake. The lake has been affected by the environmental aspects of the land. These included deforestation, urbanization, population increase

and poverty. Over the years the land degradation has affected the lake by siltation which affects the water levels of the lake.

Just like in cartography, hydrograph lacks qualified staff to produce the new charts that can depict the current situation in terms of lake depth. The government of Malawi is in the process of training young hydrographers to work on the lake and produce charts that will provide the right information in form of lake charts for navigation and lake studies.

Materials used in hydrographic charts are not locally found therefore have to be ordered form outside the country.

Remote Sensing

Remote Sensing has become very vital in the revision of maps. This has become very useful especially with the high-resolution satellite, which has gone down to 10 meters and less. The high-resolution satellites are useful for large as well as small-scale mapping. The advent of remote sensing has proved to be another milestone in the mapping of natural resources.

In Malawi, remote sensing has been used to update road mapping. The use of remote sensing was used in the updating of road infrastructure mapping under the District and National Land Management Mapping Project. The Spot imagery was used to map the road infrastructure for the whole country. The mapping forms the seamless coverage of the country.

In the past the mapping of land cover for Malawi was limited to the use of aerial photography. The mapping using this method was done by the Ministry of Agriculture mainly to map land use. With the introduction of remote sensing the mapping of land cover is done much easier than before.

However though the use of remote sensing has proved to be quite very useful and easy, there is still a problem of qualified staff. The interpretation of satellite imagery needs qualified personnel who can understand the satellite imagery.

Remote Sensing has helped the Surveys Department as well as the country at large by offering a frame work to analyse geographical related administrative records like vegetation types, plots, population, Rivers, Lakes, mountains and infrastructure. It also has enhanced the performance of measuring, mapping, modelling and monitoring activities.

As of late, there is rapid growth in number of organisations in Malawi that do employ remote sensing. Almost all of these organisations; their main source of information relies from Surveys Department. Just to cite some of these organisations that employ remote sensing and their products includes:

City Assembly which uses remote sensing in land acquisition, location analysis and site selection.

Parks and Wildlife Department uses remote sensing in assessing vegetation or land cover in its National Parks and Game Reserves in Malawi. This also includes recreation resources and habitat analysis.

Agriculture also uses remote sensing in soil and vegetation analysis.

There are other small estates like tea, macadamia, sugar, cotton estates and fishing cites that have just shown interest in the use of remote sensing with a prime purpose of monitoring their field crops and irrigation in some quarters of these fields.

Land and Geographic Information System (GIS)

Malawi as developing nation has not been left behind in terms of the use of this new technology. To make the most of this technology the Malawi Geographic Information Council (MAGIC) was set up to look among other things the coordination of Spatial Data Infrastructure in Malawi. The National Spatial Data Centre (NSDC) has been se up as a secretariate for the MAGIC. The council is made up of government departments, the private sector, the spatial data users and producers. and the academic institutions in the country. The Malawi Geographic information Council is to look into matters of data standards, creation of metadata, provision of the GIS services and the dissemination of spatial information among many other activities.

The Land Information System is the integral part of the Land Reform Program which the government is advocating. Under this program the government is to have a land information system for all the districts in the country. It is expected that with all the land registered it will provide a better management tool for the land information in the country.

This program has experienced its own problems in that there are not enough qualified personnel in the country. There is need to have skilled personnel at the district level to manage the geographic information at a district level. This is one the reasons that the National Spatial Data Centre was set up to assist with GIS services to other geo-spatial data users in the country. However the Centre is also experiencing problems as it also has not enough personnel to meet all the data service requirements. The centre has data sets, which are made available to people at the cost of transfer:

Surveying

The surveying sector has not been able to match with time technologically. The field teams are using old equipment like theodolites. There is more advanced equipment like totals station and EDMs which could be used in data capture. However the lack of resources and skilled personnel to use the modern equipment have affected the adoption of the new technology.

Digital Spatial Datasets available in Malawi

Below is a list of data sets available at the National Spatial Data Centre.:

