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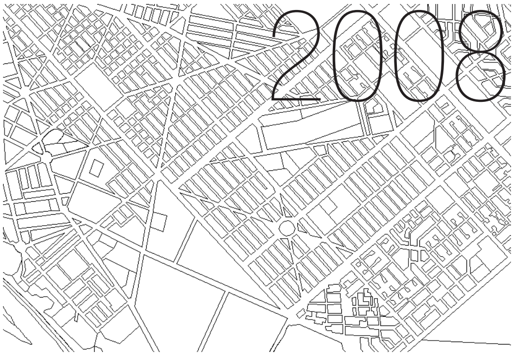
Discussion and Guiding Principles for Africa

Land Management Information Systems in the Knowledge Economy



ICT, Science and Technology Division

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2008

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Land Management Information Systems in the Knowledge Economy: Discussion and Guiding Principles for Africa

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Table of Contents

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Acronyms

AARS	Asia Association of Remote Sensing
ADF	African Development Forum
ADR	Alternative Dispute Resolution
AfDB	African Development Bank
AFREF	African Reference Frame
AGIS	Abuja Geographic Information system
AGRHYMET	Centre de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle (Intergovernmental Agriculture, Hydrology and Meteorology Center)
AIDS	Acquired Immune Deficiency Syndrome
AISI	African Information Society Initiative
ALS	Alberta Land Surveyors Association
APC	Association for Progressive Communications
ATRCAD	African Training and Research Centre in Administration for Development
AU	African Union
AUGT	l'Agence d'Urbanisme du Grand Tunis
AVHRR	Advanced Very High Resolution Radar
B2B	Business-to-Business (as in services)
BdD	La Base de Données
BML	Building Material Loans
CAADP	Comprehensive Africa Agriculture Development Programme
CAD	Computer-Aided Design
CAFRAD	Centre Africain de Formation et de Recherche Administratives pour le Développement (African Training and Research Centre in Administration for Development)
CAPRi	Collective Action and Property Rights
CASLE	Commonwealth Association of Surveying and Land Economy
CBOs	Community Based Organizations
CCDM	Core Cadastral Domain Model
CDI	Charte du Domaine Irrigué
CePRC	Canada's e-Policy Resource Centre
CFA	Communauté Financière Africaine (currency)
CGRN	Cellule de Gestion des Ressources Naturelles
CIR	Color Infrared
CNCR	Comité National au Code Rural
CNTIG	Comité National de Télédétection et d'Informations Géographiques (National Committee for Remote Sensing and Geographic Information), Cote d'Ivoire
COFOs	Composition des Commissions Foncières
CONSAS	Conference of Southern African Surveyors
CR	Conseils Ruraux
CSOs	Civil Society Organizations
CTA	Technical Centre for Agricultural and Rural Cooperation
DADC	Direction des Affaires Domaniales et Cadastrales
DADT	Direction de l'Aménagement du Territoire

DAERA	Direction des Aménagements et Equipements Ruraux Agricoles
DataGrid	Graphical user interface element (widget) that presents a tabular view of data.
DBMS	Data Base Management Systems
DCDB	Digital Cadastral Databases
DCF	Data Collection Files
DEM	Digital Elevation Model
DFID	Department for International Development UK
DGPS	Differential Global Positioning System
DLR	German Aerospace Center
DoL	Department of Lands
DRC	Democratic Republic of Congo
DSG	Department of the Surveyor General
DSM	Department of Surveys and Mapping
EASSy	East African Submarine System
ECA	United Nations Economic Commission for Africa.
ECE	United Nations Economic Commission for Europe
EDD	Enterprise Development Department
EIU	Economist Intelligence Unit
EMS	The Electromagnetic Spectrum
ERDAS	Earth Resources Data Analysis System
EROS	Earth Resources Observation Satellite
ERS	Earth Resources Satellite
ESA	European Space Agencies
ESRI	Environmental Systems Research Institute
ETM	Enhanced Thematic Mapper (LANDSAT)
EULIS	European Land Information Service
FAO	Food and Agriculture Organization (United Nations)
FCT	Federal Capital territory
FELIS	Federal Land Information system
FEWS	Famine Early Warning System
FIG	International Federation of Surveyors
GDP	Gross Domestic Product
GEGIS	Geospatial Information Systems
GIS	Geographical Information Systems
GIScience	Geographical Information Sciences
GLONASS	Global Orbiting Navigation Satellite System
GLTN	Global Land Tool Network
GML	Geography Mark-up Language
GNP	Gross Nation Product
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning System
GRS80	Ground Reference System 80
GSDI	Global Spatial Data Infrastructure
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (German society for technical cooperation)
HABITAT	UN-HABITAT
HIV	Human Immunodeficiency Virus

HMLR	Her Majesty's Land Registry (UK)
IAAO	International Association of Assessing Officers
IAG	International Association of Geodesy
IBM	International Business Machines Corporation
IBPs	International Backbone Providers
ICM	Information Communication Management
ICT	Information and Communication Technologies
IDPs	Internally Displaced Persons
IDRC	International Development Research Centre
IGNN	l'institut Géographique National du Niger
IIED	International Institute for Environment and Development (UK)
IJC	International Joint Commission (Canada and USA)
IMF	International Monetary Fund
InfoDev	Information for Development Program
INRAN	Institut National de la Recherche Agronomique du Niger
IP	Internet Protocol (as in TCP/IP)
IS	Information Systems
ISBN	International Standard Book Number
ISK	Institution of Surveyors of Kenya
ISO	International Organization for Standardization
ISP	Internet Service Provider
ISPRS	International Society for Photogrammetry and Remote Sensing
ISPs	Internet Service Provider
ISTD	ICT and Science & Technology Division (ECA)
IT	Information Technology
ITC	Institute for Aerospace Survey and Earth Sciences (ITC), The Netherlands
ITPOSMO	Information, Technology, Processes, Objectives, Skills, Management Systems, Other Resources
IXP	Internet Exchange Points
KANU	Kenya African National Union
KEI	Knowledge Economy Index
KISM	Kenya Institute of Surveying and Mapping
KIT	Koninklijk Instituut Voor de Tropen (Royal Tropical Institute, Amsterdam, Netherlands)
KNSDI	Kenya National Spatial Data Infrastructure
KWS	Kenya wildlife Services
LAA	Land Administrative Authorities
LAB	Land Administrative Body
LANDSAT	Land Remote-Sensing Satellite (System)
LB	Land Board
LDN	Loi du Domaine National
LiDAR	Light Detection and Ranging
LIM	Land Information Management
LIMS	Land Information Management System
LINZ	Land Information New Zealand
LIS	Land Information System
LMIS	Land Management Information System
LOASP	Loi d'Orientation Agro – Sylvo – Pastorale

LSC	Land Surveyors Chapter
LTO	Land Titles Office
LUD	Land Use Decree
LULC	Land Use / Land Cover
MCD	Modèle Conceptuel de Données
MDG	Millennium Development Goals (UNDP)
MLS	Ministry of Lands and Settlement
MNT	Modèle Numérique de Terrain
MODIS	Moderate-resolution Imaging Spectroradiometer Satellite
MOU	Memorandum of Understanding
MP	Members of Parliament
MSAT	Metis Settlements Appeals Tribunal
MSS	Multispectral Systems
NARC	National Rainbow Coalition- Kenya
NARO	National Agricultural Research Organisation of Uganda
NAS	National Academy of Sciences
NAVSTAR	Navigation Satellite Timing & Ranging
NCGIA	National Center for Geographic Information and Analysis
NEPAD	New Partnership for Africa's Development
NETR	Nationwide Environmental Title Research
NGO	Non-Governmental Organization
NICI	National Information and Communications Infrastructure
NLPFP	National Land Policy Formulation Process
NOAA	National Oceanic & Atmospheric Administration (USA)
NRC	National Research Council
NRTK	Networked Real-Time Kinematic
NSDI	National Spatial Data Infrastructure
NTDF	National Technical Development Forum
NTIC	Nouvelles Technologies de l'Information et de la Communication
OACT	Organisation Africaine de Cartographie et de Télédétection (African Organisation of Cartography and Remote Sensing)
ODI	Overseas Development Institute
OECD	Organization for Economic Co-operation and Development
OGC	Open Geo-Spatial Consortium
OGIS	Open Geodata Interoperability Specification
OGS	Open Geographic Information System Consortium
ONG	Organisation Non Gouvernementale
OSG	Office of the Surveyor-General
OSGOF	Office of the Surveyor General of the Federation (Nigeria)
OSRS	Open Source Remote Sensing
OSRU	Occupation du Sol par application des Règles Urbaines
PASIDOF	Projet d'appui à la mise en place d'un dispositif de formation, information et documentation sur l'organisation foncière
PDA	Personal Digital Assistant
PID	Preliminary Index Diagrams / Parcel Identifier
PLOF	Plans Locaux d'Occupation Foncière

PNUD	Programme des Nations Unies pour la Développement (United Nations Development Programme)
POCR	Principes d'Orientation du Code Rural
PostgreSQL	Open Source database software
PSCAP	Public Sector Capacity Building Program
RADARSAT	Radar Satellite
RCMRD	Regional Center for Mapping of Resources for Development
RECTAS	Regional Centre for Training in Aerospace Surveys
RICS	Royal Institution of Chartered Surveyors
RIM	Registry Index Maps
RLA	Registered Land Act (Kenya)
RRR	Right, Restriction, Responsibility
RS	Remote Sensing
RTA	Registration of Titles Act (Kenya)
RTK	Real-Time Kinematic
SAA	Selected Agricultural Areas
SDA	Selected Development Areas
SDI	Spatial Data Infrastructure
SENELEC	Société National d'Electricité du Sénégal (National electricity company of Senegal)
SGBDR	Système de Gestion de Base de Données Relationnel
SHHA	Self Help Housing Agency (Botswana)
SIF	Système d'Information Foncière
SIFOM	Système d'Information Foncière Multi-Usage
SIG	Système d'Information Géographique
SLB	Sub-Land Boards (Botswana)
SLIMS	State Land Integrated Management System (Botswana)
SLM	Sustainable Land Management
SME	Small and Medium-sized Enterprises
SNB	Service New Brunswick - Service Nouveau Brunswick
SoK	Survey of Kenya
SONATEL	Société Nationale des Télécommunications du Senegal
SP	Secrétariat Permanent
SPCR	Secrétariat Permanent au Code Rural
SPV	Special Purpose Vehicle
SQL	Structured Query Language
SRO	Survey Records Office (Kenya)
ST	Science and Technology
STC	Scientific Technologies Corporation
STDM	Social Tenure Domain Model
SURCON	Surveyors Council of Nigeria
TIWSS	Tunisian Interdisciplinary Workshop on Science & Society
TLIMS	Tribal Land Integrated Management System (Botswana)
TM	Thematic Mapper
UA	Universal Access
UCLAS	University College of Lands and Architectural Studies
UFA	Umbrella Final Agreement
UML	Unified Modelling Language

UN	United Nations
UNB	University of New Brunswick (Canada)
UNCHS	United Nations Centre for Human Settlements
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN-HABITAT	United Nations Human Settlements Programme
UNPAN	United Nations Online Network in Public Administration and Finance
UNU	United Nations University
UoN	University of Nairobi
USAID	United States Agency for International Development
UTM	Universal Transverse Mercator
VFS	Vallée du Fleuve Sénégal
WASC	West Africa Submarine Cable
WCMC	World Conservation and Monitoring Centre
WGS84	World Geodetic System 1984
WWF	World Wide Fund for Nature
XML	eXtensible Mark-up Language

Executive Summary

The economies of most African countries rely heavily on agriculture and other land and land-based activities such as tourism, mining and livestock production. Indeed, these are the core activities through which African countries participate in the global economy.

Moreover, land is key to food security and the social-cultural needs of most communities in Africa. It has also been established that the performance of most sectors of the economies of African countries is indeed tied to that of the land sector. The management of this sector must therefore be accorded priority attention in all countries in order to unlock the overall performance of national economies. This is best done through comprehensive land policies developed to address all the cross-sectoral needs and the unique circumstances in each of the countries.

It is in response to this challenge that the African Union (AU), the African Development Bank (AfDB) and the Economic Commission for Africa (ECA) embarked on an exercise to develop a continental framework to guide land policy formulation and implementation in AU member States. The background document for the framework observed that a progressive improvement in the quality and completeness of cadastral and land information data bases is required to facilitate planning, land use change and to ensure that the land claims and economic needs of the poor and vulnerable are not ignored in the process of structural economic transformation. One of the substantive policy areas identified in the document is the reform of government land agencies, which deals with the clarification of institutional mandates and roles and establishment of business-like and customer-oriented land agencies; modernising survey procedures, land information and cadastral systems; streamlining of land titling procedures; better documentation of land transactions to support development of formal land markets. This emphasizes the fact that effective formulation and implementation of land policies can only be best done in circumstances where all the land information necessary is availed in a suitable, timely and up-to-date form to enable expedient decision-making by the policy planners in each of the sectors.

The Economic Commission for Africa (ECA) therefore set out to support the above AU-AfDB-ECA continental land policy initiative through a parallel exercise to develop some guiding principles to govern land management information systems in AU and ECA member States. It is expected that these guiding principles will greatly complement the efforts of these member States in their on going efforts to formulate and implement national land policies. Appropriate land management information systems will also be helpful in the evaluation of the implementation of national land policies and the overall performance of the land sector.

The discussion, guidelines and principles contained in this publication was developed following a colloquium of experts on the subject from around Africa but informed by best practices from around the world. A detailed task brief was circulated through various networks, describing the objectives of the publication and calling for proposals from interested contributors. The contributors decided on their exact topics within broad themes. This approach allowed for both a wide participation and a wide scope of topics being treated. The authors of the fifteen proposals that were selected for inclusion constituted the panel of experts to discuss the pertinent issues for this publication. In addition to the selected submissions, Natural Resources Canada contributed three papers on relevant Canadian experience and best practice, and also commissioned a background paper prepared by the Centre for Property Studies of the University of New Brunswick.

The colloquium discussed, among other issues,

1. Information needs for land administration in various jurisdictions and sectors – urban, rural, environmental management, and social and economic development;

2. Land rights in customary/traditional systems, legal/formal systems, common property regimes, and gender issues;
3. Land identification methods in cadastral and rural jurisdictions and other situations; and
4. Information solutions for land administration.

The publication is expected to be of great value to decision makers, researchers and all others in the public and private sectors charged with developing or implementing national land policies and the technocrats entrusted to develop and maintain land management information systems in member countries.

The publication recognises the centrality of the knowledge economy in the global market. Today, the knowledge economy is primarily driven by information communication technology (ICT), which is dependent on the availability of optimum electronic ("e")-infrastructure in the respective jurisdictions. Another central assumption of the publication is the fact that all material wealth derives directly or indirectly from land. With economic growth in African largely being driven by land based activities, the land sector therefore need to be brought into the prevailing knowledge economy by using the current technologies to better manage information about land in order to achieve sustainable, integrated management of land resources.

However, Africa remains e-challenged and could therefore be easily left behind in the development of its knowledge economy and by extension, remain at the periphery of the global economy. This publication however points out that African communities have always practised some form of rudimentary knowledge economy throughout history, the lack of e-infrastructure notwithstanding. This has been done through various traditional methods of information gathering, storage and dissemination. It is these methods that need careful analysis and organized documentation by information managers to prepare ground for the harnessing by ICT once member States have sufficient e-infrastructure and funding. This will therefore help African states to maintain presence and participation in the global economy despite the prevailing challenge in e-infrastructure.

The publication points out Africa's unique circumstances in regard to the application of technology and modern land management information systems. There are ownership concepts only unique to some jurisdictions in Africa yet the design and development of the intended systems is driven from jurisdictions quite unfamiliar with such concepts. This therefore results in the development of systems inappropriate for some of the intended jurisdictions in Africa, leading to gaps or major limitations during application. To bridge this gap and help institutional and state land information managers identify and prescribe appropriate specifications to system developers, this publication has gone to some reasonable depth in identifying the unique challenges prevalent in most African jurisdictions.

This includes the types of interests associated with land in Africa, the low levels of e-readiness, limited levels of technology and literacy and cultural and attitude barriers. The publication also points out the need to take advantage of some of the broadly spoken languages in Africa such as Kiswahili which could greatly enhance the participation of communities in information management at local levels and minimise barriers occasioned by the interface languages of systems found in most parts of Africa, English and French. Familiarity with the discussion on these limitations will help development partners keen in supporting the development of technological solutions for the land sector in Africa insist on the correct software and hardware specifications.

The publication has suggestions on the possible way forward for member States, relevant to their circumstances. It points out the need to identify and tap the wealth of knowledge and authority resident in traditional authorities, be they leaders or institutions, local authorities or state organs with influence at the lowest local levels for the effective management of land information. It also emphasizes on the need to embrace low-technology solutions, essentially paper-based, provided focus is maintained on the need for the necessary transition to modern systems with time. Improvement of the access to affordable land information by rural land owners and other users at lower levels is underlined through a case example of the Bhoomi system of Karnataka State in India. This system, now driven through modern technology, evolved from a basic paper system. Though it, the community is served through land record kiosks spread around selected centres in the rural areas where farmers can verify land ownership and obtain certified copies of their land records for their respective uses. Through it, transparency has been improved, costs of services brought down and corruption in service delivery greatly reduced. This should inspire member States in challenged circumstances today.

For the more hands-on manager who would do with some technical depth, the publication dwells to some depth on the general subject of cadastres. There is some good treatment on the subject of land identification and boundaries. A basic discussion on maps and plans raises useful questions on the accuracies desirable and considered sufficient for proper land management. There is a very good treatment on the need to explore and identify suitable parcel identifiers appropriate for the jurisdiction of application and modern systems. The need to borrow from the "multipurpose cadastres" concept, which allows integrated land information management with different sub-systems developed for different functionalities, is discussed briefly. Where the system is designed as integrated sub-systems, different parts of a country can place emphasis on different functionalities. The case of Botswana's systems, one designed to address tribal land and the other to address state land, have been carried in the publication to exemplify this. The link between land management information systems and the Spatial Data Infrastructures (SDI) in each of the countries is clearly drawn within this section to help managers understand the complementary relationship between these two.

To be able to fully tap the potential benefits of an effective land management information system in countries, the publication points out the need to build capacity through some well designed communication strategy. This should target user groups including communities, land owners, land administration managers, practising professionals, politicians, the media, civil society and academicians.

Some thirteen broad principles listed at the end of the publication gives an overview of some broad concepts that system designers, managers, users and decision makers should routinely bear in mind in regard to land management information systems.

Land Management Information Systems in the Knowledge Economy

The administration of every public service and every branch of national activity connected with land is greatly assisted in the execution of its work by the existence of an up-to-date and unimpeachable map and record of landed property throughout the country.

[Kain, R.J.P. and Baigent E. 1993]

Introduction

The concept of knowledge or knowledge-based economy refers to an economy in which the generation and exploitation of knowledge plays a predominant part in the creation of wealth (Houghton and Sheehan 2000). The related concept of knowledge society implies "a society in which systematic knowledge and technology, defined as the use of knowledge, are central in the definition of values and the design, development, and operation of organizations and programs" (Carroll 1975). The knowledge economy is being driven by developments in information and communication technologies, which has made it possible to transmit large volumes of facts at very high speeds in electronic form through networks. The knowledge economy is therefore sometimes referred to as e-economy, emphasizing the electronic communications aspect, network economy, emphasizing the fact that the communication is through networks, or information economy, emphasizing that what is actually stored, manipulated and transmitted is information (and data).

While efforts are continuing, and limited success is being achieved, to transform African economies and make them knowledge-based, they are still largely dependent on land-based activities. These include agriculture, livestock production, tourism and the extraction of mineral ores and oil. Even in transformed economies, land still remains the ultimate source of all material wealth and sustenance of life. Food, fuel, clothing, shelter and all metals and plastics are ultimately derived from land. The challenge is therefore how to apply the concepts and technologies of the knowledge economy to the land sector, rather than completely abandoning them.

The major land-based economic activities in Africa are agriculture, livestock production, tourism and the extraction of mineral ores and oil. These activities still remain the drivers of economic growth in Africa. For example, agriculture alone provides . . .

> . . . 60 percent of all employment, constitutes the backbone of most African economies; in most countries, it is still the largest contributor to GDP; the biggest source of foreign exchange, still accounting for about 40 percent of the continent's hard currency earnings; and the main generator of savings and tax revenues. The agricultural sector is also still the dominant provider of industrial raw materials with about two-thirds of manufacturing value-added in most African countries being based on agricultural raw materials. Agriculture thus remains crucial for economic growth in most African countries.
>
> [NEPAD 2002, 12]

The land requirements of the various activities are not always compatible with one another. For example, the use of land for mineral extraction could be inconsistent with the requirements for forestry, which might not be compatible with agricultural needs, and which in turn could be at variance with the needs for housing developments. There is therefore a need for integrated management of land resources to reduce, if not eliminate, potential conflicting demands of the various land based activities to ensure sustainable development. The data (and information) needed for such integrated management of land includes land parcel mapping (ownership, administrative and geopolitical boundaries), land ownership and governance, land cover/land use, ecosystem zones and regions, socio-economic data, utilities and infrastructure assets.

A joint initiative of the African Union (AU), the African Development Bank (AfDB) and the Economic Commission for Africa (ECA) to develop a land policy framework for Africa has recognized this need for land information for integrated land management:

> The implication is increasingly that agricultural development planning, suitable land tenure and access arrangements, and local economic development strategies must be worked out simultaneously. At the same time, a progressive improvement in the quality and completeness of cadastral and land information data bases is required to facilitate planning, land use change and ensure that the land claims and economic needs of the poor and vulnerable are not ignored in the process of structural economic transformation. (AU-AfDB-ECA, 7)

The diversity and volume of the data obviates the need for dedicated management of land information, using modern technologies to manage them and make them easily available to the sectoral and professional groups that are invariable involved in managing land. The new technologies available for land information management are already being developed on an ad hoc basis across the continent. The time is therefore ripe to look for ways of capturing best practices of what works best in the African land tenure context and for ways to achieve cost savings and economies of scale as these technologies become mainstream.

The main objective of this document is to provide a guide for decision makers, researchers and others who are dealing with land issues in Africa, on the role of information management in formulating and implementing land policies. It will address land information management in the context of the knowledge economy, but recognizing current realities in Africa. These realities include the existence in some jurisdictions of interests and rights in land that are not common in jurisdictions from where the technologies and concepts of the knowledge economy are imported; and the low level of e-readiness in many African countries. Yet such jurisdictions are expected to adopt knowledge-centric management practices inherent in the current global economy.

This document is organized into several parts. The first part analyses the cultural factors that will have to be considered in the development of any workable land management information system for ECA's member States. The implementation and operation of the LMIS will draw on lessons from cadastres and land inventory systems. The next part therefore reviews relevant technical issues, including spatial data infrastructures, of which the LMIS is a component. The final part of the main discussion deals with challenges and problems that are specific to Africa. This is then followed by a set of principles recommended to guide the implementation of LMIS in Africa.

Guiding Questions

This document deals with the sort of basic information that a person who needs land for whatever purpose, would like to have: from whom do I get it? On what terms? What can I do or not do with it? Where is it located? It also deals with the needs of administrators and decision makers who would like to know the stock of land capital available to them. What interests or clusters of rights do people have in different portions or parcels of the land stock? Who (individual or group, natural or artificial) are these interests vested in? What restrictions are placed on particular uses to ensure complementarities of the rights? What responsibilities have been created to protect the rights and enforce the restrictions?

Bentsi-Enchill (1965) suggests that such questions can be embraced in the schematic question: Who holds what interest in what land? This formulation leads to . . .

> Three principal concerns or lines of inquiry . . .: (1) The types of interest in land that are or can be held in the particular system under investigation. The principal factors to ascertain concerning any given interest, it is suggested are: (a) the respects in which it falls short of plenary rights of users and disposal; (b) the specific confines of the land to which that interest relates; and (c) its duration, an inquiry that leads to considerations about inheritance patterns. (2) Secondly, the question, "Who?" points to a general inquiry regarding the "persons", natural or artificial (not excluding

> the state) who hold or can hold various types of interest in land. And where groups of persons are the holders of such interest, it points to an inquiry concerning the machinery of group administration. (3) Thirdly, both lines of inquiry raise questions regarding whatever arrangements or machinery there may be for storing information concerning these matters. (p. 116)

It is this third concern — information management — that is the focus of this document. What mechanisms or arrangements should be put in place to answer basic questions that may be asked by land owners, potential investors, policy makers and administrators? While recognizing the need to encourage investment by individuals, groups and communities, the arrangements should include measures that support other social objectives.

Knowledge Economy Context

One such objective, which in fact is closely linked to the investment push, is to reduce poverty by increasing Africa's share of the global economy driven by knowledge.

> To participate in this new global economy, developing countries must be seen as attractive offshore production bases for multinational corporations. To be such bases, developing countries must provide relatively well-educated work-forces, good infrastructure (electricity, telecommunications, transportation), political stability, and a willingness to play by market rules.
>
> [Thurow 2000, 20]

The major contributions of Africa to global markets are agricultural and other land-based resource products and services, such as mining and tourism. The background document for the AU-AfDB-ECA land policy framework points out that "Business activities require access to physical space." Economists have argued that as an indispensable factor of production for a competitive market, the land itself should be subject to the same market forces. Even remote rural lands are therefore being sucked into national and global market economies:

> The basic factor responsible for this development was the economic emancipation of the individual as a result of new patterns of economic activity. … The idea of personal acquisition was bound naturally to affect the system of land tenure; with his wealth the individual began to seek after land as a personal possession. The cash economy also led gradually to a change in the method of land exploitation, from subsistence farming to the cultivation of cash crops on commercial lines.
>
> (Nwabueze 1972, 35)

One example of this trend are the horticultural farms in Kenya and Ethiopia that produce flowers for European markets. The operators of these farms need to have relevant information to assure them that their investments are safe. At another level, the destination markets of the flowers, and other agricultural products destined for off-shore markets, need to be convinced that the production environments meet stipulated standards. Though these trade issues are beyond the scope of this document, the onus is on African producer-nations to make the information available for potential investors and off-shore regulators to answer, among others, basic questions about land rights (access, security, etc) and production environments. Without these facts, the investors could not make relevant decisions and the countries could miss the economic opportunities.

Two important aspects of the knowledge economy are services and choice. The set of tools and procedures provided by ICTs enable services to be offered to the public at large, who then choose from several service options and levels. With this approach, once the necessary infrastructure is in place, marginal transaction costs to reach additional service takers become minimal, resulting in large efficiency gains in terms of output per worker. Service objectives are also easier to achieve due to the fact that the informed public choose for themselves what most suit their needs – more effective services. Because these services are provided via the electronic communication systems, they are therefore usually referred to as "e-" services, e.g., e-government, e-commerce, e-health, e-cadastre, etc. Further, since the most common form of electronic communication is the Internet, reference to any e-service usually implies service delivered through the Internet, e.g., e-commerce, e-consultation, e-discussion, e-banking, etc. A very important feature of this new economic model that is made possible by our new technologies, is that it is the information and its dissemination that constitutes the value. Today, the more the users of data, the greater the value it has.

Interests in Land

Therefore the starting point for bringing the land sector into the knowledge economy is the organization of information for land management to enable adoption of service-oriented approaches and using appropriate e-tools to reduce transaction costs, increase transparency and improve access to the information to answer the basic question: Who holds what interest in what land? What exactly are these interests in land?

Bentsi-Enchill defines "interest" as the sum total of "rights" vested in a "holder" (who may be an individual or group of persons) with respect to a particular parcel of land.

A right is a three-way relationship between the right holder, X, the thing over which the right is exercised and the rest of the world, having the following basic features:

a. it is generally understood what privileges or liberties X can exercise at will over the thing;
b. all others are enjoined by the system of moral and jural relations operative within the particular community not to interfere with X's exercise of this liberty or privilege; and
c. persons infringing on this prohibition will be deemed to have "wronged" X and may incur the reactions flowing from the type of remedial machinery available in the particular community or jurisdiction (Bentsi-Enchill 1965, 119).

The general understanding implies "knowledge": the general public knows who X is, what X is at liberty to do and what they are enjoined not to do. They, as well as X, know the extent of the land over which X exercises these rights. Members of a small community could be expected to know these facts about land in their immediate locality. However, it has been established that since products from any land can end up on any global market, "strangers" or "outsiders" from these markets could be interested in the rights and privileges that exist in any land. The participation in the e-economy of land information has to work both for the commercial interests seeking new resources, as well as the current possessors and the land administrator. That the new information technology is vital to good governance and participation is illustrated very well in the contrasting positive and negative sustainability outcomes in recent natural resource decisions in the Andean region. Those local populations who were able to increase their scope of understanding through access to land information on line and to participate in a wider world of social capital by bringing in environmental groups, etc., were able to benefit from, and control decisions made concerning new uses of their traditional land base (Bebbington 2008). To bring the benefits of the new economic model to the land sector, African countries need to learn from such examples and introduce openness to the management of information about land. It should be observed that in the post industrial world, low return economies are built on obfuscation and secrecy and non-shared data. All the new economic models are tied to increasingly open systems, as exemplified in the growth and wealth of the Internet search providers (exemplified by Google and Yahoo!) versus the old proprietary sales channels. This is just as true for land information. In OECD countries, land information in the land registry, cadastre and everywhere else is readily available. For instance, anyone can purchase a copy of any Title Deed registered in Her Majesty's Land Registry. In the poorer countries, it is not.

H M Land Registry

For about £8 you can get a copy of your Title Deeds as registered at HM Land Registry. You can also obtain a copy of anyone else's Title Deeds for the same amount if they are registered.

All you need to do is to click on www.landreg.gov.uk and click on the English or Welsh sections. Once in click on "information about finding out about property ownership " and follow the instructions. No-one will know that you have obtained a copy of their Title.

Source: http://www.gardenlaw.co.uk/boundaries.html

Generally, clusters of rights that have a high frequency of occurrence form named interests for the purposes of administrative and social transactions. These interests in land could be ranked in some sort of descending order of amplitude or range, along a theoretical ladder. In codifying the facts into an information system, the named clusters become the entities (albeit abstract ones).While names provide shorthand for referring to broad classes of facts or relationships that are understood by users of any information system, emphasis should not be placed on the names or terms used, as these may imply concepts specific to other jurisdictions or communities. Bentsi-Enchill (1965, 120) points out that:

> One difference in tenure systems from community to community can be said to lie in the fact that the clusters of rights forming one common type of interests in one community do not correspond exactly with common clusters in another and fall on different points of the ladder.

The Ownership Interest

Ownership is the relationship between the interest "holder" (natural or artificial, individual or group) that accords the owner the fullest cluster of rights over the land in question, the maximum range of use and disposal allowed within a given legal system. Allodial ownership is the concept of an absolute, original interests in land, held of no one, with maximum amplitude, "indefinite in point of user, unrestricted in point of disposal, and unlimited in point of disposition." While this may not exist in real life, it provides a theoretical absolute maxim for comparing land rights. .In many jurisdictions, the closest to the absolute ownership interests are vested in a collective community, such as the village, clan or family. Increasingly, they are vested in the State or administrative subset of it, especially following land reform legislations, for example, the Nigerian Land Use Act provides that:

> Subject to the provisions of this Act, all land comprised in the territory of each State in the Federation are hereby vested in the Governor of that State and such land shall be held in trust and administered for the use and common benefit of all Nigerians in accordance with the provisions of this Act.
>
> [http://www.nigeria-law.org/Land%20Use%20Act.htm]

Lesser Interests

Common interests in land could include one or more of the rights to farm, build, pasture, pass on to heirs on death, dispose of by will or by sale, etc. Some of the rights that make up an interest cluster may exist alongside other rights in the same piece of land, with implied or specified orders or priority; some may terminate after specified periods of time, with or without the right of renewal or extension. Some rights may be vested in the public at large, e.g., the right to pick fallen twigs or wood or fruits, to collect wild or uncultivated grass for fodder, etc; others rights may be vested in owners of neighbouring property, e.g., the right of passage – not necessarily immediate neighbours. At the apex of the descending ladder of interests or clusters of land rights is allodial ownership. Even where it cannot be vested in a holder per se, it still forms the absolute standard against which existing interests are described in terms that imply how far down the ladder they are. The more exclusive and longer a right is, the higher up the ladder it is considered.

Appendix IV presents the findings of breakout groups on land rights at the symposium on land management information systems in the knowledge economy (in Africa). The list is not exhaustive, but rather exemplary.

In designing the information system, interests in land "should be described in terms of the ways in which [they fall] short of the plenary rights of user and disposal of the land to which [they relate], and of the boundaries of the said land . . ." (Bentsi-Enchill 1965, 110).

Group Interests

It has been stated that interests in land could be held not only by natural persons, but also by artificial persons or groups. Such groups include cultural or political communities (referred to as polities). Such a community are normally held together by a common system of jural relations, i.e. a precept that disputes between its members should be settled by arbitral or judicial methods, including traditional or customary rules. These political communities now exist within the confines and context of modern states, with explicit or implied recognition and roles in land management. New polities created by the modern state, such as provinces, districts, communes, etc, may also be given roles in land administration with interests that are similar to the polity.

Within its area, the community would allocate different interests in specific portions of its land to different sub-groups, such as clans, families and lineages, down to individuals. The main group retains the maximum possible "ownership" interest. Smaller groups under the community would hold lesser interests, varying according to the type of group and from community to community. This document is not concerned with the debate regarding the existence or otherwise of individual tenure in traditional African societies. It however accepts that while it is not peculiar to African systems of law,

> It is perhaps the phenomenon of group title, the fact that everywhere groups of varying sizes are recognized or recognizable as the owners of land that most forcibly strikes the foreign observer almost, we might say, as distinctive or different.
>
> Bentsil-Enchill (1965, 124)

The land holding group could be a tribe, village, clan, lineage, or family, with the family being the most common and important group. In the African context, the term family usually implies a wider group than the in common parlance. For example, the common meaning of family in Southern Nigeria is:

> a social institution consisting of all the persons who are descended through the same line (the male line in a patrilineal, the female line in a matrilineal, society) from a common ancestor, and who still owe allegiance to or recognise the over-all authority of one of their number as head and legal successor to the said ancestral founder . . .
>
> (Coker 1966, 9)

At other times, the term could refer to the extended family, described as:

> a group of closely related people, known by a common name and consisting usually of a man and his wives and children, his sons' wives and children, his brothers and half-brothers and their wives and children and possibly near relations. . . . All the people born in a village believe themselves to be descended ultimately from a common ancestor.
>
> (Coker 1966, 24)

However the family or other land holding group is defined, questions arise as to the clusters of rights recognized and vested in the whole group (or sub groups) communally and individually (if any) in members of the group; what restrictions are inherent or explicitly placed on members (and/or the world at large) to ensure the rights; what management or control responsibilities exist and on whom are these incumbent. How much of these rights, restrictions and responsibilities should be codified and maintained in the information system would depend on their relative importance in particular communities, and would be contained in relevant laws and/or policies.

From the perspective of the information system, the immediate question is how to represent such groups as interest holders. One possibility would be to treat them like "customary associations" entitled to transact business and own property, just like any other association. The information system should "provide machinery which would make it possible to ascertain the person or persons responsible for the administration of such land and the precise boundaries thereof." Bentsi-Enchill likens this to "the general requirement in the corporation or company law of modern states for the submission of the names of officers and the machinery for ensuring that such information is up to date." It is the information aspect that concerns this document because:

> Where title to a particular piece of land is vested in a group, it is usually the group that can transfer such title. Questions therefore arise concerning the constitutional machinery for ensuring that a particular step taken can be said to be the act of the group.

This question also applies to offices of the modern state because buyers have fallen victim to con men posing as state officials and entered into bogus land deals. Sometimes corrupt officials could process undocumented "sales" or "approvals" to development applications. The fraudulent transactions reported in Box 2 were possible mainly due to flaws in the information support arrangements. Firstly, as admitted by the 'source at the ministry,' the manual system made it difficult, if not impossible to detect anomalies before the fraudulent titles would be secured. Secondly, the incompleteness of the information allowed the officials involved to keep some pertinent out of public view until the spurious transactions are completed. To reduce, if not prevent such practices, the supporting information system for land transactions and title recording should require that all interests, including those in the process of being transferred, should be documented showing clearly their status or stage in the process. Thirdly, such land records should be open to the public, as implied by the theory of the cadastre.

Five senior Lands officers suspended

BY GAKUU MATHENGE

AN entire department at Ardhi House was sent packing in a bid to dismantle corruption networks said to have been operating a parallel bureaucracy.

Five suspended departmental heads are now under investigation over what the PS, Mr Kombo Mwero, described as "dubious and irregular transactions".

Mwero has also produced a list of former senior officials who have been sacked, suspended or retired in public interest and who have now been banned from ever setting foot at the ministry headquarters.

All the Senior Plan Record Office staff at the Ministry of Lands head office were kicked out on Friday. The department deals with land transactions and documentation.

Chief Land Registrar, Mr Cyrus Waweru Ngatia, was suspended and replaced by Mrs Teressia Mburu. Also suspended is Mombasa Land Registrar, Mr Harrison Musumiah, his Machakos counterpart, Mr James Khemoni, and Mr John Koskey, a Senior Plans Record Officer at the headquarters. Mr Nelson Manthi, a cartographer at the office, was also sent home.

"The ring has been operating its own parallel land system. If they are interested in a property and they know the official channels would not approve of it, they just get the retired senior officers to sign them and backdate the transactions while the insiders do the necessary filings and approvals.

"In a system that is still largely manual, by the time anomalies a detected, new titles have been produced and sale transactions concluded," a source at the ministry told *The Standard*.

Mwero's circular faxed to the media on Friday read in part: "The Ministry of Lands has stepped up the war on corruption and in this regard suspended five senior officers suspected of engaging in irregularities."

It went on: "We also wish to encourage the public to report cases that do not conform to procedures…and caution our staff against engaging in or promoting irregular deals."

Despite pledges to streamline operations at Ardhi House, former Lands minister, Mr Amos Kimunya, did little to dismantle the old networks, which presided over the rot exposed in the Ndung'u report. Kimunya is yet to be replaced.

The fate of the Commissioner of Lands, Mrs Judy Okungu, is also said to be hanging in the balance because the offices affected by the crackdown are under her docket.

Among other issues under investigation is a prime plot in Upper Hill said to belong to the National Social Security Fund.

In a public notice on January 26 and 30, and February 1, the Government said LR No 209/10777 (Upper Hill) had been irregularly allocated to a company called Kenya (RTF) Ltd and title number No LR89464 issued.

Box 2: The Standard (Kenya): Monday, 5 February 2007

Administrative Responsibilities as Interests

In addition to the basic question about who holds what interest in which land, we also need to provide for information about the various management responsibilities and controls that are assigned to different arms or agents of a community, government or state. In addition to being able to hold land, just like any other artificial person or group, these entities have an additional importance as land administrative authorities (LAA). In the modern state, the responsibilities of the LAAs could include master planning and land use zoning; licensing and approval of certain development activities; approval or, in the least, acquiescence of disposal of certain types of interests; and maintenance of registries and administrative information systems. In more traditional settings, the controls could include prohibition of farming, fishing or other uses in certain places, or on particular days; the determination of the commencement of harvesting or bush firing; the distribution of land and provision of land to strangers. Depending on their level, both modern and traditional LAAs may exercise the power of eminent domain, i.e., the power to compulsorily acquire land for public purposes. These management responsibilities and/or controls could be a factor in deciding on the question regarding what one can and cannot do with land and therefore should be available to both the prospective investor and the current possessors of land. The information should include details of the actual process to follow to apply for an interest, the expected time to be taken to finalize the transaction and any fees or other payments involved.

Land Identification and Boundaries

In any records or information system, manual or computerised, the attributes of interests are determined and recorded against separate entities. With land, the entities are units of land that are continuous and contiguous with other units or parcels of interest. They are also fixed in space and are immovable. The immovability of land gives it certain advantages over other objects of property, resulting in, for instance its use as savings and investment, and as collateral for securing loans. The same immovability presents certain disadvantages. Since a land owner (however "ownership" is defined) cannot remove their property to a safe place, a fraudulent seller, for example, could try to sell the land parcel again to another unsuspecting buyer. There is therefore need for special procedures to describe the land entity *in situ*. These special procedures usually include rules for describing the boundaries of the land within which a specific cluster of rights exists.

The rules would usually be contained in the laws and regulations dealing with land allocation, land subdivision, property ownership and transfer, etc, and are specific to each country. Cadastral surveying regulations in particular stipulate the accuracies to be achieved, and sometimes instrumentation and field techniques to achieve these accuracies, and recording procedures to conform to legal rules of evidence, among other provisions.

Except when the land is bounded by permanent physical features, such as a cliff, water bodies or identifiable natural ecosystems, the boundaries are usually invisible lines on the ground. However, their locations would be suggested by markers, such as fences, walls, blazed trees and survey beacons. The land could therefore be described, for transactional land records, in relation to these visible or traceable features, usually accompanied by a diagram depicting the features to facilitate correct location and identification of the land in question.

Maps and Plans

Such individual diagrams or plans are usually attached to legal documents, but for administrative purposes, it is usually more efficient and effective to depict the parcels of land on index maps. The map then provides a means for identifying and describing the land parcels which are the subject of an administrative action, such as allocation or development approval. Referring to cadastral surveys and land records, Dale (1995, 20) observes that "since the object of the map is to provide a precise description and identification of the land, the scale must be large enough for every separate plot of land which may be the subject of separate possession … to appear as a recognizable unit on the map". Such large-scale maps, sometimes called 'plans', constitute the "essential foundations" of the cadastre and should be "of sufficient accuracy of the territory whereby every parcel registered can be unambiguously identified" (Dowson and Sheppard 1956, 71). It should be noted that the "essential foundation" is not the "plans" *per se*, but the ability to unambiguously identify parcels. Bearing in mind that the maps or plans should only be "large enough" to enable this unambiguous identification, they should not be overly accurate as to make their compilation too expensive for the jurisdiction, e.g., in rural areas where land holdings are small and consequently have low commercial values. Where coordinates or dimensions are required, they should be stored as attribute information, rather than scaled from the index map or even an individual title plan, as the medium of the map or plan is subject to distortions and inaccuracies. To make this point, Ordnance Surveys, since the passing of the Land Registration Act 2002, includes the following warning on every official copy of every title plan:

> This title plan shows the general position of the boundaries: it does not show the exact line of the boundaries. Measurements scaled from this plan may not match measurements between the same points on the ground.
>
> (Ordnance Survey 2007)

It further explains that:

> No attempt is made to depict legal property boundaries. The map/data depicts ground detail, which is surveyed to Ordnance Survey specification and published accuracy standards and, although some property boundaries may be coincident with surveyed mapped features, no assumptions should be made in these instances.

