



# **Designing a Land Information System for Rural Land Use Planning: A Situational Analysis and Feasibility Study**

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**SESSION 4: INSTITUTIONAL STRUCTURES FOR LAND REFORM:  
OPPORTUNITIES FOR AND OBSTACLES TO LAND DELIVERY SERVICES  
DELIVERING LAND AND SECURING RURAL LIVELIHOODS:  
POST-INDEPENDENCE LAND REFORM AND RESETTLEMENT IN  
ZIMBABWE**

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# **DESIGNING A LAND INFORMATION SYSTEM FOR RURAL LAND USE PLANNING: A SITUATIONAL ANALYSIS AND FEASIBILITY STUDY**

by

**Phanuel Mugabe and Wilson Magaya**

## **1. INTRODUCTION**

Management of information is an important task that is linked to the ability of institutions to make decisions. Important information about land relates to the characteristics of land resources and related productive capacity of the land. This aspect of land management and planning relies on information on soils and soil chemistry, terrain, people's production culture and socio-economic objectives of agricultural production. Each of the aspects in the foregoing is related to many classes of information that can be represented spatially by a number of layers or related maps. Other attributes of land that are important in land management are land ownership, soil type, and slope.

Information analysis and management is critical to decision-making on land use. Classes of information important to this are parcel sizes, quality of land in terms of production potential, biological and chemical characteristics, and physical attributes of land. Ownership records that identify current parcel outside coordinates, ownership by name, economic group, and issues related to gender are important in the process of making decisions on parcel reallocation.

The Zimbabwean government has embarked on a land redistribution exercise in an effort to reduce pressure in over populated parts of the country. This has seen new farms emerging as the large farms are subdivided and redistributed, and consequently the land transaction incidence has increased.

Problems requiring information management services have become more complicated in recent times due to the current land reforms taking place. Applications in agriculture now require high-level analytical capabilities for which manual approaches have become almost irrelevant. Analysis of spatial landscape data needs to be integrated into an analysis that has specific applications in economics, land management, and social planning. These are applications that are difficult to manage outside computerised land information management systems. (Mugabe, 1998).

Computer applications have improved the quality of information management and its accessibility to users. Computers have increased the capacity to store, manipulate and analyse large amounts of data. Information in computers is easily accessible through query processes. Geographic Information Systems (GIS) are computerised systems that have a capability of storing attribute data that is linked to the spatial dimension of land.

Data is stored in GIS in three-dimensional format, that is  $x$ ,  $y$ , and  $z$ . The ability of GIS to handle three-dimensional data makes it a suitable tool for analysis of landscape data. The capacity of GIS is further enhanced by computer capacity to analyse data at high speeds. GIS enable users to capture change without changing the whole map as is necessary with paper maps. The versatility provided by GIS for spatial data manipulation, storage and retrieval on request makes it an appropriate tool for the Fast track Land Reform process currently underway in Zimbabwe.

In Zimbabwe, activities on managing data related to land management are mostly manual. The Office of the Surveyor-General handles data related to land use, aerial photo coverages of the nation, and is responsible for production of maps covering a broad range of themes including, agricultural production, relief, urban development, land classification, climate, and land use. Most of the information is currently in hard copy, however the department is in the process of converting the hard copy maps into digital format.

Manual processes of managing land information present problems related to capacity of handling large amounts of data, and the difficulties of updating such information. It is not easy to change information related to an individual parcel that appears with other parcels. If one farm changes ownership, a new ownership map would have to be generated to reflect this change. This can be easily overcome by operating a digital spatial database. GIS provides an advanced tool for capturing, manipulating or analysing and string spatial data.

The objective of this study was to generate information on the level of use of GIS and LIS use and identify organizations that use digital spatial data. The study identified data gaps and availability of information, access to data and costs. The study was used to understand problems in the use of digital data in Zimbabwe.

## **1.1 Study Objectives**

The goal of this study is to investigate the feasibility of constructing an LIS/GIS for the purposes of rural land use planning, by looking at the existing institutional set-ups that use GIS and other forms of spatial data analysis in the country. Data acquisition, human resource

capacity, computer hardware and software capabilities are variables that will be considered in the study.

The study went through objective steps including:

- a) Assessment and identification of necessary information types that are important for land use planning processes and activities, and other applications of Land Information Systems.
- b) Analysis of digital and analogue data sets that have relevance and application in land use planning.
- c) Determine the technical or institutional issues (if any), which would impede the co-utilisation of existing databases.
- d) Define the structure of land information system for rural land use planning constructed from existing data bases (i.e. what layers would it contain) and specify what rural land use planning questions could be addressed with such an LIS.
- e) Identify data gaps that interfere with efficient application of LIS/GIS in land use planning activities, and how they could be dealt with.

## **2. METHODS**

Data collection started with a stakeholder workshop. The workshop was intended to focus the study objectives. The research processes were keyed to the specific study objectives.

Participants at the workshop were identified from organizations, which from experience by researchers had been part of a GIS network that existed in Zimbabwe before this study commenced. The network was used for sharing ideas and carried out seminars and discussions on GIS applications. It was coordinated from the Institute of Environmental Studies, in the University of Zimbabwe.

Respondents to interviews were selected at national, provincial, and local area levels were identified on the basis of knowledge and involvement in the land reform and planning activities. These interviews were carried out partly to obtain information requirements for activities dealing with land reform and land use planning. It was also done to get views on information requirements for application of Land Information Systems and Geographic Information Systems in rural land use planning, and get a feel of the understanding of all

phenomena related to this. The research process sought to establish possibilities for collaborative work, and integration of data acquisition and analytical activities.

An inventory of existing land information systems/geographic information systems, and data layers already developed by public, NGO and other organizations, which would have relevance for a rural land use planning LIS/GIS was compiled. This task was done most closely with Ministry of Lands Agriculture and Rural Resettlement, Forestry Commission, Department of Natural Resources, Deeds Registry, and World Wide Fund for Nature (WWF).