Boundaries

Dataset Description	Database Name	Scale	Format Shapefiles (Mb)	(Size) Coverages (Mb)	Date completed
Country Boundary	Ma_bordr	1:1,000,000		0.20	May 1, 1999
Cities	Ma_city	1:1,000,000		0.01	May 1, 1999
District_Boundary	Ma_dist	1:1,000,000		0.34	May 1, 1999
Extension Planning Areas (old)	Ma_epas	1:1,000,000		0.80	May 1, 1999
Proposed Forests	Ma_fprop	1:1,000,000		0.08	May 1, 1999
Forest Reserves	Ma_fres	1:1,000,000		0.48	May 1, 1999
National Parks	Ma_parks	1:1,000,000		0.94	May 1, 1999
Protected Areas	Ma_prot	1:1,000,000		0.70	May 1, 1999
Protected Areas (updated)	Ma_protn	1:1,000,000		0.72	May 1, 1999
Regional Bondaries	Ma_regn	1:1,000,000		0.28	May 1, 1999
District Boundaries	Mw_dist_bnd	1:250,000	0.62	0.17	February 28, 2001
District Headquarters and Main Centres	Mw_dist_mainctr	1:250,000	0.09	0.02	February 28, 2001
Villages	Mw_villages	1:250,000	3.71	3.31	February 28, 2001
Traditional Authority	Mw_tas_bnd	1:250,000	0.38	0.00	February 28, 2001
Country Boundary	Mw_bnd	1:250,000	0.21	0.12	February 28, 2001
Extension Planning Areas	Mw_epas	1:250,000	0.95	0.36	February 28, 2001
ADD Boundaries	Mw_add_bnd	1:250,000	0.36	0.15	February 28, 2001
Enumeration Areas and Population 1998	Census_pop1998	1:50,000	26.75	12.01	March 31, 2002
Administrative	mw_admin_50k_line	1:50,000	4.06	2.70	March 31, 2002
	mw_admin_50k_poly	1:50,000	6.82		March 31, 2002
International Boundary	mw_intl_bnd	1:50,000	0.84	0.50	March 31, 2002
Villages	mw_centres_50k	1:50,000	0.48	0.53	March 31, 2002
Districts	mw_districts_bnd_50k	1:50,000	30.00	10.20	March 31, 2002
Traditional Authorities	ta_bnd	1:50,000	12.00	2.75	March 31, 2002

Transportation

Dataset Description	Database Name	Scale	Format	(Size)	Date completed
			Shapefiles (Mb)	Coverages (Mb)	
Airports	Ma_airpt	1:1,000,000		0.00	May 1, 1999
Roads	Mw_roads	1:250,000	5.06	2.72	February 28, 2001
Railways	Mw_railways	1:250,000	0.28	0.13	February 28, 2001
Railway	mw_railways_50k	1:50,000	0.68	0.68	March 31, 2002
Roads	mw_roads_50k	1:50,000	74.00	41.00	March 31, 2002

Water Resources

Dataset Description	Database Name	Scale	Format	(Size)	Date completed
			Shapefiles (Mb)	Coverages (Mb)	
Lakes	Ma_lakes	1:1,000,000		0.21	May 1, 1999
Streams	Ma_strms	1:1,000,000		0.51	May 1, 1999
Water Resources	Ma_wres	1:1,000,000		0.12	May 1, 1999

Dataset Description	Database Name	Scale	Format (Size) Shapefiles (Mb)	Coverages (Mb)	Date completed
Rivers	Mw_rivers	1:250,000	13.10	24.20	February 28, 2001
Rivers Annotations	Mw_river_names	1:250,000	0.82		February 28, 2001
Wetlands	Mw_wetlands	1:250,000	4.87	3.00	February 28, 2001
Lakes	mw_lakes	1:50,000	0.53	0.40	March 31, 2002
Rivers	mw_rivers_50K	1:50,000	191.00	124.00	March 31, 2002
Wetlands	mw_wetlands_50k	1:50,000	2.40	1.70	March 31, 2002

Land Resources

Dataset Description	Database Name	Scale	Format (Size) Shapefiles (Mb)	Coverages (Mb)	Date completed
Agloclimatic Zones	Ma_agclm	1:1,000,000		0.97	May 1, 1999
Digital Elevation	Ma_demp	1:1,000,000		1.30	May 1, 1999
Extension Planning Areas (old)	Ma_epas	1:1,000,000		0.80	May 1, 1999
Landcover 1973	Ma_lc73	1:1,000,000		1.72	May 1, 1999
Landcover 1991	Ma_lc91	1:1,000,000		3.02	May 1, 1999
Soils	Ma_soils	1:1,000,000		0.51	May 1, 1999
Contours	Mw_contours	1:250,000	43.60	22.30	February 28, 2001
Digital Elevation Model	Mw_dem	100m grid		117.00	
Landuse	Mw_landuse	1:250,000	27.20	14.50	February 28, 2001
Soils	Mw_soils	1:250,000	24.30	10.00	February 28, 2001

Demographic

Dataset Description	Database Name	Scale	Format (Size) Shapefiles (Mb)	Coverages (Mb)	Date completed
Census 1987	Ma_pop4	1:1,000,000		1.22	May 1, 1999
Enumeration Areas (1987)	Ma_eas	1:1,000,000		9.12	May 1, 1999
Enumeration Areas and Population 1998	Census_pop1998	1:50,000	26.75	12.01	March 31, 2002

Imagery and Raster Data

Dataset Description	Database Name	Scale	Format Geo-TIFF (Mb)	Date completed
1:250K Topographic Map Series				
Geo-referenced TIFFs				
Clipped	utm36_nyika_c.tif	1:250,000	17.50	February 28, 2001
	utm36_nsanje_c.tif	1:250,000	10.00	February 28, 2001
	utm36_mzuzu_c.tif	1:250,000	23.00	February 28, 2001
	utm36_mzimba_c.tif	1:250,000	21.00	February 28, 2001
	utm36_liwonde_c.tif	1:250,000	50.00	February 28, 2001
	utm36_lilongwe_c.tif	1:250,000	15.00	February 28, 2001