Using an index map that emphasized "ground detail" rather than legal boundaries would be appropriate in Africa where most territories are rural and land is not held under "title deeds", except in commercial farms and other designated areas. It will therefore avoid the question of whether to embark on a land titling exercise before implementing a land information system. Even where some land parcels are held under some sort of statutory title, the ground-detail emphasis would avoid the problem of multiplicity of legal systems and implied superiority of some over others. Usually, there are boundary markers accepted by the community or locality. In built up areas, these are usually fences, walls or hedges. In rural small-holder subsistence farming areas, communities would usually have adopted specific perennial plants that do not grow into very big trees, as boundary markers. For example, in parts of Nigeria, *neubouldia laevis trees*[1], which are also used in herbal medicines, when planted along fairly straight lines, would be understood to mark boundaries. In more arid and open environments, stone or earth ridges (or mounds larger than the normal cultivation mounds) could be used to mark the boundaries. There could also be other occupation marks or signs that distinguish separately held parcels, e.g., landscaping, cropping-related vegetation, etc. It is worth emphasizing that, as in modern property laws, the boundary markers are not necessarily the legal or official boundaries, as these could have been located for their convenience rather than accuracy. If the legal boundary is required for any purpose, it is expected that the anticipated benefit from that use or activity would justify engaging a professional to make the determination as required by the laws in operation in the jurisdiction.

In compiling such maps, approximate methods could be adopted to meet the accuracy standard commensurate to the nature of jurisdiction. For example, in Kenya where about 50% of the country has been surveyed, different methods have been employed, with different accuracy specifications. The index maps compiled from accurate survey methods are know as Registry Index Maps (RIM); those based on general boundaries that are not clearly defined n the ground (but supposed to be known by the land owners and marked by visible ground details, like rivers, roads, hedges, fences etc.) are know as Preliminary Index Diagrams (PID). Both the cadastral surveys and the index maps are not always connected to previous surveys. When they are connected, usually in urban areas, and the connection is not necessarily to the national system.

The accuracy standard for such index maps could be determined on the basis of the land values, the nature and number of transactions expected, or educational level of practitioners or users. It should be remembered that the main purpose of the plans is to depict the topological structure of land holdings and provide for indexing and cross referencing between the ground location and the records in the database relating to the land. The breakout session on land identification during the symposium identified possible methods to include GPS surveys (positioning of corner points and joining them), aerial photography, satellite imagery (large enough resolution to enable identification of occupation or use parcels), and video recording of scenes. Consideration might even be given to the use of sketch maps. Whatever method is used, its effectiveness depends on acceptance by the user and the local population. In a digital environment, the map would be maintained in a Geographic Information System (GIS) and linked to the attribute databases. Even without a GIS, such an index map should still be an integral and indispensable part of the land information system, maintained in analogue form and identifying all the parcels in the area of coverage.

1 Yoruba: Akoko; Igbo: Ogilisi/Ogirisi; Hausa: Aduruku.

Land Inventories

A complete register or inventory of the land stock in a given jurisdiction should be a prerequisite for the formulation and implementation of land policies, and the integrated management of land resources. Policy formulation usually starts with a benchmark study based on statistics of the current situation. Some of the social objectives of land policy framework are to increase agricultural productivity, improve access to land by the poor, ensure gender equity, increase the security of tenure and redress historical and other imbalances in land distribution, among others. A thorough analysis of the current situation will require statistics of the ownership structure, disaggregated by gender, farm sizes and yields, investment and credit facilities. This implies the compilation of a comprehensive inventory of land parcels at local levels, which will eventually be aggregated and collated at different levels of administration. The result will then inform policy choices and implementation priorities.

The land resource inventory will also provide an indispensable tool for managing the land resource base, similar to the need for a complete inventory of any asset being managed. Modern management requires the manager to maintain up-to-date information and/or accounting systems to support and defend their decisions. Land management is no different, and land managers/administrators should maintain land "registers" (or more appropriately land records). The term land register is used here in the context of the French *livre foncier* or the German "ground book" concept – a complete inventory of land resources – rather than the common law conveyance-biased term.

It has been established that current thinking on land information management tends towards "multipurpose cadastres" or integrated land information systems with appropriate sub-systems for land tenure, revenue collection and general administration. If the system is designed as integrated sub-systems, different parts of a country can place greater emphasis on different functionalities. For example, in Botswana, the land management information system is designed as two sub-systems: the tribal lands integrated management system and the state lands integrated management system.

The Botswana Tribal Land Integrated Management System (TLIMS)

The Tribal Land Integrated Management System (TLIMS) project is ostensibly for tribal land administration functions, which is the core business Land Boards and their respective subordinate offices, i.e. Sub-Land Boards (SLB). The TLIMS application is designed as an online, multi-user, GIS-based, web-enabled land management system. This implies that, a Land Board and its respective subordinate offices in this instance will constitute a resource site that will be communicating with the main repository located at the Department of Lands. TLIMS is developed to assist the Land Board to manage land effectively and efficiently and improve service delivery in general. TLIMS also facilitates data sharing between Land Boards and sub-Land Boards as well as other government departments. The system performs two main functions, namely: (1) the day to day transaction data processing and management of the Land Board; and (2) spatial data analysis using GIS to assist in decision making required for land management. Some of the TLIMS project functionalities are shown in Table 1.

Table 1: TLIMS functionalities

TLIMS Requirements Description	Dept. of Lands	Main Land Board	Sub-Land Board
1. Planning Desk			
Land Use Planning		¤	¤
2. Front Desk			
Correspondence Register		¤	¤
Application Enquiries	¤	¤	¤
3. Application Desk			
Applicatin entry for new allocatins for			
a. Plots		¤	¤
b. Water Points		¤	¤
c. Surface Rights		¤	¤
4. Application for modifications to land rights, i.e. :			
Title Transfers		¤	¤
Change in Land Use		¤	
Conversions		¤	
Sub-Divisions		¤	¤
Sub-Leasing		¤	¤
Plot Consolidations		¤	¤
Plot Extensions		¤	¤
Plot Registrations		¤	¤
Plot Reversion		¤	
Renewal of Lease		¤	
5. Processing Desk			
Vetting of Applications		¤	¤
Plot Allocation		¤	¤
Board meetings:			

[Source: Department of Lands, 2003]

The system development is complete and the project is at a stage of populating and testing. The system is expected to create a country wide land management information system that will allow information to be safe, easily accessible and easily updated.

The Botswana State Land Integrated Management System (SLIMS)

State Land Integrated Management System SLIMS is a system analogous to TLIMS but designed for management of state land which is administered by the Department of Lands. State land comprises of the National Parks, Game Reserves and all the urban areas. The functionality of the system is similar to TLIMS but with application bias towards state land administration. The SLIMS application provides the following functionality in support of the land administration and management processes that are carried out at Department of Lands (DoL), Self Help Housing Agency (SHHA) and Deeds Registry.

The functionalities of the SLIMS project are shown in Table 2.

Table 2: SLIMS functionalities

Process	DoL	SHHA	Deeds Registry
Land inventory maintenance	¤		
Process Plot applications	¤	¤	
Waiting List allocation	¤	¤	¤
Direct Plot Allocation			¤
Title Deed Registration			¤
Change of Land Use	¤	¤	¤
Transfer Title		¤	¤
Conversion (Certificate of Rights to Fixed Period State Grant)	¤	¤	¤
Development Control and compliance	¤		¤
Acquisition & Compensation	¤		¤
State and Private Lease Management	¤		
Valuation Roll Maintenance	¤	¤	
Land Revenue			
Building Material Loans (BML)			

[Source: Botswana Department of Lands, 2003]

The spatial data for SLIMS is derived from the Department of Surveys and Mapping (DSM) where it is maintained on paper as well as digital formats and meets the cadastral standard of accuracy. The digital data from DSM appears in various formats which required conversion to ESRI shape format. The shape files are used in SLIMS to create requisite spatial database. The data capture for urban areas includes the following: general plans, survey diagrams, base maps indicating rivers, roads and other important features, layout maps and orthophoto maps. The attribute data for SLIMS is derived from the Department of Lands, Deeds Registry and the Self-Help Housing Agency (SHHA) offices.

Uniform Unique Parcel Identifiers

Every information or record system requires an identifier to link the objects to the data about them. Land records have traditionally tended to use different numbering systems. The multipurpose cadastre concept emphasized the need for linkages between land registers or land records systems. Such linkages could be achieved by maintaining a look up table of all known numbering systems. However, it is more efficient, especially in the computerized environment, to adopt a uniform unique parcel numbering system for all land parcels in the country. The justifications for such a system include:

- **Integrated Information Management**. Land is central to all economic and social activities. Different sectors could maintain registers and information systems to support their activities, but there is still a need for a uniform approach to land management and administration and to cross reference the information with one another.

- **Government-wide Numbering System**. As illustrated by the SLIMS of Botswana, the management of land involves several government agencies and departments, including municipal administrations. Even in such integrated approaches, different agencies could be responsible for different subsets of the data, and may even maintain other records or files. The information in these data sets needs to be cross-referenced for effectiveness and efficiency. The processing of requests or formal applications for land allocation for any purpose would need to verify existing land rights and any prior approved activities, which would be found in records or data sets maintained by different departments, e.g., mining, tourism, agriculture, etc.

- **Nation-wide Numbering System**. The information in any land record could be of interest to higher levels of government, or to non-governmental and civil society organizations with national coverage. The Botswana TLIMS example involves the land boards, their sub offices with smaller jurisdictions below and the Department of Lands with wider jurisdictions above.

- **Computerization.** In information systems such as LMIS, the underlying source of data is the database. In database construction, the objects or "entities" under consideration must first be defined and assigned unique identifiers before any attributes can be stored describing them. Even if resources do not permit immediate computerisation, provision should be made for eventual computerisation without having to renumber parcels then.

The desirable features of good parcel identifiers have been described in the literature (see for example, Moyer and Fisher 1973; IAAO 2003; IAAO 2004) to include:

- **Uniqueness**: Each identifier must be assigned to one and only one parcel; violation of this condition leads to the possibility of mis-identification—the wrong parcel may be identified. Also, each parcel to which an identifier is to be assigned must be assigned one (and only one) identifier in that identifier system; violation leads to the possibility of non-identification—a parcel being omitted.

- **Simplicity**: The identifiers should be easy to understand and maintain. There should be a high probability that the general user will remember the identifier of the parcel whose information they need to access. On the other hand, the administrative personnel responsible for maintaining the system should have easy access to the information needed to assign new numbers.
- **Permanence**: The identifier assigned to a parcel should be permanent and should not change unless the boundaries of the parcel have changed by subdivision, consolidation or remapping, in which case new parcels have been created.

- **Flexibility**: It should be compatible among various sub systems, allowing for data sharing and coordination. It should also allow for technology changes and selective retrieval of subsets of data.

- **Accuracy**: Some identifiers may contain coded information. For example, a numbering system could be made up of a string that includes state, province, zone or city code. The relevant part of the number that represents such information must be correct. For instance, if a state code is included, then the relevant portion must be the same as the state in which the particular parcel is found. The same applies to parcel identifiers based on coordinates.

- **Sorting**: The identifiers should lend themselves to being ordered into a logical and generally understood sequence.

- **Spatial Ordering**: As much as possible, parcels whose identifiers are close to each other in sorted sequence should also be close on the ground.

It is difficult, if not impossible to design a numbering system that possesses all the above desirable features. Different parcel identifier systems are in use, each with some advantages and disadvantages. The common ones in use include coordinate-based systems derived by concatenating geographic or Cartesian coordinates of a distinctive location within the parcel; file reference numbers issued by the administrative body that deals with the land; title or deed certificate number; simple sequential numbers assigned sequentially as parcels are being brought into the system by the relevant processes (e.g., surveyors' lot numbers); clustered sequential numbering whereby ranges of sequential numbers are reserved for parcels in zones to ensure that close by numbers refer to parcels that are in the same zone; and hierarchical numbering, whereby the sequential numbers are clustered within the lowest administrative unit, prefixed by numbers or codes for the higher level administrative or statistical units. The appropriate system to use will depend on the exact situation, with high priority given to compatibility among various user communities that need access to land information.

Cross Referencing Other Identifiers

Even though this discussion has been based on using a uniform unique parcel identifier system for all land records, it is noted that in some there may be legacy records using other numbering systems. Some administrative bodies may also be interested in different land units than allotment parcels and may need to device and use other numbering systems. The information in some of those systems will still be of use to other land management bodies in their activities. For example, census and other statistical programmes may identify different spatial units for data reporting and will likely use a different hierarchical numbering system for ease of aggregation. Such systems should be encouraged to carry the adopted uniform unique parcel identifiers as attributes, and vice versa. Preferably, a special look up table could be maintained to cross-reference all known identifier systems. This way, when a new identifier system is created, only this table would be re-structured to include the new field, rather than all bilaterally applying the change to all tables.

Indexing Rights "Owners"

Though the system under consideration is land-based, and therefore emphasis has been on indexing land parcels, the administrative uses of the information will usually require a reference to some rights "owners". There is therefore a need to also consider the unique indexing of people in the appropriate sections of the databases. The use of names is not appropriate because of the repetition of names, especially when applied on a national level. This problem is further exacerbated by the fact that the translation/transcription of words and names from phonetic languages (especially those with their own scripts, such as Amharic) into European and Latin scripts may differ among different people. The standard practice in database about people is to use an identification number, such as, social security number, student registration number, employment number, etc. Countries that have national identity numbers for citizens should therefore consider adopting them as the key field for persons, with names entered with other attributes. And where such national identity numbers do not exist, this is one more justification among many others to introduce it in the long run.

Since Land ownership is not limited to natural persons, provision has to be made for the indexing of rights-owning companies and other institutions. The laws governing property laws usually provides for them to be treated as legal persons. This implies that they would have gone through some registration process recognised by law and will be expected to have a registration or incorporation number. This can be used to index them in the database. The database design should consider the pros and cons of creating a separate relation for institutional rights holders in view of the fact that their attributes are different from those of natural persons, e.g., companies don't have given names and surnames.

The Cadastre and Cadastral Mapping

References have been made above to the "cadastre", "cadastral" mapping and index maps, without formally defining them. This is deliberate to avoid being detracted by the histories and terminologies that have professional (and sometimes national) nuances. Yet most of the concepts discussed above have been drawn from cadastral theory and a discussion of land information in any shape or form would not be complete without reference to the cadastre and associated concepts, and to the work of the International Federation of Surveyors (FIG).

The FIG statement on the cadastre defines the cadastre as follows:

> A **Cadastre** is normally a parcel based, and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, the ownership or control of those interests, and often the value of the parcel and its improvements. It may be established for fiscal purposes (e.g. valuation and equitable taxation), legal purposes (conveyancing), to assist in the management of land and land use (e.g. for planning and other administrative purposes), and enables sustainable development and environmental protection
>
> (FIG 1998)

Most economic, social and subsistence activities on land are organised in spatial units defined by humans. These could be units of ownership, possession, cultivation or administration and are referred to as parcels. Cadastral records are maintained at these parcel levels and normally consist of two parts: "an illustrative part in the form of a map, and a descriptive part comprising at least two registers, one arranged according to parcels and the other according to proprietors" (Simpson 1976, 110). Dowson and Sheppard (1956, 47) describe these components as:

> the marriage of (a) technical record of the parcellation of the land through any given territory, usually represented on plans of suitable scale, with (b) authoritative documentary record, whether of a fiscal or proprietary nature or of the two combined, usually embodied in appropriate associated registers.

The FIG (1998) notes that:

> Traditionally the Cadastre was designed to assist in land taxation, real estate conveyancing, and land redistribution. … But today, the information is also increasingly used by both private and public sectors in land development, urban and rural planning, land management, and environmental monitoring.

ECA (2001) however observes that cadastral systems have been continuously improved and reformed to make them more responsive to the needs of the society, the most far-reaching improvement being the introduction of the multi-purpose cadastre concept, formally linking traditional cadastral records with relevant administrative information. Further improvements have followed advances in information and communication technologies. The principles of database management were applied initially to indices to aid navigating the registers and eventually the whole the descriptive records (boundary descriptions, ownership, administrative and proprietary attributes) were computerised. At the same time advances in computer graphics led to cadastral maps being computerised as digital cadastral databases (DCDB). However, the early computerised land information systems emphasised the official needs for land records retrieval, and the DCDB focussed mainly on the needs of professionals and officials involved in cadastral and utility mapping, property conveyancing and land taxation. Eventually advances in Geographic Information Systems and the Internet led to information in various cadastres being repackaged for online delivery of cadastral information as e-cadastres. Examples of such online land information sources are Landonline of New Zealand (Land Information New Zealand), the Land Channel of the State of Victoria, Australia (State of Victoria 2004), and SNB Land Registration and Information of the province of New Brunswick, Canada (Service New Brunswick 2007). There are also examples from the private sector, such as the Property Data Store of the Nationwide Environmental Title Research (NETR 2007). The information offered by these systems is usually drawn from several sources. For example, the sources for the information in Land Channel include: Department of Sustainability and Environment; Department of Primary Industries; Department of Infrastructure; Department of Justice; State Revenue Office; Sustainable Energy Authority; Parks Victoria; Local Councils; and Utilities.

These examples have tended to emphasize the needs of land professionals for real estate information used mainly in conveyancing, planning and financial transactions; however, they do contain other land related information and provide for other activities, as demonstrated by the Business Channel of West Australia's Landgate and the Bhoomi system of Karnataka, India.

Box 3: Landgate's Business Channel (West Australian Land Information Authority)

Business Channel

The Business Channel offers easy, online access to land and property information integral to many business activities including:

- Agriculture;
- Planning;
- Land development;
- Land valuations;
- Real estate;
- Mining; and
- Tourism and recreation

The channel includes many useful tools and resources, including online manuals and publications, land registration "How-To" kits, flight diagrams, common registration forms and map indexes.

Landgate's online Map Viewer provides access to the latest property, survey, native title, and planning data, available as map layers which can be turned on and off and displayed transparently over aeril photography

The latter emphasized the needs by farmers and officials to reduce confusion in their centuries old land records system, thereby fighting corruption and boosting transparency. The system runs on specialized software designed in-house, and is accessed publicly at state-run "Boo Dhakilegala Malige", or land-record shop, where farmers can walk in and buy certified printouts of land records which help them verify or prove land ownership or tenancy.

Source: http://www.revdept-01.kar.nic.in/Bhoomi/Components.htm

> In the process, they are nearly free from the whims, inefficiency and corruption associated with village accountants who create, change and supervise handwritten records
>
> Karnataka has about 6.7 million farmers and 17 million land records spread over 30,000 villages, and is spending about Rs.180 million on the land-records project. An additional bonus is a wealth of easily digestible data on irrigation, soil, crops, rights, tenancy and ownership which officials say will help in development planning.
>
> (CIOL 2001)

CIOL (2001) reports that farmers "happily pay Rs. 5(30 US cents) for a printout" as opposed to Rs.50, 100 or even 500 they would have paid to the village accountant. The system also provides for faster transactions. For example, it now takes two minutes to get a printout compared to 3 to 30 days; less than 35 days to process a "mutation" compared to 70 to 200 days; and five days for credit processing by banks as opposed to 25 - 30 days, this mainly because the banks now have direct connectivity to the records to verify farmers' titles and crop data. Other benefits of the system include (Bhoomi nd):

- Land records are easier to maintain and update than in the manual system;
- Support for development programs based on land records, such as the crops grown in a village or sub-district, fertilizer and pesticide requirements;
- Monitoring of government land and prevention of encroachment.

LMIS as a Component of the Spatial Data Infrastructure

The above examples demonstrate that the information in the land information systems have wide application. Land information should therefore be organised to be easily accessible to the various user communities that would need it, which is just about every sector of the economy. The information would usually be combined with other social and economic information in the decision making process. Therefore they should be organised to facilitate combining them and cross-referencing with such other information products as may be required for other uses. This is best done by designing the land management information system as a component in spatial data infrastructures (SDI).

The SDI concept is a multi-stakeholder cooperative framework for producing, managing, disseminating and using geo-spatial data and information products in a coordinated manner. The objective is to have each dataset produced once and made available to a wide group of potential users from one source. The rationale is that data collected for one project or purpose can be used for several other purposes, if not in their current form, with little re-processing that requires much less effort, time and cost than collecting the dataset afresh.

> The SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general.
>
> [Nebert 2004]

Apart from the obvious datasets and associated technologies for discovering, disseminating and processing the data, the components of the SDI include policies, standards and institutional arrangements. These are described in detail elsewhere; see, for example, Nebert (2004), ECA (2001) and ECA (2003).

The actual data themes and layers to be included in the SDI will depend on the needs of the particular jurisdiction. Nevertheless, there are datasets that are expected to be required by many users from key economic and social sectors and therefore important layers or themes of the SDI. It has been demonstrated above that land information is one such wide-interest theme and should therefore be designed as a layer of the SDI.

The African Context

The development of land management information systems in the knowledge economy must be domesticated to the practical realities in Africa. The levels of economic and technological development in the respective countries must inform the prescribed designs. Moreover, the cultural context within which any of the prescribed systems shall operate must be well understood and respected. Therefore, solutions designed for Africa must consider the challenges and limitations unique to the intended jurisdictions of operation.

Low e-Readiness

One such limitation is the low "e-readiness" score. This is a numeric score that measures the degree to which factors exist in a country that are requisite for the e-economy:

> E-readiness is the "state of play" of a country's information and communications technology (ICT) infrastructure and the ability of its consumers, businesses and governments to use ICT to their benefit. When a country does more online—or, as is increasingly the case, wirelessly—the premise is that its economy can become a more transparent and efficient one essentially a measure of its e-business environment
>
> [EIU 2006, 1]

African countries have low e-readiness scores, as suggested by the fact that only four African countries feature in the Economist Intelligence Unit's (EIU) ranking of the world's top 68 countries. African countries scored lower than the lowest score in the above list (3.32 for Algeria). Africa (combined with the Middle East) had the lowest regional average score of 4.76.

Economist Intelligence Unit e-readiness rankings, 2006				
2006 e-readiness rank (of 68)	2005 rank	Country	2006 score (of 10)	2005 score
1	1	Denmark	9.00	8.74
2	2	US	8.88	8.73
3	4	Switzerland	8.81	8.62
4	3	Sweden	8.74	8.64
…	…	…	…	…
35	32	South Africa	5.74	5.53
55	53	Egypt	4.14	3.90
60	58	Nigeria	3.69	3.4
63	63	Algeria	3.32	2.94

In spite of the low e-readiness of most African countries, we should still strive to bring the land sector into the knowledge economy. While the current "e-centric" definition of the knowledge economy is new, the use of knowledge for economic and social benefits is not entirely new; even in ancient societies, "knowledge has always played a role in all human activities and knowledge acquisition and knowledge transfer are among the most distinctive characteristics of mankind" (Weert 1999, 51). Applying this nuanced point of view, we should aim to develop a knowledge-based land administration system, by emphasizing, for the time being, the need for information content to support administrative decision making, using whatever tools are currently available, but structured to facilitate up-scaling and upgrading as new technologies become available.

Technology and Literacy

The knowledge economy is highly dependent on technology, and in particular, the computerisation and dissemination of information through e-networks. Yet many jurisdictions in Africa have had fairly low levels of exposure to information technology. Physical infrastructure, such as communication networks and power supply, on which the e-economy depends, are poorly developed and maintained. This limits the ability to adopt e-communication and associated modern methodologies in land management. This is particularly true in rural areas where most economic activities and livelihood are dependent on land. The lack of reliable power supply means that users of information technology need to invest in stabilizers and stand-by generators which are expensive and limiting. Lack of communication infrastructure makes it difficult for potential users to connect to the networks from homes, schools, offices and other convenient locations. Internet services, which are the mainstay of e-services, are therefore mostly available at commercial Internet cafes.

Related to the low level of technology is literacy. One of the prerequisites for the knowledge economy is the existence of an educated workforce. This is required to implement and maintain the various components of the technological framework, as well as to access and use the information and knowledge products and services. The prevalent low literacy levels means that technological skills are not always available. External support could be used to implement the systems, but there is still need for local skills to support their operation. Sustaining the system also needs a user community with enough awareness of the utility of the system, and the knowledge to use it, to ensure their willingness to pay for such services that may be chargeable. Any designs must therefore go a step further to develop features that are a lot more user-friendly than would be required in technology-savvy jurisdictions.

Language

Many African countries have adopted the language of colonial governments for official and commercial transaction. The technologies of the e-economy have been built on concepts developed in these languages, especially English. These languages are taught only in formal schools, making it difficult for the unschooled members of the society to participate in the economy. Providers of e-services, including land administrators employing modern information management systems, must therefore explore ingenious options of reaching out to people through local languages spoken by vast groups of people. Given the multiplicity of local languages in Africa, it may not be economically viable to develop systems in all the local languages. A sub-regional approach should therefore be considered to achieve viable economies of scale in developing systems. For example, Kiswahili is spoken in Zanzibar, mainland Tanzania, Kenya, Uganda, Rwanda, Burundi and parts of the Democratic Republic of Congo (DRC). This could be made a language of choice in systems to be operated within such countries. While the backend databases and application systems would be developed in English (or whatever language), the user interfaces could be developed and presented in Kiswahili, which the local land owners use for normal transactions. This would make the information and knowledge products and services accessible to many land owners and users who have not had the benefit of acquiring proficiency in French or English. Other vastly spoken languages in the South, West and Northern parts of Africa should be identified and similarly adopted. Use of iconic languages for the user interface would further extend the system beyond sub regional clusters of countries, increasing the economic potential for system developers.

Culture and Attitudes

In Africa, most communities have developed a culture that government knows and will provide what is good for them. Oddly, many government officials have encouraged this attitude when designing service delivery policies. This passive attitude by communities and the patronising one by governments are inappropriate for land management information systems which thrive best with regular interaction between the information managers, sources and users. A participatory approach must be encouraged and built into the design and implementation of all information management programmes. Civil society lobby groups are emerging in some countries to advocate the need for governments to consult and involve people in all programmes.

It is also important to remember that traditionally, some communities do not easily open up to those that they do not know. This must be respected and dealt with through careful public awareness programmes to disabuse such groups and promote the importance of sharing land information openly to fully tap the associated benefits.

Possible Solutions

The above challenges and limitations require that African governments and institutions, along with the development partners who wish to support the development of systems in Africa, adopt more innovative approaches. African institutions must embrace a knowledge economy within their circumstances. Models and methods that are affordable and effective could be encouraged and adapted to the principles of the knowledge economy.

Decentralized Land Administration Authority Concept

It has been noted above that many communities have developed a culture of dependence on a faceless "government" that knows what is good for them, and that governments sometimes, perhaps unknowingly, encourage this passivity. The participatory approach suggested for managing information about land could be achieved by introducing a formal concept of a local land administration authority or structure, such as the Land Board (LB) in Botswana established by the Tribal Land Act (Botswana 1968), with members "appointed or elected, as the case may be," performing "functions vested in it" under the Act. The functions include the allocation of tribal lands:

> … Provided that no grant of land shall be of any effect unless the land board by resolution approves such grant and a record of the substance of such resolution is recorded in the minutes of the meeting at which the resolution was passed – 7(1).

The land boards (and subordinate land boards) are formal structures for land administration, with membership including the Chief or Local Authority, as ex-officio, and some members appointed by the Chief (or Local Authority), and others elected.
A slightly different provision is found in the Eritrean Land Proclamation of 1994, which provides a

> "Land administrative body" [as] a body established to manage land use and allotment in accordance with this proclamation and governmental and administrative directives issued based on this proclamation – 2(11)

The functions of the LAB include maintaining a registry containing:

> … clear information on the size and boundary of all arable and non-arable land, distributed and non distributed land, residential areas, buildings and sites required for conducting various social and development works (such as schools, hospitals, mosque, church, village assembly halls, offices, etc.) forest and pasture areas, sources of water, roads, and the name of every person to whom land has been distributed, the size and boundaries thereof, the date of distribution and change of distribution thereof, and other important information – 17(2).

Its members include a representative of the Land Commission as head, and members drawn "from the village assembly and various governmental bodies of the locality."

The duties vested in these land administration authorities include by necessity (in the Botswana case) and explicitly (in the Eritrean case) the maintenance of registries and information systems. The Botswana Tribal Lands Information Management System (TLIMS) has already been described above. Such explicit provision for the roles of local authorities in land maintaining and operating land information systems, and in land administration in general, should be encouraged. Even when they are not explicitly provided for as in these examples, the designer of a land information system should check for local institutions and structures, identify their roles (formal or informal) and include them in the operational arrangements for information management. Local authorities that could have direct or indirect roles in land administration, and which should be considered for involvement could include traditional rulers, farming cooperatives, savings societies, age grades, women's support groups, etc.

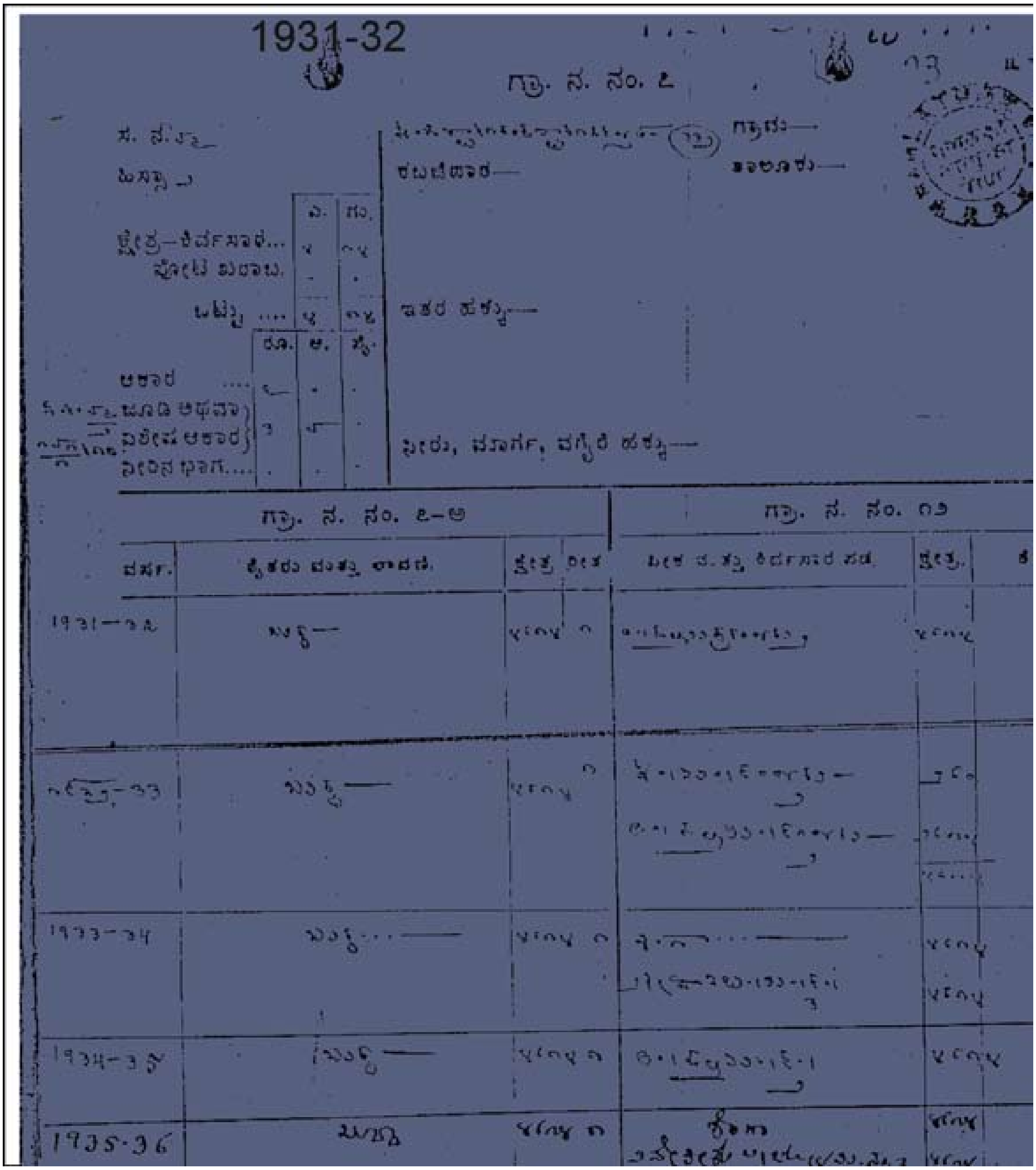
Interim Low-Tech Solutions

The LMIS, being part of the e-economy should ideally be computer-based and accessed through networks. However much of Africa has low e-readiness scores. It has been argued above that such societies should not be left out in LMIS developments. Rather emphasis should be placed on the concept of increasing the role of information in decision making using manual technologies as interim solutions. Such what-works-for-now solutions should be based on sound database principles: data models, entities with unique identifiers, relationships and indexing systems, among other features. As such, the records should be maintained on structured tables or forms with columns or data fields similar to attributes in normalized database tables. Appendices I - III show possible templates for the Land, House and Person Information Sheets for a manual land records system that can easily be migrated into relational database tables. Such information sheets could be maintained in loose folders or notebooks, with appropriate arrangements for physical security of the collection, including backup copies.

The computerised Bhoomi land records system was preceded by more than a century of formalised land records management to support the systematised revenue collection system in Karnataka State in India. The system was based on tables with as much as 26 columns at one point, including such data fields as "nominal holder, the person actually in possession, and the name of the cultivator, with the terms of his tenancy." Figure 2 shows one of the three forms that comprised the village record in the1930s. It is instructive to note that the farmers of Karnataka have developed a culture of using the data in the village records to support their transactions and therefore were willing and eager to support the modernisation project that became Bhoomi. It is this example that informs the recommendation to develop interim solutions and concentrate on developing awareness on the use of information in everyday decision making, until the appropriate technologies and infrastructure become available.

Despite the interim nature of the implementation, appropriate policies, standards and protocols should also be developed for using the system.

Figure 1: Karnataka Village Record 1931-32



Community Access Points

The value of the system depends on it being used not just by administrators, but also by the community at large. However it has been established that technology permeation and that the skill level are low, due to a combination of poor infrastructure development and poverty. The system should therefore make provisions for community access points. The Bhoomi system includes land records kiosks where farmers can collect copies of their records for a fee, and also lodge their requests for transactions, in this case, land mutation. These access points could be installed at the offices or premises of the local land administration authority involved in maintaining the system.

For paper based registries, arrangements for public access would best be made at the site where the records are kept.

Awareness Campaign and Communication Strategy

Even the best designed system would not succeed if its introduction is not accompanied by a strategy to increase awareness on its potential benefits and build capacity of the various classes of users. The design of the system should therefore include a communication strategy. In developing the strategy, messages should be targeted to various user groups, including land administrators, lawyers and conveyancers, politicians and policy makers, land owners, the press, academics and civil society groups. Effective communication may involve engaging the services of professional communication public relations officers.

On-the-Job Training, Centres of Excellence and Resource Pooling

The introduction of new concepts and technologies into any organisation usually involves retraining of existing staff. However, because of the novelty of the technologies some of the existing staff may not have the necessary background or prerequisites to follow a full theoretical course in the implementation of LMIS. Yet, these personnel possess the institutional knowledge on the processes involved. On-the-job training and short skills courses have been recognised as a very effective medium of supplying necessary skills and expertise in the geospatial industry. These courses are normally offered through special training centres affiliated or run by the national mapping organisations, e.g., Kenya, Nigeria, Ghana and Botswana, among others, have survey training schools under the Surveys and Mapping Departments/Divisions. While these centres started as pure technical surveying training facilities, their curricula have been revised continuously to include the operation of modern geoinformation technologies. With further revisions of the curricula of such institutions and possibly a change in its management structure to include representatives of other land management departments and ministries in the governing bodies, they could serve to provide similar skills training in the broader fields of land resource management in the knowledge economy.

At the supranational level, regional centres dealing with geoinformation management and services have provided similar training for its member States that do not have national centres, or in more specialized areas that are not available in existing national centres. Notable examples of such centres are the Regional Centre for Mapping of Resources for Development (RCMRD) and the Regional Centre for Training in Aerospace Surveys (RECTAS) – though these centres also run formal degree courses in collaboration with Universities.

In addition to the training activities, these regional centres also serve as equipment and human resource pools for activities that are not performed with enough regularity to warrant acquiring the expensive equipment by any one country. The national centres, where they exist, can also be structured specifically to provide similar pooling services, with contributory budgeting arrangements for maintaining the centre.

Conclusion

Even as we move into the knowledge economy that emphasises innovation and electronic service delivery, land still forms the basis of most human activities. We still need to build schools, hospitals, factories, homes and offices on land. E-agriculture does not reduce the need for farming on land to produce food. So the basic questions regarding from whom to get land, on what terms and what can be done thereon are still very pertinent. The land sector is therefore being brought into the knowledge economy by integrating the transactions in that sector of the economy into the e-service system. This requires that the information systems that provide answers to the basic questions about land be integrated into mainstream e-networks. This can only be done by designing the land management information systems on open architectures that can grow as technology changes, conforming to standards and guided by appropriate policies, with relevant institutional arrangements to coordinate the environment. The SDI concept provides the framework for land information to be combined with other geo-spatial information to support e-government and location-based services.

Another aspect of the knowledge economy is the integration of markets and services into a borderless global economy. Thus questions about a particular piece of land could be asked by people on the other side of the globe. A regulator in a destination country of produce from a supposedly remote location would want to know about environmental conditions on, or around, a small family farm. A potential investor in a farming, mining or tourism development might be interested to know about the land tenure regime in the village. The information system providing answers to their questions should therefore adopt regional or global approaches to be easily understandable to outside users.

While the SDI, like other aspects of the knowledge economy, relies on information and communication technologies, many African jurisdictions lack the e-infrastructure and technical skills to implement and maintain on-line land management information system. Therefore the LMIS in the African context should provide for low-tech solutions in technology laggard jurisdictions. Such solutions should be designed as interim implementations, based on as sound theory and principles as possible to facilitate migration to newer technologies as resources become available.

Guiding Principles

Following from the above discussion and deliberations of the Addis Ababa colloquium on LMIS, the following principles could inform a land policy and land information system process that leads to sound and transparent community and government decisions, minimises crises and capitalises on opportunities. These principles are only a guide for action, rather than prescriptions that must be followed.

Principle 1:	The knowledge economy is not synonomous with the e-economy

There is much valuable information about land that is held both orally and at a local level, as exemplified by the knowledge that chiefs have of resource use agreements. Although all communities should be encouraged and assisted in moving toward an e-economy, such encouragement must recognize that the knowledge economy is fundamentally based on access to information.

Principle 2:	LMIS need not necessarily be computer-based

Where appropriate, particularly at the local level, paper-based systems might be more effective. Certainly, in those communities which have little technological infrastructure, it is much easier to search and file paper records.

Principle 3:	Although the classical cadastre has merit, unorthodox approaches should also be considered

The cadastre typically consists of demarcating boundaries through surveying, calculating and drafting plans, and preparing transfer documents based on the plan descriptions. Unorthodox approaches might include non-survey-based sketches, picture evidence (still and video photos), and community-based boundary determination and dispute resolution mechanisms.

P rinciple 4:	The knowledge economy must be based on a sound regulatory framework

The framework must include appropriate legislation and policies that address issues of governance and administration, data access and quality, the use of ancillary data, and the currency and status of information (such as aerial photography).

Principle 5:	Information about land must be geo-referenced and descriptions of parcels must be unambiguous

Land administrators need accurate information about the location and shape of parcels. However, the accuracy should be a function of the use to which the land is to be put, and can be achieved using a range of techniques (high resolution satellite imagery, photo-mosaics, terrestrial photography, GPS, sketches based on pacing).

Principle 6:	The value of information can be increased by making it widely accessible

The principle of free access to all data and information resources whose collection and maintenace is funded by the public must be promoted. The sharing of information helps local communities make decisions about the use of resources, requires that administrators ensure that the data is both secure and correct, and creates opportunities for entrepreneurs.

Principle 7:	Access must be weighed against local culture

It might well be that a community is particularly sensitive about the widespread dissemination of land information, in which case some access could be made conditional.

Principle 8:	Accessiblity is enhanced by having the surveyor generals administer the LMIS

Although the private sector has a key role to play in gathering information for input to the cadastre (such as through plans of subdivision) and of using information from the cadastre, public access is best assured if a state or national governement is the sole custodian of the cadastre.

Principle 9:	The private and public sectors should form partnerships

Such partnerships should also include universities and technical colleges, civil society, lawyers and notaries, and should be assisted by relevant ICPs. For example, the Canada's Geomatics Industry, including Canadian universities, colleges and government institutions, or a consortiuum thereof. The partnerships should set out areas of responsibility, revenue and cost-sharing models, data sharing and warehousing arrangements, and the value-added products and services to be offered.

Principle 10:	Good and effective governance is essential

The organizations responsible for administering land information must ensure that the management is transparent, and that the information itself helps to promote good and effective governance by other groups. Such governance is encourged by including a wide range of partners (across many sectors) and by including all levels. For instance information could be collected at a local level by members of the community, maintained at the state level, and then used by multiple beneficiaries to support numerous inter-related socio-economic objectives, including environmental sustainability and the eradication of poverty.

Principle 11:	Land information management encourages and requires changes in institutional cultures

Computer-based systems require different management and work techniques than paper-based systems. Indeed, the transition is only brought about through visionary management, that will build the political will at senior levels of government and at the same time generate enthusiasm and recoginition of the need for structural change at all levels, starting with the grassroots. Thus, moving towards a digital knowledge economy presents an opportunity to help re-design the insitutional infrastructure of a country.

Principle 12:	Indigenous and gender issues must be captured in any LMIS

Much land tenure in Africa is based on customary and religious systems, so any LIMS must adapt, and adapt to, such heritage. At the same time, land information management can and should empower women by recognizing the significant role that they play in the composition of the household, in gathering resources, and generally, in the knowledge economy. All sectors of society can and should benefit from better mangement of land information.