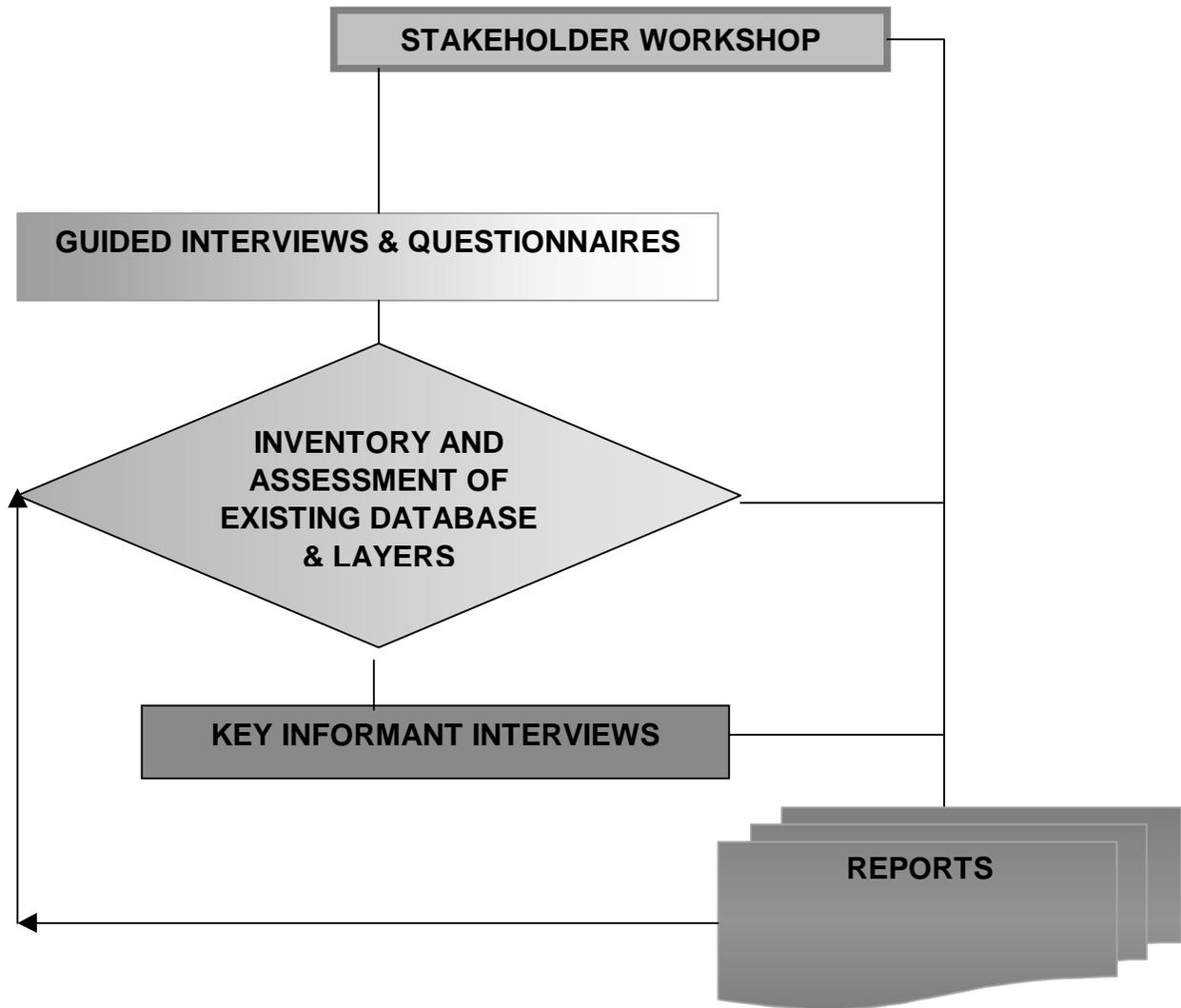
Special applications of GIS and LIS were brought up in interviews with respondents. This process was used to identify gaps and information requirements. Organizations were requested to make suggestions on how more easily access to digital data could be made. Data formats available in each of the organizations; hardware capabilities, staff qualifications and experience in relevant fields were discussed and recorded. Software types and versions available in user organizations, data scale requirements, cost of acquiring layers of data, ownership and copyright aspects were other issues explored in the research exercise.

The foregoing process was used to identify data requirements that could not be satisfied locally. Organizations and researchers expressed the data requirements necessary to make their applications more effective that were not locally available. These are gaps in available data.

Questionnaires were used to collect more quantitative information relating to hardware capacities of organizations using GIS, staff numbers, levels of training, and periods of relevant experience. They were used to document data requirements and sources of information by organisation. Each organisation had to respond to its activities on the questionnaire as well. This question dealt with the activities for which GIS and other computerised forms of data analysis would be relevant.

The research process used in this study is shown in Figure 1.

**Figure 1: Research Process**



Key informants in the data collection process were from the Department of the Surveyor General Harare and Bulawayo offices, Deeds Registry in Harare and Bulawayo, Geological Survey, Forestry Commission, WWF, Ministry of Lands Agriculture and Rural Resettlement and Department of Physical Planning.

### **3. FINDINGS**

The data collection revealed that there are organizations whose primary activities were related to production and generation of information that fed into digital data production.

Other organizations were grouped as users of information. This study worked more with organizations whose legal mandate it was to generate spatial data, although some effort was spent on user organizations. This section outlines findings from each of the organizations that participated in the study.

### **3.1 Department of the Surveyor General (DSG)**

The department of the Surveyor General falls under the Ministry of Lands Agriculture and Rural Resettlement. The department was established through an act of parliament, the Land Survey act (chapter 20:12). The act outlines the duties of the surveyor general as well as those of land surveys; it also outlines the procedures for the survey of land for registration of title in Zimbabwe. The DSG's main responsibility is to supervise the survey and charting of land in Zimbabwe.

The department is divided into Administration, Research and Development, Geodesy, Cadastral, and Cartography sections. The department compiles geodetic, photogrammetric, cadastral and topographic layers. Cadastral data is predominantly analogue. The few layers that are in digital form are in the Universal Transverse Mercator (UTM) projection system and the analogue compilations are in gauss (meters).

The department collects data from various sources, which include, aerial photography, land survey, satellite imagery and global positioning systems. They share data with any organisation that is prepared to satisfy copyright requirements. Data is sold in the form of maps and aerial photographs to members of the public.

The department generates digital data using aerial photographs and maps. Themes captured by this are administrative boundaries at international, provincial, district, and local area classifications, topography, land use, and cadastral sets that are in field or source books. Source books are field books that the surveyor records all measurements done in the field. A summary of the data available at the DSG is shown in Table 1.

Geodetic and cartographic sections of the department update their information outputs more frequently. Most of the data they generate is now digital. This is converted from aerial photography mainly. Metadata base in these sections exist and they are regularly updated. The geodetic section updates their database as soon as changes are made to the geodetic coverage in Zimbabwe and the cartographic section updates their maps on each aerial photograph coverage of the country. This is supposed to be done every five years. The last full coverage was done in 1997. This implies that the next was to be done this year, 2002.

This is however a very doubtful situation given the unavailability of funds in the national fiscus. Table 1 gives the classes of data that are available from the Surveyor General's Department.

**Table 1: Data layers available at the Department of the Surveyor general**

<b>Data layer</b>	<b>Scale</b>	<b>Ref. System</b>	<b>Format</b>	<b>Date of production</b>	<b>Data source</b>
<b>CADASTRAL SECTION</b>					
Cadastral layers	1:1250 1:2500 1:5000 1:10000 1:25000 1:50000 1:250000	Gauss/UTM	Analogue and digital	Continuous	Field surveys
Administrative boundaries	1:1250 to 1:1000000	Gauss	Analogue	Continuous	Local government
Town survey marks	1:1250 to 1:5000	Gauss	Analogue	Continuous	Geodetic branch
Trigonometric beacons	1:10000 to 1:50000	Gauss	Analogue	Continuous	Geodetic branch
Servitudes and boundaries	1:1250 to 1:50000	Gauss	Analogue	Continuous	Field surveys
Electoral boundaries	1:30000 to 1:250000	Gauss	Analogue	Every 5 years	Registrar General
<b>GEODETTIC BRANCH</b>					
Trigonometric beacons	National	UTM, Gauss, Geographical and WGS 84	Analogue and digital	Digital from 1998	Field surveys and DSG archives
Benchmarks	“	“	“	“	Field surveys, DSG archives
International boundaries Zim	“	“	“	“	Field surveys and boundary beacons and relevant international treaties
Town survey marks	“	“	“	“	

Data layer	Scale	Ref. System	Format	Date of production	Data source
<b>CARTOGRAPHIC SECTION</b>					
Roads	1: 1000000	UTM	Digital	On going	Ministry of roads
Relief and streets	1:1000000	UTM	Digital	On going	Geodesy
Land classification, soils and natural regions	1:1000000	UTM	Digital	On going	MoLARR
Administrative	1:1000000	UTM	Digital	On going	Physical planning
Tourist map	1:1000000	UTM	Digital	On going	Natural resources
Aeronautical map	1:1000000	UTM	Digital	On going	Civil aviation
Vegetation and woody cover	1:1000000	UTM	Digital	On going	Forestry commission
Population map	1:1000000	UTM		On going	Central statistics

The department is being commercialised. This is a move that requires the department to operate as a commercial unit that is able to meet its operational costs from the sale of data that they produce. The commercialisation process has seen the department moving towards provision of demand driven services and products. This makes it difficult for them to satisfy some of their statutory obligations that may not necessarily be profit generating. Some activities that have suffered due to this are production of adequate maps for educational purposes, production of maps adequate to circulate for government operations.