Dataset Description	*Database Name*	*Scale*	*Format*	*Date completed*
			Geo-TIFF (Mb)	
	utm36_kasungu_c.tif	1:250,000	20.50	February 28, 2001
	utm36_karonga_c.tif	1:250,000	11.00	February 28, 2001
	utm36_blantyre_c.tif	1:250,000	17.50	February 28, 2001
	utm36_monkey_bay_c.tif	1:250,000	63.00	February 28, 2001
1:50K Topographic Map Series Geo-referenced TIFFs		1:50,000	6,700.00	
Land Resources Conservation Project				
Lilongwe		1:250,000	174.00	November 1, 2000
Present Landuse		1:250,000		November 1, 2000
Soils		1:250,000		November 1, 2000
Kasungu		1:250,000	165.00	November 1, 2000
Present Landuse		1:250,000		November 1, 2000
Soils		1:250,000		November 1, 2000
Karonga		1:250,000	148.00	November 1, 2000
Present Landuse		1:250,000		November 1, 2000
Soils		1:250,000		November 1, 2000
Blantyre		1:250,000	105.00	November 1, 2000
Present Landuse		1:250,000		November 1, 2000
Soils		1:250,000		November 1, 2000
Machinga		1:250,000	190.00	November 1, 2000
Present Landuse		1:250,000		November 1, 2000
Soils		1:250,000		November 1, 2000
Mzuzu		1:250,000	190.00	November 1, 2000
Present Landuse		1:250,000		November 1, 2000
Soils		1:250,000		November 1, 2000
Salima		1:250,000	152.00	November 1, 2000
Present Landuse		1:250,000		November 1, 2000
Soils		1:250,000		November 1, 2000
Shire Valley		1:250,000	104.00	November 1, 2000
Present Landuse				
Soils				
Satellite Imagery				
SPOT (26 clipped scenes)		~1:25K	2,600.00	
LANDSAT 7 (12 scenes)		~1:50K	12,000.00	
LANDSAT 5 1994		~1:100K	3,200.00	
LANDSAT 5 1991		~1:100K	3,200.00	
LANDSAT 5 1984		~1:100K	3,200.00	

Education and Training aspects

Currently there is a very big shortage of skilled personnel in the Land Information and Management and GIS. The University of Malawi started providing courses in Land and GIS, however they don't have qualified staff to teach areas of geoinformation. This then requires that more people should be trained to teach in the universities and colleges GIS related subjects. The NSDC was set up as a starting point for GIS activities in Malawi. The head of the NSDC is a graduate of geoinformatics from the ITC in the Netherlands. The enormous amount of GIS requirements for GIS services by the public cannot all be met by the NDSC. Therefore education and training is very much required to meet this demand.

Scientific and technology requirements
The demand to acquire the skills to make the best out of the GIS technology is very overwhelming. The basic things required therefore are:

Software
Hardware
Trained personnel
Data and
Procedures

The requirements above are very vital if the fully-fledged GIS are to be realized in Malawi. However some positive steps have been taken in Malawi to realize these requirements. Scientifically people have to be educated in the principles of Surveying and mapping so that knowledge can easily transferred to those practicing Land and Geographic Information Systems.

Hardware is required in the establishment of GIS. This comprises of computers for data processing, monitoring of results and also production of outputs e.g. tables charts statistical results and maps. The computer hardware needs to be replaced almost every three years. This requirement may not be possible in a developing country due to the lack of resources.

Software
There has been the discovery of different software on the market for the GIS. However there is need to asses the software for its user friendliness and products. Most of the software on the market has their limitations in terms of what they offer. Therefore there is need to be careful in the selection of software to be used.

Procedures
These are important in the establishment of GIS. The hardware and software may be available but if there are no procedures put in place, you may not have the results. Procedures in Malawi have not been really set in the operation of the GIS. Though we are able to produce results in terms of map production and tables and charts. We need to have comprehensive established procedures for GIS establishment.

Benefits
We have observed that there are quite a number of benefits realized from the use of the new cartographic skills and information systems. Among the many benefits realized are:

- Easy operations of equipment in the production of results from the systems and outputs.

- Storage of information is easy; we don't need bulky cabinets and boxes for the storage of maps.

- Fast and accurate information produced within a very short period of time. Checking of information can be done within the system before the results are

produced. Cartographic presentation in terms of fonts, colour and symbology can be checked within the system.

- Smart and accurate. The system enables everything to be done within the system within physically getting involved. The system provides a smart process without getting dirty and soiled in the process.

- The benefit of the system is that it saves time. Results can be obtained within a short period of time, thereby serving a very number of customers within a very short period of time.

Conclusion

The Government of Malawi has a very big interest in the development of Surveying and mapping. Efforts are been taken in terms of training of personnel, acquisition of modern equipment, use of satellite imagery in the updating of maps. However there is more to be done in terms of having more qualified personnel.

The establishment of National Spatial Data Centre in Malawi is a first step towards the establishment of a National Spatial Data Infrastructure. The infrastructure will regulate matters of data standards, creation of metadata, provision of GIS services, coordination spatial data infrastructure in Malawi.

The lack of adequate personnel in this venture remains a big challenge in the development of Surveying and mapping in Malawi.