Principle 13:	Public awareness is central to transparency and openness

The government is expected to employ decision-making processes that are open, as well as transparent, to stakeholders and the public. There is the need to enhance the sensitivity of various groups – government officials, professional bodies (surveyors and lawyers), and traditional leaders – to the benefits of better managing land information. Just as the LMIS should fit within the context of local culture, so too should the message of the importance of LMIS use community metaphors, local examples, and customary icons. The level of expected risk and controversy, and the need for timely decisions, should guide the nature and extent of consultation undertaken.

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Appendix I: Parcel Information Template

Land description section			
Parcel Identifier:	2441A0085	Street Address:	[address]
Land Admin Authority:	Village of . . .	City:	[city]
Original Interest:	Customary Right of Occupancy	State/Province:	[state]
Allotted to:	[ID number] [Name]		
Date:	[date]	Cadastral index map:	[map number]
Adjacent parcels:	[PID-1] [PID-2] [PID-3] [PID-4] [PID-5]	Background parcel: Subdivision: Date:	[PID-0]

Rights Section (neatly cross out expired or disposed rights; do not include house-specific rights)

	Grantor		Grantee				Expiry	
Date	ID No.	Name	ID. No.	Name	Doc folio #	Interest Type	Doc folio #	Date
8/12/96		Land Board	00898761	[name]	LC/96/9	Lease		

Houses Section

Date	HouseID	Building Approval #

Other Rights

Date	Beneficiary	Doc. Folio No..

Appendix II: House Information Template

House description section			
Parcel Identifier:	2441A0085	House ID:	H001
Construction started:	12/1/97	Building Approval: Date:	AS/97/09 2/6/97

Rights Section (neatly cross out expired or disposed rights)

	Grantor		Grantee				Expiry	
Date	**ID No.**	**Name**	**ID. No.**	**Name**	**Doc folio #**	**Interest Type**	**Doc folio #**	**Date**
2/6/97		[name]	00898761	[name-2]	97/093	CRO		
3/8/97	00898761	[name-2]	R/09890	Commercial Bank	97/121	Mortgage		
7/9/97	00898761	[name-2]	01187609	[name-3]	97/159	lease		

Appendix III: Individual Rights Owner Information Template

Personal Section

Identity No:	Date of Birth:
Name:	Sex:
	Nationality:

Rights Section (neatly cross out expired or disposed rights)

PID	House ID	Interest Type	Co-proprietors (if any)	
			ID Number	Name

Mortgages Section

PID	House ID	Doc folio #	Mortgagor	Discharge		Official
				Date	Doc folio #	

Address Log (to be printed on the reverse side of the information sheet)
(cross out old address and enter current address in the last row)

Street Address	P/Office Box	Phone Number	Fax Number	E-mail

Appendix IV: Reports of the Breakout Sessions of the Colloquium on LMIS

Session 1: Information Needs for Land Administration
Guiding Questions

1. *What is your definition of land administration?*
2. *What datasets would be needed for land administration in your assigned jurisdiction/topic?*
3. *And in what format will they be needed? Sources?*
4. *What are the administrative responsibilities for land administration? Their respective roles?*
5. *What are specific information requirements for allocation and access to land rights/resources?*
    » *Procedure and processes?*
    » *How long does it take?*
    » *Fees and charges?*
6. *Specific information requirements for conflict mitigation and resolution?*
7. *Other Issues*

Group Reports

<u>Group 1: Information Needs for Urban Land Administration</u>

1. *Definition:*
   Land administration involves implementing policy to regulate the use of lands; the identification of the land (locational), use of the land in conformity with land use plans, identification and recording of ownership (who) and interests (e.g., mortgages) in the land. Urban land administration could be guided/informed by the (unique) intersection of national, provincial/state, and local policy or law.

2. *Datasets:*
   - Cadastre (formal) w/ attribute data (e.g., owner)
   - Informal settlements (possibly captured through aerial photography, terrestrial, satellite)
   - Geophysical base layers (e.g., topography, hydrology, geology, etc.)
   - Infrastructure layers (e.g. transport, facilities and utilities, etc.)
   - Economic values (market, assessed, and taxation)
   - Cultural, spiritual, or religious values
   - Land use zoning
   - Socio-cultural layers (e.g., health, socioeconomic variables)
   - Land charges (e.g., ground rent, premium, etc

3. *Format and sources:*
   - Likely a function of local resources (e.g., more wealthy communities may be all digital while poorer communities may get by with hardcopy/analogue)
   - Surveying/fieldwork
   - Imagery/remote sensing
   - Terrestrial photography
   - Historical record (e.g., registers, deeds)
   - Documentary evidence (some may be oral, for example)
   - Video

4. *Administrative Responsibilities:*
    - Take stock of available land
    - Identifies uses
    - Identify and open up new areas for use
    - Allocation as provided by law
    - Ensures registration
    - Process title to secure tenure
    - Organizing development control w/ the town planner
    - Specific roles are contingent on the jurisdiction and local division of labour
    - Administrative responsibility of the land administrator is facilitated by a number of operators (lawyers, politicians, surveyors, town planners, land officers, etc.) that work as a team

5. *Information requirements for allocation and access:*
    - Availability of and access to land
    - Depends on jurisdiction
    - Depends on intended use, the applicant (e.g., private citizen for residential construction v. private sector speculation or 1st use v. 2nd use)
    - Matrix of state land - private land v. vacant – established land
    - State/Private/Vacant/Settled land

¤ *Procedure and processes:*
  » Formal application
  » Feasibility studies may come into play
  » Survey plan may be required
  » Topographic and sometimes soil tests
  » Contingent on jurisdiction

¤ *How long it takes:*
  » Contingent on jurisdiction (three months plus)

¤ *Fees and charges:*
  » Contingent on jurisdiction

6. *Specific information for conflict mitigation/resolution:*
    - Land registry transaction history
    - Depends on the type of conflict (e.g., boundary, title, zoning, building)
    - Sometimes not a conflict per se but remedy an error

7. *Other issues:*

    To what extent can a uniform continental policy apply to individual jurisdictions at the risk of ignoring local context (e.g., AU land policy)?

Group 2: Information needs for rural land administration

1. *Definition:*
   Land Administration is the processes of coordinating, controlling, facilitating, recording and disseminating information about the land allocations and land use rights when implementing land management policies

2. *Datasets:*
   - What are the resources : Land Cover / Land Use
   - Where are the resources : locations, dimensions of feature
   - Who are the stakeholders : local leaders, individuals, government, NGOs/Civil society
   - What are the rights : Grazing rights, fishing rights, etc

3. *Format and sources:*
   - Depend of the kind of information to be delivered and the audience
   - For people on the ground : Simplest format : 3-D data, analogue format
   - In the higher level : Digital format
   - Sources : Orthophotomaps, satellite imagery, etc

4. *Administrative Responsibilities:*
   - Traditional authorities (Chiefs, Communities leaders...) : Land allocation, Coordination, dispute resolution...
   - Public sector : Make the information valuable and available

5. *Information requirements for allocation and access:*
   All the information about rights

¤ *Procedure and processes:*
   » Simple, realistic, participatory
   » Maintenance procedures

¤ *How long it takes:*
   » As shortest as possible

¤ *Fees and charges:*
   » Low cost, affordability

6. *Specific information for conflict mitigation/resolution:*
   - Times series information about land use changes
   - Oral information about traditional disputes, mediation, resolution
   - Existing local level institutions available

7. *Other issues:*
   Incentives issues

Group 3: Land Information needs for environment and natural resources management

1. *Definition:*
   - A certain group of people regulating a piece of land at a certain period of time.
   - What is Land Administration?

- Depending on the purpose of the land
- Land Use and Land Cover

2. Datasets:
   - The Data Set that we need depends on:
   - >>Identify the activities first (suggested) :
   - Ownership
   - Allowable land use
   - Current Land use

3. Format and sources:
   - Digital, analogue, e.g. graphics, attributes
   - Sources: communities, private individuals and government agencies

4. *Administrative Responsibilities:*
   - Guidelines, monitoring mechanism, certificate of ownership (right/condition i.e. use permits) e.g. mining lease for a given period.
   - Admin level differs from the State to the community: sometimes negotiation needed in case of a community affected.
   - Respective Roles:
   - To communicate to one another to avoid problems,
   - For enforcement of law
   - Provide efficient services

5. *Information requirements for allocation and access:*
   - Stating what it is for!
   - Issue: Land inheritance claimed; but the state insists on reserving it for mining
   - Compensation should be given by looking at the cost
   - Is there a process to mediate?

¤ *Procedure and processes:*
   - » Depending on the country:
   - » Apply for the concerned ministry, if it is a community

¤ *How long it takes:*
   - » Cannot be specified. It depends also on the country. Generally, it is easier at community level

¤ *Fees and charges:*
   - » Also differs from country to country:
   - » In urban areas for e.g. fishing area would be expensive
   - » Fees depend on the type of activity on the surface.
   - » Fees for environmental damage should be considered

6. *Specific information for conflict mitigation/resolution:*
   - Get the real interest on land
   - Land demarcation problem especially in traditional societies. If resolved could reduce conflicts.
   - Conflict of right vs. development

7. *Other issues:*
    - Enforcement should not be weak.
    - Younger generation awareness with the traditional older society vs. (Generation Conflict) on how to use the land.
    - Dispute resolution mechanism
    - Data needed for each purpose could be used to convince

<u>Group 4: Land information needs for social and economic development</u>

1. *Definition:*
   Land administration is the process of determining, recording, and disseminating of information about ownership, value and use of land when implementing land management policies

2. *Datasets:*
   For instance datasets on topography; hydrography; geodetic; area sizes; demography and census data; property rights and value; land use and planning; natural environment; income levels; poverty trend; pollution; education; physical infrastructure; . . . data on disputes

3. *Format and sources:*

    - Format: Oral, paper (analogue) and digital
    - Sources: Community memory; maps; land-related documents

4. *Administrative Responsibilities:*
    - Collecting, maintaining, and disseminating comprehensive, complete, up-to-date, accurate data to support sustainable trends in socioeconomic development related to land
    - Support stakeholder objectives and decision makers

5. *Information requirements for allocation and access:*

6. *Specific information for conflict mitigation/resolution:*
   Property (in relation to gender, minority groups etc.) and land resource information with a framework of good laws and polices, and information that conforms to the qualities previously identified

7. Other issues:
   "Good" administration exists within a framework of "good laws and policies". However, "good" laws and policies ought to incorporate consideration of gender issues, poverty issues, and minority groups to support sustainable socioeconomic development

Session 2: Land Rights, including intangible access and use rights
Guiding Questions

1. *All possible rights that people can have in land. Who can have that right?*
    » Primary rights?
    » Secondary rights?
    » Tertiary rights?
    » Residual rights?
    » Access rights?

» Use rights?
» Partial interests
» others

2. *List the accepted transactions and/or arrangements on land use/access/management*

3. *What legal and institutional structures do people have to enforce their rights in land?*
   » Any rights that people choose not to claim or enforce?

4. *What rights are likely to create conflict?*

5. *Maritime, coastal and riparian rights. Coastal resources?*

6. *Other Issues*

Group Reports

<u>Group 1: Indigenous, traditional and Customary systems</u>

1. *Possible rights:*
   - Law in Action –a way of doing things
   - Customary laws (Traditional laws) - are where people live by on daily level; e.g. walking on the left side.
   - 90% of things are done in customary laws as in family obligations at home.

   - Indigenous vs. traditional
     » Traditional: antiquity
     » Indigenous: E.g. in Canada, traditional use of land 'the Nisga's' nomadic, fishing, hunting…live in their customs. They have the right to use their piece of land.

   - Legal recognition is also there for traditional use of land.

   - Clashes:
     » Water harvesting in sedentary people clashing with pastoralists
     » Suggestion: Always in favour of a previous (indigenous) people.

   - Conflict between new things to do and customs (traditions).Examples:
     » Cannot cut trees because the tree belongs to communities or the tree could be sacred. But when drought comes there could be cutting of trees.
     » Relocation of people, movement of people…etc

   - There has to be a mechanism so that the law will not be too rigid.
   - When the pressures are much how can we anticipate the problem:
   - Non compatible use of land

¤ *Primary rights?*

» Exclusive of right

¤ *Secondary rights?*

» Seniority: Chief, inheritor of the land

» Secondary :Agreement of right to let through

¤ *Tertiary rights?*

» Owner Ë home developer Ë Government (State); varies from state to state

¤ *Access rights?*

» Agricultural lands developed into urban lands. The previous settlers claim the land. Is there any compensation?

» Giving boundary (zone) for future planning in case of expansion of cities

¤ *Partial interests*

» Continually friction of customary law with new

» The state should be Proactive and shouldn't react when new situations arise

¤ *Others*

» The law should depend on the ability of people to sustain life

2. *Accepted transactions and arrangements:*
   - Inheritance, Lease, pledging, share cropping, pastoral right (grazing right)

3. *Legal and institutional structures to enforce rights:*

4. *Rights likely to create conflicts:*

   - Animals passing through a particular route vs. city development: Animals have the right to pass through.
     » So when planning the route of those animals

   - Do a proper planning while upgrading

5. *Maritime, coastal, riparian rights*
   - For medicine, for logging, fishing right
   - The community has the right
   - The government has the right for the nation's need
   - Oil leases
   - Pollution (Protection) right

6. *Other issues*
   - Arbitrary right

Group 2: Legal and formal systems

1. *Possible rights:*

- Parcel/polygon:
  - » Fee simple (ownership that can be transferred or bequeathed):
  - » Financial rights (e.g., mortgages)
  - » Right of occupation (but not ownership)
  - » Leasehold right (short- v. long-term)
  - » Access and use rights (e.g., licenses for mining, forestry)
  - » Archeological/historical/preservation "rights" (e.g., ruins in Tunisia)
  - » Tourism licenses (in Canada)
  - » Indigenous rights in Canada for sustenance (fishing) and these are now codified

- Linear:
  - » Migration of animals
  - » Right of way/easements
  - » Water rights (e.g., in Zimbabwe it's effected by a license to draw water)
  - » Riparian rights (but in Rwanda, for example, you can not restrict access to water)

- Point:
  - » Nigerian example of right to pick dropped apple (udala) fruit (illustrating the boundary between informal and formal rights)

¤ *Primary rights?*
  - » Right to occupy and use land with shared interest

¤ *Secondary rights?*
  - » Distinction between formal and customary rights is not always unambiguous

¤ *Tertiary rights?*
  - » Transition from informal to formal
  - » State maintains the right of expropriation (usu. with compensation)

¤ *Residual rights?*
  - » Residual rights to the local community in Nigeria arise where no explicit federal or state rights exist.
  - » Life estates are examples of residual rights/rights of reversion

¤ *Access rights?*
  - » Wildlife protection legislation may restrict human interests in land

2. *Accepted transactions and arrangements:*

- Wildlife protection legislation may restrict human interests in land.
- In Tunisia, for example, protected zones exist at Lac Ishcolthere (for migratory birds, etc.) and that land remains protected.
- Land use planning restrictions and municipal bylaws. But these community/public benefits from these restrictions

3. *Legal and institutional structures to enforce rights: . . .*

4. *Rights likely to create conflicts:*

- State v. individual conflicts
  - » Zimbabwe: formal boundary of a national park is imposed affecting hunting and gathering
  - » Rwanda: protected areas creating conflict between humans and animals
  - » Nigeria: original settlers being displaced/resettled owing to urbanization
  - » Tanzania: natural resources, forestry
  - » Tunisia: expropriation (e.g., tourism development in Hammemet)

- Individual v. individual:
  - » Perhaps most common is right of access/trespass conflicts

Group 3: Common Property Regimes

1. *Possible rights:*

Regions that have known for their pastoral societies should give basic use rights for the pastoralists

¤ *Primary rights?*
  - » Region that is known to belong to the pastoral community

¤ *Secondary rights?*
  - » Fallow land this is subjected to the negotiation between the pastoralists and the owner of the land
  - » Use of watering points like water wells and rivers should be used with a negotiation with the surrounding non-pastoralist societies

¤ *Residual rights?*
  - » Corridors of movement from one region to another

¤ *Use rights?*
  - » Use of wild fruit although the trees belongs to no one in particular

2. *Accepted transactions and arrangements:*
   - Agricultural societies leave their land for the pastoralists for some time with an agreement so that the soils fertility will improve
   - Agricultural societies leave their land for pastoralists after harvesting season

3. *Legal and institutional structures to enforce rights:*
   - Chief, council of elders, religious elders

¤ *Any rights that people choose not to claim or enforce?*
  - » Women can choose not to claim land rights

4. *Rights likely to create conflicts:*
    - Access rights
5. *Maritime, coastal, riparian rights*
    - Due to activities like farming and mining around these areas creates a conflict of interest
6. *Other issues*

Group 4: Gender issues

1. *Possible rights:*
    - Land use rights
    - Access to land

¤ *Primary rights?*
   » "Chef de terre" (Man or Woman)
   » Land Owners (Co-ownership in family)

¤ *Secondary rights?*
   » Family (Sons, Daughters, expanded family…)

¤ *Tertiary rights?*
   » Equal rights regardless of sex
   » Users (Tenants…)
   » Condominiums

¤ *Residual rights*
   » Tenants family
   » Expanded community

¤ *Access rights?*
   » Everybody

2. *Accepted transactions and arrangements:*
    - Dispose
    - Sell
    - Mortgage

3. *Legal and institutional structures to enforce rights:*
    - Traditional systems: Chiefs
    - Formal institutions

¤ *Any rights that people choose not to claim or enforce?*
   » Rights of passage

4. *Rights likely to create conflicts:*
    - Succession rights based on people gender
    - Remarried widow taking land away
    - Inheritance rights

5. *Maritime, coastal, riparian rights*
    - Use resources rights

6. *Other issues*
    - Blocked access to the beach

Session 3: Land Identification
Guiding Questions

1. *How do we identify and describe the land?*

¤ *Two issues to identify are:*
   » Unambiguous description for purposes of transactions and land management
   » To enable re-establishment of boundary if lost or obliterated, e.g., after a disaster

2. *Which jurisdiction level is a proprietary unit of land first defined/described?*

3. *What kinds of markers do we have in place to demarcate boundaries?*
   » How effective are they?
   » What has worked and what hasn't?
   » What conflicts arise or could arise — associated to boundaries and land identification
   » How do we mitigate and resolve conflicts?

4. *When are discontinuous or fragmented lands described and treated as one holding?*

5. *What numbering, referencing and coding systems exist?*
   » How effective are they?

6. *What kinds of surveying techniques are appropriate for specific jurisdiction?*

7. *Other Issues*

Group Reports

<u>Group 1: Cadastral Systems</u>

- Land identification and description
- The land Policy: Land Tenure System (Land Policy/Land law)
- Land zone according to use : Identify Urban Land Vs Rural land then go down

¤ *Unambiguous description for purposes of transactions and land management:*
   » Land policy of the state- granted by the state, distributed among people
   » By features e.g. point parcels
   » Aerial photo

¤ *To enable re-establishment of boundary if lost or obliterated:*
   » Document needed to identify eg sketch, areal photo, surveyor field map
   » In case of lost features (visible boundaries) using of aerial photo and satellite maps help to resolve disputes.
   » Proper documentation of records, ownership (certificate of occupancy)
   » Unique parcel identification for the State. The municipality should consider all the parcels in the state is coded or registered

- *Which jurisdiction level is a proprietary unit of land first defined/described?*

    - Depending on the State, or land tenure system or law
    - Municipal, National, communal (locality)
    - Who is in charge of the land?
- *Boundary demarcation markers:*
    - Document of physical features
    - Good Large Scale maps
    - Beacons
    - GPS coordinate
    - Condominium: 3D concept: Block of flats wall

¤ *What conflicts arise or could arise — associated to boundaries and land identification?*
    » Dispute arises when people just start to build so an authority should decide the position of the boundary.
    » Mathematical methods to demarcate the boundary eg GPS

¤ *How do we mitigate and resolve conflicts?*
    » Surveyor, Ask lawyers, elders, discuss with people (institution) who work with land policies

- *Discontinuous or fragmented holdings:*
    - In some areas we don't consolidate lands that are fragmented
    - Parcels must be adjacent?? Depending on the scale- has to be large scale
- *What numbering and referencing systems:*
    - Depending to the State
    - A unique ID for each parcel (plot)
    - Beacon place
- *Surveying techniques:*
    - GPS, satellite images, aerial photo, digital photo, total station, video cameras

<u>Group 2: Rural Lands</u>

1. Land identification and description

¤ *Local knowledge; formal recognized markers; coordinates; written descriptions*
    » Unambiguous description for purposes of transactions and land management:
        ¤ Local knowledge where there have been some community agreement; limits on gardens
¤ *To enable re-establishment of boundary if lost or obliterated:*
    » Local knowledge; recorded information not lost in the disaster

2. Which jurisdiction level is a proprietary unit of land first defined/described?
    - Needs empirical determination: great variability

3. Boundary demarcation markers:

    - Survey markers; trees; shrubs; other natural boundaries; roads; stones; fences
        » How effective are they?
            ¤ *Effectiveness dependant on local acceptance*
        » What has worked and what hasn't?

        ¤ *Local knowledge, imposing new things*
    » What conflicts arise or could arise — associated to boundaries and land identification
        ¤ *Conflicts arise where there underlying problems*
    » How do we mitigate and resolve conflicts?
        ¤ *Commission, village councils, ward councils, traditional structures etc*

4. *Discontinuous or fragmented holdings:*
    • Needs empirical verification. What is the local system?

5. *What numbering and referencing systems:*

    • Geo-referencing, village identifications, localities etc
        » How effective are they?
            ¤ *Effective if well understood by users and local population*

6. *Surveying techniques:*
    • GPS, photomaps, high resolution satellite imagery etc

Groups 3 & 4: Non-Parcel Systems Environmental and Natural Boundaries

1. *Land identification and description*
    • By physical and biophysical components (e.g., forest, soil types, watershed boundaries, all natural resource mgt. Systems)
    • These are irregular polygons.
    • Non-parcel: road network and associated points along the network; geometric delineation (e.g., 30m radius from a dwelling)
    • These "boundaries" may be overlapping (e.g., aboriginal rights between two First Nations)
    • Some are ambulatory (e.g., riparian rights as river courses change) and pace of shift and possibly subject to recurrent negotiation

¤ *Unambiguous description for purposes of transactions and land management:*
    » Use more stable natural features
    » Need for a combination of a general boundary + natural boundary approach
    » Scale effect: boundary shift might be agreeable between states but contentious to local communities
    » In Senegal-Mauritania, even a shift in the centre of the river is acceptable (i.e., a floating river)

¤ *To enable re-establishment of boundary if lost or obliterated:*
    » Remote sensing and linkage in the field (discussion with locals, field surveying, reference to orthophotography)
    » Instability of natural boundaries (e.g., US-Canada has few natural boundaries)
    » Repeat the process

2. *Which jurisdiction level is a proprietary unit of land first defined/described?*
    • Contingent upon the type of boundary (e.g., if forestry might be provincial)
    • Local communities negotiate resource access
    • IJC to advise on water issues between Canada and the US

3. *Boundary demarcation markers:*
    - Geodetic/control + natural features markers to reconstruct the boundary
    - Maritime boundaries are more complex
    - Consideration of the vertical plane at the boundary
    - Sometimes a complex quantification of the resource (e.g., ore body) and agreement to share the royalties

¤ *What conflicts arise or could arise — associated to boundaries and land identification*
    » Over resource allocation (e/g/. oil between Senegal and Guinea-Bissau)
    » The nature of environmental/natural boundaries requires more cooperation and equity, bi- or multi-lateral
    » Emergence of transboundary environmental issues (oil spills, acid rain)

4. *Discontinuous or fragmented holdings:*
    - Islands (e.g., Indonesia)
    - Biophysical resources are discontinuous (e.g., river through forests)
    - Habitats

5. *What numbering and referencing systems:*
    - Coding schemes are usu. discipline-specific
    - Standard georeferencing
    - Control points, anchors, markers
    - On water on paper, terrestrial tends to be physical markers
    - Indexing system from topo sheets
    - Existing cadastral systems
    - Administrative (postal, legal)
    - Community maps
        » How effective are they?
            ¤ *Depends. Some are ambulatory (e.g., plants)*
            ¤ *Effective for their specific uses*

6. *Surveying techniques:*
    - Conventional surveying in urban
    - Remote sensing + ground-truthing
    - Oral interviews with local community/landowners using consensus approach
    - GPS techniques

Session 4: Information Solutions
Guiding Questions

1. *Data collection and storage? What information should be collected to incorporate into a land administration database to encourage:*
    » Investment?
    » Agricultural production?
    » Environmental sustainability?
    » Social cohesion?

2. *Data Security: how to prevent unauthorized altering of the data?*
3. *Legal Frameworks: When would it be necessary to enact laws to legitimize the land information system?*

- Must we have a legal framework for an LIS before it is created?
- Can the LIS be used for policy formulation and administrative purposes without a legal instrument

4. *Data Accessibility: what information should be open to the general public?*
   - Privacy issues?
   - Transparency and accountability?
   - What is the role of the LIS to cultivate good governance?

5. *How can the LIS be used to mitigate conflict?*

6. *Transaction costs of the information system and access to it?*

7. *Technology: what simple tools can be used to implement a system in specific jurisdictions?*
   - What works now?
   - How to allow for upgrade as new technologies become available and affordable?

8. *Data output: what forms of output are possible?*
   - Variety of Different Ways to Present Information
     - *Oral/verbal reporting*
     - *Written reports*
     - *Tables*
     - *Maps*
     - *Charts*
     - *Three Dimensional Surface*

9. *What level of detail should be kept at the local level and how should the local level interface with higher levels of government?*

10. *How should the LIS interface with other information and database systems? (Procuring/sharing data from/with other agencies)*

11. *What is the role of the land administrator in implementing and maintaining the information system?*
    - What incentives should be implemented to encourage land administrators to maintain the system?

12. *What is the role of the citizen in implementing and maintaining the information system?*
    - Incentives to encourage citizens to support the system and provide necessary information to maintain it?

13. *What is the role of professional associations in implementing and maintaining the information system?*
    - Incentives to encourage them to participate?

14. *What administrative arrangements should be put in place to ensure that the system is kept up to date?*

15. *How can communities empower themselves to kick-start the process of implementing information systems before the need for outside input?*

16. *Other Issues*

Group Reports

<u>Group 1: E-cadastre and Information and Communication Technologies (ICTs)</u>

1. *Information content*
    - » Investment?
        - ¤ *Spatial data (location, extent, area)*
        - ¤ *Attribute data: land cover, use, zoning, facilities and infrastructure, accessibility, transport facilities, valuation and taxes, tax incentives, social information, types of rights)*
    - » Agricultural production?
        - ¤ *Again, spatial data*
        - ¤ *Attribute data: soil quality, water/irrigation availability, topography, climatic conditions, hydrography)*
    - » Environmental sustainability?
        - ¤ *o We interpret this as "conservation"*
        - ¤ *o Flora and fauna inventory*
        - ¤ *o Land cover/land use*
        - ¤ *o Soil quality*
    - » Social cohesion?
        - ¤ *Education, health, tribal culture, types of tenure (in the sense of avoiding conflict), identification of public/communal land*
2. *Data Security*
    - Physical security
    - Database security (passwords, access levels)
    - Use both hardcopy and digital records
    - Implement logical controls

3. *When to enact laws*
    - » Services depend on the LIS
    - » Perhaps even before implementation
    - » When inefficiencies (travel time, administrative burden) are significant
    - » When countries are developing national NICI/ICT policies
    - » Use without legal framework?
        - ¤ *Yes, it can inform/help with the legal system, not in place of it*

4. *Public Access?*
    - » Privacy issues?
        - ¤ *Owner name is in the public domain but perhaps outstanding mortgage is not; transaction history and recorded legal status*
    - » Transparency and accountability?
        - ¤ *Yes, subject to privacy constraints; sales are widely published; this also depends on applicable land policy (limits to ownership)*
    - » What is the role of the LIS to cultivate good governance?
        - ¤ *Important role, data is "democratized," invaluable to support decision-making efficiently and expeditiously*

5. *Use in conflict mitigation*
    - If the LIS is regarded as credible, then conflict is often resolved immediately; visual representation is often seen as unambiguous; LIS can be employed in models and simulation to illustrate the conflict
6. *Transaction costs*
    - The system per se is not a significant cost; it's the data collection and its maintenance
    - Can begin with a prototype/experiment and then roll-out nationally
    - Requires generous bandwidth and reliability electricity supply be factored into the total cost, especially with a distributed access system
    - Transaction costs could be reduced by open source solutions

7. *Technology*
    - GIS
    - Database management systems
    - A simple desktop PC could be sufficient for data entry but the data should be stored for municipal use and some data will be stored on a web server

¤ *Upgradeability*
    - Demonstrate/convince how those developments are relevant for the community and worth investing in
    - How those systems could mitigate conflict, increase efficiency, turnaround time

8. *Data output*
    - Demonstrate/convince how those developments are relevant for the community and worth investing in
    - How those systems could mitigate conflict, increase efficiency, turnaround time

9. *Level of detail and hierarchy*
    - Need to construct another application which collects data from municipal systems into a nationally centralized spatial data warehouse; resulting indicators and data products (maps, charts, graphs, etc.)
    - Different datasets are more or less appropriate to different levels (e.g., cadastral from municipal)

10. *Interface with other information systems*
    - Ensure compatibility before purchase/development
    - Standards-based

11. *Role of the land administrator*
    - Role is validate and be accountable for the data
    - All people involved in data collection, processing contribute
        » Incentives for land administrator
            ¤ *Training and capacity building*

12. Role of the citizen
    - Must inform of changes in short time
    - To maintain updates to the system
        » Incentives for citizens?
            ¤ *Inform on time obviates penalties*
            ¤ *Fair valuations*
            ¤ *Public access and transparency*
            ¤ *Can facilitate e-government and, thus, gain time efficiencies and cost savings*

13. *Role of professional associations*
    - Advisory role
    - Quality control
        » Incentives for processionals
            ¤ *Publicity and recognition and gain experience*
            ¤ *They, themselves, profit*

14. *Administrative arrangements for updating*
    - Rules on allowable editing time (e.g., 1-week limit)
    - Triggers on the system
    - Code of good conduct

15. *Empowering communities*
    - Need a clear understanding of how THEY can benefit from LIS
    - They will be assisted; it's participatory, may involve experts and specialist and doesn't have to be daunting
    - Demonstration through a pilot system that they can evaluate and build their confidence in the technology
    - Their IT skills could be enhanced, perhaps through extension services
    - Result is more reliable with faster turnaround
    - Participatory process from the beginning earns their buy-in; they have a stake

<u>Group 2: ICT - Challenged (ICT laggard) jurisdictions</u>

1. *Information content*
    - Building a information policy is first challenge
    - Basic information can be sufficient.
    - Proof of ownership
    - It may be non digital (on paper) or digital
    - Basic topographical maps or photo
    - NSDI framework
    - Learn from the mistakes in the western countries
    - Try to use the models that are invented
    - Policies
    - Basic information
        » Investment?
            ¤ *Ownership*

2. *Data Security*
    - Digital security, back-up data base, lock on the room, log-in, fingerprints
    - Fire security etc

3. *When to enact laws*
    - It should be in the information policy. Example Botswana
        » Legal framework before LIS?
            ¤ *Regulatory environment*
            ¤ *Yes, obliged*
            ¤ *Policies*

- » Use without legal framework?
  - ¤ *In cadastre = No*
  - ¤ *If more information = Yes*

4. *Public Access?*
   - Non-sensitive information for national security
   - Public-funded data should be free
   - All, especially all the information of the person involved
   - As many information from others, keep in mind privacy issues
     - » What is the role of the LIS to cultivate good governance?
       - ¤ *Non politic, democratic, transparent, public information*
       - ¤ *Free information will open up development*

5. *Use in conflict mitigation*
   - Availability Information within the large framework
   - Information and policies (society values framework)

6. *Transaction costs*
   - Transaction cost must be as low as possible (otherwise nobody will use information)

7. *Technology*
   - » v What works now?
     - ¤ *o What can be used by the people at that place at that moment, its evolutionary, and sustainability*
   - » v Upgradeability
     - ¤ *o Not driven by technology, drive by demand*

8. Data output

- What is possible, what is needed at the place, at the time, at the appropriate level of technology for the community; demand-driven
  - » Information Presentation
    - ¤ *Variety of ways following the need of final user and his profile*
    - ¤ *Sounds, video*
    - ¤ *Atlases, reports, flyers*
    - ¤ *Tables, database, spreadsheet*

9. *Level of detail and hierarchy*
   - Local: 1/5.000 to 1/50.000
   - National : 1/100.000 to 1/1.000.000

10. *Interface with other information systems*
    - Peer-to-peer data share
    - NSDI, what will be possible regarding technique, network, etc.
    - Evolutionary approach
    - Authentic registers

11. *Role of the land administrator*
    - As the prime stakeholder he has to market the LIS to the Decision maker, for them to accept
    - And to the public for getting their involvement; has to sell his product
    - Develop public awareness
        - » Incentives for land administrator
            - ¤ *Achievement of his operational plan, contribution to the economic growth of; and*
            - ¤ *Good salary*
            - ¤ *Up-to-date hardware and software*

12. *Role of the citizen*
    - Data collection
    - Participate to policies definition
    - Land administration
        - » Incentives for citizens?
            - ¤ *Security of tenure*
            - ¤ *Free access to data*

13. *Role of professional associations*
    - Promote technologies and scientific knowledge
    - Promote standards and best practices

14. *Administrative arrangements for updating*
    - Organizational structures, modern management, product development, business structure, day to day execution of the task

15. *Empowering communities*

16. *Other Issues*
    - What can we organize LIS Data to move forward to the ICT society

Group 3: Role of Traditional Institutions in Land Information Management

1. *Information content*
    - The basic assumption for this discussion is that traditional intuitions are involved in rural communities
    - In many areas in Africa traditional chiefs still have a strong impact on land administration activities
    - In some cases community chiefs are even involved as a member of land administration commissions
    - We need to record how the traditional authorities collect and store information
        - » Investment?
            - ¤ *Land use rights and other underlining interests*
            - ¤ *Who has the authority to allocate the land*
        - » Social cohesion?
            - ¤ *Community participation: every member of the community has a right to participate in any decision related to land*
            - ¤ *Community dispute resolution structures - Community groups gather and discuss around their dispute in order to solve their problems*
2. *Data Security*
    - We need to have a copy of all documents at all levels of land administration institutions

- When to enact laws
    - » Legal framework before LIS?
        - ¤ *We have to go with the development of the system while working on putting the legal frame work in place*

3. *When to enact laws*

4. *Public Access?*
    - Should be accessible (it shouldn't be restricted)
    - It should be available at a local level
        - » Transparency and accountability?
            - ¤ *This will come after once the data is being available*

5. *Use in conflict mitigation*

6. *Transaction costs*
    - The central government should subsidize this costs as many rural communities are poor

7. *Technology*
    - » What works now?
    - » Upgradeability

8. *Data output*
    - » Information Presentation

9. *Level of detail and hierarchy …*

10. *Interface with other information systems …*

11. *Role of the land administrator*
    - » Incentives for land administrator
        - ¤ *Appropriate compensations should be given for community chief considering the time they spend to deal with land administration matters*
        - ¤ *Recognition and reduced effort to make their job easier*

12. *Role of the citizen*
    - » Incentives for citizens?
        - ¤ *Quicker service of dispute resolution resolve or transaction*
        - ¤ *Involvement in the process*
        - ¤ *Improved security of tenure*

13. *Role of professional associations*
    - » Incentives for processionals
        - ¤ *Giving them access to information and possibly incur payment for license fee if they're going to use electronic information*
        - ¤ *Identifies cases needing professional intervention*

14. *Administrative arrangements for updating . . .*

15. *Empowering communities*
    - Educating the communities and having a dialogue how these information system could benefit them

Group 4: Role of Community Based Organizations (CBOs) and Civil Society Organizations (CSOs)

1. Role of the citizen
- To start with communal owned properties
- Sensitization of projects or issues: common use of land vs. individual use
- Economy of the community: Money (capacity building), human capacity
- The benefits that would be brought to the community
- Partnership of government with CBOs
    - » Incentives for citizens?

2. Role of professional associations
- » Incentives for processionals

3. Administrative arrangements for updating
- If the community has the info and the gov hasn't the info, the system doesn't go far. So, supervision of local governments needed.
- Lack of structural arrangements leading to distrust, coordination needed
- Transparency and accountability when coordinating

4. Empowering communities
- » Exchange of experiences by showing pilot projects,
- » Prioritizing of interests should come out of the communities
- » Funding of projects

Appendix V: List of Participants

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Annex 1. Background Paper for LMIS Symposium

The Unique Challenge of Land Information Systems and the Knowledge Economy in Africa – Untying the Lion Addis Ababa, Ethiopia, December 4 – 8, 2006

"The Hand That Tied the Lion Knows Best How to Untie It"
(African Proverb - Malunga and Banda 2004)

Ian R. Methven[2], Michael D. Sutherland[3], and Boipuso Nkwae[4]

Abstract

In this paper we explore the concepts of information and knowledge; examine the context for Information and Communications Technology and Management (ICT/M) in Africa; analyze the failure of information systems in general, and Land Information Systems (LIS) in Africa in particular; and describe a selection of major factors or dimensions that need to be addressed if failure is to be avoided. The paper examines four approaches or methodologies for minimizing the probability of failure in the design and development of LIS based on reducing the gap between the actual reality on the ground and the desired future. The paper concludes with describing and listing the major ICT/M and LIS issues that need to be addressed, and providing some suggested approaches and design criteria for advancing ICT/M and LIS in Africa.

Keywords: information, knowledge, communication, management, technologies, policies, regulations, access, capacity, culture, design, organizations, and land rights.

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Introduction

The purpose of this paper is to identify the major issues to be considered in the design and implementation of information support systems for land administration, management and use in Africa. This information, along with input from a panel of invited contributors to the symposium, will be used to develop a set of guidelines for managing land-related information for Africa. A basic assumption here is that Land Information Systems are part of the Information Society that contributes to the Knowledge Economy, and as such, that they are computer aided or supported.

This is not a technical paper dealing with Information and Communications Technologies (ICT) per se. While the technologies are important as a language for organizing, disseminating, and accessing information, and form the backbone of the Information Society, the technologies are not the major challenge in the development of Land Information Systems. The major challenges are institutions, organizations, management and capacity related to land rights and information systems. The focus of the paper, therefore, will be on these aspects while at the same time suggesting ways and means for ensuring the technologies selected in the design and development of land information systems are relevant, appropriate, achievable and maintainable. As Menou (2002) has pointed out, *"in many ICT endeavours, the "I" and the "C" are grossly overlooked in favour of the "T"*.

Africa is a continent of 54 countries comprising a diversity of ecosystems, a kaleidoscope of cultures, a pluralistic legal system, and a complex and dynamic history. This is reflected in the variety of land administration and management systems. In spite of this complexity and diversity, we will attempt to extract the principles and commonalities that are reflective of the African experience as a whole, without in any way trying to diminish or exclude the realities associated with individual countries and ethnic groups. As our title implies, solutions will have to be designed and developed by those living with the realities.

Before addressing land information systems directly it is instructive to examine the concepts of information and knowledge, and to look at the wider field of Information and Communications Technologies and Management (ICT/M) first, since these provides the context and supporting structure.

The Information Society / Knowledge Economy

Information and knowledge represent an adjacent pair in the hierarchy of data-information-knowledge-understanding-wisdom. There has been considerable confusion in the literature in differentiating between information and knowledge, but the difference is critical (Wilson 2002). Information precedes knowledge and can be defined as data that has been organized, processed or manipulated in order to increase its' value. Knowledge, on the other hand, can be defined as information that has been enhanced through human experience, reflection, interpretation, reasoning and critical analysis. Knowledge exists in the mind. Thus information can be managed but knowledge cannot be managed; it can only be used or applied by the person that posses it.

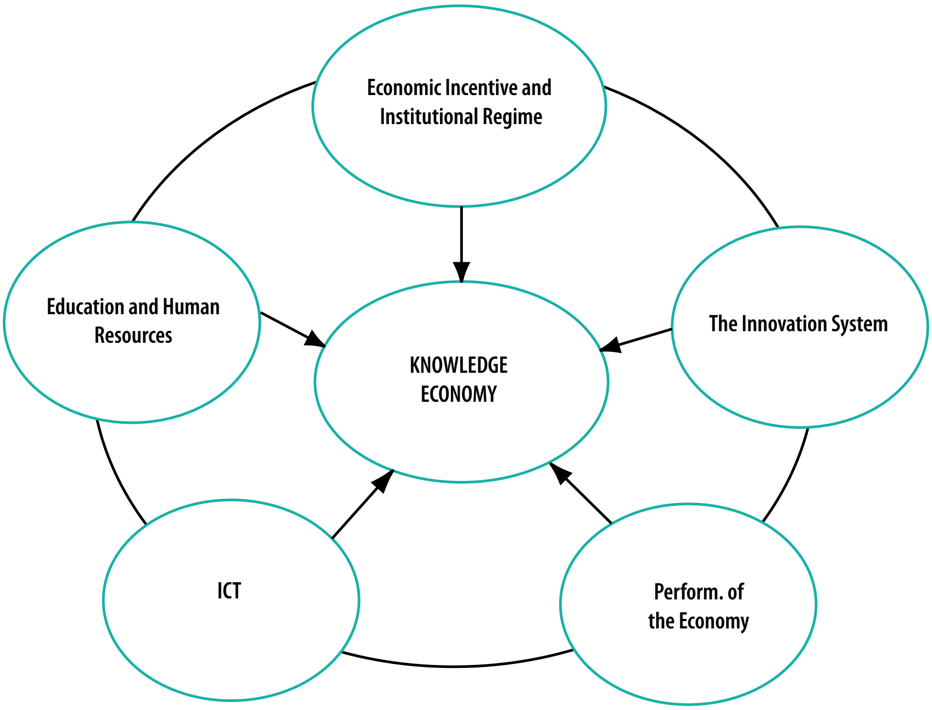
Information precedes knowledge in the hierarchy, yet paradoxically, the term or concept of the 'Knowledge Economy' (Drucker 1969) precedes what is termed the 'Information Society' by almost two decades. The latter was essentially dependent on the development of the Internet and the World Wide Web, neither of which penetrated the public domain in a significant way until the 1990s.