The department has pride in being sole custodian and owner of spatial information in the country. They determine types and nature of symbols used in publication of maps. Their symbols provide a guide that organizations producing maps should follow strictly. These are used in representation of map features like scale, rivers, mountains, roads, footpaths, boundaries, and settlements. They manage the process of adaptation of international cartographic standards in Zimbabwe. They also administer copyright regulations as they apply to circulation of spatial data as contained in maps and other forms of digital information.

Enforcement of copyright law is handled through an officer who advises the public and other members purchasing data on restrictions to circulation. This is just information on what could happen if illegal passing on of data to unauthorised users. This falls short of the follow-up that would be necessary in enforcement of such regulations. There is a requirement that makes it a responsibility of individuals to notify the Department when they come across maps circulating outside copyright provisions.

The Copyright Act provides for permitting to use digital data in organizations outside the DSG upon payment of purchase fees, or annual license fees, whichever is applicable. The DSG can use digital data internally. Conversion of data from analogue to digital should only be done with permission from the DSG. It also permits for organizations to go into special arrangements with the DSG for manipulating data. The Forestry Commission has taken advantage of this and obtained permit to produce vegetation data including baseline features like roads, railway lines, topography and administrative boundaries in digital format.

Procedures for updating maps have been established in the department. All new cadastral data coming into the department is incorporated into map compilations. The same is done with geodetic data. Boundary maps are updated when descriptions change. All updates done to maps are also done on digital datasets.

The department enforces accuracy standards on their products. All data that comes out of the department must comply with these accuracy requirements. All maps are checked for accuracy before they are passed for circulation. When the required updates to maps are found accurate they get passed on through data capture and changes on maps are effected. The system for updating maps is still being developed. Old maps are all backed up in digital format in the time updating goes on.

Admissible error ranges on manually drawn placed points on maps should not exceed 10mm in terms of variation from verified actual location. Root Mean Square error on digital data is limited to 0.025. This figure is a statistical representation derived from the square of differences between variation of point locations in the  $x$  and  $y$  dimensions of a map. Accuracy and quality are maintained across the organisation through adherence to minimum standards.

Information that has importance of security like maps showing military bases is highly classified and confidential. A selected group of civil servants is allowed to have access to that type of information. This category includes descriptions of other sites that are regarded security risks. The Official Secrecy Act controls circulation of security information.

Geodetic data has an error margin of maximum one cm, for gauss and UTM and three cm for lat/long positional coordinates. Data is categorised into primary, secondary, tertiary and quaternary classes. Heights are given to a maximum of one cm and ten cm for trigonometric beacons. The branch has a statutory obligation to collect and update national geodetic data.

The data held by the DSG falls short of the complete set that they should hold as per the provisions of their statutory requirements. Some cadastral and topographic maps have not as yet been converted to digital formats. This operational problem is due to insufficient funds being made available to the department by the treasury. The department concentrates personnel efforts on production of items that clients require the most. Much less effort is put to production of data for public and national interest. With the land reform exercise by government, the department has put focus on some areas that are considered problems areas.

The department has in excess of 100 workstations. These workstations are networked using a star bus topology, with a Windows NT server. The operating systems are all within the Microsoft products. The network operates on TCP/IP and NETBEUI protocols. This makes the network compatible with those that are with the Forestry Commission, Deeds Registry and Geological Survey. The equipment range from Pentium 166MHz to the latest Pentium 4 with speed of 1.5GigaHtz and 20 gigabyte memory. The software that is used range from Microsoft Access, Pix Edit, R2V, Surpac, AutoCAD PC, Arcview, ArcInfo and MapInfo. All these software are compatible.

The department feels that the equipment they have is not adequate for their purposes. They would require additional equipment to fully satisfy the requirements of their statutory mandate. They require A0 scanners, additional Arc/Info Workstations, software for linking spatial databases to descriptive databases, additional vectorising software, and Global Positioning Systems (GPS) with real time kinematic capabilities.

The DSG is part of a nation wide public service network that links all government departments to the Ministry of Finance. The department comes in all organizations consulted as a major supplier of spatial data. This means that there is an existing network of partnerships that could be enhanced for increased functionality.

The department employs technical people in the area of spatial data compilation and analysis. Non-technical employees are in the sections dealing with Finance and Administration. Qualifications held by people working in mapping and cartographic sections range from

diplomas in cartography, through first degrees, and Masters degrees in disciplines including Surveying, GIS and LIS.

Most of the training in the technical section was done at local institutions including the University of Zimbabwe, European colleges and universities like ITC in Holland, Danish Colleges, English schools and a few in North America. This provides a multi-spectral human resource base that gives the department a good base. Qualified staff leave the department due to unfavourable conditions of service that include low salaries and generally unattractive benefit packages.

The department has not undertaken a survey of information requirements by their clients. This means that the DSG is not able to tell gaps in the data they provide and how it can be improved to meet specific requirements of their clients. Their knowledge of the size of their market is just based on purchases and enquiries handled through the office.

Sale prices for DSG products are set by the department and send to the Ministry of Agriculture and Rural Resettlement for approval. This can be a long process in some cases and has proven not to be very efficient. Consumers for digital data are still very few. This observation is made from demand levels for digital information. The small size of the market means that consumers have not started to benefit from economies of scale. Data is still relatively more expensive because of that. Users continue to share information illegally because of the high market prices that make costs unbearable, especially for small users.

### **3.2 Deeds Registry**

The Deeds Registry falls within the Ministry of Local Government, Public Works and National Housing. It is mandated to keep records of all land transactions in Zimbabwe. The department receives information from lawyers, building societies, chartered accountants, individuals and anyone involved in land transactions. They supply information to anyone who would like to use it. Their information system, be it manual or digital is public domain. Any interested party only needs to pay a search fee to have access to information.

Information at the deeds registry is descriptive information on the transactions that take place on land parcels and the bounds of the land parcel are stored in the form of a cadastral diagram at the DSG cadastral section. Diagrams and descriptive statements are used to differentiate land parcels.

The department has both manual and digital systems working. The digital system has two databases, the Alpha and Oracle systems. The Alpha system replaced the manual indexing

system and the Oracle database is the digital land register, replacing the manual registers. There are data capture clerks whose job at the Deeds Registry office is to enter data into these database systems. Data is derived from the deed itself. The land register keeps a record of all transactions that may have occurred for a particular land parcel. This means that although the Deeds office has digitalized its land register and indexing system, it still has to digitalize the transaction process, which includes the workflow of a deed of transfer across the board up to the storage of the deed at the Deeds Registry.