The one-way dependence of knowledge on information is not reflected, therefore, on the dependence of the Knowledge Economy on the Information Society. The two are interdependent with information providing content to the knowledge economy, and knowledge leading to the advancement of the information society through enhanced capacity and technologies. In the context of this symposium, land information systems contribute to the knowledge economy on land management, but knowledge about land and society needs to inform the design and content of land information systems. This is particularly relevant in Africa, where land and society relations have some unique characteristics emanating from history and culture (e.g. Cousins and Claassens (2006).

The current meaning of a Knowledge Economy as one where knowledge itself is a source of wealth as opposed simply to the production of goods, is one that has arisen since the Enlightenment. This was accompanied by a spread of knowledge and power from an elite few to the general population along with the concepts of human rights, democracy and universal education. This reached its current peak in the West with the advance of information and communications technology and the onset of the information society. A Knowledge Economy, therefore, can be defined as one *"where organizations and people, acquire, create, disseminate and use knowledge more effectively for greater social and economic development"* (World Bank 2006).

The Knowledge Economy is generally considered to be founded on four important pillars: 1) the Economic Incentive and Institutional Regime; 2) Education and Human Resources; 3) the Innovation System; and 4) Information and Communications Technology. The World Bank has combined these four pillars along with the Overall Performance of the Economy into a Knowledge Economy Index (KEI)(Figure 1).

Figure 1: Components of the Knowledge Economy Index



Within the global spectrum of KEIs, African countries tend to rank at the lower end of the scale although there are great differences across Africa (Figure 2). Thus the values for the KEI in Africa range from a high of 5.28 for South Africa to a low of 0.47 for Sierra Leone. This compares to a global high of 9.25 for Sweden which ranks #1 out of 128 countries.

Figure 2: Relative position of countries and regions based on the Knowledge Economy Index (KEI) (from World Bank nd)

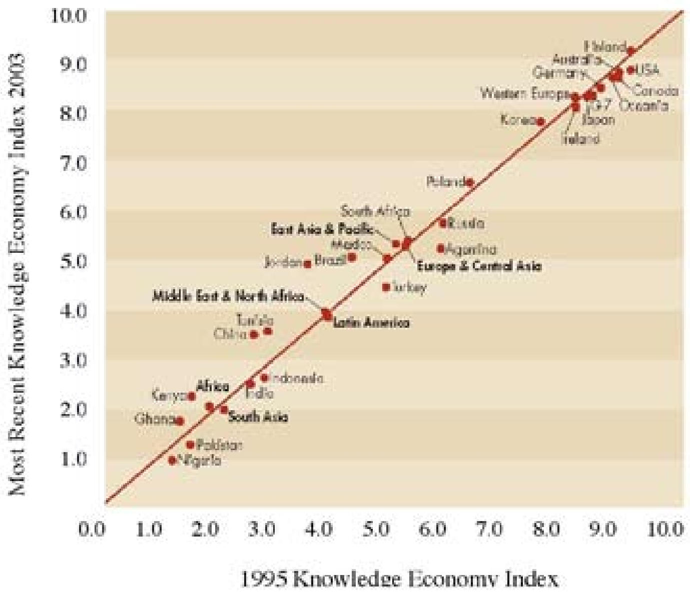


Figure 3 displays the strong correlative relationship between the Gross Domestic Product per capita and the Knowledge Economy as expressed through the KEI, showing once again that African countries are at the lower end of the scale.

Figure 3: Relation between Gross Domestic Product and the Knowledge Economy Index (KEI) (from World Bank nd)

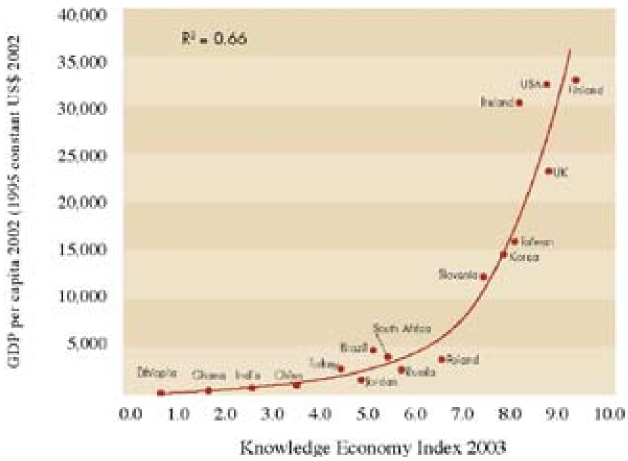
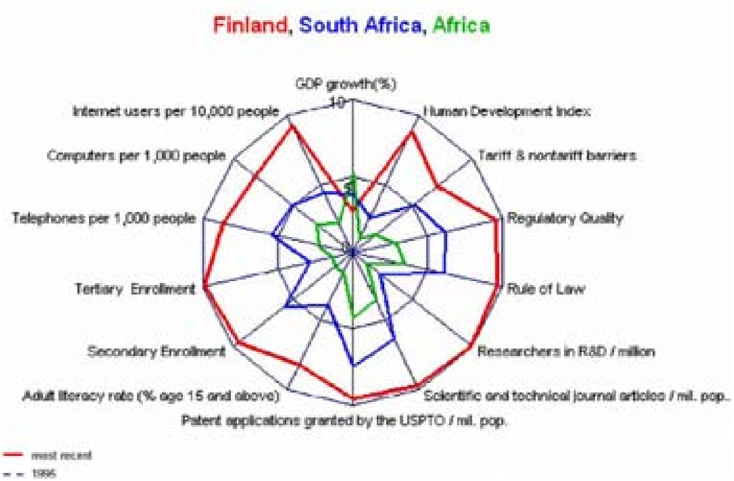


Figure 4 displays a spider chart comparing Finland, South Africa and Africa as a whole. Finland ranks #2 with a score of 9.11, South Africa #55 with a score of 5.08, and Africa #9 out of 10 regions with a score of 2.45. It can be seen that Finland ranks high on all the variables except for GDP growth, while both South Africa and Africa as a whole show great room for improvement on all variables including the ICT variables associated with the Information Society and the Knowledge Economy.

Evidence for the lack of a contribution by ICTs to the Knowledge Economy can be derived from the fact that in the developing world there is no positive correlation betwween ICT capital and productivity, or between ICT investment and returns, unlike in the industrilized world (Heeks 2002). This would suggest that the overall ICT infrastrucure in the developing world is not contributing to the knowledge economy.

Figure 4: Comparison of the Knowledge Economies of Finland, South Africa, and Africa as a whole based on 14 key variables (from Aubert 2006)



More importantly, however, is the implication that the overall economic, social and technical environment may not be conducive to the development of the type of Land Information Management systems associated with the Information Society and theKnowledge Economy in the developed world.

Information and Communication Technologies and Management (ICT/M)

Information and Communication Technologies (ICTs) are the tools, processes, and procedures for gathering, organizing, storing, retrieving, processing, analyzing and transmitting information. Information Communication Management (ICM) on the other hand is concerned with the capture, integration, organization, access and use of information assets (Rege 2006). For the purposes of this paper the two will be combined and referred to as ICT/M

ICT/M has been described recently as "the main driver for productivity growth" in Africa, and further that "investment in ICT/M/M and in higher education boosts competitiveness, making both key parts of the growth agenda" (Ndulu 2006), or as Kirkman et al (2001) have expressed it:

> There can no longer be any doubt about the importance of every economy plugging into global information and communications networks. The new information and communication technologies and the internet in particular, have changed the rules of economic competitiveness.

This dependence of global competitiveness on ICT/M investment displays a very strong relationship with an R 2 of 0.92 (Figure 5)

Figure 5: Impact of ICT/M investment on global competitiveness (after Ndulu 2006)

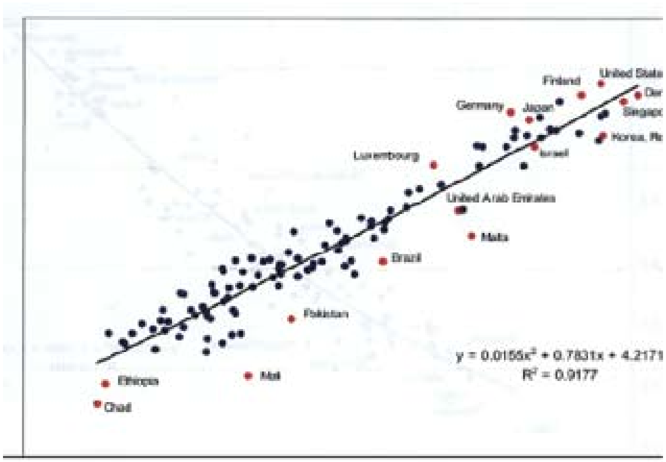


Figure 5: Impact of ICT/M investment on global competitiveness (after Ndulu 2006)

At a more immediate or basic level it is part of e-development, which "is development that uses ICT/Ms to increase people's opportunities, to empower poor people, and to counter insecurity and vulnerability" (Menou 2002).

The convergent complex of information, telecommunication and network technology that makes up ICT/M is the heart of the information society and the knowledge economy and critical to the evolution of all societies regardless of culture, or geography. Castells (1996-2000) in his seminal trilogy on the information age characterized a networked society as one in which,

> the entire planet is organized around telecommunicated networks at the heart of information systems and communication processes" and that "the availability and use of information and communication technologies are a prerequisite for economic and social development in our world. They are the functional equivalent of electricity in the industrial world.

Thus if a country or region is not part of the networked system then it is virtually excluded from a major force driving the world economy.

To realize the benefits of ICT/M remains a major challenge in Africa where only 2.6 percent of the population has internet access, and only 3.7 percent have access to fixed line or mobile phones (Panos 2006). This extremely low penetration of ICT/Ms, the lowest in the world, can be considered as another serious form of poverty; information poverty as opposed to the more traditional income and asset poverties (although information can be considered a new form of asset). The consequences for Africa in terms of the digital divide, productivity, competitiveness, and economic development are dire. Essentially, there are six main causes or constraints on the development of ICT/M in Africa: policy; infrastructure; cost; literacy and culture; capacity, and access, all of which are related.

Policy

Most lower income developing countries have failed to recognize the importance of ICT/Ms as being critical to information and knowledge policy, and as being integral to productivity and growth (Duncombe and Heeks 2001). In Africa especially, *"the formulation and implementation of policies in the ICT/M sector is still very rudimentary. . ."* (Munyua 2000). However, four Sub-Saharan African countries do have ICT/M policies in place – Ghana, Rwanda, Tanzania and Zambia (Rege 2006). While some of the blame needs to be assumed by African leaders themselves for this general deficiency, Ogbu (2006) has argued cogently that a great deal of the blame needs to be assigned to the donor community and particularly the so-called 'Washington Consensus'. The argument goes that throughout the 80s and 90s institutions such as the International Monetary Fund (IMF) and the World Bank placed far too much emphasis on macroeconomic reform, market liberalization and trade policy to the detriment of the positive role that can be played by government and public institutions. This is particularly critical in the area of science, technology and innovation (ST&I) policy (including ICT/M), where experience in the West has shown that success demands strong government policy and support in order to create the necessary research and policy capacity at universities, research centres, the private sector and within the government itself.

The net result was that any capacity in ST&I policy research in Africa was emasculated, the policy space was occupied and dominated by donors and their experts, and there was a complete loss of policy autonomy. Africa was faced with *"forced transitions to knowledge-laden goods, services and processes, [but] lacked both the human and infrastructural capacity to interrogate, adapt, absorb or reject these changes"* (Ogbu 2006).

While policy research and development in ST&I remains a major challenge for Africa, steps are being taken to correct the situation. There is, for example, the establishment of the African Technology Policy Studies Network as a secretariat of the IDRC in 1994, as an autonomous institution in 2001, and as a full-fledged international organization in 2003, based in Nairobi Kenya. Or NEPAD's recent initiative to establish the *African Science, Technology and Innovation Indicators Initiative* programme (Tijssen and Hollanders 2006). Recent workshops include one under the theme *"Development and Implementation of ICT policies in Africa: Strengthening the capacity of stakeholders"* held 16-19 October 2006 in Dakar, another on *'Involving the African Private Sector in Building the Information Society'* held from 8-9 June 2006 in Tunis, and a third entitled the *African Union Ministerial Conference on Communications & Information Technology (CIT)* to be held in Cairo November 18-19, 2006.

Infrastructure

The telecommunications and electricity infrastructure is poorly developed (Munyua 2000; Duncombe and Heeks 2001), with the result that *"Bandwidth [which is] the lifeblood of the world's knowledge economy. . . is scarcest where it is most needed – in the developing* *nations of Africa"* (Jensen 2006). This deficiency has been widely recognized throughout Africa, and has resulted in a *Plan of Action for the Implementation of the e-Africa Initiative for Good Governance* (CAFRAD 2003) in which Part IV calls for *Building Indigenous African ICT/M Industry and Capability*, and more specifically to *"Build and standardize a robust and upgradeable ICT/M infrastructure".*

Cost

The cost of using ICT/M and accessing the internet is much higher in Africa than in North America or Europe. The monthly cost for accessing a particular band-width in the USA may be around $50 per month while the cost in Africa can be in the thousands of dollars. The Economic Toolkit for African Policymakers produced by the Africa internet Forum and UNECA, and published by the World Bank (1998) broke down the cost of 30 hours of internet access as follows: 15% for telephone access; 42% for equipment; and 43% for the Internet Service Provider (ISP) subscription. The cost of equipment, which is largely computer and modem equipment, can be handled to some degree through public internet access centres and cybercafes, at least in urban areas, which leaves the cost of the ISP as a major barrier to access (except in rural areas where equipment remains an issue).

The biggest contributor to high cost is the international connections to the global telecommunications backbones. This lack of international optic fibre infrastructure in Africa along with a shortage of Internet Exchange Points (IXP) and peering agreements between ISPs results in a local e-mail within Africa being routed through North America or Europe with the resulting international connectivity charges.

In the developed world all three levels of service from local Tier 3 ISPs through regional or national Tier 2 providers to Tier 3 International Backbone Providers, (IBPs) all reside in the same country. This greatly reduces costs in the developed country. Since the IBPs are located largely in North America and Europe, and more than 90% of international IP connectivity passes through North America, developing countries that wish to connect have to pay the full costs of the international leased line. Thus the costs of two-way exchanges are borne primarily by the developing country ISP and consumer regardless of the origin of the call (Nicol 2003). This situation, known as 'reverse subsidy', is estimated to cost African ISPs $250 to $500 million a year (Bell 2002).

Another problem associated with cost is the monopolistic nature of state-owned telecommunications providers in Africa. The only large-scale international fibre link in Africa is the SAT-3/WASC that operates in eight West African countries. It operates as a monopolistic cartel. A second component linking South Africa to Malaysia operates in a similar manner. Thus two-thirds of African countries remain unconnected to the global backbones, and depend on high cost access through satellite links (Jensen 2006), and those that are connected to optic fibre face monopolistic charges.

A current initiative known as the East African Submarine System (EASSy) has been in the process of adopting a similar business model as SAT-3. However at a meeting of Southern African ICT/M policy makers last November (2005) a request was made to NEPAD e-Africa Commission to consider or explore an open access model involving a Special Purpose Vehicle (SPV) in which there would be many more local shareholders. This resulted in an International Working Commission being established earlier this year (2006). The meeting of this body resulted in *Draft Final Protocol on Policy and Regulatory Framework for NEPAD ICT/M Broadband Infrastructure Network for East and Southern Africa* that has been approved recently (June 2-3, 2006) by the responsible Ministers of 23 countries as the *Draft Resolutions of the Ministers Responsible for ICT/Ms and/or Telecommunications in Eastern and Southern Africa* (Jensen 2006).

Another promising example, but at a much more operational and community oriented level, is that of the Electronic Delivery of *Agricultural Information to Rural Communities in Uganda* promoted by the National Agricultural Research Organization (NARO), and CAB International and funded by the International Development Research Centre (IDRC). This initiative aims to improve the delivery of agricultural information to farmers through both traditional media and contemporary ICT/MS such as radio, video, print, e-mail, CD-Roms and the internet using existing telecentres as information resource centres (Munyua 2000). Costs are controlled through using only the most appropriate and acceptable technologies, and using existing physical infrastructure.

These kinds of initiatives along with the e-Africa Plan of Action referred to above, augurs well for addressing some of the major problems facing implementation of ICT/M across Africa.

Literacy and Culture

In addition to traditional literacy (reading and writing), the Information Society or the Knowledge Economy cannot be realized without computer literacy and information literacy (Menou 2002) or what Lewis (2006) has called e-literacy or cyber-literacy. The former deals specifically with computers and their peripherals plus the various software applications, and is relatively straightforward once the psychological hurdle of addressing a technology has been overcome. The information component of e-literacy however, is considerably more complex because it requires developing capacity for critical appraisal or judgment of information, or the ability *"to locate, evaluate, manage, and use information in a range of contexts"* (Bundy 1998). However, there is also the fact that *"the specialist and functional approaches to information literacy miss the fact that culture and information are facets of each other. The entire cycle of information and knowledge is culture-dependent at the same time contributing to the evolution of culture"* (Menou 1983). This is analogous to Fukuyama's (1996) statement regarding institutions that *"the ability to create certain institutions and run them effectively is itself culture bound"* or more broadly that, *"As Adam Smith well understood, economic life is deeply embedded in social life, and it cannot be understood apart from the customs, morals, and habits of the society in which it occurs. In short it cannot be divorced from culture"* (Fukuyama 1995).

Probably the most obvious expression of culture in this context is language, since the dominant language of ICT/M and the Internet is English, while the vast majority of people in Africa are not literate in English. However, the problem is much greater than language alone. As Hamel (2006) has indicated, *"Africa is resisting the universalizing pressures and forces of technology"*. To help address this issue he has grouped the views of technology into several general categories, to help in analyzing the appropriate approach. Cochrane and Atherton (1980) have developed some principles to keep in mind when analyzing cultural conditions within a context of information poverty. These are reminiscent of the principles for information system design and included:

- Contextualism: fitting materials to the cultural environment;
- Incrementalism: deciding how much can be done at each step;
- Motivation: assessing receptivity to information; and
- Absorptive process: how best to acquire information (Menou 2002)

Capacity

The UNDP (1997) has defined capacity building as:

> The process by which individuals, organizations, institutions, and societies develop abilities (individually and collectively) to perform functions, solve problems, and set and achieve objectives.

This comprehensive definition constitutes a major challenge in itself. When combined with the well-established need for capacity development in ICT/M the challenge becomes almost overwhelming, particularly given the time frames required to reduce the digital divide.

Capacity needs to be approached from both the consumption and production points of view. Consumption in terms of user ability with respect to traditional, computer, and information literacies, in order to develop the potential market, and production in terms of the technological skills and abilities required to design the necessary systems.

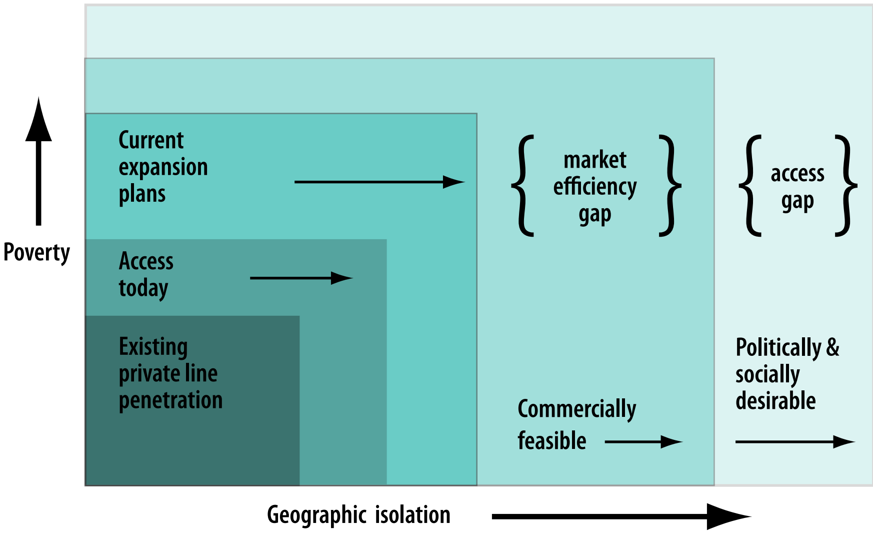
In spite of the importance of both ICT/M and capacity development, there has been a reluctance by donors and African governments to place them front and centre in terms of funding effective programs. For example, in partial response to an OECD evaluation of its capacity building in Africa (World Bank 1995), the World Bank has generated a major report entitled *Building Effective States: Forging Engaged*

Societies. Report of the World Bank Task Force on Capacity Development in Africa (World Bank 1995), that is described as a new compact for capacity development based on a new paradigm as per the title. While this is a comprehensive report that covers a great deal of valuable ground it makes passing reference only to ICT/M and this within a Public Sector Capacity Building Program (PSCAP) initiated by Ethiopia in 2003. The Bank has recognized this deficiency by stating that *"some issues were identified as underrepresented in the work: the information, communication, and technology(ICT/M) gap"*. While recognition of this gap is positive, the omission from the body of the report indicates that the role and fundamental importance of ICT/M to Africa's growth and development still needs to be promoted and supported.

Access

The degree of Universal Access (UA) to ICT services is a function of capacity (see above) and reach. Reach is a function of poverty and geographic isolation (Dymond and Oestmann nd). The first is general across urban, peri-urban and rural areas, while the latter applies largely to rural areas alone. Current reach or access via private lines occupies a small part of the available space as signified by the bottom left corner in Figure 6.

Figure 6. The relationship of poverty and geographic isolation on the reach of ICT and access to ICT services (from Dymond and Oestmann nd after Dymond et al 2000)



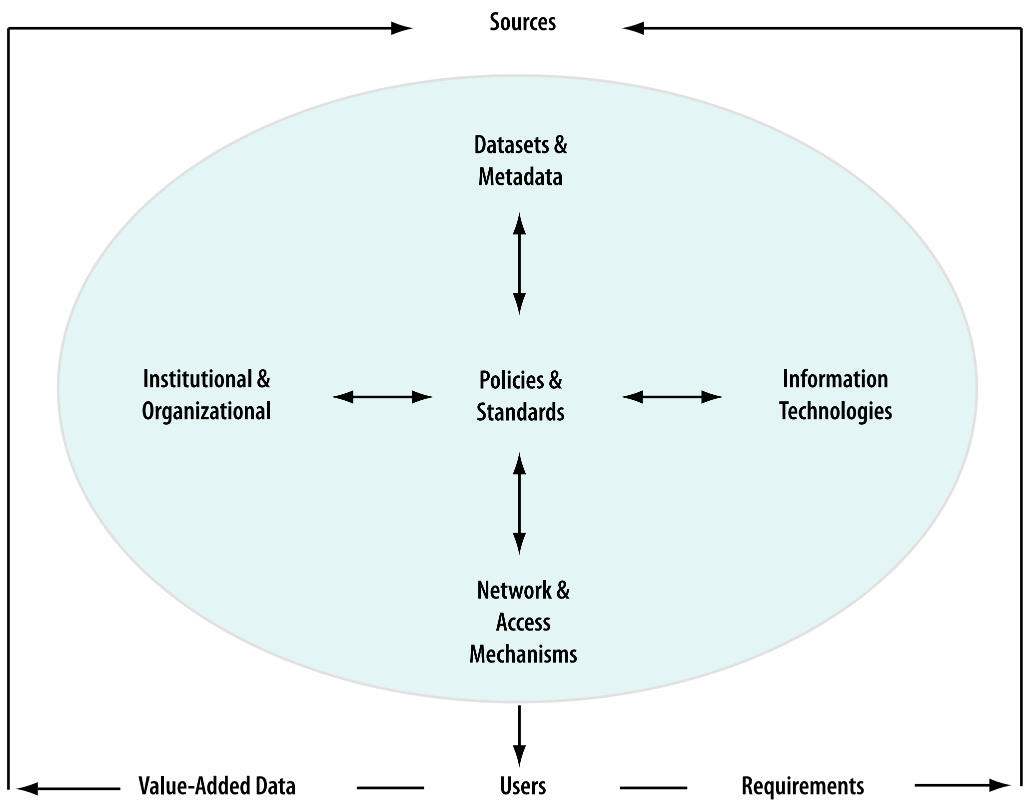
This is expanded by mobile telephony, public phones, public call offices or phone shops, and existing telecentres. The third is based on the expansion of facilities available in the second area, i.e. forms of public rather than private access. The fourth area, currently unoccupied, is referred to as the 'market efficiency gap'. This is a space that is potentially feasible from a commercial or market viewpoint but is currently being hampered by restrictive regulation and excessive, monopolistic charges, both of which are correctable through policy and regulatory changes. The fifth or final area tends to be beyond market access and requires public support in terms of subsidies or support through a mechanism such as Universal Access Fund.

Land Information Systems

The purpose of land information is primarily to provide the information necessary to achieving sustainable land management (SLM). SLM combines land administration (cadastre, land rights), land allocation and use, and natural resource management. In its broadest sense, therefore, SLM can be described as seeking to achieve a balance of agricultural, economic and environmental benefits through the productive use of soil, water, and biological resources. SLM strives to combine production (crops, livestock and forest products) and environmental management such that the combined social and economic benefits are greater than those from production alone. The benefits to the land user can be improved yields, reduced risks of production, reduced input costs, reduced labour, and improved social and economic wellbeing. The benefits to the environment are control and mitigation of land degradation and desertification, improved watershed management and water quality, improved soil carbon sequestration, and improved biodiversity and agro-bio-diversity.

The core of land information systems has traditionally been related to the cadastre and the recording of land rights or title. The inclusion of off-title information related to issues such as zoning, environmental hazards, and natural resource management is relatively recent. In essence, these merely represent additional sources of data. More important is the fact that land information systems are part of a much larger system involving institutions and organizations serving a wide clientele and receiving data from a variety of sources (Figure 7).

Figure 7. Components of a Land Information System



The Challenge of Information Systems

Computer-based Land Information Systems are part of the class of contemporary information systems in general. Unfortunately, these systems are characterized by failure rather than success in both the developed and less developed worlds in general (Lyytinen and Hirscheim, 1987; Eason 1998; Horton and Lewis, 1991; Moussa and Schware, 1992, Jeffcott and Johnson, 2000, Heeks 2002, 2003), and in Africa in particular (Peterson 1998). According to Heeks (2002), who emphasizes the difficulties in identifying and classifying failure, one fifth to one-quarter of IS projects in industrialized countries are a total failure, one-third to three-fifths are a partial failure, and only a minority succeed. While the evidence base for developing countries is weak, all the indicators point to high rates of failure (Moussa and Schware 1992, Peterson 1998). In 2005, Heeks estimated the failure rate in developing countries as being one-third for total failures, and one-half for partial failures, leaving only one-sixth that might be classed as successes. The reasons for these failures are multitudinous. They include weak government bureaucracies, limited managerial and technical capacity, lack of institutional support, the nature of organizational authority, lack of champions and political support, obstructionism at middle management levels, cultural and social incompatibility, inappropriate design, the contingent nature of information systems, and sustainability in the face of long-term projects. With respect to the application of Geographic Information Technology and Systems specifically, Barrett et al (2001) found that failure was a function of formality versus informality of information, rationality versus social discourse in decision-making, differing concepts of land, and lack of trust. They concluded that understanding local socio-cultural characteristics is critical to the resolution of opposing forces and the achievement of success.

A large number of issues need to be addressed carefully both before and during the design, development and implementation of an LIS since it is an ongoing process fraught with a high probability of failure. A selection of these issues are described below, followed by four structured methodologies for addressing the critical issues and ensuring that the design that is developed actually meets the reality of the context, the available resources, and human and organizational capacity.

Institutions, Property Rights and the Knowledge Economy

Linked strongly to the issue of land rights and the economy is the role of institutions, and particularly property institutions in economic development.

> According to North (1990) *"efficient institutions [require] a polity that has built-in incentives to create and enforce efficient real property rights"*.

The challenge encountered in institutional development per se, and in reconciling formal and informal institutions, is best discussed within the context of the three primary roles of institutions. These are: 1) to provide information on markets, goods, and participants; 2) to define and enforce real property rights and contracts; and 3) increase, or decrease, competition in markets (World Bank 2002). The performance of these functions has a number of critical outcomes for overall growth and economic development including affecting *"the distribution of assets, incomes, and costs as well as the incentives for market participants and the efficiency of market transactions"* (World Bank 2002). These outcomes are also critical for the poor, since without the appropriate institutions, they are deprived of the benefits associated with these outcomes.

In informal institutions these functions are an inherent component of group, community, or ethnic mores. Because of common traditions, culture, implicit knowledge, trust and close communication, information about local markets, goods and participants is readily and rapidly transmitted throughout the members of the community. The net result is a lowering of risk and transaction costs, and efficient institutions. Similarly, real property rights, though often complex, are protected by cultural tradition within a system of customary tenures. They are essentially self-enforcing through individual and social sanctions such as reputation loss and social exclusion.

The strength of informal institutions can become a serious weakness as community structures and relationships break down (e.g. in peri-urban areas) as inter-community exchanges increase in importance, and as distributed, community-based economies shift to more centralized national economies. Globalization of trade and financial markets can exacerbate the problem. The net result of these forces and shifts in economies and increases in scale is a breakdown in trust, communications and coordination, imperfect and asymmetric information, increases in transaction costs, decreases in efficiency, and overall economic decline.

Such evolutionary trends to larger markets require a shift to more formal institutions if economies are to develop with an increase in opportunities for all citizens. Such formal institutions are necessary for the realization of

> Government's role in the protection of real property rights, and the provision of other public goods [which have] been closely linked to its role in ensuring peace or law and order. Conflicts over real property between private agents, are some of the more important issues that governments have had to deal with, because they often lead to a breakdown in law and order (World Bank 2002).

The challenge of reconciling formal and informal institutions is not a trivial one. The ultimate source of institutions, however, is social. As Etounga-Manguelle (2000) points out, *"culture is the mother; institutions are the children", or "the ability to create certain institutions and run them effectively is itself culture bound"* (Fukuyama 1995).

It is critical, therefore, that the institutions associated with property and land rights, which include Land Information Systems, are relevant to the societies or environments in which they are to function, particularly if they are to interact positively and effectively with the Knowledge Economy. Within Africa, for example, legal pluralism is one of the customs, and this constitutes a major challenge of its own to the development of supportive property institutions.

Organizations and Management

The Champion

Probably the single most important requirement for success and sustainability is a strong, committed champion from the most senior ranks of the organization, up to an including the political level. Without such a champion the resources required for organizational change and development are unlikely to come available or be maintained. The importance of this issue cannot be over-emphasized.

Organizational Change

Throughout the literature on the failure of information systems in general and land information systems in particular, one issue stands out above all others as a source of failure; the inability to manage organizational change, and the compounding effect of information and communications technology. Information technologies in themselves demand change because of the need for business process reengineering (see below). ICT can either enable change, cause resistance to change or disrupt the functioning of organizations depending on how it is implemented. The high failure rates with information systems indicate that insufficient attention has been paid to the sensitivities inherent in organizational change within different cultural contexts.

A detailed examination of the theory and practice of organizational change per se is beyond the scope of this paper. For that readers are directed to the literature (e.g. Orlikowski 1996). Here we will focus on the highly contingent nature of organizational change with respect to information systems (Lorsch and Morse 1974, Peterson 1998; Robey and Boudreau1999; Heeks 2002). By this is meant that the success or failure of a particular system is dependent on a number of situation specific factors (Heeks 2002) that need to be identified and analysed as objectively as possible. A few of these issues will be examined here before considering approaches to their resolution.

Organizations and Management

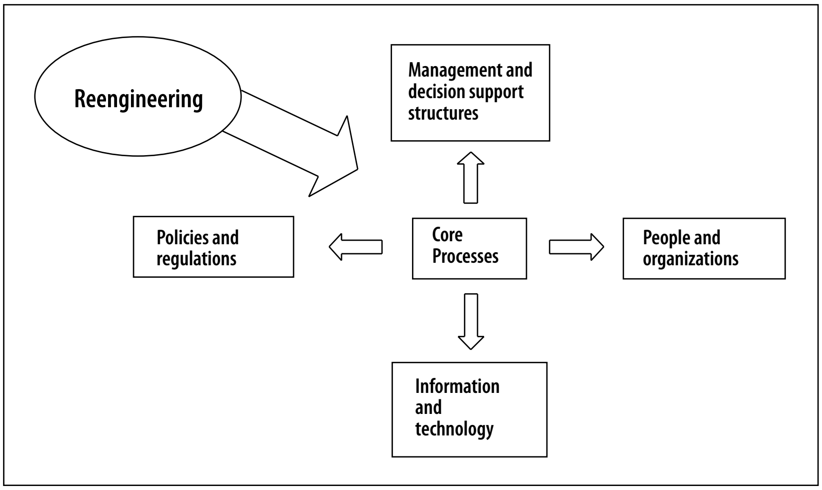
Public bureaucracies in Africa tend to be weak, with authority personalized in the hands of senior officials. While this results in an appearance of centralization, it is in fact one of dispersed authority among these officials operating in a hub and wheel type of organizational system (Peterson 1998). While this has its advantages, it also has its disadvantages. Within the context of Land Information Systems it limits the scale and complexity of operations that can be managed effectively. In other words, information systems, which are managerially complex, can rapidly overcome management capacity. Individualized authority can also result in lack of continuity since initiatives tend to be embedded in individuals rather than in the system. Furthermore, the organization operates with procedural informality, something that is anathema to information systems dependent on standards, specifications and structured procedures. Information systems demand delegation of authority to those able to design, develop, install and maintain the systems, placing great stress on the hub and wheel organizational management approach, and inhibiting the opportunities for departmental integration of information. It should be remembered also *"the fundamental task of systems development is establishing a process for solving organizational problems, not installing hardware and software"* (Hopelain 1984 in Peterson 1998).

Business Process Re-engineering

The implementation of new LIM technology could motivate process (re)engineering. Process (re)engineering can have cascading effects upon such things as organizational structures, policies and regulations, staffing requirements etc. Also, process (re)engineering could motivate the implementation of new LIM technology (Unites States General Accounting Office 1997). Within this primary issue there are a number of secondary issues or pitfalls that need to be avoided (Greenberg 1996).

The bottom line is that business process (re)engineering will influence the core processes of the organization, and thus influence all the associated activities and processes (Figure 8).

Figure 8. Diagram displaying the impact of Reengineering on core processes and associated components and processes (from USGAO 1997)



Allocation of Expenses

Care should be taken not to underestimate the cost of business process (re)engineering relative to the cost of new technology. Acquiring the latter is attractive and relatively simple, and thus tends to receive the bulk of the financing.

Delegation

Business process (re)engineering must empower and involve the organization's staff and should not be given to an outside consultant to carry out. The only external help that should be sought is that of a facilitator.

Requirements analysis

This will be dealt with in more detail below, but is one place where an external consultant (not a vendor or systems supplier) can play a valuable role, and save considerable expense by ensuring that the subsequent (re)engineering design is both relevant and appropriate.

Failure to Commit Sufficient Resources

The challenge facing key executives is maintaining operations while going through the (re)engineering process. This leads to a failure to prioritize and commit sufficient resources to ensure success.

Administrative Reform

Government is (usually) the largest owner/user of land information and is therefore heavily involved in LIM. E-government, which is an application of information systems, is now an integral part of the knowledge economy. Many governments operating in knowledge economies offer e-government services to citizens, businesses, and other government departments. Transitioning from traditional government service delivery models to e-government models requires administrative reform that will include process (re)engineering and organizational restructuring to efficiently incorporate the use of modern ICT and information technologies applied to providing LIM services.

Within this context The African Training and Research Centre in Administration for Development (ATRCAD 2003) has called for a Plan of Action to:

- Develop a master plan for modernization of public administration, especially with the view to simplify administrative procedures; to make it results-oriented; to improve women participation and status in the public service; and, to promote professionalism and ethics in civil service within the framework of the African Charter of Public Service;
- Broaden the social base for public policy decision-making;
- Demonstrate clear-cut commitment to the use of ICT in government operations;
- Introduce systems for evaluation and quality control of public services.

Capacity

Capacity Building and Retention

Between 1995 and 2004 Africa received more than $9 billion in aid and grants from the World Bank alone to build capacity in the public sector with limited results (World Bank 2005), while enrolment in secondary education remains low at 26%, and enrolment in tertiary education is at only 5% (Saint 2002, World Bank 2006). The contribution of Africa's 334 or so universities to world knowledge has been estimated at 0.3%. Even more disturbing is that 30% of graduates are lost in the brain drain. These figures cannot build or support a knowledge economy.

Socioeconomic indicators of a country's capacity building potential are education, health (e.g. life expectancy), information and ICT connectivity, skills retention levels, economic growth, and population growth. Capacity building should happen at the individual, organizational and institutional levels, and relates to both formal education at the post-graduate level and special skills development. To implement LIM requires many and varied skills: computer programming; database management; many dimensions of geomatics including GIS, cartography, mapping, spatial modeling, and that is just at the operational level. If Africa is to implement LIM as well as move towards the knowledge economy then it will have to invest in higher education and attempt to solve the socioeconomic conditions that cause many of its skilled human resources to migrate to "greener pastures".

Impact of the Digital Divide

The digital divide is simply the gap that exists in the opportunities to access advanced information and communication technologies between geographic areas or by individuals at different socio-economic levels. The gap can be defined as having four dimensions in a global sense: 1) levels of access to information infrastructure; 2) levels of access to broadband infrastructure; 3) quality of urban versus rural access; and 4) variance of quality of access among countries (OECD 2001).

Policies and programmes have been developed to reduce the divide, particularly pro-competitive regulatory initiatives aimed at increasing network infrastructure competition. In some countries, the strategies being articulated and employed are as yet by way of very general 'vision' statements about the pursuit of universal access.

Africa is the least e-ready region in the world with the lowest rate of e-participation. While this affords a major opportunity for progress, it also presents a significant danger. The danger is that implementation of information infrastructure and ICT without ensuring enhanced capacity and much broader access by the rural and urban poor could simply exacerbate the internal digital divide. Thus the socioeconomic and infrastructure problems of access need to be addressed at the same time.

Structure and Technology

Appropriate Technology

Technology deals with the tools and techniques for carrying out plans, and can be digital or manual. It includes all products, services, techniques, knowledge, know-how, methods and methodologies that aim at facilitating and improving access to land information.

Technology may be a variety of high, medium, and low tech (different levels of technology). Implemented technology should be able to manage the unique and complicated land information associated with African regions. Concerns about implementing technology in low e-ready societies such as in Africa relate to gaining high returns on investment (usually high initial setup costs) plus all the concerns about **maintaining** systems (trained personnel; personnel retention; physical maintenance); **ability to upgrade** in order to access emerging technology and **avoid obsolescence**. It is critical, therefore, to apply the appropriate technology, particularly in a low e-readiness society.

Applications complexity

Computer applications cover a broad range from relatively simple and transparent applications like e-mail, and word processing to more complex and 'black box' applications such as decision-support systems and simulation models for scenario planning. The former are relatively straightforward and carry no assumptions about either the organization or its personnel. The latter, on the other hand, contain assumptions about the organization and the functionalities within the system that may not be relevant or true with respect to the actual functioning of the organization. As with size, there is increasing risk with complexity.

Information Architecture

All the components of information architecture need to be considered as follows:

- *Data architecture*: an overall plan for the data items and their relationships necessary to deliver spatial information online.
- *Process architecture*: a plan of the key activities that the administration will support and undertake
- Technology architecture: how computers will be sized and connected for spatial information, and an outline of the software to be used

- *Data management architecture*: how data input, processing, storage, and output functions will be divided across the information technology architecture
- *Management architecture*: the policies, standards, human resource systems, management structures, financial systems etc. necessary to support land administration and a GIS/LIS.

Data

The basic fabric of a land information system is an inventory of data on the spatial representation of legal land objects coupled with their attributes. Thus data are the heart of the system and need to be addressed from a number of perspectives including data models, standards, ownership and custodianship, and pricing and cost recovery.

<u>Data Models</u>

Issues related to the use of data models to capture the unique characteristics and relationships of African land related information.

- Entity-relational models
- Object-oriented models
- Object-relational models

<u>Spatial Data Standards</u>

Issues related to the use of spatial information standards such as the Open Geodata Interoperability Specification (OGIS) from the Open Geographic Information System Consortium (OGS). This will facilitate easy sharing of spatial (land) information.

<u>Data Ownership and Custodianship</u>

A custodian of a dataset, or a component of that dataset, is an agency having the responsibility to ensure that the dataset is collected and maintained according to specifications and priorities determined by consultation with the user community, and made available to the community under conditions and in a format that conforms with standards and policies established for the national spatial data infrastructure.

The concept of custodianship assigns to an agency certain rights and responsibilities associated with the capture and management of information. Custodianship is not synonymous with ownership. Rather, it views all information captured by a government agency as forming part of a State's corporate information resource, and custodians are appointed to manage information about that resource on behalf of the government.

Custodianship provides a means of achieving accountability for and reliability of information sources. While everyone has a right to capture information, this would result in unnecessary duplication and inconsistency in the way information is captured and maintained (GONSW 1998).

<u>Data Pricing and Cost Recovery</u>

Government must develop consistent and integrated policies and procedures related to information management and access. For example, partnership development may be a key component of the Land Information System's delivery strategy. But partnership arrangements can be impacted by data pricing and freedom of information policies (GOBC 2003)

Questions?

- How much to charge customers for services and products?
- Does a jurisdiction charge differentially for services and products (business vs. private citizens)?

- Does charging constitute double taxation if the data is produced from public funds?
- Will charging for data inhibit equitable access to information?
- Will charging for the information inhibit development of a valued-added market or the knowledge economy?
- Is government information part of government service, or is itto be treated as a corporate asset?

Design

Realism

The design must conform to the reality of the situation and what is possible. Computerized information systems are highly demanding on personnel and organizations, and the capacity of both can be exceeded very easily. The design must be relevant, user-centred, and dynamic in the sense of being a work in continual improvement through individual and organizational learning. Needs for maintenance, monitoring, support, and evaluation need to be incorporated from the beginning. The latter relate to the sustainability of the system. Donor funded projects, for example, tend not to provide funding for the latter leading to collapse of the system.

Documenting reality is often difficult to achieve because it can be perceived as fault finding and can cause resistance by employees. This can be overcome through creating an environment of objective analysis by encouraging stakeholders to express the difference between prescriptive models of what they should be doing, and real depictions of what they are actually doing.

Modularity and Incrementalism

The bigger and more ambitious the project, the greater is the risk of failure. Mitigation of this risk can be achieved by breaking the project down into manageable or achievable 'chunks' through modularity (supporting one business function at a time) and incrementalism (providing stepped levels of support for business functions). Such an approach also allows for early demonstrable successes and maintenance of support.

Customisation

With respect to software and systems, managers have three choices: 1) in-house design of software and systems; 2) purchase of 'turnkey' systems; or 3) purchase of tested, off-the-shelf technology that is amenable to adaptation to meet their requirements. The first two options or choices rarely succeed. The third has a much higher probability of success if the following axioms are adhered to: 'customised' not just 'off-the-shelf', and 'adapt' not just 'adopt'

Political support

The design should set priorities for the modules in terms of political support. Politicians, users, and citizens need to see short-term tangible benefits, as well as the long-term vision, in order to provide continuing support. Ensure also that influential groups such as senior bureaucrats, lawyers and bankers understand that they can benefit, and demonstrate this benefit early and soon.

Relationships and Partnerships

Designers and Users

As Heeks (2002) points out, designers and users are dislocated both psychologically and even physically, have different backgrounds and perceptions, respond to different reward systems, and operate under different assumptions. This is true everywhere, but in the developing world in general and in Africa in particular this disconnect tends to be exacerbated. This flows from the fact that information systems tend to be dominated by imports from the industrialized world as a result of aid politics and economics. In short, designers and users do not just live in different environments within a given cultural context, but live in very different development and cultural contexts. This raises the dilemma that *"designers cannot build a system until they know what is required and users have difficulty stating the requirements of a system they do not understand"* (Eason1988 in Peterson 1998).

The solution is a full participatory approach to the design process in which users, designers and implementers can establish a learning relationship and ensure the design and development of a relevant and maintainable system. Approaches to this process are developed below.

Client – Vendor Relationship Management

Vendors and developers (private sector) and clients (government) occupy different worlds with different reward systems. To avoid failures of communication and understanding between these cultures, there needs to be active management of the relationship. This means acquiring personnel (in-house or outsourced) who can bridge the gap and manage the relationship within a joint management system.

Public – Private Partnerships

The private sector can usually complete a task more efficiently than government because they have a profit incentive, are motivated to stay in business (i.e. survival), and can mobilize more resources. Public / private sector partnerships can evolve also to meet new challenges and threats rapidly and effectively. The major criterion is that both sectors derive some benefit that might not have been possible without the partnership.

ICT Consumption and Production and the Private Sector

Land Information Systems are usually developed for consumptive purposes, i.e. delivery of information services to the public and others. However, a major benefit to the Knowledge Economy is when ICT is regarded and developed as a production function. This is particularly important to private sector development, since it is in the production side that small and medium businesses or enterprises (SMEs) can build their capacity. Duncombe and Heeks (2001), for example identify four functions for ICT that are important for SME development:

1. ICTs as an enterprise output – hardware, software and telecommunications products;
2. ICTs as a primary processing technology – data entry, business services, software customization, and distance learning;
3. ICT-related support activities – computer training, consultancy, trouble-shooting, and content provision; and
4. ICTs as a secondary processing technology – communication, data processing, manufacturing systems.

The first three categories are ICT production functions while the fourth represents ICT consumers. As Duncombe and Heeks point out, category 1 would be more for industrialized and developed countries, but categories 2 and 3 should be supported by developing countries. Thus government can play a major role in this by setting a policy to grow an indigenous ICT capability within the private sector in association with building the Land Information System through local contracting and skills development, particularly if the development process is designed as a modular and incremental one leading to controlled capacity development. This can set the groundwork for productive public-private partnerships.

Outsourcing and Project Management

Components should be outsourced where appropriate to stimulate local private sector development. The components should be managed jointly and tightly to ensure joint accountability and performance.

Methodology and Approaches

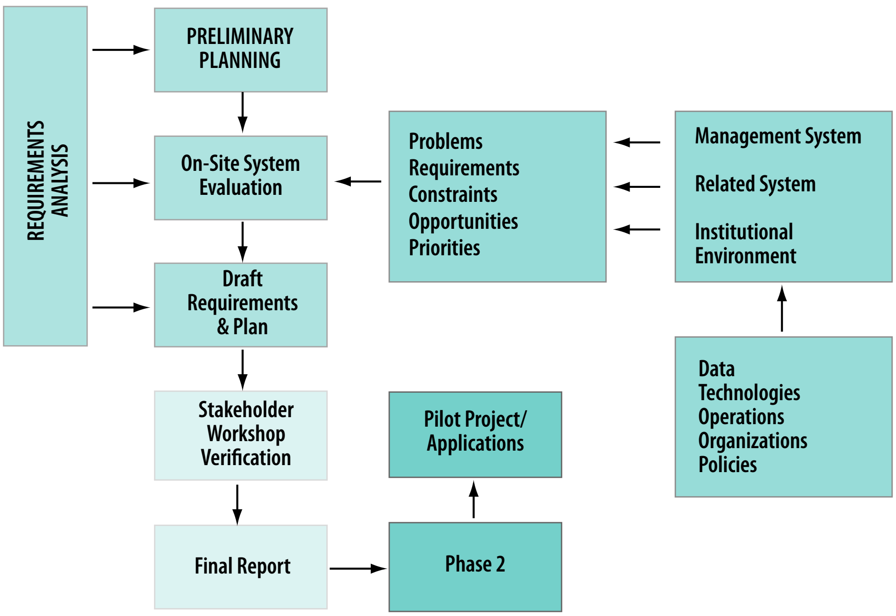
In order to facilitate and structure addressing the above and other issues, and to avoid failure, a number of approaches have been developed. These are focused on the contingent nature of LIS. Here we will explore briefly four related approaches to such a contingency analysis: 1) Requirements Analysis; 2) Risk Management; 3) Factor Analysis; and 4) Design – Actuality Gap Analysis.

Requirements Analysis

Requirements analysis or assessment is practiced commonly in the private sector and by organizational consultants, although many public sector clients are reluctant to undergo the exercise. This emanates from both a natural resistance to external assessment, as well as from an often ill-founded belief by senior executives that they know what they want. Unfortunately, failing to conduct an objective Requirements Analysis prior to installing, enhancing, or expanding a Land Information System is almost a guarantee of failure.

A requirements analysis is essentially a gap analysis focused on an objective, in-depth and detailed analysis of the current situation and the desired future. Invariably there will be a gap, and the purpose of the analysis is to provide the information for a design solution that minimises the gap and is achievable within the resources and capacity of the organization. The methodology for doing this is well documented and is composed of observation, interviews, questionnaires, and focus groups throughout all levels of the organization in order to assemble the types of information displayed in Figure 9.

Figure 9: Flow chart showing the Needs Analysis components within the overall pilot planning and development process



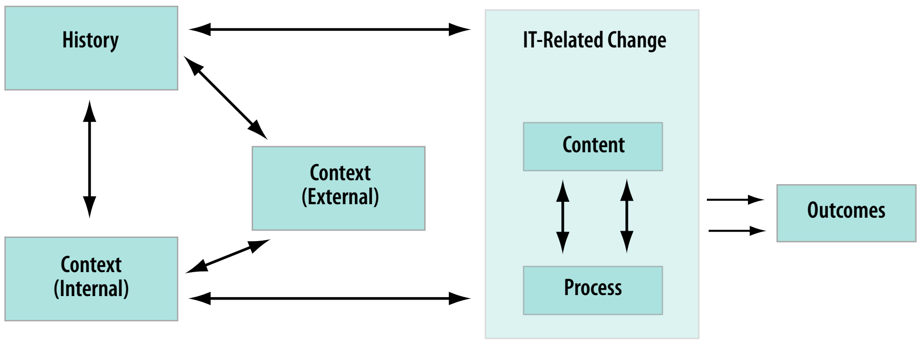
Risk Assessment

The greater the degree of change the greater the risk of failure (Clemons et al 1995; Sauer 1993, Heeks 2002) because of the increasing disconnect between the current state and the desired future state in terms of the many factors involved in the change. There is a strong tendency, however, to ignore or downplay the risk in the drive to implement what is often seen as a solution to a pressing or perceived problem, or as a display of an ICT literate organization. This results in a common failure to assess organizational risk (Kearney 1990; Buchanan 1991). Furthermore, as Hornby et al (1992) point out, *"Systems analysts do not claim to have knowledge of organizational issues in IT systems, and there is no evidence that they are encouraged or rewarded for considering such issues"*.

In response to this situation Willcocks and Margetts (1994) developed a process-oriented and organizational studies-based model for risk assessment and management that is now known as the Willcocks and Margetts Risk Assessment Model. This model incorporates six conceptual, inter-acting factors that need to be addressed in analysing the development and implementation of Information Systems from an organizational perspective (Jeffcott and Johnson 2000).

1. *History*: Prior organizational development, e.g. relevant IS experience and organizational history, and most importantly, IS success or failure.
2. *Internal Context*: The characteristics of the organization itself, e.g. strategy, structure, reward system, management, human resources and industrial relations arrangements, IS infrastructure and management.
3. *External Context*: The givens that an organization and its members need to respond to and accommodate, e.g. the economy, political and government policy, markets, competition and, in the public sector, department or local government guidelines, procedures and funding arrangements.
4. *Content*: The changes involved in and substance of a project, e.g. size and complexity of the project, technical uncertainty, whether radical or incremental in impact.
5. *Processes:* How things are done and the issues perceived, e.g. project management, project team experience, staffing stability, user commitment.
6. *Risk Outcomes*: Planned or unanticipated, desirable or otherwise, e.g. cost, time, technical performance, operational efficiency, user acceptance (Figure 10).

Figure 10: The six interacting factors in the Willcocks and Margetts Risk Assessment model (after Jeffcott and Johnson 2000)

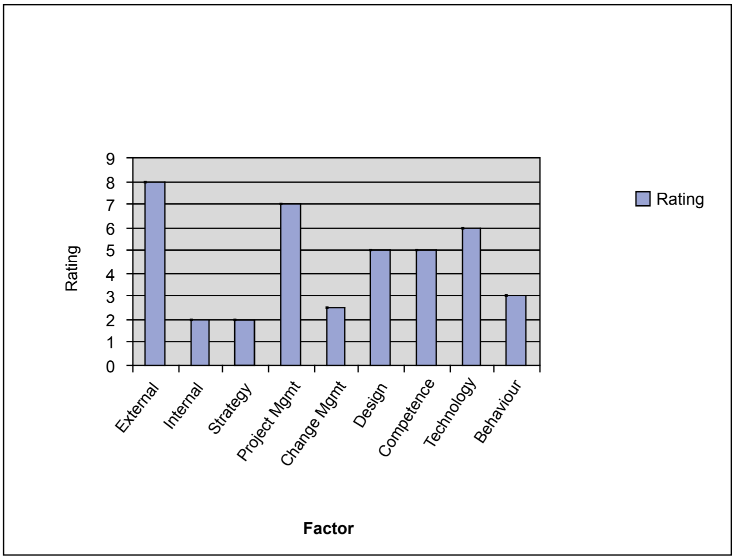


This risk management approach defines the broad categories of issues that are critical to the success or failure of a proposed information system. These should be explored in detail through a structured process, preferably employing an external objective agency working in close cooperation with the implementing organization at all levels. Obtaining the answers to the above issues will allow for a more tailored and relevant approach to the design than the managers may have conceived originally.

The Factor Model

As a result of considerable research in the field, Heeks (2003a, 2003b) has identified a number of factors responsible for failure, and developed approaches for addressing these factors in a structured and quantitative manner. One approach he terms the Factor Model in which a total of nine critical factors are identified and evaluated on the basis of whether they operate as enablers or constraints. These factors are: *external pressure; external (institutional) environment; internal political desire; vision and strategy, project management, change management, design, competencies, and technology*. The factors can be rated either qualitatively or semi-quantitatively and displayed either in tabular of graphical form in order to identify the most critical factors requiring attention (Figure 11).

Figure 11: Graphical display of gap analysis factors related to success of failure of information systems



Design-Reality Gap Model

An alternative or complementary approach is that of assessing or evaluating the gap between the current reality and the proposed design for the organization. The degree of risk, or the chance for failure rather than success, is a function of the size of the gap. This model identifies seven dimensions captured by the acronym ITPOSMO (Heeks 2002, 2003a), as follows:

Information

If a system assumes that clients value formal, objective information while in fact they use informal, selective information and gut feelings then there will be a large gap. Since this is a cultural issue it's a gap that is not easy to correct in the short term.

Technology

There is a choice of using existing technology with incremental change, or attempting to implement contemporary, even leading edge technology across the board. The latter will have a high level of risk and low chance of success.

Processes

A system founded on the assumption of rational, structured decision-making based on objective information when in fact decision-making is unstructured, highly subjective and driven by personal relations and nepotism has a high risk of failure unless the actual decision-making process is recognized and accommodated.

Objectives and Values

Different jurisdictions and cultures have different values and objectives throughout the evolution of an organization. There is a 'role culture' that values rules and logic versus a 'power culture' in which self-interest and hidden agendas are the rule. Regardless, the organizational change must accommodate the dominant culture and consider the aspirations of the senior players.

Staffing and Skills

Design should always be based on existing skills as they are, not what the designer would like them to be or thinks they should be.

Management Systems and Structures

The tendency is to build structures and systems that support rational, strategic decision-making. In fact, such systems and structures may not exist.

Other Resources: time and money

Every design should fit the available resources, and the golden rule is to start small, achieve success, build support, and build incrementally.

As in the factor model, the seven dimensions can be rated on a scale of 0 to 10, with 0 representing no difference or a zero gap, and 10 indicating that the design was radically different from the current system or usage. The ratings can then be assigned to classes based on the likelihood of success or failure.

While these ratings again are subjective, they help to pinpoint areas of concern or dimensions that need to be re-examined in terms of design or the current reality. Thus if there is a large gap in the Staffing and Skills dimension then there are two possible courses of action: 1) change the design so as to reduce the need skilled support; or 2) embark on an intensive training program to bring the reality closer to the design.

The above model can be refined in a number of ways. For example, dimensions can be weighted if it is felt that particular dimensions have more influence than others on success or failure. Or individual dimensions can be broken down into their components to improve sensitivity. For example, the Technology dimension could be broken down into hardware, software and systems, or the Staffing and Skills dimension could be broken down into senior management, middle management and technical levels.

The elements and factors considered in these four approaches or models demonstrate a significant overlap, with apparent differences being more a function of emphasis and categorization rather than substance. But each provides a somewhat different perspective that adds strength to the analyses.

Legal, Cultural and Tenure Realities in Africa

The African Context – Land Rights and Information Systems

In spite of over a hundred years of trying to impose systems of common and statutory law and the concept of individual ownership of land on Africa, customary systems of group ownership and communal property have persisted strongly, and are now gaining in strength. Unfortunately, the effort to displace them has *"disempowered vulnerable people, embroiled rural people and bureaucrats in innumerable disputes, and. . . has served to weaken the land rights of women and tenants, and down-play the status of women and the role of women as users of land"* (Adam and Turner 2005). The net result has been massive displacement, abrogation and expropriation of communal rights by state agencies (and their re-allocation to non-rights holders), the loss of several hundred million hectares in Sub Saharan Africa (Wily 2006), and loss of security by millions of people. The seriousness of this situation is illustrated by the fact that more than 90 percent of rural people in sub Saharan Africa regulate their land relations through customary processes (Augustinus 2003; Wily 2006).

The rich diversity of cultures and the rapidly evolving and dynamic condition of land governance within Africa make it particularly difficult to come up with generalizations on the nature of land rights and land relations. Moore (1998) has described these as the *"multiple, shifting, permutating, recombining practices of rural Africa"*. However, Cousins and Claassens (2005) hold the view that there are "persistent elements and relationships" in land relations in Africa, and that these can lead to the elucidation of commonalities based on underlying principles. They have listed the distinctive features of African tenure regimes as follows:

- *Land rights are embedded in a range of social relationships and units, including households and kinship networks and various levels of 'community'; the relevant social identities are often multiple, overlapping and therefore 'nested' or layered in character (e.g. individual rights within households, households within kinship networks, kinship networks within local communities, etc).*
- *Land rights are inclusive rather than exclusive in character, being shared and relative. They include both strong individual and family rights to residential and arable land and access to common property resources such as grazing, forests, and water.*
- *Rights are derived from accepted membership of a social unit, and can be acquired via birth, affiliation or allegiance to a group and its political authority, or transactions of various kinds (including gifts, loans, and purchases). They are somewhat similar to citizenship entitlements in modern democracies.*
- *Access to land (through defined rights) is distinct from control of land (through systems of authority and administration).*
- *Control is concerned with guaranteeing access and enforcing rights, regulating the use of common property resources, overseeing mechanisms for redistributing access (e.g. trans-generationally), and resolving disputes over claims to land. It is often located within a hierarchy of nested systems of authority, with many functions located at local or lower levels.*
- *Social, political and resource boundaries while often relatively stable are also flexible and negotiable, given the nested character of social identities, rights and authority structures.*

These tenure rights can be summarized as being socially nested or embedded; locally held, inclusive, derived from membership in a group; focused on access and use rather than ownership or control; subject to continual negotiation, and with flexible boundaries over space and time.

Virtually all countries in Africa have embarked on land reform, including tenure security, land restitution, and land redistribution to address these distortions and injustices. Many of these initiatives have met with little or no success, or are proceeding at a pace that leads to frustration and conflict, and a failure to address rural poverty. This failure is not just due to internal factors. Enormous pressures were brought to bear to adopt or continue with cadastral-based western land administration systems, with emphasis being placed on individualized title, collateralization, and market forces, all of which tended to be inappropriate and counterproductive within the African context. These same problems are reflected in the failure to create or maintain effective or functioning land information systems.

Augustinus (2003) and the UNCHS (2003) have listed some of the characteristics and problems with land registration, cadastral, and land information management systems in Africa as follows:

- Less than one percent of Sub Saharan Africa is covered by some form of cadastre;
- Most African countries do not have a land information system using LIS/GIS;
- Existing cadastral systems are usually in manual form with incomplete coverage;
- Land registration systems tend to be under-resourced because of the lack of financial, technical and human capacity;
- Systems tend to be based on colonial laws and individual rights, and are centralized, expensive and exclusive.
- Systems are neither transparent nor user-friendly;
- Land registration can take an average of 15 to 18 months and can extend to 2 to 7 years;
- Available information relates only to areas where formal legal procedure were used;
- Only limited results have been achieved in setting up or modernizing land information systems;
- Available information is limited, ambiguous, centralized, difficult to access, distributed among a number of agencies, and not well managed.

Western Rationalism versus African Realism

Computerized information systems have been developed largely in the West with all that that implies. Thus the technology was developed within an environment of ordered and structured property or cadastral systems. As Ciborra (1995) puts it, *"The essence of modern technology is a way of revealing that challenges the world by ordering it, that is by ordering resources, processes, people and relationships".* This includes the ordering of people's relationships with respect to land in western registration and cadastral systems, where land tends to be regarded as a commodity subject to market rationalism.

Africa on the other hand comes from a very different cultural perception, not dominated by electronic technologies, where social structures and responsibilities are paramount, and where rights to land use and access are socially embedded in a dynamic and flexible system, and where these rights flow from the community in a decentralized, even devolved, system. Land is not a commodity but a social foundation, a source of identity, livelihood and security. This tension between western rationalism and African reality is not a question of reason or logic. As Hopelain (1984) has emphasized, *"managers of system development efforts should focus on the logic of systems design and not on the logic of the system that is being designed"*. This is an insightful statement, but one that is rarely recognized or followed. Its application in Africa should lead to some innovative approaches to the design of relevant land information systems.

Legal Pluralism

Legal pluralism can be defined most succinctly as, the existence in one social construct of two or more legal orders. As Meinzen-Dick and Pradhan (2002) have pointed out, "law is not limited to acts, rules, administrative orders, court decisions etc." but can take various forms such as state (statutory) law, religious law, customary law, project (or donor) law, and organizational law.

The major debate in Africa has been largely over statutory versus customary law. However, it is now generally accepted that there is one legal system with two coequal sets of legal rules—received law and customary law—and the judicial systems are empowered to fuse the systems over the long term. This equality means that communal and collective rights in land are recognized and protected, and people can choose one equal tenure and legal system over another. There is also local-level land administration and registration, where all customary interests are recorded and protected in land adjudication and customary as well as statutory alternative dispute resolution processes. In addition, pluralist tenure and land law extend to urban areas, along with land regularization schemes and urban land adjudication (McAuslan 2006).

ICT/M Issues and Recommendations – The Ties that Bind the Lion

A great deal of activity is occurring in Africa, but advances are slow, and many policies and regulations remain either in draft form or have not been enacted. The net result is that infrastructure remains underdeveloped, costs are prohibitive, and uptake is low, depending on he technology and the location. The two most critical or operative words or concepts that epitomize the challenge are 'access' and 'capacity', both of which are a function of poverty, and geographic isolation in rural areas.

The challenge of access can be divided into two parts: 1) the market efficiency gap; and 2) true access gap. The market efficiency gap is caused by existing policies, regulations, business models and cost structures that greatly inhibit development of private sector service providers and the development of ICT/M into areas where such services are commercially feasible. Policies, for example that support monopolistic business models, and regulations that prevent cost recovery by small and medium service providers prepared to address the market efficiency gap.

The true access gap is a function of geographic isolation, low population density and poverty. It is not commercially feasible, and therefore remains a direct responsibility of government in terms of service provision. This can be achieved through such mechanisms as Universal Access Funds, and least subsidy auctions. Access, therefore, is not an insoluble or financially prohibitive challenge; it is amenable to the kind of bold initiatives and serious commitment that are well within the power of governments. With the right enabling environment, it is possible to stimulate, facilitate and empower the private sector to deliver the access, and at the same time contribute to the knowledge economy through the production as well as the consumption aspects of ICT.

Capacity is closely associated with access from both the consumption and production aspects of ICT/M. From the production aspect it must involve technical and professional training in ICT as both a science and a technology, and as a socioeconomic activity involving business, government, and the broader social and cultural context. In addition, there needs to be ICT business specific and on-the-job training since the latter has a much higher rate of economic return in the short term, a critical issue where catch-up is a serious challenge.

The consumption aspect is about traditional literacy, computer literacy, and information literacy. Without these literacies existing from the highest political and business levels to the poorest rural communities, it will be difficult to move ahead with the ICT agenda.. Literacy is important at the higher political, government ministry and business levels in order to ensure relevant and effective policies and regulations. Literacy is important among the general population in order to 1) attract people into the ICT/M industry as a viable and attractive career at the technical and professional levels; and 2) to create the consumer market that will enhance commercial feasibility and contribute to closing the market efficiency gap.

Access specifics

Throughout much of Africa (given that there are also great differences through out the continent) there is a pressing need to (after AISI – UNECA 1999):

- accelerate the approval of ICM policies and strategies, most of which are still in draft forms;
- create an enabling environment to facilitate the deployment, utilization and exploitation of ICTs within the economy and society (e.g. facilitation of SPVs and open access for international bandwidth; creation of special tax packages, instruments and incentive programs; facilitation of an investment climate for the mobilization of financial and technological resources, removal of existing regulatory and bureaucratic barriers);
- reduce the high and prohibitive telecommunications costs;
- develop local ICT industries to facilitate the production, manufacturing, development, delivery and distribution of ICT products and services (e.g. through sub-contracting or outsourcing, and through support for R&D);
- foster the application of ICTs in the private sector to improve the efficiency and effectiveness of businesses both large and small;

- develop the legal, institutional and regulatory framework and structures required for supporting the deployment, utilization and the development of ICTs (e.g. national ICT structures and bodies; legislation around e-commerce, Intellectual Property Rights, data protection, security and freedom of access to information etc.);
- improve the ineffective repacking of existing information for particular stakeholders, such as farmers, on whom much of the economy depends;
- design adequate indexes and/or information storage systems for effective retrieval of collected information. This is compounded by lack of standards and national regulating bodies
- ensure design and implementation include plans for maintenance and sustainability. Financing through donors alone is unsustainable.
- develop human resource capacity at all levels of society to meet the changing demands of the economy (e.g. through ICT training and education in schools, colleges and universities, but particularly through business and on-the-job training which have the highest immediate returns);
- provide competitive compensation within government to enable recruitment and retention of skilled staff;
- engage government as a model user of ICTs – to provide an example and encourage the expansion of local markets;
- embark on process reengineering within the public sector to breakdown barriers and ensure sharing of information, and creation of a one-stop-shop concept;

LIS Issues and Recommendation – The Ties that Bind the Lion

Little has appeared to change with respect to Land Information Systems since the latter part of the 1990s when Durand-Lasserve (1997 in Augustinus 2003) noted that, "Despite numerous initiatives during the last decade in Sub-Saharan Africa to set up new land information systems or to modernize existing ones, limited results have been achieved". This is all part of the overall ICT/M picture, and while the two cannot be separated in achieving the goals of both, specific issues can be identified with respect to LIS that need special attention. As with ICT/M, these can be summed up in two words or concepts; 'culture' and 'design'.

Culture, in turn, has three aspects that need to be addressed; 1) language; 2) legal pluralism; and 3) communal or common property resources. As with ICT/M, LIS have been based largely on English, while the majority of people and particularly in the critical rural areas of Africa are not literate in English. Either literacy in English needs to be improved (which has serious cultural implications if it leads to the loss of indigenous languages) or such systems need to be designed using local languages. In this case literacy refers to traditional literacy (reading and writing), not computer or information literacy, but these will be required as well.

Legal pluralism involves the range of legal systems from western-based statutory law to customary or traditional law and the hybrids that have developed between the two. The recognition of rights under customary law and/or its hybrids by statutory law varies from jurisdiction to jurisdiction. Furthermore, customary law is highly flexible in adapting to environmental, social and political realities, and thus constitutes something of a moving target. Finally, customary law is highly local, meaning that LISs must also be locally based if they are to be relevant. Customary law, therefore, is a complex social construct within the African reality that must be accommodated. This demands the design of unique cadastres and LISs.
A defining component of land rights (access and use) under customary systems is communal or common property resources. These are not necessarily geographically defined over extended periods but are part of a complex multi-tenure system that involves the designation of various types of land with respect to access, use, and 'ownership' over time (Nyamu-Musembi 2006).

Design must take culture into account as emphasized above. However, design has also a set of principles and requirements that must be met if success is to be achieved. The most important is undoubtedly realism; realism in terms of the goals, objectives, and plans, and the actual situation on the ground with respect to types of information, technology relevance, organizational processes, management structures, capacity, and resources. The gap between the plan and the reality for these issues has to be minimized by either changing the plan or changing the realities. This requires, hard, objective analysis that is better carried out by an independent body.

Land – Specific Issues

The specific issues that need to be taken into account or addressed include (e.g., UNECA 1998; Augustinus 2003; UNCHS 2003; Cousins and Claassens 2006):

- Land policies and regulatory frameworks tend to be weak in the sense of either not being in place, not being implemented or being out of date.
- Central administrations are generally weak and lack the personnel and organizational capacity and resources to manage contemporary type information systems.
- Management systems in government bureaucracies tend to be of the hub and wheel type with limited management capacity and low procedural formality
- The requisite ICT infrastructure or information architecture is not yet in place.
- Land Information/Geographic Technology systems are generally not in place, or have not been maintained because of resource and capacity limitations.
- The availability of formal, current, and maintained cadastral information is minimal except in selected urban areas.
- Where information does exist it tends to be scattered among a number of departments and agencies with no systems for networking or sharing.
- Resources and capacity are not generally available for the development of cadastres through formal surveying approaches in the tradition (western) sense.
- Rural populations have much greater faith in local adjudication processes for establishing rights and boundaries than in expensive, formal surveying approaches.
- Tenure rights in rural areas are largely under some form of implicitly recognized or statutorily supported customary law. These rights are socially nested or embedded; locally held, inclusive, derived from membership in a group; and focused on access and use rather than ownership or control.
- Boundaries of access and use are subject to continual negotiation, with flexible boundaries over space and time with respect to different resources.
- Tenure rights in peri-urban areas tend to be in a state of flux between customary and statutory law or between informal and formal forms of recognition and registration.
- Tenure rights within fully incorporated urban areas tend to follow conventional current approaches of formal registration of individual ownership
- The current trends are to increasing decentralization either in the form of devolution or deconcentration to local authorities or communities.

The challenge therefore is to design options or a broad framework that can address the lack of progress and move the land information systems agenda ahead (e.g. UNECA 1998; FIG/UNCHS 1998; Fourie 2000a; UNCHS 2003).
Moving the land information systems and knowledge economies ahead can only be done by those with an intimate knowledge of the jurisdictions in which they are to be applied. However, as with information systems themselves, there are certain principles and commonalities that can be considered.

Design Guidelines

Key central requirements for the integrity of land information systems are currency of the information, maintenance of the records, and affordability. To meet these requires participation by all landholders and trust in the system. Given the realities described above this indicates a need to think or plan globally but act locally. In other words, the production and management of land records should be done locally within communities, or within cities in cooperation with local authorities.

This has three major advantages: 1) community leaders (traditional or elected) are in a much stronger position to adjudicate conflicts or disputes; 2) people can readily access the information that is most important to them; and 3) updating and maintenance can be managed relatively easily.

A fundamental assumption that needs to be made is that members of local communities have the capacity and initiative to develop and build the necessary systems from land subdivision, and plot layout, through housing, and water and sewer installation, to production and maintenance of local registries and land records. All that is required is some support and training, and an incentive in terms of empowerment. This in no way minimizes the problems and challenges of local governance, but involvement of local governance is crucial to success.

Given the major diversity in capacity and resources between communities, districts, regions, and cities, there needs to be a similar diversity of land registration and information systems. In other words, there needs to be an acceptance of parallel systems of varying complexity and sophistication, but based on a common set of fundamental standards to ensure compatibility and future integration and upgrading.

The basic requirements for such an approach are that:

1. standards for data collection and maintenance are set centrally to ensure compatibility, ease of transfer, and the opportunity for upgrading in the future;
2. that land records clerks are trained to produce and manage land records in each community;
3. a reliable means of communication is devised between the local community, the local authority, and the central registry; and
4. all transactions are recorded whether they are in contravention of existing legislation or not (required where customary law is operating or where land occupancy and rights are in a state of flux such as in peri-urban areas and informal settlements.

Informal settlements should be blocked out formally, and internal land rights (access and use) should be adjudicated through local governance mechanisms. The same should hold true for communal lands, except that boundaries in this case tend to be fluid and subject to negotiation between adjacent communities. This needs to be accommodated.

With respect to technology, affordability and capacity should be the major criteria. This relates both to the initial acquisition and purchase, and to continuing maintenance. There is a wide variety of available technologies from paper records (which can be very effective and efficient in the appropriate environment), through simple, self-standing computer systems, or server-based networks, to online web-enabled systems, or combination of these alternatives. Possibilities for data generation range from hand maps, to aerial photography, and photogrammetry, to geo-referenced satellite images. The availability of GPS has greatly simplified location work, and raised the possibility for geo-codes of plots or land objects. The motto should be: keep it simple, modular and incremental.

In the final analysis the LIS should fit into and be part of a national reference framework to which all geospatial data can be referenced regardless of how it has been obtained, or where it emanates from as long as it meets certain basic standards. This would require possibly two types of reference framework; a graphical or pictorial framework and a geodetic framework (UNECA). The advantage of the former is that it is immediately achievable, and can provide exactly the kind of spatial related imagery needed by decision-makers.
The design criteria for such a reference framework have been listed by UNECA as follows:

- *An ability to link existing (and future) paper maps and/or GIS data sets of varying accuracies and scales to the LIM system;*
- *An ability to link existing (and future) cadastral information to the LIM system, both locally surveyed low accuracy and professionally surveyed information, geo-referenced and not geo-referenced;*
- *That work should be able to be undertaken in phases, with each phase done in parallel or sequentially, and with each having a separate visible outcome;*
- *An ability to service cross-sectoral users;*

- *An ability to service national, regional and local level decision makers, as well as communities in rural and urban areas;*
- *The facility for decision makers to visualize the spatial information, both with respect to the framework and the information outputs, rather than geometric data being the core component of the system;*

The development of land information systems and the associated infrastructure should not be driven by a desire to match systems from other jurisdictions, or follow donor requirements, but to decide what is possible, relevant, and affordable in Africa. These criteria should lead truly innovative and effective designs.

Conclusion

Context is everything. The context for Land Information System development and the Knowledge Economy includes the policy and regulatory environment, ICT infrastructure, property institutions, public sector management, organizational change, private sector capacity, education, and resource availability. Throughout most of Africa these contextual factors tend be relatively weak for a number of historical and contemporary reasons, and they are keeping the lion tied tightly, to revert back to the title. The design and development of effective and relevant Land Information Systems, therefore, will require a major push to develop the Innovation pillar of the Knowledge Economy if the lion is going to untied, since Africa will have to find unique and innovative solutions to the challenge.

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Annex II: Other Papers Presented at the LMIS Symposium Addis Ababa, Ethiopia, December 4 – 8, 2006

Towards Sustainable Spatial Data Acquisition Techniques for the Development of African Land Management Information Systems

by M. Hagai

Abstract

The need for careful stewardship of the land together with intensive use and management of resources upon it, is gradually emerging an issue of major concern. Additionally, human largely uncontrolled exploitation of natural resources and the ever increasing needs of an-arguably overpopulated world have lead to a situation in which only use of Geographic Information Systems (GIS) in assessing, planning and management of land resources is inevitable.

Land being the most valuable possession of mankind and also an important asset for any country's development; its use need to be rationalized; such that it may be of benefit to the present and future generations i.e. sustainable land management. If land is sustainably managed, it can contribute significantly to the quality of the environment as well as to the social economic well being of people living on it. Soundness of decisions that are based on up-to-date land information; and the methodical collection, processing and dissemination of such information is currently drawing attention of many countries.

It is a well known fact that sustainable land administration is a catalyst for meeting goals of the Africa Development Agenda which inter-llia includes: poverty reduction, economic growth, conflict prevention & management, fight against land degradation etc. Indeed sustainable land management can be achieved through exclusive use of land information i.e. having information about each one land parcel. Land Management Information is of particular importance to developing countries, particularly Africa, where the livelihood of most people depends on land on scarcely available resources. It is estimated by United Nations Centre for Human Settlements (UN-Habitat) that in Sub-Saharan Africa, only 1% of land sites or plots are surveyed and thus properly documented. With an uncertain picture of the "land reality", governments are consequently unable to ensure land tenure security, as well as making informed decisions when designing land policies and national development strategies. At this era of information age, sustainable land administration can be achieved effectively through utilization of Land Management Information System (LMIS and/or LIS (Land Information Systems (LIS) - A contemporary Land Data Management Tool. Essentially a LMIS is a computer system for management of land related data including both spatial and non-spatial data.

Methods mostly applied for acquisition of spatial data i.e. the mapping (graphic) component of a LMIS in most of Africa countries are based on classical techniques, which are slow, designed entirely for urban applications and expensive particularly when applied in rural areas to the extent that their costs may not be justified compared to the value of the land.

The paper firstly posits effectiveness of classical spatial data acquisition techniques with a view highlighting their limitations. Secondly the paper proposes land parcellation and spatial data acquisition strategy based on application of Earth Observation data and finally the paper reiterates on the need of a uniform geodetic frame of reference for Africa and definition of boundaries in the context of Information Technological (ICT) developments and the societal needs of up to date land information.

Introduction

Three aspects of land Management Information Systems are considered in here, which are classical spatial data acquisition, Data Management and/or analysis as well as adaptation to modern spatial data acquisition techniques in the wake of Information Age and/or Knowledge Society.

Land Management Information Systems is broadly used in here to connote all aspects of Real, Fiscal and Real Cadastres. It is note worthy that despite advances in Information Technologies which are renowned to be a catalyst of process engineering and automation, Land Management Information Systems in developing countries are generally weak and/or loosely related or connected.

Advantages of Land Management Information Systems *interllia*: are effective land transactions -leading to good governance, increased government revenue, peace and tranquility; ease identification of unused land; sustainable land utilization etc. Sustainable Land management on one hand contributes significantly to social economic well being of a country and on the other hand to the quality of its environment. Additionally, LMIS facilitate decisions that trigger strategic actions to be taken to achieve sustainable development projects and/or programmes. Such kinds of actions usually are based on up-to-date geoinformation. On the other hand ineffective land management leads to haphazard developments, congruence of users and disorderliness and utter disorderliness characteristics.

Success of the New Partnership for African Development (NEPAD) conceived to be an Integrated Strategic framework within which member states of the Africa Union are to individually and collectively bring about holistic socioeconomic development of the continent, will depend mainly on availability of information. Information will be required in design, implementation and monitoring of development and investment initiatives and/or projects. Amongst the information to be needed is Geoinformation which can be managed and manipulated using Geographical Information Systems (GIS), which may be defined to be a computer based system of hardware and software capable of geospatial data input, Manipulation, Analysis, retrieval and displaying. Specifically, GIS will be crucial in realizing of NEPAD'S aspirations, due to its ability to integrate disparate data sources and ability to undertake analyses that enable priority area to be identified at a sub-national level for Government intervention in the provision of services and/or regulatory framework of a project (Schwabe, C, (2002). It is note worthy that Land Management Information System (and/or LIS) is a subset of a GIS. Whereas GIS is a general data management tool, LIS/LMIS is particular to land related data management. Specifically a LMIS may be defined to be a system holding data for making decisions in support of certain perceived objectives with regard to the inventory, allocation, settlement development, use and conservation of land resources. For a LMIS to be operational it needs Land Management Information.

Since data for Land Management Information ought to be used or serve a wider audience, thus, it needs to be collected within a framework which takes into consideration of the societal outlook, policy, theoretical, international best practices and prevailing conditions on the ground so as to facilitate ownership of the data sets and consequently resulting in the data being optimally used.

It must be noted that land management is a veritable tool for sustainability in the sense that effective management of land is something which is likely to affect our today and tomorrow lifes. The relationship between human society and the land they in habit is an evolving historical process, therefore the way the relation between human and land is institutionalized has major implications with respect to creation and distribution of wealth, social/political harmony or disharmony and the credibility of ecological resources and values (Childress, 2000).

As noted earlier on, in the developing world, Land Management Information Systems are not only weak but in most cases non-existent. Problems besetting development of LMIS in developing countries *inter-llia* are:

i. Non availability of up-to-date spatial information about the land, this has lead to non functioning land markets. For example it is extremely difficult identifying what land is available, its ownership, its rights, effective limitations to its use and its price. Necessary information about land in developing countries is either lacking and/or contradictory, of course coupled with poor recording leading to pervasive inefficiency in Land management. Such inefficiency may adversely affect the contribution of land resources to development from both private and public sectors. Additionally, absence of adequate information on existing land holds and lack of clarity to title of ownership causes severe practical difficulties in land consolidation and reallocation. It must be noted that the basic Land Information Systems are not only woefully inadequate in relation to development implications;

in very many cases they are deteriorating. In a number of developing countries, the proportion of land holdings effectively surveyed and registered whether for fiscal or legal purpose is declining. Additionally, land Use information is often increasingly out of date or lacking adequate interpretation or ground survey control to become of practical use for development of policies. Older documents, maps and records are in many cases simply disintegrating; boundary marks are disappearing.

ii. In-effective Spatial land data acquisition methodologies- spatial land data is acquired through classical field surveying techniques which entails taking of physical measurements of land and processing them to yield required spatial data. Spatial data obtained from field surveying alone cannot lead into formulation of an effective LIMS for they equal need respective non-spatial data, which are characteristic data describing land use, the rights, owner etc. Apparently classical methods of spatial data capture tend to be expensive and slow involving expensive equipment and expertise (Martine, 2001; Ruther et al, 2002). This has always resulted into a situation where only small portions of land are surveyed and thence legitimately documented. Success of LMIS will squarely depend on readily availability of Spatial and non-spatial data sets of the land under consideration.

Land Acquistion and Delivery Systems – A General Perspective

Urban Land

Land for urban expansion is usually acquired by the Government through the Ministry responsible for urban Development. Urban areas are usually gazetted and within such areas no one is allowed legitimately to do any development without permission of the relevant local or urban authority. Such a permission is issued inform of a building permit, the purpose of which is monitoring the process of any construction from foundation to actual occupation. Any land acquired by the government is of course susceptible to compensation (Land Act No.4 of 1999 and Village Land Act No.5 of 1999 of the United Republic of Tanzania). It is on the basis of Base maps of the acquired land that physical Planning Schemes are designed. Approved planning schemes then forms a basis for the land parcellation, which results in plots which are advertised in news paper. Applications for plots are channeled through respective regional and/or district land office, whereas development process monitoring is effected under the prerogative of a respective local authority.

Realization of above land acquisition procedure exclusively depends on availability of land management information, specifically information about land ownership, use, location and its spatial extent.

Land acquisition procedure reiterated above is operational in urban areas where land information is readily available in relevant offices. Owing to abundance of surveying control points, it is note worthy that spatial data acquisition methodologies in urban areas are well developed and as such straight forward. On the contrary, land acquisition in rural settings is relatively difficult due to:

i. Lack of survey control points
ii. Lack of up to date land information
iii. Given the value of land, application of conventional spatial data acquisition techniques tend to be tedious, time consuming and thus infeasible.

The difficulty of land acquisition in rural areas is partly attributed by the fact that spatial data acquisition techniques are based on conventional methods which makes use of expensive as well as sophisticated equipment and expertise. This difficulty results in hazardous acquisition of land, more importantly to unnecessary delays in land delivery.