The processing of the deed of transfer, from buying to final transfer and storage of information, can take up to three months. A deed lodged with the Deeds office will take eight working days to process. This information when lodged with the office is examined to see whether it complies with the Deeds Registry Act and the Deeds Register Regulations. The deeds registry office has a very impressive quality control and compliance system in operation.

The office runs a back up system for digital information. Deeds are manually filed and there is no electronic storage for these. The Alpha database is backed up weekly and the Land register is backed up when the storage space on the server has reached a certain level. These back up copies are kept off site. The back up system is however not adequate, it only effectively backs up the indexing system and does not take care of the most important component of the deeds registry process.

The Deeds Office maintains some confidential data sets. These include the statistics database, which includes all land transactions, and their value, and the schedule of properties transferred database (SPTD). These two databases are in Microsoft Access.

The department's Harare and Bulawayo branch has state of the art computers all in the Pentium category. Star Bus Typology links these computers, which is peer to peer. The networks have routers, both in Harare and Bulawayo. The networks are linked with hubs and switches. The network is 10/100Mbs with UTP cabling. This department, as with all other government departments, is linked to the national public finance network. The network use TCP/IP protocols on a Windows NT server. The department feels that for them to effectively deliver their services to the public there is need to have ten (10) more workstations and their own copy of the database softwares. The Central Computing unit installed the copies they are using and they did not leave a copy of the software. They also feel that the server needs to be heavy duty for them to effectively convert their system to become fully digital.

There are sixteen people working in the Deeds office in Bulawayo with a wide range of qualifications. The least qualified has 'A' Level while others have higher national diplomas from the polytechnic and degrees from the local universities. The department has human resources development programs. This programme though is not clearly laid out by the Ministry. They also run an internal training and human resources development program. They make an observation that they need more staff.

The department has never done a user needs analysis. This is a very important department in terms of land transfers and property holdings in the country. No other organizations hold the type of information they have. It might be a good idea to improve the applicability of their information and regular consultations with clients could help in this direction. Price adjustments have to be approved by the Ministry of Finance and this also usually takes long. Most of the data available at the Deeds Registry is data pertaining to property of people with the money that purchase for investment purposes. It is not a good idea to subsidise the production and sale of this information since the clients can afford. The department is one of the biggest revenue collectors for the national Treasury.

### **3.3 Forestry Commission**

The Forestry Commission is a Government Parastatal falling under the Ministry of Environment and Tourism. The Commission runs commercial forest operations including nursery establishment, logging, and also has a State Forest section that deals with Community Forestry, and extension. Inventory of national vegetation resources is an activity being handled by the research section at the Commission's Head Office. This activity has expanded in the last few years to include mapping and production of digital data, and analogue analytical vegetation maps. The list of maps identified at the Commission is given in Table 2 below. They hold a very comprehensive metadata base in digital format for all maps they have produced.

**Table 2: Data available at the Forestry Commission**

<b>Data</b>	<b>Scale</b>	<b>Ref. System</b>	<b>Format</b>	<b>Date of prod.</b>	<b>Data source</b>
Woody cover map	1:250000 1:1 million 1:3 million	UTM TM TM	Digital & Analogue	1996	Land Sat TM 1992, aerial photos 1992 and local knowledge
Land classification 1 <sup>st</sup> phase resettlement	1:1 million	TM	Digital & Analogue	1995	DSG
Agro-Ecological zones	1:1million	TM	Digital & Analogue	1995	DSG
Vegetation type maps	1:2.5million	TM	Digital & Analogue	2000	Wild and Barobosa 1968/VegRis 1996
Rivers & roads topographical maps	1:1million	TM	Digital	1994	DSG
Silvicultural zones	1:3million	TM	Digital	1995	DSG
Administrative boundaries					

As evidenced in Table 2 the Forestry Commission obtains most of their data from DSG, Spot Image, Satellite Application Centre in South Africa, District Development Fund (DDF) and the Ministry of Lands Agriculture and Rural Resettlement. The District Development Fund is a unit operating under the Ministry of Local Government. They have a specific function of land use planning in communal areas. Their other activities relate to development projects like road construction, water development, provision of rural amenities, and planning of settlements. The unit produces maps and spatial data that is meant to service their activities and interests.

The Research unit at Forestry Commission has in the past produced data for requirements by environmental consultants both local and foreign, international educational institutions like International Institute for Geo-Information Science and Earth Observation (ITC) Holland, three German institutions, forest companies, and government departments. Most of their activities in vegetation maps are in response to requirements by clients who are expected to bear the full cost of the activity. The clients also own products they fund. Circulation of data paid for by a client can only take place with the permission of the respective client. Mapping

is not the primary function at the commission. Production of updates is dependant on client requests and preparedness to pay.

The DSG and Forestry Commission have established protocols for sharing data and these are guided by governing agreements. Forestry Commission relies on other organizations like DDF for primary data that they use for base lining maps. This brings about problems related to data compatibility and raises questions related to accuracy.

Accuracy of commission maps varies between 80% and 90% depending on resolution. Higher resolution maps are more accurate than the lower resolution data. Symbols used correspond to those adapted by the DSG. The Forestry Commission has strict quality control requirements on data and accuracy is taken very seriously. All data that is obtained from other organizations goes through accuracy tests and verification before internal use.

The section handling spatial data has six computers that are strictly used for analysis and production of digital spatial data. Two of these computers are located in Bulawayo and the other four at the head office in Harare. The machines have each a minimum storage capacity of 5 Gigabytes, and minimum speed of 133 Megahertz. The machines are linked to a server by a star bus topology with peer-to-peer communication framework. The operating software in use on them is Windows NT. It was observed that three more computers and a hand held Global Positioning System unit are required to bring the operations of this unit to necessary level.

GIS/LIS software being used at the Forestry Commission are TNT MIPS, Arc/Info 3.5, ERDAS 8.0, and Arcview 3.0. The department needs an upgrade of software packages. These packages will impede capacity of unit to link with other organizations in the country, and will inhibit their capacity to share information with other organizations. GIS activities at the commission started as an isolated activity that was funded by the Germans. Government does not allocate financial resources for them up to this time even though foreign support has been discontinued. They make a small income from sale of data. This would have been viable income if they were able to cover the vegetation requirements of the whole country at required resolutions. Finances available are not adequate to support activities of the GIS unit.

The GIS mapping unit in the commission employs six people. The Bulawayo office has an establishment of two and the other four work in Harare. One of the employees has a higher diploma in GIS obtained from Canada, two hold Masters degrees in GIS and Remote Sensing from the United Kingdom and two hold Forestry Diplomas obtained locally.

There is high demand for vegetation data by organizations working in areas of ecology and agriculture. Government departments requiring this type of information include AREX, Natural Resources, Agricultural and Rural Development Authority. The University of Zimbabwe requires vegetation information in teaching. WWF uses this data for ecological analysis. A number of NGOs in the environmental sector need this data as well. Data is available at very high costs at the moment. Some of the remotely sensed data that the commission has is quite old and organizations may not want to buy it for analytical work.

### **3.4 Worldwide Fund for Nature (WWF)**

The World Wide Fund for Nature is an international non-profit organisation with a mission to save life on earth. Central to their mission is the strategic approach to accommodating nature in sustaining human livelihoods. Management of ecosystems, human and ecological interactions, and environmental governance are issues central in the design and execution of their activities.

In Zimbabwe, they have been very active in the management of the Zambezi River Basin, an ecosystem that is marginal and fragile. This is a region rich in hardwoods, and providing habitat to a wide range of wildlife species. They have also done work in many other parts of the country and continue to hold interest in the expansion of their natural resource conservation program.

Among the datasets are a metadata base held in Microsoft access, which is over 15 megabytes in size, conservancies, forestry areas, CBNRM areas, livestock densities, large herbivore distributions, veterinary fences, tsetse areas and major minerals. The data sets that are available are shown in Table 3.

There is a comprehensive metadata base of all the information that is available at WWF Harare office. Most of their data is obtained from detailed studies by scientists and produced as maps overlaying baseline datasets from the department of the surveyor general, as such there is a feeling that there should be a data custodian for the nation so that data can be readily available to the public at an affordable price through government. WWF has undertaken a national survey of commercial farms in Zimbabwe with an ecological characterisation on the basis of soils and ecoregions. GIS maps have been generated and these are held in their digital database.

**Table 3: Data layers produced at WWF-SARPO**

<b>Data layer</b>	<b>Scale</b>	<b>Ref. System</b>	<b>Format</b>	<b>Date prod.</b>	<b>Data source</b>
Cities	1:1million	tm/lat long	Digital	1998	ADS
Wetlands	1:1million	tm/lat long	Digital	-	ADS
Vegetation	1:500000 1:250000 1:50000 1:5000000	tm/lat long	Digital	Varied 1996-98	Cunliffe & Timberlake Flora Zambezia, Whites WWF-USA WWF-USA
Rainfall	1:2500000	Lat long	Digital	1996-98	DSG, Hussein (Agroclimatological analyst)
Protected areas	1:1,2,3,5mil	Lat long	Digital	-	ADS, Alcom (DNPWLM), DSG,UZ, Vet dept, WWF
Butterflies	1:1000000	Lat long/utm	Digital	1998	A Gardener & McKinnon
Amphibians	1:2000000	Lat long	Digital	1997-98	Meussian & Crowe
Rivers	1:1million 1:250000 1:50000	Tm Utm Utm	Digital	1995-2000	DSG, ADS, MOE (Nam) AGRITEX, WWF and UZ
Soils	1:50000	Lat long	Digital	1996-98	Hunley & Walker, DR & SS, WWF, UNESCO, FAO, ILRAD, Vet dept.
Railways	1:1million 1:250000	Lat long	Digital	1998	ADS
GMAs	1:3million 1:500000	Lat long	Digital	-	DSG, FAO, Alcom, Baison, WWF, FEWS
Powerlines	1:250000	Lat long	Digital	1998	ADS
Wards	1:250000	Lat long	Digital	1995-1997	DR & SS, Cunliffe and Timerlake, DSG, WWF, FEWS
Land tenure	1:1million	Lat long	Digital	1996-2000	Anderson, DSG, WWF, UZ, CSIR
Elevation	1:250000	Lat long	Digital	1995-1998	DSG, Vet, ADS, WWF, UZ
Catchment	1:1million	Lat long	Digital	1996-98	FAO, Alcom, DSG, WWF-USA, Whites

The Worldwide Fund for Nature obtains most of its baseline data from the Department of the Surveyor General, Central Statistics, Department of National Parks and Wildlife Management, Forestry Commission, and Geological Survey. The data is not collected on synchronised time periods and differs in terms of thematic focus. Organizations receiving data generated by WWF include Central Statistical Office, IUCN-ROSA, students the world over, CIRAD (a French research organisation working in rural livelihoods and management of natural resources), Southern African Research and Documentation Center (SARDC), and Department of National Parks and Wildlife Management.

WWF carries out surveys on an annual basis. Information generated from the foregoing is used to update data held in form of digital maps. This makes them one of the few organizations with data that is fairly current. The process of editing is responsive to the requirements of other sections of WWF. Requests are made to the GIS unit from respective user sections and the process of editing is done on that basis.

WWF has a policy guiding distribution and use of their data. This policy deems all information produced by WWF confidential. There are provisions for sharing and purchasing data from WWF that are clearly spelt out in the policy framework. Users of data are, among other things, required to acknowledge source of data as WWF.

Symbols used on WWF maps are borrowed from the DSG. This makes it easy for collation of baseline data that WWF gets from DSG. Data produced by WWF is required to have an accuracy level not less than 90%. Management of data quality is a final responsibility of the head of the GIS unit.

The GIS unit has five (5) computers dedicated to it. GIS computers are connected to the WWF network which is peer to peer with star bus topology. They are connected via an eight (8)-port base 10 hubs with UTP cabling. The network uses TCP/IP protocol. They have dialup links to their service provider, which gives them access to the Internet. The computers are old and need replacing. The unit also needs an AO scanner, and CD writers. GIS softwares currently being used are TNT professional, Arcview, Atlas GIS, Erdas Imagine and others. All the workstations operate on windows platforms.

There are two (2) officers dedicated to the GIS unit with supervision by one (1) researcher. Their qualifications range from Diploma in cartography for the technician and Doctorate for the researcher. They intend to hire a GIS/Biologist specialist with at least a post-graduate qualification to manage the GIS facility and make it stand alone rather than project driven.

The organisation encourages staff self development with its support at local and international institutions and will bring in experts to train its partners.

The feeling within WWF on the value of information is that information should be shared freely. They advocate for a pricing system that facilitates payment of the GIS staff rather than cost recovery on the production of the data since the data will have been paid for by the projects. Ultimately they want to help to foster a data sharing culture in Zimbabwe and Southern Africa.

### **3.5 Agricultural Research and Extension**

The Department of Lands and Rural Resettlement falls within the Ministry of Lands, Agriculture and Rural Resettlement. The department has sections, which include those undertaking activities in mapping and planning. The planning section is responsible for allocating land to specific activities while the mapping section captures the distribution of these on paper for visual analysis. Village and other forms of area plans are captured on maps as well. Their responsibility spans across all facets of rural land use planning. They mainly produce farm plans, ward plans and village plans, at representative fractions ranging from 1:12500 to 1:25000. They get most of their basic data from AREX, a sister organisation in the Ministry. Organizations getting data from them include DSG, Rural District Councils, Ministry of Local Government, Department of Water and Sanitation, Department of Natural Resources, NGOs, and community members.

Maps are done manually and there is no digital processing. The department still goes through the painstaking process of manually updating maps as and when necessary. The map filing system used is manual as well. There is no felt need for improving the system. Employees in the Bulawayo office felt the system in place was adequate for the activities done in the department. This might go to suggest that the biggest benefit they get from GIS and computerised processing of data is improvement in quality of outputs and efficiency.

It was felt that information available from other organizations in the country is adequate for the operation of the planning section. They experience problems related to currency of data they obtain from the DSG. They also note that data from the Forestry Commission is produced at a resolution that is too coarse for detailed ward and village planning and analysis.

The Chief Agricultural Extension Officer in AREX handles requests for data produced by the planning section. This is the office that decides on release of information to the public and

manages information distribution. The information sharing process is not very formalised, and copyright procedures are handled through provincial AREX heads.

Symbols used on hard copy maps produced in both the planning and mapping sections are borrowed from the DSG. There are variations in colour symbols but these do not distort information represented by signs by symbols. The departments has some computers to run a GIS unit but mobility staff and training problems have kept this on hold for a long time.

The department is historically an agricultural extension unit. This has meant that its staff complement is largely in the technical fields of agricultural sciences. Qualification levels range from first degrees to Masters level. The department trains spatial data analysis and management to all its new staff members. This is part of the technical skills officers get on getting into the department.