Rural Land

Rural land in most African countries is generally under the customary land tenure. Some of the land is directly under village management. Tanzania in particular, rural land is the village land i.e. it is administered by respective village authorities. Within the village land, some of the land are still under the customary land tenure form of ownership and the remaining land is under the lease hold form of tenure under the village administration. Customary land tenure is pre-colonial Africa land ownership systems which still exist today. Continued existence of customary land tenure is historical. Before the continent was besieged by colonial regimes, all land was owned communally and by native customs, collective ownership of land was fundamental for social organization and provision of social organization and provided a basis for equitable sharing of rural livelihoods, (Ngombe et al, 2006). In this tenure system, each member of a society freely enjoys the rights to use the land. The rights to the land under this system are transferred by bequest. Integration of land under customary land tenure into modern tenure systems is on top agendas in major global fora. It is proposed that Africa can only develop if the traditional land tenure consisting of about 90 % of African land resources are to be reformed or integrated into the lease hold tenure system which is based on principles of individualization (Ngombe et al, 2006). However, this kind of propositions has always encountered resistance from Communal Leaders and/or Chiefs on fears that reforms would undermine the chief's traditional political authority and powers. Land being vital for survival and poverty reduction in Africa where some 80% of the population relies on agriculture for their livelihoods and given the increase in population, the demand for land has increased leading to conflicts. Additionally, given that land plays an important role in the livelihood of the majority of Africans, food security and poverty reduction cannot be achieved unless issues of access to land, security of tenure and capacity to use land productively and in a sustainable manner are properly addressed (Kironde et al, 2006). Most of land problems can effectively be tackled through implementation of a land data bank which can be used to derive the land information. A land data bank in this context is conceived to contain all data about land parcels. It is on the basis of the land data bank that a LMIS runs to solve land problems. Kironde, 2006, advocates that dealing with land problems in a framework of good governance has the potential for positive and sustainable outcome. Good governance in the context of land management entails the Government having a land data bank and/or information (spatial and non-spatial) about each one and every parcel of land. Hence the need for a national wide inventory of land parcel to support development of African Land Management Information System)

Land Parcellation

Conventional land parcellation is effected through Cadastral Surveys. A Parcel in this regard is defined to be a piece of land of a broad characteristic as may be defined at either National or Regional or District or Village level. The land characteristics could be based on land use or Land Cover, as it deems appropriate. This definition of a land parcel is meant to exclude individually-owned small sized parcels e.g. urban plots, as they ought to be defined under a higher level land characteristic or category. For example, urban plots may be defined under category Urban Areas (which may include residential areas, commercial, industrial etc) or Farms (to include small scale and large scale farms etc.). Broad land characteristics in this regard can be derived from processing of Earth observation data, particularly optical remote sensing data as elaborated in foregoing sections. In the view of that a land parcel is to be defined after it has been delineated from remote sensing data and has been verified on the ground. Alternatively, parcellation may be effected on the basis of Land Use. To that effect Villages, Districts and Regions would need to design Long Term land use Master Plans which may also be delineated on the ground and upon which parcellation is effected. Once a land parcel is delineated or stratified on the ground it may be used as a primary entity whose attributes will be maintained in a database for use by a Land Management Information System.

Spatial data being critical in development of a LMIS, it is important that cost effective spatial data acquisition methodologies be improvised to cope with the increasing demand for land resources. In the view of that all land holds should be identified, delineated, their attributes established and entered in a databases onto which a LMIS may be developed to facilitate sustainable Land Management.

Parcels Delineation and Spatial Data Acquisition

Mapping in general requires an abstraction of the world. The simplest way to do this is by categorizing the land into classes or themes. In the view of that land parcel delineation could be achieved by using remotely sensed data. The process would need application of medium and/or high spatial resolution remote sensing data, which could detect distinct land characteristics with minimal ambiguity. Essentially the process involves image processing and interpretation for purpose of extraction of specific information. In general, information extraction from remote sensing data can be effected along two main approaches, which are:

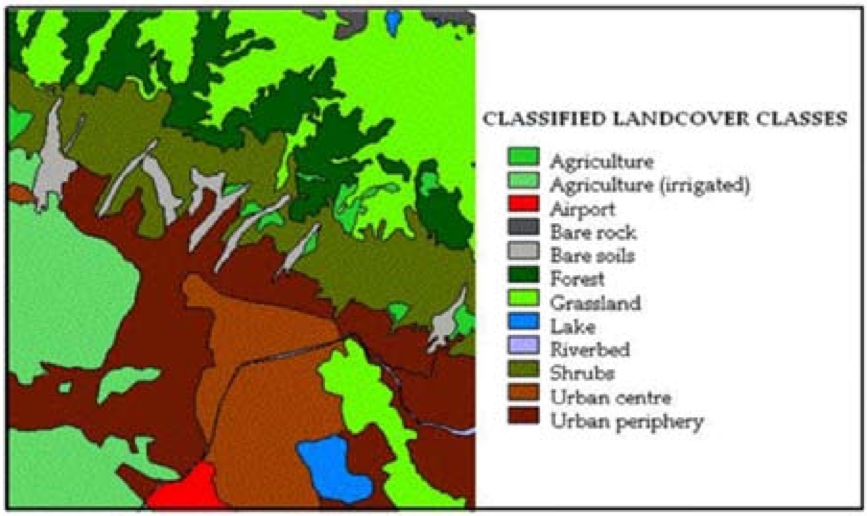
i. Visual analysis or manual interpretation of then image data. Typical examples of this approach are visual image interpretation for Land use and Soil mapping. Also this approach is used in generation of and/or updating of Topographic maps from aerial photographs
ii. Information extraction based on Semi automatic processing using on a computer. Examples applications of this approach is generation of image classification and calculation of surface parameters

Whereas visual information extraction is relatively very subjective as it is based on human judgment, which in turn may depend on background knowledge and intuition, semi-automatic information extraction also referred to as image classification is faster, convenience and user friendly and relatively accurate.

In the view of afore said and in the light of the current state of the art technology, it is being proposed that land parcels be delineated from remote sensing data by image classification using semi-automatic interpretation technique. Image classification can be through either supervised or un supervised classification schemes. Supervised image classification scheme is mostly preferred as it is based on a sample training data set from which specific land characteristic spectral signature are delivered and used classify an entire image. Supervised image classification requires prior knowledge of existing land characteristics or land cover types as on the real ground as data set, often referred as ground truth data set. Partly the data set is used as training sample and partly as test set.

There exists a multitude of software packages for effecting image classification. The mostly applied software are those based on Maximum Likelihood classification algorithm Lillesand, T. M. and Kiefer (2004); Richards J. A. and Xiuping, J. (1993). As of now image classification algorithms are implemented as modules within most GIS'es. The output of image classification processes is a thematic map showing graphic description of individual themes as reflected from the ground. Themes mainly are land cover and/or use. The land themes can be used as basis of land parcellation or stratification, see Figure 1, which is a classified satellite image of an area in Morogoro region in Tanzania.

Figure 1- Classified Landsat TM Image of an area in Morogoro- Tanzania



After image classification, the resulting thematic maps are then geo-referenced and from them spatial extent of resulting land parcels could be established by on-screen digitization technique. On screen digitization thus leads to spatial data acquisition of the land parcels in vector format ready for storage in a spatial database (see Figure 2).

Figure 2 – Polygons extracted from a classified satellite image

Accuracy Considerations and Land Parcels Verification

It is expected that by using the Maximum Likelihood algorithm, it is possible to achieve up to 80 – 90 % accuracy. This implies that extracted land parcels would be adequately accurate for purposes of developing a LMIS. It is important to note that after delineation of the parcels from images, they should be verified to exist on the ground. Owing to the whole essence of developing a LMIS as being able to use the land data stored in a spatial data base to respond to queries of a general nature like " where is what", "area extent a particular land parcel" and so on, it is not deadly necessary for the extracted spatial data set to be highly accurate.

Application of image classification in thematic mapping is now a common process particularly in many regional scale projects. In Asia, Association of Remote Sensing (AARS) is using image classification to generate various land cover data sets based on unsupervised classification of multispectral satellite data. Another example is the Africover project (by the Food and Agriculture Organisation FAO) where image classification techniques were used to establish a Pan African Land Cover data set. The European Commission requires national governments to employ companies to make a first land inventory using image classification techniques followed by field checks. Thus image classification is an operational process, which at the current state of the art technology is accepted as being a standard method of information extraction from satellite data.

Conclusions and Recommendations

It has been urged in this paper that remotely sensed data is has a great potential in acquisition of spatial data for development of a Land Management Information System and for sustainable use of land resources. An effective Land Management Information System is a catalyst for sustainable and land management which in turn can facilitate Africa Development Agenda of poverty reduction, Economic growth etc.

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Système d'Information Foncière Multi-Usage: Définition du Contenu en Données et Information Selon le Niveau d'Echelle Territoriale

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Introduction

La terre a toujours été la principale et ultime ressource à posséder pour divers usages. Depuis les temps immémoriaux, les activités socio-économiques (agriculture, élevage, chasse, pêche, etc.) reposent sur celle-ci, ce qui explique les relations étroites entre l'homme et sa terre à laquelle d'ailleurs il est très attaché. Cette relation étroite entre l'homme et son patrimoine «terre» a été en constante évolution selon les réalités socio-économiques de chaque communauté. C'est aussi le cas en Afrique où les règles régissant les rapports entre l'homme et la terre, ont connues certaines évolutions, ce qui explique la coexistence de plusieurs régimes sur la propriété foncière et dont les plus importants sont :

- le régime coutumier hérité des traditions ancestrales, qui face aux nouvelles exigences de la vie moderne est de moins en moins sécuritaire.
- le régime d'immatriculation (titre foncier) hérité de la colonisation qui est mal adapté aux réalités socio-économiques de l'Afrique, car très long et coûteux.
- les nouveaux régimes fonciers plus récents dont les objectifs sont d'assurer une meilleure sécurité foncière aux détenteurs des droits coutumiers avec une procédure souple et moins longue.

Malgré les efforts de certains pays africains pour moderniser ou reformer leur régime foncier, il reste encore énormément à faire dans ce domaine, car selon certaines statistiques, 90 % des terres des pays en développement ne disposent d'aucun titre d'immatriculation dans un registre foncier. Dans le même ordre, moins de 1% des terres en Afrique sont couvertes par une quelconque forme de cadastre (UNECA, 1998).

Une des conséquences de ce manque d'enregistrement des terres en Afrique est l'insécurité foncière tant en milieu rural que dans les centres urbains qui est la principale cause du faible taux d'investissements par les opérateurs ruraux en vue mettre en valeur leurs terres et malheureusement, cela se traduit par une plus grande paupérisation des populations et une dégradation des terres.

Pour renverser cette tendance, plusieurs pays se sont engagés dans des réformes de leur régime foncier en vue de sécuriser les populations principalement en milieu rural ou c'est le régime foncier coutumier qui prévaut et qui malheureusement n'est basé sur aucune preuve écrite tangible opposable aux tiers. C'est ainsi qu'en exemple, le code rural a été instauré au Niger et le plan foncier rural Bénin. Une définition des attributs du code rural du Niger se trouve dans l'ordonnance 93-015 portant principes d'orientation du code rural (SP/CNCR, 1993), tandis que les principes du plan foncier rural sont expliqués dans Ouédraogo et al. (2005) et Bah, (2006). Ces deux nouveaux régimes fonciers sont orientés vers la reconnaissance des droits de propriété coutumiers et sécuriser ainsi les propriétaires et opérateurs ruraux à travers l'enregistrement et la délivrance de documents attestant l'enregistrement au dossier rural pour le code rural au Niger ou au registre foncier pour le Bénin.

Dans la pratique, ces processus entraînent la production d'une grande quantité de données décrivant la propriété foncière (localisation, dimensions, superficies, etc.), sur le statut et les ayants droit (type de propriété, mode d'acquisition, propriétaire ou ayants droit, etc.). La gestion de toutes données (collecte, traitements, analyse, archivage, etc.), nécessite la mise en place de système d'information foncière facilitant les opérations de collecte, d'analyse, de gestion et d'archivage de la documentation foncière constituée d'informations de type cartographique (plan parcellaire, photoplans, etc.) et de type descriptif ou alphanumérique.

Système d'Information Foncière Multi-Usage

De plus en plus, les nouveaux systèmes de gestion foncière, essaient d'aller au-delà des informations relatives aux statuts de la propriété et à son emplacement pour prendre en charge d'autres informations liées à l'occupation et l'utilisation du sol et d'autres données de type socio-économique. Ces systèmes d'information foncière de nouveau genre sont alors dits polyvalents ou multi-usages, car ils peuvent intéresser différents utilisateurs (Nebraska. IM Services, 2000).

En milieu urbain, ces systèmes peuvent fournir des informations indispensables pour les prises de décision en matière de gestion et planification urbaine, comme par exemple des informations sur les types d'occupation de sol, sur les types d'activités exercées sur ces terres, sur la disponibilité de certains services (santé, écoles, loisirs, etc.) et enfin sur la disponibilité de certains réseaux de distribution (eau potable, électricité, téléphone, etc.). Pour le milieu rural, au-delà des données foncières, ces systèmes peuvent intégrer des informations sur les ressources naturelles (forêts, eaux, type et qualité de sol, etc.) ainsi que sur les activités socio-économiques (agriculture, élevage, chasse, pêche, etc.) exercées sur ces terres.

En Afrique où les nouvelles politiques de décentralisation et de gouvernance locale font apparaître des besoins pressants en données et information fiables pour permettre des prises de décisions éclairées dans les programmes de développement durable et de lutte contre la pauvreté, ces systèmes sont les bienvenus. Pour obtenir des données et informations fiables et précises, il faut les collecter à la base au niveau des communautés locales (quartiers, villages, terroirs, etc.), pratiquement au même niveau d'échelle que les données foncières. Comme, les pays africains sont à des stades divers de développement de leur système d'information foncière, il est donc bien possible d'élargir leur fonction en prenant en charge ces besoins en données et informations socio-économiques et environnementales indispensables à une meilleure prise de décisions dans les actions de développement. Cependant, même si les systèmes d'information foncière multi-usage ont fait la preuve de leur capacité à mobiliser et gérer une énorme quantité de données, il n'en demeure pas moins que ces systèmes ne peuvent pas prendre en charge tous les types de données et informations socio-économiques sans perdre en efficacité et souplesse. C'est pourquoi, leur contenu en données et information mérite d'être analysé et adapté aux capacités et priorités des différents pays du continent. En effet, le contenu en données et information fait partie des composantes les plus importantes de tout système d'information, c'est pourquoi, une meilleure définition de cette composante contribuera grandement à la réussite du système. L'analyse présentée dans ce document donne certains éléments de réponse en lien avec l'échelle territoriale d'un pays. Elle s'appuie sur une étude sur le montage du système d'information foncière multi-usage du Niger (SIFOM) réalisée pour le compte du secrétariat permanent du code rural de ce pays. Cette analyse commence par une évaluation des besoins en informations foncières et données socio-économiques et une détermination des principaux intervenants dans la mise en œuvre du système. Ensuite, le contenu en données et information est analysé selon une échelle territoriale allant du niveau local (village et terroir villageois) au niveau national en passant le niveau communal, départemental et provincial ou régional. Enfin des recommandations sont formulées pour faciliter l'intégration et la gestion des données et information dans le système.

Cette démarche permettra à chaque pays africain d'adapter le contenu en information de son système de gestion de l'information foncière à ses propres besoins et réalités socio-économiques.

Analyse des Besoins en Information

Pour lutter conte la pauvreté et la dégradation des ressources naturelles, la sécurisation foncière des opérateurs ruraux est devenue une condition sine qua non pour permettre à ces derniers d'investir efficacement dans la mise en valeur de leur terre. Cette sécurisation implique la mise en œuvre sur toute l'étendue du territoire du Niger, des dispositions prévues par le code rural, à savoir la mise en place des commissions foncières et la reconnaissance systématique des droits de propriété sur les ressources foncières rurales.

Au delà de cette reconnaissance des droits de propriété qui est un besoin vital pour le monde rural, c'est l'occasion à travers la mise en œuvre du système d'information foncière multi-usage de recueillir à la base des informations sur l'état des ressources naturelles (sol, eau, végétation, etc.), des données socio-économiques sur les populations, des informations sur le milieu physique où vivent ces populations et également des informations sur leurs activités économiques.

L'ensemble de ces informations servira aux décideurs (autorités politiques au niveau national et décentralisé, élus nationaux et locaux, chefs traditionnels), planificateurs, aménagistes, responsables administratifs à tous les échelons, responsables d'ONG, etc., à asseoir correctement, une politique cohérente et adaptée en matière d'aménagement du territoire, de mise en œuvre des actions de développement tant au niveau national, régional et local. Selon le document de projet du PAFIDOC du SP/CNCR, (2002), ces informations serviront également à :

- soutenir les différentes administrations (agriculture, élevage, forêt, pêche, hydraulique, statistiques, cadastre, domaines, justice, plan, urbanisme, aménagement du territoire, etc.) en leur fournissant des informations dont elles ont besoin pour élaborer leurs stratégies et politiques d'interventions.
- faire des choix judicieux en toute connaissance de cause tout en répondant à quelques questions élémentaires, qui intéressent les individus, les communautés et les collectivités et qui commandent les voies d'accès au développement.
- éviter des pertes importantes aux économies concernées en sécurisant les producteurs et les investissements réalisés principalement dans les secteurs du développement rural, en améliorant le rendement, en favorisant la mise en valeur des terres et en atténuant la dégradation de l'environnement à travers une rationalisation de l'exploitation des ressources naturelles.
- donner à l'Etat des assises solides pour gérer le territoire à travers la disponibilité d'une information fiable et régulièrement mise à jour.
- atténuer les conflits et querelles violentes qui résultent des litiges sur les terres à travers un mécanisme de prévention et de gestion de conflits et aussi en mettant à la disposition des administrations en charge de ces aspects toute l'information utile et nécessaire permettant de régler les conflits.

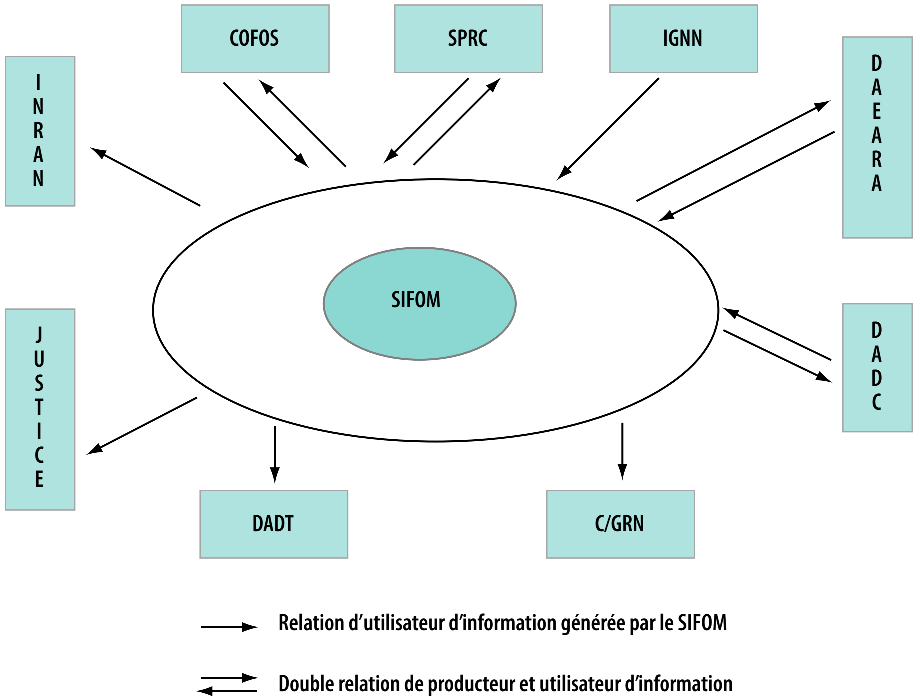
Identification des Principaux Acteurs

D'après l'analyse des besoins en information, tous les secteurs d'activités peuvent être intéressés par la mise en œuvre du SIFOM, cependant, il serait judicieux d'identifier les principaux acteurs qui peuvent intervenir dans la mise en œuvre du système. Nonobstant, les aspects institutionnels qui nécessitent une analyse approfondie, les principaux acteurs impliqués dans la mise en place du système sont retenus en fonction de leurs attributions dans la production d'information géographique et surtout à partir de la composition des commissions foncières (COFOs) chevilles ouvrières du code rural au niveau départemental, communal et villageois. C'est ainsi que les acteurs suivants qui ont une relation directe (comme producteurs ou utilisateurs d'information foncière voir Figure 1) sont retenus comme intervenants directs dans la mise en place du SIFOM :

- le CNCR (Comité National au Code Rural) est chargé, à travers le SPCR de l'élaboration, de la vulgarisation et du suivi de l'application du code rural au niveau national. Le SPCR, Secrétariat Permanent au Code Rural est l'organe national chargé de mettre en application l'ordonnance 93-015 portant principes d'orientation du code rural. Il est le maître d'ouvrage de la question foncière en milieu rural au Niger ;
- les COFOs ou Commissions Foncières, sont des structures décentralisées du SPCR au niveau du terrain. Elles sont chargées entre autre de procéder sur le terrain à la reconnaissance des droits fonciers et de délivrer les titres de droit (propriété et usage) ;
- les nouvelles collectivités territoriales décentralisées qui, de par les textes en vigueur, auront la responsabilité entière quant à la gestion des ressources naturelles de leurs terroirs ;
- la DADC, Direction des Affaires Domaniales et Cadastrales, est chargée de mettre en application en partie la législation foncière en milieu urbain. Certains textes lui confèrent des attributions même en milieu rural.
- l'IGNN, l'institut Géographique National du Niger, a pour mission, la mise en œuvre de la politique nationale en matière de cartographie. Il est chargé de la production cartographique nationale et aussi de la gestion de l'information géographique au niveau national.

- la DAERA, Direction des Aménagements et Equipements Ruraux Agricoles est chargée de la mise en œuvre de la politique nationale en matière d'aménagement des terres et des eaux, de la protection et de la conservation des sols, des aménagements hydrauliques du drainage et du remembrement des terres agricoles et pastorales.
- l'INRAN, Institut National de Recherche agronomique s'occupe principalement de la recherche agronomique et environnementale au Niger.
- la DADT, Direction de l'Aménagement du Territoire est chargée de l'élaboration du schéma directeur d'aménagement du territoire tant au niveau national que régional
- la CGRN, Cellule de Gestion des Ressources Naturelles dont la mission première est de contribuer à la mise en œuvre de l'axe Gestion des ressources naturelles tel que défini par les principes directeurs d'une politique de développement rural pour le Niger.

Figure 1 : Liste des principaux acteurs et leurs relations avec le SIFOM (d'après le document du SIFOM (Amani et al., 1998) et modifié dans le document du PAFIDOF (SP/CNCR, 2002))



Analyse des Données et Information en Fonction de l'Echelle Territoriale

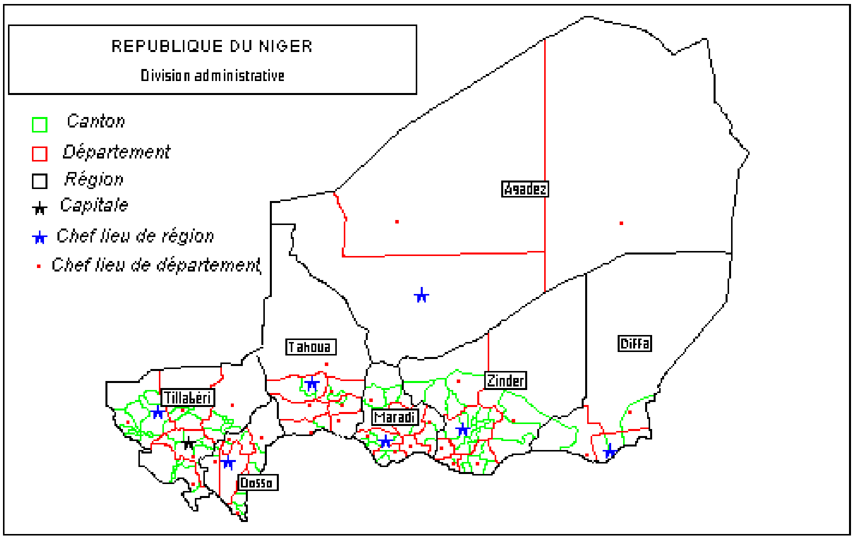
Le type et la qualité de données à utiliser pour analyser un phénomène donné dépendent toujours du type et de la précision de l'information recherchée et aussi des besoins exprimés par l'utilisateur. C'est ainsi que, les besoins en information des utilisateurs au niveau local, provincial ou central (national) n'exigent pas la même qualité et quantité de données. Pour analyser le contenu optimum en données et information du SIFOM, il est d'abord opportun de présenter les différents niveaux de l'échelle territoriale du pays.

Niveau d'Echelle Territoriale au Niger

Avec le phénomène de décentralisation et la gouvernance locale, le Niger a opté pour la communalisation intégrale avec la transformation des départements en régions et des arrondissements en départements. La figure 2 présente les divisions administratives du Niger, les communes n'apparaissent pas sur cette carte. Les échelles de collecte et d'analyse des données se présentent comme suit en commençant de la base vers le sommet :

- La parcelle ou tout lopin de terre (champs, jardins ou tout domaine foncier défini par ses limites et son contenu) qui est l'entité de base de l'information foncière.
- Le terroir villageois ou de tribu qui est un ensemble terres rattachées à un ou un ensemble de villages. Toutes les activités rurales du ou des villages sont exercées sur leur terroir.
- Les communes (rurales et urbaines) qui regroupent un ensemble de villages ou de quartiers pour former une entité administrative décentralisée (il y a 52 communes urbaines et 213 communes rurales)
- Les départements, qui étaient les anciens arrondissements avant la décentralisation et qui sont au nombre de 36
- Les régions qui étaient les anciens départements au nombre de 8
- Le niveau national ou central dont la capitale est Niamey ou sont basés les principaux ministères et services centraux.

Figure 2 : Carte administrative du Niger selon de la décentralisation de 2004 (les communes ne sont pas représentées) (source projet SIGNER, PNUD Niger).



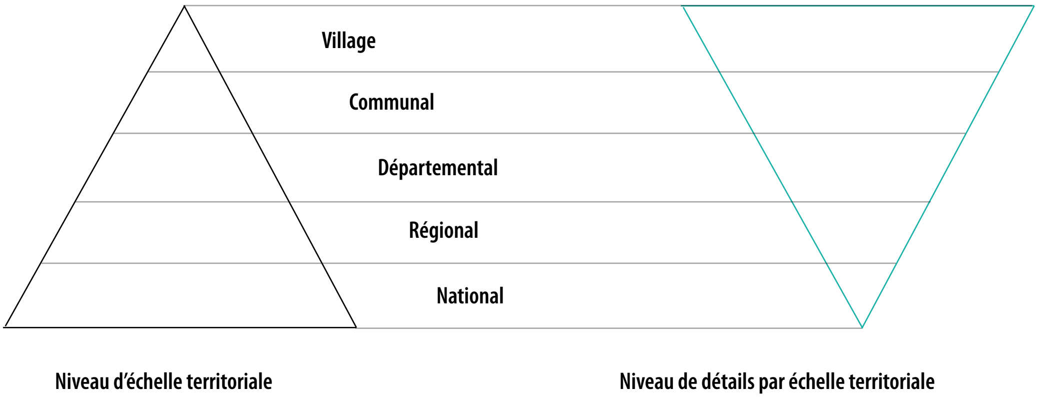
Relation Entre le Niveau de Détails et l'Echelle Territoriale

Avec la décentralisation et la gouvernance locale, les systèmes centralisés ont montré leurs limites quand il s'agit de fournir des informations fiables et efficaces aux décideurs tant provinciaux que locaux. En effet, le niveau de détails et la qualité de l'information fournis par les systèmes centralisés au niveau de la capitale sont inadéquats pour analyser les phénomènes à l'échelle locale où les nouveaux élus et autres opérateurs locaux de développement tentent de mettre en œuvre des programmes adaptés de développement local et de lutte contre la pauvreté.

Le niveau de détails d'une information est donc inversement proportionnel avec le niveau d'échelle territoriale. C'est ainsi que plus le territoire couvert est petit (village), plus grands sont les détails fournis par les données et information collectées à ce niveau comme l'indique la figure 3 montrant la relation inverse entre le niveau de détails et l'échelle territoriale.

La même relation entre le niveau de détails et l'échelle se retrouve au niveau des images de télédétection, où la résolution spatiale est inversement proportionnelle au niveau de détails fournis par l'image. Plus la résolution spatiale est basse (1 km et plus par exemple) plus le territoire couvert est grand et moins les détails sont importants. Par contre plus la résolution spatiale est haute (1 m par exemple) plus le territoire couvert est petit et mais plus les détails sont importants. Cette relation inverse entre la résolution spatiale des images et la densité des détails est analogue entre les échelles des cartes et leur niveau de détails. Plus l'échelle est grande, plus le contenu de la carte est détaillé et moins elle couvre de territoire et à l'inverse, plus l'échelle est petite, moins elle contient de détails et plus le territoire couvert est important.

Figure 3 : Relation inverse entre l'échelle territoriale et le niveau de détails



Les données et information à collecter et à intégrer dans le SIFOM étant de type géographique ou à référence spatiale, elles n'échappent pas à cette relation inverse entre le territoire couvert et la densité des détails. En fonction de l'échelle territoriale, les données de type géospatial de localisation peuvent varier de la forme régulière de l'objet «terre» à une généralisation à un point, tandis que les données descriptives d'attributs seront adaptées aux besoins en information du niveau territorial.

Données et Information Selon le Niveau d'Echelle Territoriale

Les données et information prises en charge par tout système d'information à référence spatial comme le SIFOM sont de types : géospatial indiquant la localisation et la forme des objets et de type descriptif en forme d'attributs décrivant les noms, les qualités et les quantités ou tout autre identifiant. Le contenu en données et information du SIFOM se classe en quatre grands groupes thématiques qui sont :

- les cartes de base ou fonds topographiques sur lesquelles reposent toutes les informations collectées qu'elles soient du type foncier ou socio-économique. Ces cartes de base sont dans un système de référence unique qui permet l'assemblage aisé des documents cartographiques couvrant le territoire au niveau national. Les cartes de base servent de support pour la collecte de données sur le terrain. Toute autre information à référence spatiale à utiliser doit donc être ramenée au même référentiel cartographique que les cartes de base pour permettre son intégration dans le système et sa superposition avec les autres couches d'information. Les cartes de base sont constituées de cartes topographiques de base d'un pays, des orthophotos ou orthoimages dans un référentiel cartographique national ou d'un fond topographique dérivé des cartes topographiques de base ou des orthophotos.

- Les données et information foncières directement liées à la parcelle ou «lopin de terre». Elles sont de deux types : géométrique décrivant la localisation de la parcelle et sa forme géométrique et de type attribut décrivant sa surface, sa valeur, les droits de propriété qui y sont rattachés, le ou les noms des ayants droits, etc. Ces données et informations sont collectées directement sur le terrain au niveau du terroir. Toutes les parcelles relevées et enregistrées, sont reportées sur un support graphique pour former un plan foncier superposable sur les cartes de base. Ces données sont archivées au niveau de la commune ou du département où est situé le dossier rural. Compte tenu de leur détails et sensibilité, ces informations foncières restent au niveau des communes, mais le plan parcellaire peut être transféré au niveau du département pour servir dans l'élaboration du schéma d'aménagement foncier au niveau du département.

- Les données et information sur les ressources naturelles et l'occupation du sol. Ces données décrivent l'état des ressources naturelles (sol, eau, végétation, faunes, etc.) et les types d'occupation et d'utilisation du sol (géomorphologie, zonage agro-écologique, élevage, etc.). Pour de raisons de coût ces données et informations sont dérivées des images de télédétection et complétées par quelques relevés sur le terrain. Les détails des informations recherchées déterminent la résolution spatiale des images à utiliser. Généralement, les hautes résolutions (15 à 30 m) sont suffisantes pour la majorité des zones rurales du Niger. Pour des zones particulières à haute densité de détails, des images de résolution plus fine peuvent être recommandées. Pour être intégrée dans le système des informations dérivées de ces images doivent ramenées dans le même référentiel que les cartes de base citées plus haut. Les informations sur les ressources naturelles et l'occupation des sols dérivées des images de télédétection s'accordent bien aux besoins d'analyse du niveau communal, départemental et régional. Pour le niveau national ces informations peuvent être généralisées à un niveau d'échelle correspondant.

- Les données de type socio-économique fournissent des informations sur les populations (nombre, état civil, composition, etc.), les services offerts à ces populations (santé, éducation, eau potable, énergie, loisirs, infrastructures de transports et de télécommunications, etc.) et les activités socio-économiques exercées par ces populations (agriculture, élevage, commerce, etc.). Plusieurs base de données gérées par différents services fournissent ce genre d'informations à de degré de détails moins développé que le niveau local. Ces données et information ne sont pas adaptées aux besoins d'analyse locale au niveau des villages ou de communes. C'est pourquoi, elles doivent être collectées sur le terrain au cours des opérations de collecte des données foncières.

La classification du contenu en données et information, démontre clairement qu'en fonction de leur mode d'acquisition et leurs caractéristiques, certaines données et informations ne sont utilisables comme tel à tous les niveaux de l'échelle territoriale. D'autres contraintes liées à la sensibilité (confidentialité) de l'information, à la quantité des détails et à la résolution spatiale imposent des limites quant au niveau d'intégration en fonction de l'échelle territoriale. Une analyse du niveau d'échelle approprié pour chacune des composantes des données et information est proposée au tableau 1 ci-dessous.

Tableau 1 : Utilisation des données et information dans le SIFOM en fonction de l'échelle territoriale

	National	Régional	Départemental	Communal	Villageois
Information foncière					
Plan de la parcelle (limites, surface. etc.)				√	√
Plan parcellaire			√	√	√
Statut ou type de propriété			√	√	√
Activités exercées			√	√	√
Propriétaires ou ayant de droit				√	√
Information sur les ressources naturelles					
Sols (types, état, etc.)	√	√	√	√	√
Ressources en eaux	√	√	√	√	√
Végétation (forêts, reboisement, agro-foresterie, etc.)	√	√	√	√	√
Faune	√	√	√	√	√
Occupation du sol et systèmes de production					
géomorphologie	√	√	√	√	√
hydrographie	√	√	√	√	√
Zonage agro-écologique	√	√	√	√	√
Données socio-économiques					
Populations	√	√	√	√	√
Santé	√	√	√	√	√
Éducation	√	√	√	√	√
Elevage	√	√	√	√	√
Infrastructures hydrauliques	√	√	√	√	√
Infrastructures de transport	√	√	√	√	√
Agriculture	√	√	√	√	√

Les données et informations foncières et socio-économiques collectées à la base sur les terroirs villageois sont assez détaillées et ne peuvent être transférées comme tel d'un niveau d'échelle territoriale à un autre sans aucune forme de généralisation qui risque fort de leur faire perdre leur valeur de base. Ainsi, pour conserver cette richesse d'information il est recommandé que les systèmes d'information foncière multi-usage soient implantés au niveau de chaque commune ou département où les données seront efficacement exploités et pour fournir des informations les plus précises et fiables possible permettant des prises de décision éclairées en faveur du développement local. Les données socio-économiques seront agrégées pour faciliter leur utilisation au niveau régional et central et la mise à jour des bases de données déjà existantes à ce niveau d'échelle territoriale.

Conclusion

Au-delà de leur mission classique de gestion de l'information foncière, les systèmes type SIFOM constitue une alternative de collecte et de gestion de données et informations de type socio-économiques fiables et précises indispensables aux prises de décision éclairée pour une bonne gouvernance au niveau locale.

La grande quantité de données et information générées dans ces systèmes est incompatible avec la gestion centralisée de l'information foncière et la mise en place des SIFOMs par communes ou département est la plus recommandée pour mieux conserver le caractère sensible de l'information foncière et la richesse du contenu des données socio-économiques. Il est également recommandé la mise en place d'un référentiel cartographique unique qui servira de support à toutes les informations à référence spatiale. La mise en place de ce référentiel facilitera l'intégration des données et informations au niveau départemental, régional et même national.

Enfin, le développement de l'informatique et des nouvelles technologies de l'information permettra dans un proche avenir la mise en réseaux des bases de données SIFOM développées au niveau des communes pour rendre accessibles les données et information détaillées à partir des autres niveaux de l'échelle territoriale (national, régional et départemental).

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Optimisation de la Collecte des Taxes Communales à l Aide d'un Système d'information Géographique

by Nadaud F. Desiré

Contexte

Le processus de décentralisation amorcé en Côte d'Ivoire dans les années 1990 a conféré aux collectivités locales une autonomie de gestion dans certains secteurs d'activités. Ainsi ces collectivités peuvent entreprendre toute action visant à améliorer le cadre de vie de leurs administrés. Pour accomplir ce principal objectif, les collectivités entreprennent des actions visant à acquérir des fonds au nombre desquels la collecte des taxes communales sur les activités économiques dans leur espace géographique.

Introduction

Toute activité s'exerçant sur un territoire communal est assujettie à des taxes qui sont payées aux services des impôts ou directement à la commune. Ces taxes varient selon la nature et le type d'activités exercées. On peut ainsi noter :

- L'impôt synthétique qui est payé au service des impôts
- La taxe communale journalière
- La taxe communale forfaitaire
- La taxe sur l'occupation du domaine public

La collecte des taxes s'est toujours faite de façon déstructurée où des collecteurs sont envoyés sur le terrain, encaissent les taxes qu'ils reversent ensuite chez le régisseur de la commune sans autres moyens de vérification de la part des autorités. Cette façon d'opérer entraîne d'énormes déperditions de fonds préjudiciables à la municipalité, réduisant du coup les moyens d'actions et d'investissements dans la commune.

Comment arriver à réduire, voire maîtriser ces disfonctionnements afin d'élaborer des budgets tenant compte des réelles capacités financières de la commune ? Telle est la véritable problématique qui se pose à la majorité des collectivités décentralisées. Par ailleurs, les systèmes d'information géographique de par leur capacité de traitement de données spatiales et d'aide à la prise de décision peuvent aider à mieux maîtriser l'espace et la matière imposable.

Objectifs

Les objectifs visés par la réalisation de ce SIG sont :

1. Améliorer de façon substantielle les recettes de la collectivité locale à travers une localisation précise des activités économiques et commerciales ; et une bonne maîtrise des modes de collecte des taxes.
2. Mettre à la disposition des autorités communales une banque de données à référence spatiale concernant toutes les activités imposables sur leur territoire et dont la mise à jour est facile.
3. Développer un outil d'aide à la prise de décision pour la gestion quotidienne reposant sur une meilleure connaissance du potentiel foncier et économique administré par la collectivité locale.
4. Vulgariser l'outil SIG à travers son appropriation par les décideurs qui ont à charge la gestion des collectivités décentralisées.

La Mise en Œuvre

La méthodologie est axée autour du processus d'élaboration d'un système d'information géographique. Pour ce faire il est primordial d'associer à la réalisation du projet tout le personnel opérationnel de la commune. Il faut en outre informer et sensibiliser au mieux les opérateurs économiques sur le bien fondé du projet.

Le Choix du Matériel et des Logiciels

Il est important pour la mise œuvre du projet de choisir des logiciels très pratiques d'utilisation. Aussi avons nous choisi d'utiliser le logiciel ARCVIEW 3.1 de ESRI.

L'Acquisition et la Numérisation des Plans

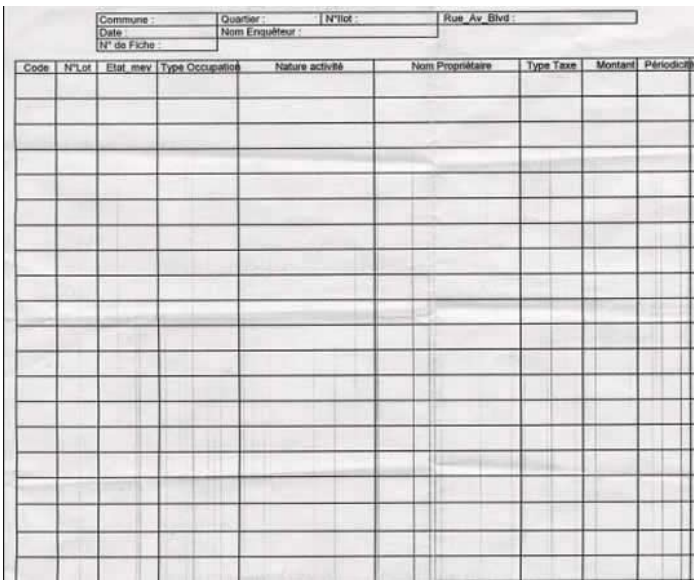
Ces plans sont constitués essentiellement des cartes du cadastre de la zone communale et certains plans du schéma directeur d'aménagement. Ils sont par la suite numérisés sur une table à digitaliser ou scanner puis vectorisés directement sur ARCVIEW. Vu la très forte urbanisation de la commune, les zones ne figurant pas sur les différents plans y sont intégrées à l'aide d'un complètement à partir de photographies aériennes et de relevés GPS. Les cartes vectorisées sont par la suite projetées en système de coordonnées approprié avant d'être assemblées. Un numéro de lot et d'îlot est attribué à chaque parcelle.

Les Enquêtes Terrain

Elles consistent à collecter des données relatives aux activités économiques sur le territoire communal. Pour ce faire il est élaboré une fiche d'enquête de commun accord avec les autorités communales. Il est aussi produit plusieurs plans de structuration de la commune.

Une équipe d'enquêteurs est ensuite recrutée, formée et repartie en fonction d'un découpage effectué par zone dans chaque quartier de la commune. Chaque enquêteur est muni de fiches d'enquête et de plans détaillés de son secteur.

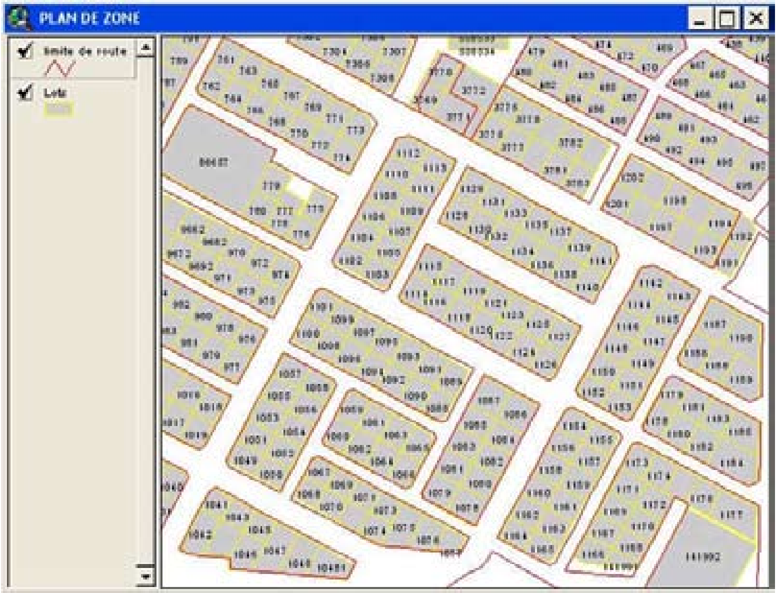
Figure 1 : Fiche d'enquête



Commune :
Quartier :
N°Ilot :
Rue_Av_Blvd :
Date :
Nom Enquêteur :
N° de Fiche :

Code	N°Lot	Etat_mev	Type Occupation	Nature activité	Nom Propriétaire	Type Taxe	Montant	Périodicité

Figure 2 : Plans d'enquête



Les informations sont ensuite collectées auprès de chaque acteur économique et transcrites sur les fiches. Ces fiches sont ensuite validées par rapprochement avec les plans des secteurs et saisies.