An assessment of the client base is necessary to focus activities and outputs of the department. Such a survey would tremendously improve the processes of planning. The department has never done a user needs analysis and so does not fully know the extend of their clientele. They are central government dependant and so produce information on request from other government departments. They have had no need to do a user needs analysis because they are a monopoly in the provision plans for rural land use. Their client base is mainly composed of communal farmers who can barely make ends meets and so the department feels that their information should be subsidised to make it affordable for their clients.

### **3.6. Geological Survey**

The Geological Survey is under the ministry of Mines. They are mandated to collect store and maintain all data pertaining to the geological formations of Zimbabwe. The department has two sections that deal with spatial information; these are the cartographic section and the data management section. Most of the data they deal with is obtained from the Department of the surveyor General, companies and other government departments. All the data at the geological Survey is in digital format as well as analogue format. There is a metadata base, which is maintained in separate database software on the departmental server.

The data maintained at the Geological Survey is as shown below in table5.

**Table 4: Data layers supplied at the Geological Survey**

<b>Data layer</b>	<b>Scale</b>	<b>Ref. System</b>	<b>Format</b>	<b>Date of prod.</b>	<b>Data Source</b>
Geology	1:1000000	Utm/lat long	Digital-SHP		
Regional geology	1:100000	Utm/lat long	Digital-DXF		
Rivers	1:1000000	Utm/lat long	Digital-MIF		
Roads	1:1000000	Utm/lat long	Digital-MIF		
Faults	1:1000000	Utm/lat long	Digital-MIF		
Towns	1:1000000	Utm/lat long	Shp,DXF,MIF		
Mines	1:1000000	Utm/lat long	Shp,DXF,MIF		
Border	1:1000000	Utm/lat long	Shp,DXF,MIF		

The department supplies data to mining companies, educational institutes, government departments, military, police, United Nations organizations, geosciences organizations, local and international libraries, local authorities and individuals. Most of the data is at a scale of 1:1000000 but they can also deliver at any scale required by the client. Their data is in digital form and so it is easy to produce it in hard copy at any scale. The data include geological maps as well as exploration data.

The data that is produced by the department is mainly supplied by the Department of the Surveyor General (DSG), Department of Water, mining companies and primary sources such as surveys by Geologists. This data they obtain mainly in analogue format and convert into digital form.

Because they are mandated to keep up to date data on the geology of Zimbabwe, the department has a comprehensive updating process. The department queries the database for expired EPOs and also take note of new EPO applications so that these are plotted onto an updated EPO Geological map. To ensure accuracy all digitising maintains a maximum RMS error of 0.025. All members of staff involved in the collection, processing and presentation of geological data in the department are responsible for quality control. To ensure greater accuracy on the 1:100000 and 1:1000000 scale they work from a larger scale topographic map.

The department feels that the information system, staff members included, they have is adequate for their purpose. The metadata base is maintained within the spatial database and this database is resident on the departmental server.

## **4. DISCUSSION**

### **4.1 Introduction**

Globalisation has seen the dawn of an era driven by technology and knowledge. These developments have called for necessary integration of existing information systems to take advantage of economies of scale and give wider choice to users. Development of Geographic Information Systems particularly in Zimbabwe is purpose-specific and affects lives of very few people. It is important that at this stage where everyone is moving towards integration of information systems for effective management of resources that informed policy debates should take place.

Policy can definitely shape the development and outcome of geo-spatial data and information production and distribution. If we as a nation do not participate in the policy dialogues necessary to shape the outcome of land information management in Zimbabwe, because of globalisation we will be left behind. Policy makers should be informed so as to understand the evolving global technical issues, which may impact on their constituencies and consider the interests of such constituencies. This will enable technologies to make their way into the communities in an orderly and systematic fashion that satisfies the needs of the communities.

The public sector, which through its creation has a social mandate to provide baseline spatial information for public use, is highly de-fragmented. There are different government arms dealing with land and land information in Zimbabwe. To further complicate the situation these departments are housed in different ministries, which have different objectives. This results in competition for customers hence duplication of work in a bid to lead the production of spatial information race

The DSG in a bid to raise funds for its day-to-day running is on an aggressive commercialisation drive. This implies that the DSG produces information and sells to enable it to recover costs as well as invest in capital equipment. It came out strongly in our discussions with users that commercialisation of public sector data is viewed as selling information collected by the public sector using funding from the public. It was therefore emphasised that information distributed should be at the production cost to offset

inefficiencies created by lack of funding from the national fiscus. It was further suggested that the allocation of funds should consider the whole stream. For example the process of registration of a deed of transfer.

The deeds office, which is one of the largest revenue collectors for the country's treasury, obtains data from the DSG. For a deed of transfer to take place there is need for a document that accurately describes the land parcel that is being transacted. A deed of transfer that is submitted into the deeds office has to have a cadastral diagram produced by the DSG. Most interviewees felt that it is important for those involved in ensuring that a deed of transfer is registered share the costs. Government funding should be structured such that some department do not subsidise others.

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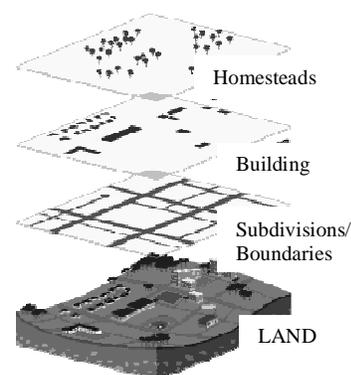
### Scenario 1: GIS/LIS in the Land transaction process in Zimbabwe

Land transaction is an integral component of good land management. The land reform process in Zimbabwe has seen a major shift in land ownership from the privately owned commercial farms to the public sector owned resettlement areas. This shift has seen the transfer of land from the private sector to the Public sector. The fundamental instrumental in which the value of land is enshrined as capital, the deed of transfer is cancelled and all land becomes state land. This is in accordance with the Deeds Registries Act. This has the repercussion of reducing access to capital for the new farmer as financial institutions battle to have some collateral to hedge the financing of the agricultural sector.

It is therefore important for the driver of the land reform process to create value in the land by putting in place a system that clearly defines land and rights thereof of an individual to the land. In order for clear definition of these rights a register of land ownership and land transactions has to be kept. Good characteristics of this register would amongst other things have an accurate cadastral diagram that clearly defines the boundaries of the land in question. A surveyor who then submits these diagrams to the Surveyor General for inspection produces the diagram. The duties of the Surveyor General include the control and supervision of the surveying of land for purposes of land registration. The registration of land in the public sector is therefore being hindered by the production of diagrams that define the boundaries to land parcels that have been allocated to beneficiaries.