Le Traitement des Données

Les données ainsi saisies sont corrigées et mises en relation avec les plans numériques sous le logiciel ARCVIEW 3.1 afin de procéder à la validation. Un rapport comprenant les plans de localisation et le listing des activités sont ensuite produits afin d'harmoniser les montants des taxes perçues par type d'activités. On procède ensuite à la correction des données avant de produire le rapport final.

Figure 3 : Tableau de saisie

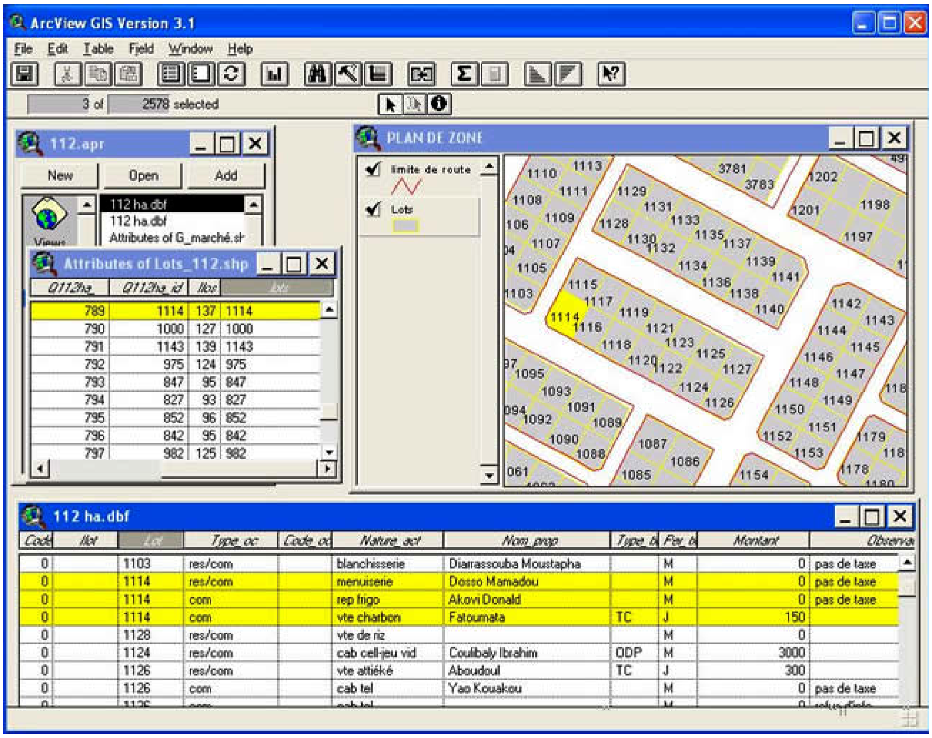
tableau de saisie

Mev	Type_oc	Lot	Nature_act	Nom_prop	Type_t	Per_t	Montant	Observatio	Mont_nom	T_tx_nom	Per_nom
bati	res/com	1225	s.couture	bamba Aicha	P	M	6000		8000	IC	M
bati	com	1225	teinte-peinture	Mara Ibrahim	P	M	5000		5000	TF	M
bati	com	1225	cab cell	Diana bassira			0	nvelle act	3000	ODP	M
bati	com	1225	vte chaussures				0	refus d'info	150	TC	J
bati	res/com	1224	cab tél	Bosson Niangoran			0		3000	ODP	M
bati	com	1224	rep TV-Radio				0	absent	5000	TF	M
bati	res/com	1222	vte art religieu	Brahim Diana			0	absent	150	TC	J
bati	com	1222	s.couture	Arouna sangaré			0	absent	5000	TF	M
bati	com	1222	moulin	Edor Bernard	P	M	6000		6000	TF	M
bati	com	1222	magasin				0	fermé	0		
bati	com	1222	s.couture	Akangbé Tajudeen	P	M	5000		5000	TF	M
bati	res/com	1220	WC publique	Dao Moulaye			0	absent	5000	TF	M
bati	mosquée	1220					0		0		
bati	com	1220	magasin				0	fermé	0		
bati	com	1220	boulangerie				0		0		
bati	com	1220	vte cereales	Dabo Boua	IC	M	8000		8000	IC	M
bati	com	1220	vte biscuits-bon	Bamba Yaya	IC	M	8000		8000	IC	M
bati	com	1220	vte de riz	Ouattara Mamadou	IC	M	10000		10000	IC	M
bati	com/	1220	vte de pagne	Djénébou Sylla	IC	M	8000		8000	IC	M
bati	com	1220	café express	Koné Ibrahim			0		5000	TF	M
bati	com	1220	WC publique	Sylla Bazouama	P	M	6000		150	TC	J
bati	res/com	1219	blachisserie	Moussa Ballo	TC	J	150		150	TC	J
bati	res/com	1215	menuiserie				0	absent	5000	TF	M
bati	com	1215	blanchisserie	Kouablan Emmanu	TC	J	150		150	TC	J
bati	res/com	1299	vte pagne	Diana Aicha	ODP	M	3000		3000	ODP	M
bati	com	1299	vte boite conser				0	refus d'info	150	TC	J
bati	com	1299	bijouterie	Kossonou kouakou	TC	J	150		5000	TF	M
bati	com	1239	s.couture	Karamoko Adama	TF	M	5000		5000	TF	M

L'Implantation du Système

Les plans numériques au format « Shape file » ainsi que les tables au format « Dbase IV » des activités économiques de la commune réalisés sont installés dans les services des taxes et des services techniques. L'exploitation du système se fait sous environnement ARCVIEW3.1. Le personnel d'exploitation et de maintenance du système a bénéficié d'une formation à l'utilisation du logiciel. Un contrat de partenariat pour assurer la maintenance de l'outil à été établi en vu d'assister pour les six premiers mois le personnel technique de la mairie.

Figure 4 : Exploitation



Analyse des Resultats

Il ressort des résultats que 80% à 90% des activités ont été enquêtées. Aussi tous les types de taxes communales ont été répertoriés. Les statistiques par type de taxe montrent un écart très important entre les montants encaissés et les montants escomptés sur la base du travail réalisé.

Figure 5 : L'exemple d'une zone est édifiant dans la mesure où sur les activités enquêtées dans l'occupation du domaine public nous sommes passé d'un montant mensuel de 358500Frs recensés à 624000Frs estimés.

NUM	LOT	TYPE_OC	NATURE_ACT	NOM_PROP	TYPE	PER	MONTAI	MONT1	T_TX1	PER1
187	3802	com	cab cell	Inès	ODP	M	3000	3000	ODP	M
188	3804	res/com	cab cell	Kamara Idriss			0	3000	ODP	M
189	3805	res/com	cab cell	Yao Angèle			0	3000	ODP	M
190	3806	com	dactilographe		TC	J	100	3000	ODP	M
191	3806	com	cab cell				0	3000	ODP	M
192	3806	com	vte cigarette		ODP	M	3000	3000	ODP	M
193	3958	com	kiosque café	Koné Bazoumana	ODP	M	3000	3000	ODP	M
194	3961	com	vte art divers	yessefu Ariké	ODP	M	3000	3000	ODP	M
195	3961	com	vte art divers	salamatou Oyéoumi	ODP	M	3000	3000	ODP	M
196	7201	res/com	vte fagot	Mariko Zoumanan	ODP	M	3000	3000	ODP	M
197	7301	res/com	jeu video				0	3000	ODP	M
198	7308	com	cab cel	kouamé Frederic	ODP	M	3000	3000	ODP	M
199	9002	com	cab cell	Kouamé Richard			0	3000	ODP	M
200	9002	com	jeu video	Boni Deny			0	3000	ODP	M
201	9002	com	jeu video	Boni Deny			0	3000	ODP	M
202	2a	res/com	vte art divers	Razas Jimoh	ODP	M	3000	3000	ODP	M
203	A	res/com	cab cell				0	3000	ODP	M
204	C	res/com	cab cell	Camara Lanzeni	P	M	5000	3000	ODP	M
205	Ctre Ci	res/com	cab cell				0	3000	ODP	M
206	Ctre Ci	com	cab cell	Koumoin Kouadio			0	3000	ODP	M
207	D	com	cab cell	Armel Ouattara			0	3000	ODP	M
208	D	eglise	cab cell				0	3000	ODP	M
209	D	com	vte charbon fago	Gouto Dadié Armel	ODP	M	3000	3000	ODP	M
210	D	com	baraque	Koné Koumba			0	3000	ODP	
211	ets Sy	com	cab cell	Mariko Adama			0	3000	ODP	M
212	ets Sy	com	cab cell				0	3000	ODP	M
213	ets Sy	com	cab cell				0	3000	ODP	M
214	ets Sy	com	cab cell	Ouattara Adja			0	3000	ODP	M
			ODP MENSUELLE : 214 ACTIVITES							
			MONTANT RECENSE : 358500Frs							
			MONTANT ESTIME : 642000Frs							

La spatialisation des activités montre aussi les aires de concentration des activités économiques. Toutes ces données statistiques et graphiques ont permis aux autorités communales d'affiner leur stratégie de collecte des taxes dans la gestion de la commune.

Comme problèmes rencontrés au cours de la réalisation du projet nous avons affronté trois (3) difficultés principales :

1. l'accès à l'information fiable

   Cette difficulté s'est située à deux niveaux ; à savoir au niveau des opérateurs économiques qui rechignaient à donner les vrais montants des taxes qu'ils payaient et au niveau de certains agents de la mairie qui ont hésité parfois à nous donner les informations utiles sur les procédures de recouvrement des taxes.

2. la participation
   La participation des administrés à l'opération ne s'est pas toujours faite de façon correcte en ce sens qu'il a fallu acheminer des courriers administratifs aux responsables coutumiers afin d'avoir leur accord pour le commencement de l'opération.
3. a capacité organisationnelle locale

   Elle se situe au niveau du personnel d'appui technique de la commune qui a souvent fait défaut à l'opération.

Conclusion

La demande d'information spatiale au regard de la prise de décision peut être envisagée sous différentes perspectives. Dans ce cas d'optimisation des recettes municipales elle s'est avérée d'un apport très appréciable pour les autorités qui à travers cette plate forme informatique ont estimée que les décisions prises étaient désormais éclairées. Au-delà de cet aspect il serait souhaitable que les autorités s'approprient l'utilisation des SIG dans la gestion de leur commune notamment dans la gestion des ordures ménagères et les plans d'aménagement des espaces verts.

Système d'Information Foncière dans l'Economie du Savoir : Question Relative a la Cartographie

By Sélifa SAMA

Introduction

La cartographie en général fournit des informations géoréférencées. Celles-ci sont utilisées pour la réalisation de document d'orientation et de planification. Elle est importante dans la réalisation d'un système d'information géographique (SIG).

La forme numérique des données de télédétection permet le croisement avec des données auxiliaires, un traitement souple, un archivage et une gestion simple dans un SIG. Ce travail traitera des méthodes cartographiques, de référentiel géodésique lors de la mise en place d'un Système d'Information Foncière (SIF).

Methodes Cartographiques

Plusieurs méthodes interviennent dans l'élaboration d'une carte à savoir : la télédétection, la photogrammétrie, les photographies aériennes, le positionnement au GPS, les croquis terrain.

La télédétection de par sa vue homogène et synoptique, la répétitivité des passages de satellite, permet l'établissement de spatio-cartes riches en informations et relativement faciles à réaliser. Contrairement aux anciennes méthodes d'investigation, les délais et les coûts de réalisation d'une couverture cartographique par télédétection à l'échelle d'un pays voire d'un continent sont très réduits.

Les cartes issues de l'imagerie satellitales sont définies comme cartes schématiques présentant la planimétrie et l'altimétrie.

L'altimétrie est obtenue par restitution photogrammétrique à partir d'un couple stéréoscopique générant un modèle numérique de terrain (MNT) qui permet d'avoir une vision en 3D.

La planimétrie est déduite par photointerprètation de l'image satellitale et/ou récupérée à partir de la cartographie existante.

A ces études il faudrait des travaux de terrain pour la validation des résultats issus de la téléanalyse.

Type d'Echelle pour l'Edification des Cartes

Le choix du type d'échelle est déterminant lors de la réalisation d'une carte. L'échelle permet d'estimer la valeur, la grandeur des éléments d'une région. Les échelles de couverture les plus utilisées sont le 1:200000 plutôt en Afrique de l'Ouest et le 1:250000 plutôt concentrées sur l'Afrique australe et orientale. Les cartes d'échelles plus grandes peuvent être trouvées pour des pays de plus petite superficie en Afrique de l'Ouest, ainsi que sur des pays de superficie moyenne bénéficiant de couvertures à plusieurs échelles. Il serait préférable d'utiliser deux types d'échelle pour l'édification des cartes du système parcellaire en Afrique.

Les grandes échelles seraient retenues pour la cartographie en zone urbaine et les petites échelles pour la cartographie en zone rurale.

Il est évident que la précision d'une carte numérisée au 1 :100000 qui serait tracée à l'échelle de 1 : 5000 ne sera pas améliorée. En retour pour obtenir une carte détaillée, il faudrait tenir compte des problèmes conceptuels et techniques liés à la généralisation.
En conclusion, il faudrait trouver l'échelle requise pour la sortie des produits du SIF en rapport avec les données sources utilisées.

Donnees Sources

Il faudrait réaliser un inventaire des données sources à utiliser pour la réalisation du SIF.

Les Images Satellitales

Elles sont captées par des satellites (LANDSAT, Spot) qui sont placés à des milliers de kilomètres au dessus de la terre. Les images des satellites LANDSAT-TM et Spot de par leurs caractéristiques sont adaptées pour l'étude du tissu urbain.
Immédiatement après leur acquisition, les données images se présentent sous une forme qui en générale ne permet pas l'extraction facile et immédiate des informations utiles. La première étape consistera à un traitement préliminaire des données. A la deuxième étape, l'information recherchée sera déduite des données de base, à l'aide de technique plus ou moins automatiques.

L'extraction de l'information des données images peut être effectuée soit par une photo-interprète, soit par ordinateur ou alors une association des deux (Rochon et al.1982).

Après analyse des images TM ou Spot, une cartographie du parcellaire sera élaborée sous un format vecteur afin de faciliter les diverses opérations du Système d'Information Foncière.

A la donnée spatiale que constitue la parcelle (représentation vectorielle), il faudrait ajouter les données aspatiales ou attributs (surface, longueur, largeur, nature, propriété) qui fournissent des renseignements sur l'entité spatiale.

Le Modèle Numérique de Terrain (MNT)

Le MNT permet d'avoir une vision en 3 dimensions des objets. Il est obtenu par méthode d'interpolation à partir de trois supports :

- la surface elle-même (mesure directe GPS pour la localisation des points de mesure),
- l'image cartographique de la surface,
- la représentation photographique.

Pour chacun de ces supports, les modes spécifiques de saisie pouvant être utilisées :

- un levé direct
- une restitution photogrammétrique,
- une numérisation des courbes de niveau d'une carte topographique de la région

Le MNT est utilisé soit pour la correction géométrique des images satellitales soit pour des applications thématiques.

En cas de relief relativement plat, un MNT de grande précision sera souhaitable pour des applications thématiques. Pour la correction d'images de satellite sur une zone de faible dénivelée (inférieure à 150 m), on pourra se contenter de la prise de quelques points sur l'image. Lors de l'élaboration du MNT, en cas de fort voire de très fort relief, on pourra augmenter l'équidistance des courbes de niveau c'est à dire, réduire la précision altimétrique du MNT.

Autres Donnees

- Carte cadastrale. Elle représente le système foncier avec les attributs qui y afférent. Elle servira pour la base de données aspatiales et la base des métadonnées.
- Carte topographique. Elle sert à la génération d'un MNT par interpolation après numérisation des courbes de niveau.
- Données Terrain. Elles servent à la validation des données issues de la téléanalyse.

Les References Geodesiques

Elle permet d'effectuer la projection cartographique d'une carte. Les coordonnées servent à repérer les positions à la surface de la terre. Elles s'appuient sur des mesures de déplacement par rapport à une position de référence appelée origine (Marius 1996). Elles sont de deux types cartographiques et géographiques.

Seules les coordonnées de la projection géographique sont uniques pour tout point à la surface du globe. Elle n'est pas utilisable pour produire des cartes à grande échelle. Les projections cartographiques sont requises pour la représentation en plan d'un territoire. Elle doit minimiser les inconvénients telles que : la variation d'échelle, la déformation, à l'échelle de l'Afrique. Elle doit limiter les erreurs lors des traitements d'analyse spatiale prévus dans le Système d'Information Foncière (SIF).

L'examen des différentes cartes à moyenne échelle actuellement disponibles sur la totalité des pays du continent africain laisse apparaître une diversité de situations telle qu'il n'est pas possible d'appréhender l'examen de tous les pays à partir d'un seul paramètre.

De l'inventaire des ressources cartographiques présentes sur les pays du continent, il apparaît que 20% seulement des pays sont couverts par des cartes régulières basées sur des réseaux de triangulation, 30% sont couverts par des cartes semi-régulières et 50% ne disposent que de points astronomiques.

Les projections les plus souvent utilisées pour les couvertures nationales à moyenne échelle sont cylindriques (Transverse Mercator, UTM), celle de Gauss étant présente en Afrique australe et orientale. La projection conique de Lambert et celle de Bonne se retrouvent en Afrique septentrionale et quelques unes polyconiques sont présentes en Afrique centrale (FAO, sous ≤Spécification cartographiques et géométriques du projet Africover≤).

En conclusion, la géométrie des cartes sur la globalité de l'Afrique n'est exploitable pour un système international que sur 20% du continent. Les systèmes et leurs points fondamentaux (Datums) sont également variés et difficiles à corréler les uns par rapport aux autres (Adindan, Carthage...) de sorte à obtenir un équilibre du point de vue vertical.

Une cohérence géométrique s'impose pour un SIG. Il serait souhaitable d'utiliser :

- Le réseau géodésique normalisé et précis, dans le système international WGS84; ceci permettra de maîtriser les passages aux systèmes locaux fiables et disponibles par des lois connues. En outre, ce système s'appuie sur les récepteurs GPS du marché.
- L'ellipsoïde international IAG-GRS80, (Ground Référence System 80) ellipsoïde de référence créé pour la localisation des traces de satellites. Ce modèle apportera une précision et une cohérence qui vont de pair avec le réseau WGS84. Le GRS80 est l'ellipsoïde standard utilisé pour la projection UTM.
- La projection Transverse Universelle de Mercator (UTM). Celle-ci autorisera la gestion de couvertures cartographiques aisément répertoriées sur de grandes étendues (fuseaux normalisés par tranches de 6 en 6 degrés de longitude) telle que recommandé par la Résolution de la 6ème conférence internationale de l'OACT sur la cartographie de l'Afrique, Addis-Abeba, 1986 (FAO, sous ≤Spécification cartographiques et géométriques du projet Africover≤). Ce type de projection est actuellement le plus répandu dans le monde.

Les Metadonnees

Elles décrivent les données (cartes, image satellitales…) intégrées dans le Système d'Information Géographique. Le contenu descriptif de la métadonnée varie selon la nature des documents et devrait comprendre nécessairement les éléments suivants :

- Le descriptif des données sources (l'identification, l'utilité, la provenance, la forme, le système de référence, la projection, l'échelle cartographique, les caractéristiques du matériel primaire, la date de production, la date de la dernière mise à jour…)
- Le descriptif des fichiers informatiques (les méthodes de numérisation utilisées, les systèmes d'unités et de coordonnées, la description des contenus géométriques, l'organisme ou le service ayant réalisé la saisie, la description des traitements effectués, la précision des données thématique, l'exactitude des données

Conclusion

La mise en place d'un système d'information foncière nécessite une cohérence des données en entrée. Cette harmonisation concerne : la méthode cartographique, le système de référence, l'échelle de travail.

Sur la majeure partie de l'Afrique les cartes sont très obsolètes. Le projet Système d'Information Foncière ; question relative à la cartographie sera d'un atout important pour l'Afrique en vue d'une prise de décision en temps réel. Il servira à l'aménagement, à la planification du système foncier de l'Afrique.

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Proposed GPS Survey Method for Cadastral Surveying of A2 Model Farms in Zimbabwe

By Charles Paradzayi, Andrew Chirigo[5], David Goodwin[6] and Charles Matyukira[7]

Abstract

The fast track land reform programme in Zimbabwe has been a topical issue since 2000. The government, which has been trying to redress land imbalances between the majority blacks and the minority whites, blames Britain for failing to honour pledges made at the Lancaster House Conference to provide funds for acquiring land for resettlement purposes in Zimbabwe. Over the years, several constitutional reforms culminated in the state having the power to compulsorily acquire any derelict land and any other land that was not being fully utilized for resettlement purposes. The government cited inflated farm prices by the white landowners under the willing seller – willing buyer arrangement, to justify this drastic move. Farmers were compensated only for cost of improving the infrastructure on the farms. The failure of the constitutional amendment process of 2000, where the government wanted to place the onus on Britain to compensate white landowners resulted in "spontaneous" farm occupations by the war veterans. These occupations have since been constitutionally recognized under the A1 and A2 model schemes. A1 holdings are based on the village model while the A2 holdings are self-contained commercial units. These holdings were planned using aerial photographs and other existing maps. However, rudimentary surveying techniques, such as pacing and marking boundary corners on trees, were used to demarcate the new land parcels for both the A1 and A2 holdings. The government of Zimbabwe is under pressure to grant secure tenure to the new landowners so that they could use the land as collateral to develop infrastructure on the farms. The government has adopted 99-year leases as the type of land tenure for the acquired A2 model farms. Under the Zimbabwean law, the 99-year leases have to be registered in the Deeds Registry and one of the requirements is that the land parcel in question should be surveyed in accordance with cadastral surveying standards and approved by the Surveyor-General. Under 200 of the estimated 15 000 A2 holdings have been surveyed and conventional surveying methods are considerably slow for this undertaking. At the present rate, it is estimated that the cadastral exercise will take more than two and a half years to complete. This paper is proposing the use of a satellite based GPS survey method that is quick and affordable, and also compatible with the Land Survey Act and its allied Regulations.

Introduction

At independence in 1980 Zimbabwe inherited a highly skewed pattern of land distribution. According to Chitsike (2003), a small minority of white large-scale commercial farmers owned and farmed most of the fertile agricultural land. The majority of the indigenous population farmed in the lower rainfall and poorer soil areas. Britain, the former colonial power pledged during the Lancaster House Conference, to provide funds for acquiring land for resettlement purposes in Zimbabwe. The new Government embarked on an intensive resettlement programme to decongest the communal areas by bringing derelict and under-utilized land into full production. The acquisition of the land from the white commercial farmers was based on a willing buyer-willing seller arrangement as provided for in the Lancaster House Agreement. In 1985, the Zimbabwe passed a new Land Acquisition Act, which gave the Government the right of first refusal on all large-scale commercial farms put up for sale. This was due to the slow rate at which the minority white commercial farmers were offering land for sale to the government.

In the 1990s, the government instituted a National Land Policy that consisted of four models of resettlement schemes, which sought to reduce the imbalances in land distribution and to ensure the effective use of all land in Zimbabwe. Under the policy, the Land Acquisition Act, coupled with constitutional reforms in 1990 enabled the government to compulsorily acquire, for resettlement purposes, any derelict land and any other land that was not being fully. The farmers were only compensated for the cost of improving the infrastructure on the farms. The government cited highly inflated farm prices by the white landowners under the willing-buyer

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willing-seller arrangement, to justify this drastic move. The Government would no longer be obliged to pay compensation for the acquired land except for improvements on the infrastructure.

Fast track land reform

In 2000, the government of Zimbabwe appointed a Commission to draft of a new constitution for the country. The draft constitution contained provisions relating to the acquisition of land for resettlement and it also placed the onus for providing compensation for the acquired farms on the former colonial power. The draft constitution also covered a wide spectrum of topical issues that were pertinent to Zimbabwe at that time and was rejected in a referendum for reasons that were more political than anything else. The rejection sparked "spontaneous" occupation of white-owned commercial farms by liberation war veterans and collaborators. The occupation had the blessings of the government, which hoped to derive political mileage from the occupations as the country was heading towards parliamentary elections. Ever since, the fast track land reform programme in Zimbabwe has been a major area of international discussion, mainly due to the hitherto unprecedented approach taken by the government of Zimbabwe to address this very emotive issue. The present government blames Britain's failure to provide funds for land acquisition and resettlement that it had pledged during the Lancaster House Conference.

The Zimbabwean government instituted constitutional reforms that sought to regularise the spontaneous farm occupations. The Department of Physical Planning partitioned the acquired farms into either A1 or A2 model holdings using ortho-photography and other existing maps. The A1 model farms are based on the village concept, with communal residential areas and separate farming areas. These are designed to alleviate pressure on the communal lands. A2 farms are much larger than the A1 farms and are self-contained and the owners are expected to engage in commercial agricultural operations. It is estimated that there are 15000 A2 model holdings that require title surveys for annexure to the 99-year leases. However, rudimentary surveying techniques, such as pacing and marking boundary corners on trees, were used to demarcate the new land parcels on the ground for both the A1 and A2 model farms because the whole exercise was unplanned. The human and technical resources to carry out proper cadastral surveys were limited at the onset of the land reform program. The government of Zimbabwe is now under pressure to grant secure tenure to the new landowners so that they can use the land as collateral to develop infrastructure on the farms. The net effect of a secure tenure is to unlock the investment potential of the holdings for sustainable agricultural production. The government has adopted 99-year leases as the type of land tenure for the acquired A2 model farms.

Under the Zimbabwean law, the 99-year leases have to be registered in the Deeds Registry and one of the requirements is that the land parcel in question should be surveyed in accordance with cadastral surveying standards and approved by the Surveyor-General. As the country moves towards enhancing the security of tenure of the A2 holdings, boundary definition of these myriads of parcels becomes imperative. The haphazard nature of the initial demarcation of the farm boundaries poses difficulties for the conventional surveying techniques.

Current cadastral surveying practice in Zimbabwe

The Department of the Surveyor General (DSG) is the custodian of cadastral data in the country. Cadastral surveying aims at defining and guaranteeing legal property boundaries and the determination of all measured points to give information on the size and nature of the land use of any given land parcel. Wan et al (1999) contend that the demarcation and delineation of the boundaries is aimed at defining land parcels on the ground and to secure evidence for the re-establishment of the boundary if the beacons are tampered with. A fundamental characteristic of most cadastral surveying methods is their legal traceability should boundaries established therewith become mired in controversy. The traditional methods are based on and tied to geodetic networks of trigonometrical beacons. The position of land parcel beacons is determined relative to these beacons and can be retraced in cases of dispute. Most countries have developed longstanding legislation to guide the execution of cadastral surveys within their territories. In Zimbabwe, the Land Survey Act (Chapter 20:12) and the accompanying Land Survey (General) Regulations detail how conventional ground survey and aerial survey techniques are carried out, examined and approved by the relevant surveying professionals. Ground survey methods involve the measurement of distances and/or directions starting at known control points on the geodetic network. Aerial surveys involve the establishment of ground-based control points that are connected to the trigonometrical beacon network over the area to be mapped. Aerial photographs acquired from airborne crafts or satellites are then interpreted to obtain the absolute boundary positions. The diagrams and general plans obtained from these methods are then used for annexure to title deed documents to show the extent of the land parcel being conveyed.

The conventional methods have their limitations. The cost of carrying out aerial surveys has become prohibitive considering the cost of purchasing the requisite equipment such as aircraft, cameras and related accessories. Ground survey methods are considerably slow for a survey operation of the magnitude envisaged for A2 holdings. Much of the terrain is rugged and the shortage of fuel further complicates the situation as it impacts negatively on the movement of the survey personnel. The fuel supply situation has been unstable since the onset of the fast track land reform. The current legislation in not in tandem with technological innovations, such that the legislation has become an impediment to the adoption of innovative and advanced positioning techniques based on satellite technology.

Global Navigation Satellite Systems

Technological advances in satellite-based technology have resulted in Global Navigation Satellite Systems (GNSS) that can be used to determine one's location anywhere on the earth's surface. In the 1970s, the US Military developed the first Global Positioning System (NAVSTAR), primarily for navigation purposes giving positions in real time with an accuracy of between 5 and 20 metres. The system relies on ground-based receivers that capture signals transmitted by a constellation of orbiting satellites. The signals are then analyzed and the position of the receiver is calculated using the information about the precise location of the observed satellites at the given epoch of observation. Although the American Global Positioning System is the most popular, the Russian Federation operates its own constellation of satellites called GLONASS. The European Union has recently launched the Galileo system to wean itself from dependence on foreign controlled constellations in providing spatial location information for their applications. The challenge facing GPS manufacturers is to now develop receivers that can simultaneously lock to all these systems.

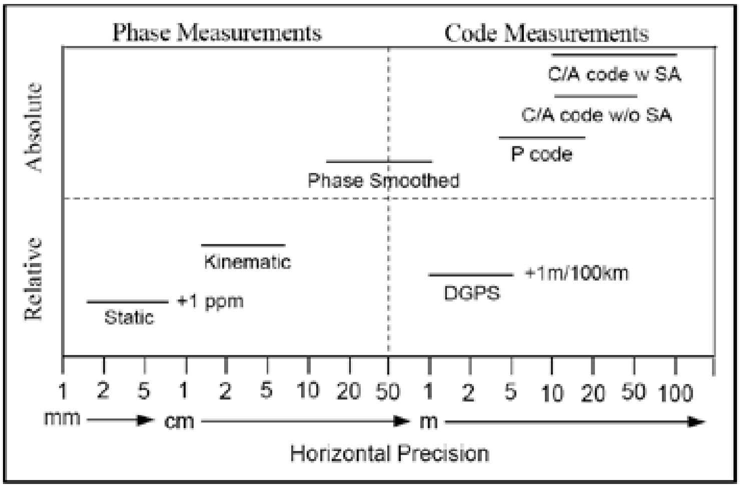
GPS Receivers

Some attention needs to be drawn to the existence of different types of GPS receivers because the use of hand-held GPS receivers has been mooted in some quotas, as a possible solution to the rapid surveying of A2 holdings. GPS equipment comes in various levels of sophistication; ranging from the low-end hand held recreational receivers to the high-end sub-centimeter receivers. The low-end is characterized by code receivers that give positional accuracies of greater than 10m, even after the removal of selective availability by the American military as of May 2000. It is possible to use differential post-processing to improve accuracies to obtain 2 –5 metre positional accuracies. However, these accuracies fall far short of the prescriptions of the Land Survey Regulations for even the less stringent Rural surveys and surveys in High Density Developed Townships.

The high-end GPS receivers are classified as single or dual frequency depending on whether they receive the L1 or both L1 and the more precise L2 carrier waves that are continuously transmitted by orbiting satellites. These receivers have accuracies of the order of 1cm although this varies according to the length of the baseline. A 10ppm (parts per million) systematic error is usual for single frequency receivers and 5ppm for dual frequency receivers (Goodwin 2002).

The GPS receivers can be used to obtain absolute or relative positioning. Absolute GPS positioning can be carried out using a single receiver, resulting in absolute position of the receiver's location. The positional accuracy of absolute positions is between 10m and 100m in the horizontal position. The major error sources that affect this position are satellite dependent errors (satellite clock, satellite orbit and selective availability), atmospheric propagation errors (troposphere and ionosphere) and receiver dependent errors (receiver clock, signal noise and multipath environment). The magnitude of the accuracies obtainable in absolute positioning makes the technique not suitable for cadastral surveys (Blick 1999).

Figure 1. GPS Positioning Techniques (from Blick 1999)



Differential GPS (DGPS) uses at least two receivers and suitable software to compute the pseudo-ranges from two receivers to give relative positions of the occupied points. DGPS eliminates most of the errors due to ionosphere, troposphere, signal noise, ephemeris data, clock drift and multi-path because the signals obtained by all of the receivers would have traveled through virtually the same atmospheric conditions. There is a significant improvement in the accuracies of the horizontal positions of points fixed by DGPS observations.

Static and Real-Time Kinematic DGPS

DGPS can be carried out in various configurations of either static or real time kinematic (RTK) modes. The static mode is good for establishing control and fixing parent property beacons. In static positioning both receivers are always stationary and is the most precise form of GPS positioning. It requires longer observation times. It is also a slow method for placing property beacons at predetermined positions because it involves post-processing of the observation data. The coordinates of the fixed points are obtained some time after the fieldwork.

The RTK mode utilizes at least two receivers with a radio link, satellite connection or mobile Internet connectivity between them. One or more receivers are placed on control points/reference stations with known coordinates. The other receiver (the rover) can then be used to determine the positions of boundaries by means of the radio connection between the reference station and the rover. The position of the rover is computed in near real-time because the time between receiving GPS data at the base station, sending to the rover, decoding, combining with the rover GPS measurements and computing the new coordinate introduces a time delay known as latency. In most modern equipment, latency is less than a single second and poses no major problems in computation of receivers' position. RTK uses broadcast ephemeris and not precise ephemeris in the field and therefore further processing in the office will improve the results now using precise ephemeris. Cordini (2006) points out that the classical single baseline RTK methodology allows for operations only within a range of 10-15 kilometres from the base station due to the correlation of some GPS errors with distance. However, a network-based RTK extends operational range to many tens of kilometres. This capability makes RTK ideal for placing calculated positions of property boundary beacons offers surveyors an opportunity to significantly lower the cost and time typically required for cadastral surveys in rugged terrain.

GPS Survey Method for A2 Model Farms

GPS survey methods are gradually replacing the traditional way surveyors have executed their fieldwork in most developed countries. In Zimbabwe, GPS has only been used on a very limited scale for cadastral surveys in Zimbabwe. The current legislation does not provide for the use of GPS equipment because of the difficulties in ensuring that their measurements are legally traceable. As a result, the use of GPS has been decided by a give-and-take process driven by necessity and conducted in a cordial spirit of enquiry and co-operation between the Department of the Surveyor General (DSG) and the private sector (Goodwin 2002). In Australia, it has been proved that when operated professionally, RTK GPS equipment can achieve accuracies specified in Victorian Cadastral Survey Regulations (Hale et al 2006). It has been noted that the use of kinematic GPS observations increases productively by a factor of 5 to 10 over static method, while still providing adequate accuracy levels (Nabed et al 2002). The accuracies of the observed points are comparable to those obtained by conventional EDM/Total Station surveying for most cadastral purposes (Wan et al 1999). However, there is often need to fine-tune existing regulations to be in line with the capabilities of the new methods.

The proposed GPS survey method for the surveying of A2 holdings in Zimbabwe does not depart widely from the usual way surveyors have traditionally carried out their functions. The method addresses the issue of legal traceability of GPS measurements and the establishment of control, calibration of GPS equipment, fieldwork and greater compliance with existing legislation in terms of misclosures, accuracies and survey record requirements.

Control Network

The basis of reliable site calibration is the availability of good horizontal control networks. The surveyors can use the existing geodetic control to constrain their GPS observations. On the other hand, the DSG/private operators can establish dedicated GPS networks for the whole country to provide for real time GPS position correction services as in the case of Australia (Denham 2006).

Geodetic Network

The density of the existing geodetic control network is high in areas that have been perceived to have high commercial value. As a result, the density of existing geodetic control network is poor in most the A2 holdings. This problem is further compounded by the fact that a number of these monuments are in a state of disrepair and require vegetation clearing by the Department of the Surveyor General crews. It is taking surveyors a considerably longer time to transfer control to sites when using conventional surveying techniques of distance and angular measurements.

GPS Network

Zimbabwe is still to establish a GPS network of control points due to limited human, institutional and technical capacities in both the national mapping organisation and private surveying and geomatics practitioners. The DSG is in the process of acquiring additional GPS equipment so that some trig beacons can be coordinated on WGS84. The ideal situation is to have base stations with "tri-band" receivers (i.e. the base receivers can receive signals from the three established satellite constellations i.e. NAVSTAR, GLONASS and Galileo) so that surveyors are not satellite constellation dependent. The GPS network can be established with cooperation of the DSG, private industry, all levels of government, academia and the community.

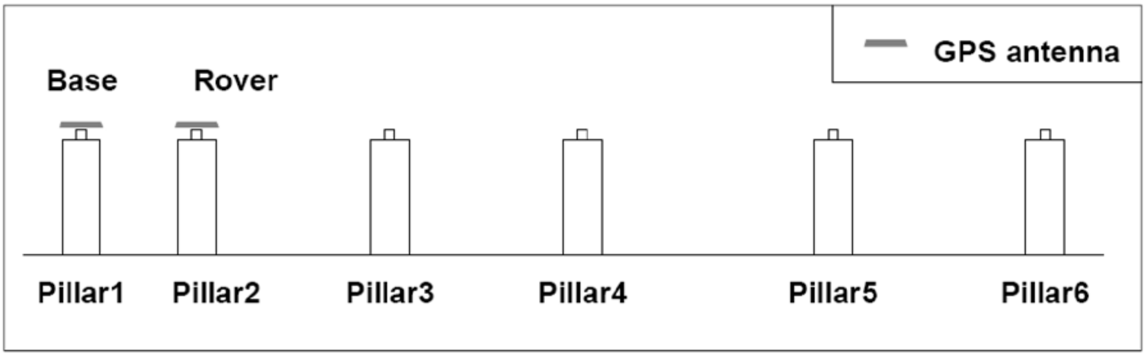
Calibration

Section 9 of the Land Survey (General) Regulations (1979) provides for the registration and calibration of traditional distance measuring equipment on standard baselines. GPS equipment that is to be used for cadastral surveys should also be calibrated, standardized and registered by Surveyor General. The DSG should establish and maintain a calibration network on which to test all GPS instruments. The testing and calibration of GPS systems ensures that GPS-derived coordinates are of uniformly high quality (Wan et al 1999) and also that GPS measurements are legally traceable. The DSG should make it mandatory that each GPS system to be used for cadastral work to undergo baseline and site calibration.

Baseline calibration

The established EDM calibration baselines can be used to test GPS equipment to ensure that its operation, associated antennas and cabling, and data processing software, give distance results that can be compared with calibrated baseline data (Ses et al 1999). The residuals between the measured distances and their known values will be used to detect if the GPS equipment is in perfect working order. If the GPS equipment can verify the known distances between the markers on the pillars of the EDM baseline, the equipment is in good order and capable of delivering baseline solutions that are within specification.

Figure 2. EDM baseline test site (from Ses et al 1999)



The DSG EDM baseline at the University of Zimbabwe can be used for undertaking this baseline calibration test for all GPS equipment to be used for cadastral purposes in the country. The equipment can then be registered in much the same way as are conventional EDM equipment, Total Stations and measuring tapes. As a result, measurements made using the calibrated GPS equipment can become legally traceable.

Site calibration (datum calibration)

The Zimbabwean Circuit datum is based on the Gauss coordinate system that uses 2-degree belts about a central meridian (longitude) to project the earth's surface on to a plane surface. GPS measurements are reduced on the World Geodetic datum (WGS84). Site calibration is part of the fieldwork and it is required to constrain the GPS observations to the existing trigonometrical or GPS network in the survey area using a full seven parameter (three rotations, three translations and a scale factor) least squares adjusted transformation. Site calibration can also be achieved by comparing the residuals of the GPS observed coordinates and the coordinates of established control points (Table 1 below). The DSG should make it mandatory to lodge copies of the data collector files which were used to capture the calibration data.

Table 1 Calibration by RTK residuals (Goodwin 2002)

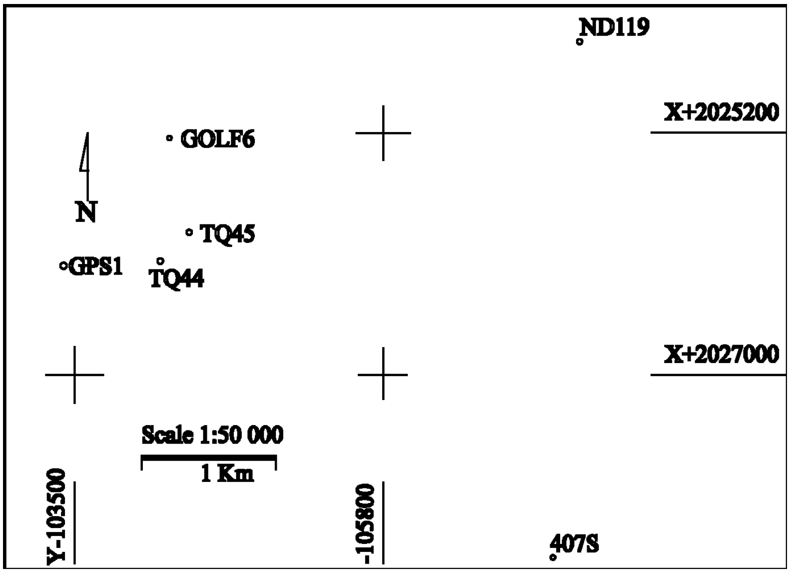
Name	Y	X	Code		
Control				Diff. CTL minus FIX in site calibr.	
407S	-107064.23	2028355.30	CTL	0.005	0.001
GPS1	-103418.32	2026184.72	CTL	-0.002	0.008
TQ44	-104138.42	2026151.80	CTL	-0.005	-0.009
TQ45	-104219.83	2025911.49	CTL	-0.009	0.017
GOLF6	-104207.91	2025236.11	CTL	0.011	-0.018
Fixes					
TQ45FIX	-104219.821	2025911.473	FIX	Calibr	Calibr
GPS1FIX	-103418.318	2026184.712	FIX	calibr	Calibr
TQ44FIX	-104138.415	2026151.809	FIX	calibr	Calibr
GOLF6FIX	-104207.921	2025236.128	FIX	calibr	Calibr
407SFIX	-107064.235	2028355.299	FIX	calibr	Calibr
407SFIY	-107064.233	2028355.294	FIX	secnd m'mnt	secnd m'mnt

The calibration process requires control points that have a good geometry over the site to be surveyed and these points should at least include trig beacons of a higher order to the type of survey under consideration. For example, suppose a surveyor finds control points GPS1, TQ44, TQ45 and GOLF6 in sound condition and carries out a site calibration with the intention of fixing ND119, which is some kilometres distant (Figure 3 overleaf). As expected, the surveyor obtains excellent residuals between the surveyed values and the values of the control points. Now, it can be seen that any small discrepancies in scale factor and swing in the site calibration although negligible in the vicinity of the control beacons may "blow up" with distance away from control. Ideally there should be a base line in the control of length comparable with the line that is being measured. In this instance it would be deemed necessary to pick up 407/S and include it in the site calibration.