The department of lands in the Ministry of Land Agriculture and Rural Resettlement has found itself managing land transactions in all the land acquired for resettlement. The department therefore needs up to date complete datasets that are accurate. For the department to effectively management the land reform process they need among other datasets;

- Up to date and complete farm boundary data; this is to be made available by the DSG according to the Land Survey act because this dataset is the baseline dataset for all land subdivisions diagrams that will define the boundaries of individual rights to land.
- Subdivision cadastral diagrams from the DSG
- Climate data from the meteorological office
- Agro-ecological regions map

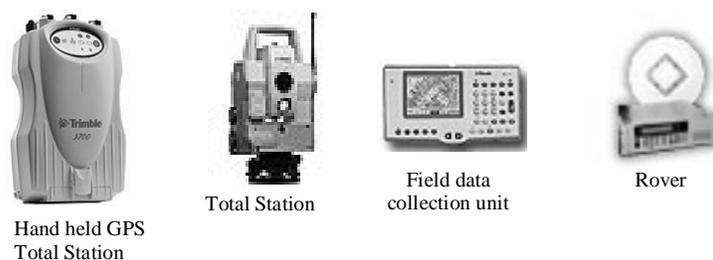


**Data layers**

The farm boundary datasets are important because they are the baseline upon which the land reform process will effectively transfer land from the current owners to the beneficiaries of the process. The land reform process therefore faces a bottleneck in the DSG. As outlined in the findings lack of funding of primary data collection is a major problem the DSG faces. Funds are needed to acquire equipment for surveying the acquired farms as well as office equipment to facilitate swift production of cadastral diagrams from the survey data.

Due to the fast track nature of the land reform process it is important to acquire equipment that therefore allows the DSG to also fast track production of the cadastral diagrams. The department can acquire GPS total stations and office softwares to produce the diagrams. The GPS Total station (see Figure 2) enables the surveyor to quickly survey land and hence allows swift production of diagrams of all the subdivisions that have taken place and so the assignment of parcels to beneficiaries.

**Figure 2: Survey data collection equipment for the DSG**



It is important to note that the most important step in the land reform process, that of transfer of land from to the beneficiaries is next. In order to enable the new farmland owners to access finance to fund agricultural production clear boundaries of the lands upon which the beneficiaries have rights are imperative. The private sector as well as government should therefore consider funding the DSG to enable the department to produce the necessary diagrams hence create an environment that allows transfer of land from the state to the beneficiaries of the land reform process.

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Funding is an important element to development of a land information system from existing data layers. It is important therefore to identify key result areas such as the survey and charting of land for registration and fund these deliberately. A land Information System for Rural Land Use Planning has other attributes, which are heavily dependant on a good funding base. These attributes include good policies, appropriate technology, good data acquisition and distribution procedures, and adequate human resources to operate the system. For the purposes of this report we will look at policies and standards, the others are looked at in the context of either of the two.

## **4.2 Policy**

Policy in the development of information systems will mainly dwell on legal issues, funding, standards, data quality and cultural issues. Policy will drive the outcome of the LIS/GIS in

Zimbabwe, for its policy that guides the way data is acquired, distributed and managed. Zimbabwe has seen many organisations producing and distributing spatial data. The value of the information has also seen salient competition taking place. Spatial information has high economic value and to protect against abuse of access, copyright laws, protection of database laws, extraction laws and contractual laws can be used. In Zimbabwe the copyright laws govern the use of spatial information. The question therefore arises, is this enough?

Major challenges faced by spatial data producers are that copyright can be upheld against everyone but it doesn't protect economic investment, rather it protects intellectual achievement. These conditions however legally speaking do not necessarily apply to facts, due to lack of originality of idea. Spatial data is a statement of fact and as such makes it very difficult to uphold the copyright laws. If data however is resident in a systematic database that shows originality in idea copyright can be upheld. (Kabel 2000) Zimbabwe is faced with looking at laws that protect data extraction, database protection and how to apply the contractual laws to check use of the data for commercial purposes.

### **4.3 Standards**

Appropriate technology, good data, its acquisition and distribution are guided by standards. According to the Survey act, land surveys are deemed a correct representation of the dimensions of a land parcel if and only if they have been inspected and passed by the Surveyor General. In Zimbabwe there are several operational spatial databases within organisations such as the Department of the Surveyor General (DSG), Geological Survey, Forestry Commission, civic organisations and the private sector. Production of Geo-spatial data in Zimbabwe is rife with examples of problems that hinder integration of information systems for rural land use planning. These problems stem from inefficiencies due to incompatibility, lack of interoperability and portability, resulting from a lack of or use of existing standards.

The scenario outlined below illustrates that standards, or the effective use of them, are a logical pre-requisite for development of a land information system for rural land use planning in Zimbabwe. They will help in creation and maintenance of spatial data at high levels of quality and consistency, which in turn improves decision-making. Rather than coming up with standards from own experiences it is important to look at the situation internationally, identify organisations that are driving formation and adherence to standards and adopt these and then complement with own national experiences.

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## Scenario 2

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The department of the Survey General depict a tarred road using continuous red lines. Varying the thickness of the lines shows the size of the road. They then depict dirt roads as brown dotted lines. The Department of Physical Planning on the other hand depicts roads both tarred and dirt using brown and varying sizes are shown by the thickness of the lines. The planning section at the Ministry of Lands uses black ink for all it's drawing and so depicts Roads Rivers and any other linear features in black. This scenario poses a challenge of integrating this data to come up with one map. There is definitely need to convert some data sets to conform to the Department of the Surveyor General standards. These incompatibilities are compounded by the fact that these departments are at different levels of converting their data to digital format. The DSG have converted 30% of it 1:50000 topographic map series, Physical planning and the mapping section still have predominantly manual systems.

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Challenges facing geospatial data sharing, a condition necessary for the creation of an LIS/GIS for rural land use planning from existing databases and layers in Zimbabwe manifests in a number of ways.

There is no government initiative to create coherence in the production and distribution of geo-spatial data and information. This results in different jurisdictions of individual departments of government that deal with spatial information creating gaps in some cases and overlaps in others. The DSG started with donor funding to develop standards for the sharing of spatial data in Zimbabwe, however when the funds ran out so did the initiative. A spatial data standards manual exists but it is not being implemented nation-wide. The proliferation of data collection and production centres especially with the civic organisation demands that there be a structure to verify authenticity of spatial data produced as well as maintain a certain level of quality control.

To ensure a future where all government arms are pulling in the same direction for the provision of geo-spatial data to users such as a Land Information System for Rural land use Planning there is need for a concerted effort with government to have one umbrella institution that deals with land information and thus subcontracts any activities and also distributes resources for the effective provision of information to users.

From 1999 the land use patterns have changed considerably due to the land reform process under way. The DSG is supposed to update maps and diagrams with instruction from the mapping section at the ministry of Lands Agriculture and Rural Resettlement. The transfer of land from the private sector to the public sectors in the land reform process has seen the transfer of land transactions from the deeds registry to the ministry of lands agriculture and rural resettlement. The ministry therefore demands the supply of accurate baseline data.

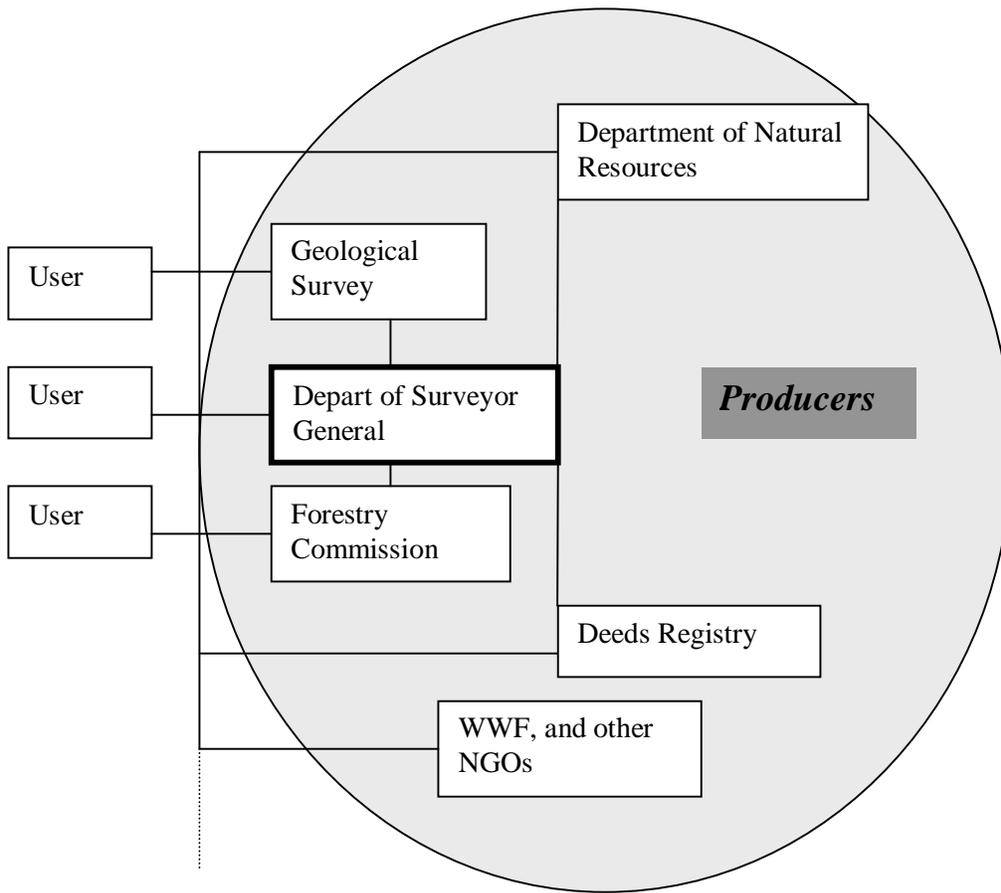
Communication within and from one organisation is important. Problems in communication are however compounded by differences in technology implementation. There is need for a shared vision in the public service in provision of geospatial data. The provider of spatial information as a public good don't know the size of their market and so compete for clients and eventually over price their products due to lack of knowledge of the market size. There is definitely need for better intra and inter organisational communication for better delivery of service.

### **LIS/GIS in Zimbabwe**

As evidenced by the findings, the DSG is the most appropriate foundation upon which any land Information System is developed. All the organisations that produce or use geospatial data use baselines from the DSG see Figure 3, below for the current institutional arrangements. The figure shows that a user has to approach many departments in order to access data. There are so many data sets that are located in various departments and organisations. It would be appropriate and user friendly if a user (Planner) could access all this data from any one of the organisations that becomes party to the LIS/GIS.

In all these organisations there are datasets that do not significantly change with time, such as river courses, roads, mountains, power lines and others. An LIS/GIS for rural Land Use Planning will have information that forms a template for any land use planner to use using these datasets. It will be upon this template that other layers will be overlaid to suit the requirements of the planning process. According to the law the DSG oversees all land surveys and the charting of lands in Zimbabwe. There are department within the government that produce information using the DSG information as baseline data. These include Geological Survey (GS), Ministry of Lands Agriculture and Rural Resettlement MoLARR), Deeds Registry (DR), Forestry Commission (FC), Department of Natural Resources (DNR) and Department of National Parks and Wildlife management (DNPWM).

**Figure 3: Current GIS/LIS in Zimbabwe**



The LIS/GIS will not necessarily be central but rather decentralised. It will be a conglomeration of distributed databases. The various departments will continue to produce data that is specific to them and maintain these databases within their organisations. A user intending to access these data sets can therefore access these at any one of these organisations and purchase these data sets. Although the DSG would have been the most appropriate interface between users and producers of geospatial data, they have only two offices in Zimbabwe, whilst MoLARR, DNR, DNPWM have offices nation wide. The institutional arrangements for the allocation of funding from the treasury can then be done such that the driver organisation (all others use its data to produce their own sets) has the highest percentage allocation.

It was strongly suggested that Zimbabwe takes the course of having distributed databases that are independent of each other but with no duplications. Supported with the evidence that all

spatial data production is dependant on the DSG as well as by the law, the DSG is the most appropriate institution to maintain standards and therefore ensure that geospatial data produced in Zimbabwe meets the minimum standards requirements. It was obvious that datasets that have been reproduced by civic organisations could have been produced by the public sector.

## **5. RECOMMENDATIONS**

Developing a Land Information System for Rural land Use Planning for Zimbabwe is feasible. It was apparent from the study however that for an effective and efficient system to be created there are some issues pertaining to policy, data and equipment standards, acquisition and maintenance standards, a good human resources base that should be addressed and funding.

Zimbabwe must have a Geospatial data strategy that all organisations use. This strategy becomes the basis upon which coherent geospatial information policies are implemented, standards on data and equipment and acquisition and maintenance are upheld and a human resource retention and capacity building strategy is enshrined.

The public sector should be responsible for the provision of baseline geospatial information. The lead organisation has to be the DSG. Streamlining the public sector will avoid duplication and unnecessary competition. There should be a concerted effort by all government ministries that house geospatial data to build data sharing capabilities through data warehouses or sharable data infrastructure. Once streamlined and clear roles have been assigned government as well as donor funding for the production of spatial data will then have to take into consideration the importance of funding the lead organisation to enable it to ensure production of up to date high quality and relevant data.

Rather than do it yourself approaches that are popular nation wide, where organisations access funding for production of geospatial data, their should be deliberate attempt to contract institutions whose core competencies are production of Geospatial data. Civic organisations should spearhead a campaign of buying data rather than producing it themselves. The current situation is however also driven by the user perceptions of the producers of spatial data. This therefore means that the producers should strive to instil confidence in their customers. To this end they need to know their customers and their requirements.

It was observed that the available data is sufficient for the development of a GIS/LIS for rural land use planning. The problem is in accessing it. A lot of baseline data is being produced on demand by clients and then the producer organisation is bound by law not to distribute this data. It was generally felt that where baseline information is produced by the public sector for a third party, the third party should pay for the cost of production and the information remains a public good. This would ensure that all information produced by the public sector for the private sector or civil society becomes part of the drive towards provision of up to date spatial data to the public unless it is of strategic importance.

The development of an LIS/GIS for rural land use planning would benefit if there is an umbrella body or organisation to sustainably manage the role out of GIS/LIS in Zimbabwe. The question then arises on funding of a system that manages the role out of spatial data in Zimbabwe. It is recommended that the DSG becomes responsible for quality control of all spatial data produced in Zimbabwe, other departments such as DNR produce data on location of natural resources and their abundance, thus adding value to the DSG data layers, the Forestry Commission produce vegetation and woody cover maps thus also adding value to the DSG layers. It is imperative that roles are clear as to who produces what baseline data sets.

Access to data for planners and any other users will be through anyone of the public sector producers. This does not mean however that all datasets have to be resident in each of these offices no, but rather that the data will be accessed through networks where ever it is resident and made available to a user on request at any office in any locale.

This calls for huge investments in equipment and communication networks. Fortunately all government departments are currently networked to the national treasury and they all have basic equipment required. What is needed is a systems approach led by the public sector with backing from the government and donors to define the minimum requirements and implement at national level rather than the prototyping that has been taking place.

All the recommendations point to funding as the underlying factor that is required for an LIS/GIS for rural land use planning. It is therefore important that a funding strategy is not only key to smooth production and distribution of geospatial data but that funding of organisations such as the DSG are important for the successful implementation of the current land reform process.

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