The GPS Survey Fieldwork

In essence, the surveying of A2 holdings involve the relocation of existing farm boundaries and the fixing of subdivision beacons so as to partition large farms into a number of smaller land parcels. The proposed method caters for the establishment of requisite control and the placing of boundary beacons in area being surveyed, with sufficient field checks to meet the standards set by the Survey Regulations Board with minimum adjustments. In order to expeditiously carry out the survey of the A2 holdings, the ideal fieldwork should be performed using full GPS systems. However, for reasons such as those cited in Section 5.1.1, the situation in Zimbabwe calls for a combination of conventional surveying techniques and GPS because the country does not have countrywide coverage of Networked Real-Time Kinematic (NRTK) base stations. Further to that, most of the practising surveyors do not own complete sets of GPS equipment.

Figure 3 Site Calibration Geometry (adopted from Goodwin 2002)



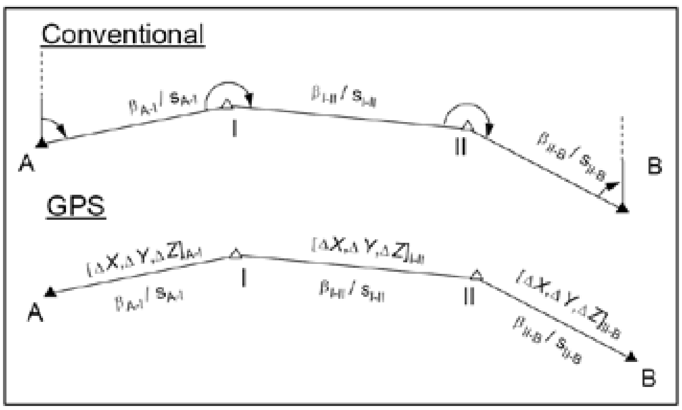
Proper mission planning is critical to the success of GPS surveys and to ensure that sufficient satellites (at least five or more at the base and rover stations) are available at the time of survey. This is true for both static and RTK measurement procedures. The elevation mask angle should be greater than 10 degrees to reduce the effects of tropospheric and ionospheric delays, as well as minimizing the effects of multipath.

Establishing site control

In difficult terrain, where it is difficult to visit all the necessary trig beacons or where their density is sparse, conventional techniques such as traversing, intersection and resection can be adopted to establish the network of control points on site. These points can then be used for site calibration as described in 5.2.2 so that the farm beacons can be fixed using GPS methods.

Static GPS surveying technique will be used to fix the control points in the area to be surveyed. The DSG must stipulate a "fixed" rather than "free" solution when surveyors establish their control networks. The traverse should start and finish at known control points and traverse closure checks should be performed just as with conventional traversing.

Figure 4 Conventional versus GPS Traverse (adapted from Blick 1999)



Blick (1999) suggests setting up two GPS receivers, one on control point A, the second on station I and the baseline A ___I is measured. The baseline can be transformed to an equivalent bearing and distance. The receiver on control point A is then moved to station II and a second baseline is measured. Hence, when the observations are completed, a traverse between control points A and B has been measured for which each bearing has been independently measured. Since each line has been measured separately, the close between control points A and B constitutes a satisfactory check on the GPS observations.

The surveyors must take extra considerations of the centering errors for the base and the rover during traversing. The traverse points should be checked by occupying them again after at least 20 minutes to allow for satellite geometry to change.

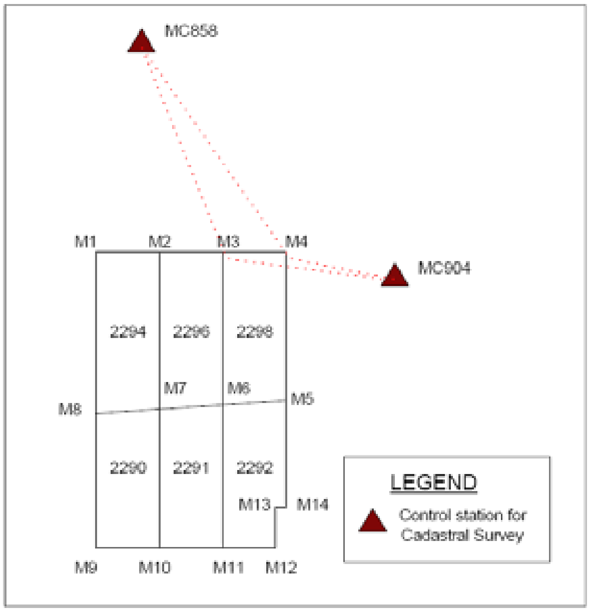
Fixing property beacons

RTK (kinematic and pseudo-kinematic) will be used to place the property beacons demarcating the A2 holdings. A number of precautions will have to be undertaken in the field to ensure high accurate positional fixes of the beacons. The base station and rover should be set up on stable observation platforms and tripods should be used to stabilize plumbing poles. The surveyor should be wary of possible problems with loss of communication (radio link loss) between the base station and the rover. The surveyor can test this link by observation to an unknown point some distance from the base station and repeat this measurement at the end of the observation routine. In most instances, to achieve the radio link, the base station is placed on higher ground so that there is inter-visibility between the base and the rover. The communication between the receivers can be improved by using mobile Internet connectivity – although this is not yet possible in Zimbabwe. One can also use satellite communication as opposed to the radio link e.g. OMNISTAR in South Africa.

Some problems can be encountered when there is loss of lock at the rover especially when observing under trees with thick foliage. The solution may be to take multiple observations and averaging the computed position. The receiver's antenna may be placed near the ground to improve the field of view of the sky and receive more satellite signals. Another solution would be to place two or three marks in clearer locations, coordinate them using RTK techniques and then radiate or intersect the cadastral detail required using a total station or theodolite.

For title survey purposes, every property beacon requires an independent check. This can be achieved by using 3 receivers. Two of the receivers are set up at base stations (e.g. MC904 and MC858) in Figure 5 below. The surveyor or his assistant will then visit the farm beacons (M1 to M14) with the roving receiver. The two base stations have been used to provide independent check on the resulting GPS coordinates for each beacon. If the surveyor has only two receivers, then the base antenna will have to be moved to different control points and then the surveyor will revisit the farm beacons being fixed.

Figure 5. Surveying property beacons (adopted from Ses et al, 1999)



A number of surveyors have faced problems when what is planned on paper fails to agree from the field conditions due to the rudimentary surveying techniques alluded to earlier in this paper. As a result, a lot of time is spent adjudicating over boundary disputes at the expense of the execution of the cadastral surveying. On a positive note, surveyors have reported that the new farmers are very cooperative when efforts are being made to resolve the disparities between the boundary points on the plans and their actual position on the ground.

GPS survey records and legal considerations

The structure of GPS survey records is not regulated as compared to survey records compiled from conventional methods. According to Part VII of the Land Survey (General) Regulations, the survey records includes the original fieldbook, the computations, the report on survey, a working plan and any other documents the Surveyor-General may require. In this regard, survey practice directives and survey presentation formats need to be developed for the application of GPS techniques in cadastral surveys in Zimbabwe.

Fieldbook – booking

Section 10 of the Land Survey (General) Regulations outlines the contents of a fieldbook to be submitted with the survey records. Even though GPS measurements produce real time coordinates and all observations are logged on to the data collector file, the surveyor should still book certain information in a traditional fieldbook.

Figure 5 Sample Fieldbook

Base @ GPS1 (plcd. 12mm i. peg) H.A 1,442m 1/6/99					
Name		**Code**	**Ht. Antenna**	**Descr.**	**Fnd./Plcd**
GPS1 RO		RO	1,6	12mm. iron peg	Plcd
ND214		CHK	"	√	√
STAMP		FIX	1,6	10mm. iron peg	Plcd
Grid		CHK	"	Again	
ND119		FIX	2,0	12mm. iron peg & scattered cairn	Fnd
GPS1 RO		CHK	1,6	√	√

The fieldbook permits sketches, and for non-standard descriptions, writing may be quicker than typing to a small format non-QWERTY keyboard (Goodwin 2002). The fieldbook may contain the following information:

- The method used to perform the survey e.g. static or RTK
- Name and description of occupied or observed points
- Date of observations
- Purpose of the measurements e.g. FIX/CHK/RO
- The base station
- The height of base and roving antennas
- The measurements that have been derived from GPS observations

It is not mandatory in Zimbabwe to lodge electronic data associated with cadastral surveys. It is proposed that surveyors should archive and submit the data collection files (DCF) as part of the survey record – to minimize the doctoring of observations by unscrupulous surveyors should results be inconsistent. The DCF can be retrieved in the event that the integrity of the measurements and reduced data is ever questioned.

Report on survey

Hale et al (2006) recommends that the Report on Survey should include the following:

- Details of the equipment
- Process used to validate the equipment
- Indication of the integrity of the measurements
- Details of the base stations used and their coordinates
- The observation technique used
- The method of reduction and the software used
- A statement on the precision of the results
- The coordinates of the origin of the GPS datum control

Conclusion

The proposed method will not result in major changes to the existing principal legislation, however the survey regulations will need fine-tuning to be in sympathy with the use of GPS techniques in surveying A2 holdings for the 99-year lease exercise. Zimbabwe should work towards the establishment of a national GPS geodetic network to provide control for GPS based cadastral surveys. The DSG can draw lessons from the Australian experience where industry, academia, private sector and other stakeholders have joined hands in building a solid GPS infrastructure.

Detailed guidelines will have to be developed if the proposed GPS survey method is adopted to ensure a high degree of uniformity among the cadastral surveys. The guidelines will deal extensively with the errors that are inherent in GPS observations and how they can be minimised or prevented during observations. The guidelines will form the skeleton document for use by the Survey Regulations Board when considering the revision of the legislation regulating cadastral surveys in Zimbabwe.
In addressing land redistribution in developing countries, governments must put in place land distribution policies together with the appropriate survey techniques to be adopted for the different types of land tenure well before the onset of such exercises. Surveyors currently have to adjudicate over boundary disputes at the expense of the expediency of the carrying out the fieldwork. Countries such as South Africa and Namibia facing imminent people driven land reforms, can draw lessons from the Zimbabwean experience and put in place legal instruments that will promote the use of emerging technologies.

Acknowledgments

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The Status of the Cadastre and Land Management in Nigeria

By C. E. Oboli[8] and P. C. Nwilo[9]

Abstract

Existing maps in Nigeria are outdated due to poor funding. About 50% of the 1/50.000 maps were undertaken with the assistance of the United Kingdom and the Canadian technical assistance and they are over 30 years old. Out of the 120 urban centres and 774 Local Government headquarters in Nigeria, only 120 cities and 30 local government headquarters have up to date maps.

The land use decree which was promulgated in 1978 was aimed at harmonizing land tenure system in Nigeria and by extension streamline land registration. This however is not the case as the customary land owners have resisted this. Several experts and professional bodies have therefore called for a review.

Varied efforts to improve the cadastre in Nigeria are carried out at Federal and State level. The Federal Ministry of Housing and Urban development set up the Federal Land Information system (FELIS) project to computerize the Federal Land registry and all related activities. Similar effort is being made by Lagos State Government to convert to digital all attribute, land related data and scanning all existing survey plans. The Federal Capital territory (FCT) set up AbujaGIS (AGIS) to convert to digital format all private and public land records in the FCT. All these efforts are aimed at reducing the time spent in processing land transactions and will provide the necessary infrastructure for enhancing land administration and management in Nigeria. It will also enhance income generation.

Introduction

Cadastral survey and mapping is of critical importance in the development of the housing sector and housing delivery is high on the priority list of the programmes of the present government in Nigeria. The Survey plan produced from Cadastral Survey is needed for perfecting title on land, which in turn acts as collateral for loan or mortgage and security to land. In summary, Cadastral Survey leads to the production of survey plan which is used by the Town Planner, Land/Valuation Officer, Builder, Tax assessor, Allottees and Finance Houses. Also as-built survey plans are needed to facilitate the construction and maintenance of infrastructural and utility services in housing estates.

Status of Mapping in Nigeria

The current status of mapping in Nigeria is such that the existing maps are both out-dated and technologically out of fashion. More than 50% of the basic 1:50,000 topographical maps of the country were undertaken through the United Kingdom and Canadian technical assistance in the early seventies. Most of the cadastral data is obsolete. Out of more than 120 urban centres and 774 Local government Headquarters, less than 10 towns and 30 Local government areas have up-to-date maps and this poses daunting challenges in all development projects. Apart from a few towns in Cross River and Kano States and in the Federal Capital Territory (FCT), most other towns in the country have obsolete cadastral maps or none at all.
The current status of mapping in the country can be seen in the table overleaf:

8 Office of the Surveyor General of the Federation, Abuja-Nigeria
9 Department of Surveying & Geoinformatics, University of Lagos, Lagos, Nigeria

Table 1: Status of large scale urban mapping (as at 2002)

Urban Centre	State	Scale of Cadastral Mapping 1:1,000 1:2,000	Average Age of avail. maps (yrs)	Ortho-Photo and maps	Digital Base map	Area to be mapped sq. km	Cost Estimate (million =N=)	Remarks
Akure	Ondo	Large Scale	30	None	None	500	83.3625	
Jos	Plateau	"	"	"	"	750	125.0428	1991 attempt to be published
Awka	Anambra	"	"	"	"	500	83.3625	
Yola	Adamawa	"	"	"	"	500	83.3625	
Port-Harcourt	Rivers	"	"	"	"	1,500	250.0825	
Sokoto	Sokoto	"	"	"	"	500	83.3625	
Lagos	Lagos	"	"	"	"	2,000	333.45	
Kaduna	Kaduna	"	"	"	"	1,000	166.725	
Umuahia	Abia	"	"	"	"	500	83.3625	
Maiduguri	Borno	"	"	"	"	500	83.3625	
Uyo	Akwa Ibom	"	"	"	"	500	83.3625	
Birnin Kebbi	Kebbi	"	"	"	"	500	83.3625	
Asaba	Delta	"	"	"	"	500	83.3625	On going
Lokoja	Kogi	"	"	"	"	500	83.3625	
Owerri	Imo	"	"	"	"	500	83.3625	
Jalingo	Taraba	"	"	"	"	500	83.3625	
Kano	Kano	On-going-project	On-going-project	On-going-project	On-going-project	1,500	On-going project	Embarked upon by State Govt
Abeokuta	Ogun	Large Scale	30 Years	None	None	500	83.3625	
Makurdi	Benue	"	"	"	"	500	83.3625	
Ilorin	Kwara	"	"	"	"	500	83.3625	
Enugu	Enugu	"	"	"	"	1,000	166.725	
Gombe	Gombe	"	"	"	"	500	83.3625	
Calabar	Cross River		2 Years	Available	Available	500	Not known	Embarked upon by State
Katsina	Katsina	Large Scale	30 Years	None	None	500	83.3625	
Ado-Ekiti	Ekiti	"	"	"	"	500	83.3625	
Minna	Niger	"	"	"	"	500	83.3625	
Abakaliki	Ebonyi	"	"	"	"	500	83.3625	

Urban Centre	State	Scale of Cadastral Mapping 1:1,000 1:2,000	Average Age of avail. maps (yrs)	Ortho-Photo and maps	Digital Base map	Area to be mapped sq. km	Cost Estimate (million =N=)	Remarks
Damaturu	Yobe	"	"	"	"	500	83.3625	
Yenegoa	Bayelsa	"	"	"	"	500	83.3625	
Dutse	Jigawa	"	"	"	"	500	83.3625	
Osogbo	Osun	"	"	"	"	500	83.3625	
Lafia	Nassarawa	"	"	"	"	500	83.3625	
Ibadan	Oyo	"	"	"	"	1,500	250.0875	
Bauchi	Bauchi	"	"	"	"	500	83.3625	
Benin-City	Edo	"	"	"	"	500	83.3625	
Gusau	Zamfara	"	""	"	"	500	83.3625	
Aba	Abia	"	"	"	"	300	50.0175	
Zaria	Kaduna	"	"	"	"	300	50.0175	
Onitsha	Anambra	"	"	"	"	300	50.0175	
Gumel	Jigawa	"	"	"	"	300	50.0175	
Wukari	Taraba	"	"	"	"	300	50.0175	
Shendam	Plateau	"	"	"	"	300	50.0175	
Ile-Ife	Osun	"	"	"	"	300	50.0175	
Gboko	Benue	"	"	"	"	300	50.0175	
Warri	Delta	"	"	"	"	300	50.0175	
Ijebu-Ode	Ogun	"	"	"	"	300	50.0175	
Kaura Namo-da	Sokoto	"	"	"	"	300	50.0175	
Afikpo	Ebonyi	"	"	"	"	300	50.0175	
Malumfashi	Katsina	"	"	"	"	300	50.0175	
Okitipupa	Ondo	"	"	"	"	300	50.0175	
Eket	Akwa Ibom	"	"	"	"	300	50.0175	

Factors Responsible for the Present Status

The present status of inadequate and obsolete maps in the country can be ascribed to various factors ranging from lack of map appreciation to poor funding and poor technology. These facts are factors are elaborated below:

a) The Surveying and Mapping Organizations are where they are today in Nigeria because of low priority given to the sector in the scheme of things. The sector has not attracted the required level of funding for manpower development, equipment purchase and production of the required map and geodata.

b) The Nigerian Society has not appreciated the immense advantages that geodata has to offer. Map use Culture is poor.

c) Geo-information (Surveying and Mapping) is technology driven and the technology is dynamic. Nigeria has been inactive in this area for over a decade. A period of six months is a long time on this dynamic technology time scale. Data acquisition methods have changed a great deal.
   - Data to information conversion tools have changed.
   - Information analysis tools have changed.
   - Data output and retrieval tools have changed.
   - Information maintenance and use to the society have changed and have improved greatly.

d) Funds meant for the surveying and mapping sector seemed to have been diffused to other sectors, which acquire sub-standard geo-data for themselves in uncoordinated manners.

e) Bureaucracy and lack of full appreciation of geo-data products

f) Poorly - motivated professionals, technologists and technicians, are working in various surveying and mapping organizations nationwide.

Mapping Operations

In Nigeria the procedure for maintaining the Cadastre has been the keeping of records, maps and data in files and cards in analog format. Data storage and retrieval is manual this does not help the updating of records. Records on land are only available for people with transactions. Therefore unregistered parcels have little or no documented information. Many survey offices lack equipment and facilities required for the necessary tasks even when some trained personnel are available.

Cadastral Surveying of Federal land holdings in Nigeria, is carried out under the Cadastral Survey Unit in the Federal Ministry of Housing and Urban Development. This arrangement has not helped production as there are bottlenecks created by bureaucracy in the system. Unlike in some other African countries, e.g. Republic of Benin, Niger, Ethiopia, Cameroun South Africa and Egypt have mapping organizations that are semi-autonomous and this reduces the bottlenecks since there is some measure of independence. The institutional framework is now being addressed with the establishment of the Office of the Surveyor General of the Federation (OSGOF) nearly a year ago, which is semi-autonomous. The OSGOF is now grappling with teething problems of the initial take off. It is hoped that the OSGOF will fully take of this year.

There is an ongoing effort to convert all 1/50,000 topographic maps sheets to digital formats. It is hoped that these will soon be completed. Also it is hoped that in 2007, these maps will also be updated using satellite imageries. With Nigeriasat1 imageries some of the changes of features such as roads and rivers could be updated. The other updates could be done using spot 5 imageries.

Efforts at improving cadastral records in Nigeria

There are efforts at improving the Cadastre in some parts of the country. Examples can be seen in Lagos State and Abuja FCT. In Lagos State all records pertaining to titles on landed properties for urban lands where documentation exists have been converted to digital format and the Land Registry has completed computerization of their records. Transactions in land in Lagos state are now very easily done and a lot of income is generated from land matters. There is a saying in Lagos state that although it does not have minerals, the state has prime lands and so considers land transactions as her own oil.

In Federal Capital Territory (FCT), the Abuja Geographic Information system (AGIS) was set up in 2004 to serve as a Spatial Data infrastructure for Abuja. This AGIS would assist in conflict resolution in plot allocation and innovation in land registration. All manually registered properties in the Federal Capital Territory of Abuja have all been re-registered under a programme to computerize the registration of lands in Abuja. The old certificate of occupancies had to be returned and new ones provided. This had to be done within a stipulated time frame. This project paid for itself as all land owners paid for the registration.

Land Management in Nigeria

Prior to the Land Use Act of 1978 two systems of land tenure were operated in Nigeria. A form of freehold system in the South where individuals, clans, families, communities held land as private properties whereas in the north all the land was held in trust for the community by the traditional leader usually the Emir and given out by leasehold through customary rights or the government. There was no absolute land ownership. The Land Use Act of 1978 was promulgated to streamline land administration and by extension harmonize land registration practice in the country. It was easier for government to acquire land in the North since it was not owned by many individuals unlike in the South. The introduction of the Land Use Act increased the demand for registration of titles since people became conscious of the need to register their interests in land. Thus it brought about the need for surveyors but the processes of land registration are slow and costly. So there is need for reforms to improve the system.

In Nigeria, data for land registration and management is spread between several government departments leading to delay in flow of information and data duplication. Different types of survey products such as acquisition, layout and perimeter surveys, as-built; sub-division and topographical surveys are needed to produce survey plans. These are in turn needed for land use planning, land management and administration and inevitably for processing of titles. All these in addition to the administrative data need to be stored in a database.

Constraints

The situation we find ourselves is an accumulation of grave planlessness over the years, misplacement of priorities and deliberate oversight of the need for basic land administration, infrastructures upon which sustainable development anchors, and neglect of best practices. The absence of up-to-date base maps in many parts of the country to facilitate charting of survey plans for title registration and for Land administration had made land management in Nigeria stressful.
In addition the following have also contributed to the situation:

- lack of continuity in governance due to the long Military rule,
- lack of sound policies to support housing delivery,
- Non-implementation and monitoring of planning policies.

Way Forward

The effort of the Ministry of Housing and Urban Development in acquiring the state-of-the-art surveying equipment at the Head-quarters is a step in the right direction- the use of the equipment will go a long way in drastically reducing the time spent in data acquisition and product generation. More of such equipment will be required for the field offices in order to expedite surveying projects. These will rub-off positively in land acquisition and hitch-free land titling.

The Ministry of Housing and Urban Development has undertaken the re-organization and computerization of the Federal Lands Registry under the Phase I of the Felis project. This will no doubt aid land administration and management. The system when it becomes fully operational is capable of boosting the national economy and paving the way for compulsory land registration. The Ministry recently signed a Memorandum of Understanding (MOU) with Her Majesty's Land Registry (HMLR). The benefits of this collaborative relationship include:

i) British government through International Development Agencies will provide technical and financial support for improvement of land administration in Nigeria;
ii) The application of uniform standards will protect the rights of citizens in respect of their interest in land; and

iii) The preparation of a cadastral map through pilot schemes which will be required for land titling, certification and a good land registration system
iv) The creation of conditions to provide the International community with the confidence to pursue investment in Nigeria.

As part of re-engineering land administration, township and cadastral mapping need to be given the serious attention they deserve. There is the need for the government to evolve and package a means of financing this basic infrastructure which has the potential to generate revenue enough to support itself and re-invigorate the economy.

Conclusions and Recommendations

Recommendations

Given the enormity of the surveying and mapping tasks to be tackled by the OSGOF (none of its printed maps is less than 30 years old), there is an urgent need to address the problems. The following recommendations are therefore made towards ameliorating the situation:

- Government should consider the establishment of a Cadastral Survey and Mapping Bureau which would be properly funded and equipped with modern equipment, infrastructure and skilled manpower to execute the task of Cadastral survey and mapping in the country.
- If this bureau is set up, one of its first assignments would be to create and maintain a digital database for the whole country. A Cadastral Information database can be created to solve this problem. In this way various agencies would be able to share the data as it would facilitate data exchange. A Cadastral GIS would streamline the procedures of land allocation, distribution and general management of land as is the case in Botswana and facilitate access to land by the government for development projects. The multiplier effect will include the mortgage and finance sector as the citizenry will have more confidence in making transactions in land.
- Government at Federal and State Levels should commit reasonable funding to mapping of state capitals and major cities in line with what the Cross River and Kano states have done and what is currently been done by Delta Rivers and Anambra States.
- State governments should adopt the kind of policy adopted the Federal Capital Territory Administration by computerizing land registration and management in states.

Conclusion

We have tried to review the state of land administration in Nigeria, highlighting the long Military rule in Nigeria, instability of government and poor funding contributed to the present state of poor mapping culture in Nigeria. Also, the Survey Department being part of the Federal Ministry of Works had its own adverse effects as more money was put into or veered to more visible projects in the Ministry such as highway projects.

The establishment of the Office of the Surveyor General of the Federation as a Semi-autonomous Unit is believed to be a panacea for improvement. In addition, efforts of the Federal Ministry of Housing and Urban Development in computerizing the Federal Land Registry are efforts in the right direction.

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Cadastral Reform, Property Rights Implementation and Land Management Systems in the Knowledge Economy

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Natural Resources Canada

Abstract

Many of the concepts regarding cadastral reform are now becoming well known. New systems are being designed for implementation for African governments that have the potential to boost economies and provide tools for land management and environmental protection. The capability exists within Africa, but the ways and means are not always available. This paper attempts to shed some light on the rationale needed to convince governments, communities and individuals of the advantages of individual property rights and effective land tenure systems. Essential to the success of any cadastral reform project is sustainability over the long term. This paper discusses how sustainable cadastral reform projects, in a low e-ready environment, can be supported through land information technology.

Introduction

Each culture has a relationship with the land which has developed over generations and is deeply ingrained within the community. The rules and customs that define how land is dealt with make up the land tenure system for the community. Land tenure is the right to use, occupy or dispose of land, and runs the continuum of rights from full ownership to the right to merely use a parcel of land for a specific purpose for a specific period.

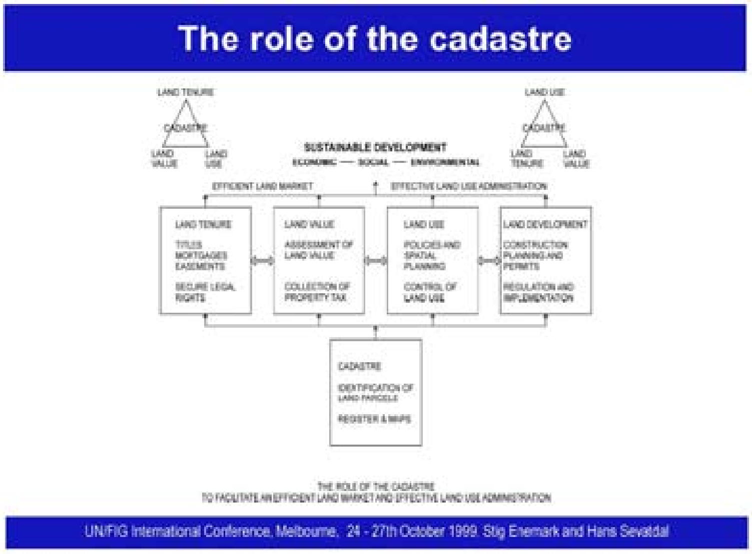
The origin of the current African context is customary law. The exclusive nature of property rights is alien to the traditional processes throughout in much of Africa. Although African communities utilize a wide of variety land management practices, they share certain fundamental approaches. A large portion of African land use is primarily based on agriculture and husbandry; this practice has been developed through collective community processes drawn from customary, tribal or family relationships. Many current land tenure systems do not recognize private proprietary rights, but rather community resource rights. All resources belong to everyone and they are regulated by the community's cultural and local knowledge systems and practices. Land ownership has been collective with individuals having communal rights to the land. Small-time farmers constitute one of Africa's most important groups with respect to the impact of land reform projects. They have abundant knowledge of the natural resource environment and, given sufficient investment, can substantially increase and diversify natural resource management practices.

There is growing pressure on African governments to adopt land reform initiatives that recognize the property rights of individuals. A great deal of information is being delivered to the African nations with respect to the advantages that can accrue should they decide to adopt property rights systems based on individual land ownership. There is, however, little information on just how this should be accomplished. With the origin of much of the African experience residing in customary law, the move away from traditional communal or tribal land holdings to individual property rights is not a simple task.

Governance

Distribution of land rights is one of the most difficult issues to be addressed by any government. The success of governments can often be measured on the basis of promises made regarding the distribution of land rights. The success of these types of initiatives has varied greatly.

It is beyond the scope of this paper to suggest recommendations to governments on how land rights should be distributed within a country. There are, however, a great many examples where land reform initiatives have failed because they were not sustainable. The best solution is to offer options from which the proper authorities can make informed decisions. Once these choices are made, however, there is much that can be done to build, augment and leverage the capacity to operate these systems in a sustainable manner.



Security of Land Tenure

Investment and risk can be directly linked to the security of land tenure: the more secure the title, the more secure the investment. Reducing or minimizing risk will increase the potential for greater benefits as individuals are more willing to invest resources in economic development activities.

The effectiveness of land reform initiatives has varied widely and this has resulted in increased uncertainty which makes attracting investment difficult and is indicative of a lack of progress in comparison to other economies. The establishment of strong, viable individual based property rights systems can, however, encourage entrepreneurial practices that will bring about sustainable development and increase production in a wide variety of natural resource sectors.

Rationale

Establishing land tenure and maintaining a property rights system are fundamental roles of government. Yet, in practice, it is often difficult to isolate and measure the contribution of land tenure systems. The systems increase certainty of ownership which will increase the investment made in property. Capital markets will improve through access to credit and the value of land will increase. Resource exploration will increase because of the security of land and resource markets and this will have an impact on the tax base and royalties contributions. Land disputes are reduced.

Land investors see reduced risk in development, reduced transaction costs, and less ignorance of environmental responsibilities. Efficient land tenure promotes effective governance. The table below shows how the various influences on property rights systems are interrelated:

Land Management and the Impacts of Land Survey and Registration Systems

	Economic Growth	Contribution to a Culture and Social Development	Environmental Management
Individual holder of land rights	- Provides certainty and stability - Increases investment in property and resource exploitation - Increases access to capital - Improves land markets - Assists in resource exploration - Basis for royalties	- Protects interests in lands and culture - Reduces disputes and defuses social tensions - Promotes social justice and equity - Incorporates cultural sensitivity - Increases employment opportunities	- Assists environmental management and conservation activities - Assists land use planning and control
Land Investor	- Reduces risk of land and resource development - Reduces transaction costs of land and resource development		- Basis for understanding environmental responsibilities
Governance	- Promotes economic development - Basis for taxation - Increases international competitiveness	- Provides social services - Supports self governance - Aids self sufficiency - Establishes sovereignty and national identity	- Assists environmental management and conservation activities - Assists land use planning and control

Implementation Issues

Policy analysis and development of land reform initiatives tend to focus on analysis of the creation of a land tenure system and ignore the issues of implementation. In any analysis, evaluating the capacity to implement and determining that the appropriate resources will be available to implement and maintain cadastral reform systems are as critical as designing the property rights system.

The capability exists within the African community to develop and recommend the changes that are necessary to create an evolution in land concepts. What perhaps is not so readily available is the capacity to do so. It is essential that along with the design of a land management system, the ways and means must be increased or leveraged at the same time. The success of any land reform undertaken will be dependent upon the design, beginning at a point from which the existing systems can evolve in a sustainable manner.

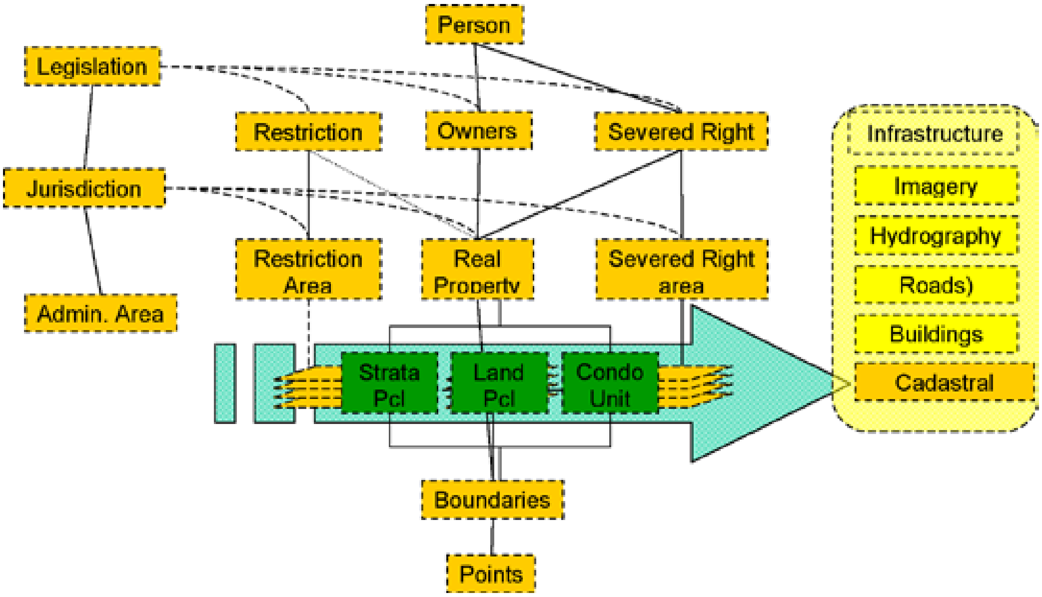
Canadian First Nation Experience

In the earliest days of European settlement of North America, the most efficient method of gathering information about the land before settlement was through the use of land surveyors and the production of cadastral information. For example, in Canada, extensive reports on the quality of the land were required as the initial township surveys were completed. This resulted in a build up of not only the cadastral information that dictated the settlement patterns, but also the link of spatially-related information to the cadastral fabric. Even today, much of the large scale mapping of the country shows the fundamental cadastral layers.

Land management by Aboriginal "First Nations" in Canada is limited by legislation and the policies of the federal government. In order to protect federal land that has been set aside by treaty for the exclusive use of First Nations, controls are in place to regulate who can sell, dispose of or buy First Nation lands. Control of much of the land that has been set aside for their collective use (customary property) is in the hands of First Nation band or tribal councils. There are lands held as individual property holdings that are similar, but not equivalent, to fee simple title under the English-based system. This creates a level of uncertainly in the land tenure system that directly impacts the ability of First Nations to maintain a level of security needed to attract outside investment and credit.

The Canadian First Nation requirements of property rights systems vary widely. There is no homogenous thread that can be attributed to the communities that would reflect a single system. The lands vary from urban reserves to community lands set aside for agriculture or traditional activities. In a study produced for the Centre for Cadastral Management of Natural Resources Canada, the Centre for Property Studies at the University of New Brunswick recommended that a menu of rights be established from which First Nations could select, based on the requirements that best met individual First Nation needs. The diagram below illustrates the land tenure system that the Canada Centre for Cadastral Management is suggesting for use by Canada's First Nations.

First Nation Land Tenure Structure



The resulting land tenure systems could be unique to each First Nation, determined by the needs of the community to monitor and control land use, their desire to promote natural resource development, the need to protect traditional activities, the need for exclusive possession, claims of Aboriginal Title and the need for outside investment.

Canada is in the midst of proposing a process that would permit First Nations to opt out of the Indian Act in favour of a self-administered property rights system. Under this system, a First Nation would be able to manage its own lands without the approval of the Minister of Indian and Northern Affairs. The responsibilities of the First Nation and Band member would be described in a land code which would set out the powers and rights of an owner in relation to the land.

Property Rights and Cadastral Reform

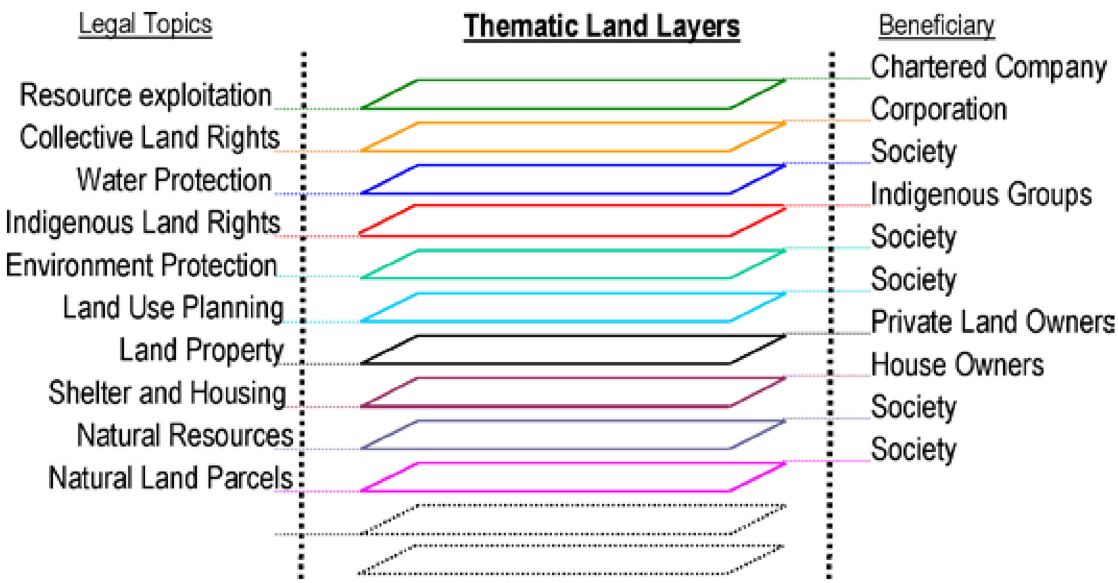
There are many common cadastral reform elements between what is needed by the First Nations in Canada and what is needed by many of the jurisdictions of the African continent. It must be stated, however, that drawing parallels between diverse economies, cultures and social structures and then extrapolating solutions is difficult. At best, the lessons learned and the derived best practices from the implementation of a land tenure system in one jurisdiction can be tested within another jurisdiction to evaluate the results.

It is with hesitation that any recommendation should go forward purporting to be the universal solution to cadastral reform.

Implementation

The diagram below represents a continuum of jurisdictional responsibilities, laws, rights and ownership, the extent of which can be related, in space, to the existing physical infrastructure such as roads, buildings, electrical grids, etc. This also provides a point of beginning from which existing property rights can evolve along the continuum of property rights and overall land tenure systems.

Data Base Design Concept



As noted in the previous diagram concerning the First Nation Land Tenure Structure, a benefit of the integrated cadastral management model is the use of the cadastre as the foundation for integrating large amounts of thematic information not directly related to property rights. The common thread is thematically layered data sets that are spatially aligned. The cadastral fabric is aligned by the coordinate structure and the road network. The road network can then be associated, by its spatial relationship, with other thematic information.

The occupation and use of the physical infrastructure is a good point of beginning when ownership and possession are evidence of an existing individual property right. This is in direct contrast to the system being proposed for Canada's First Nations; nevertheless, the latter can be made an equally viable approach.

It is from this point that options for individual property rights, land registry and surveying must be assessed. If need be, incremental steps can be implemented to allow for increasingly higher levels of registration of rights and more rigorous determination of the extent of those rights. Eventually, there needs to be a focus on property, the parcel and the cadastral fabric. Surveying and land registration identify the parcel on the ground to which the legal rights apply, and ensure that the rights are recorded so that both the holder of the rights and the wider community are given notice of the land tenure. Systems of surveys and of registry can evolve from the creation of these databases. While there is no universal solution to cadastral reform, all approaches must be flexible enough to permit the evolution of property systems as the cultural, social and economic situations dictate.

Technology

Despite the relative low e-readiness in many African jurisdictions, today's technology will permit many to leap over numerous steps taken in the initial development of land information systems in North America.

There is a clear trend to make today's automated technology more user-friendly. Much of the complexity of these systems will be hidden and transparent to the user and the user/computer interface is becoming more intuitive. This will mean that land planning specialists or infrastructure managers will not also have to be GIS experts in addition to their land management expertise.
The technology that is available today permits the gathering of large amounts or spatially-related information at very little cost, in comparison with the first European land surveyors that were employed to gather land related information in the western hemisphere.

It is now possible for Africa to take advantage of the developing cellular communications systems which require much less infrastructure to capture, store, analyse and disseminate large amounts of data. It is now possible to maintain the complex automated systems through call centre concept technology and retain the data locally to facilitate decision-making. Africa is much better placed to take advantage of these new systems than certain western nations that are becoming confined by the use of outdated technology which is increasingly expensive to maintain and convert.

Conclusion

It is clear that the knowledge of cadastral systems exists within Africa, yet, what is not available is the wider knowledge of the contribution these systems can make within the African cultures and economies. This is perhaps the most difficult challenge. The property rights systems should evolve from the current system based on communal and tribal relationships to one which is base on individual ownership and for exclusive use. The capacity to implement these systems must be further supported and augmented by leveraging and using what economies of scale are available. Up-to-date mapping will be essential to any move towards sustainable systems. Current infrastructure can be use to map out and reference existing property limits. The use of spatially related information will also permit electronic systems to efficiently maintain property rights information.

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Contribution aux problématiques de réforme foncière et d'élaboration d'outils de gestion en Afrique : cartographie et système d'information

By Landing MANE and Seydou CAMARA, SAED

Introduction

Après avoir essayé un développement administré dans le cadre d'une planification centralisée, nombre de pays africains initient, aujourd'hui, des politiques de décentralisation et de développement local pour aborder autrement le développement.

Dans le domaine particulier de la gestion foncière, le développement administré a souvent abouti à des lois et règlements insuffisants ou très peu appliqués, laissant s'exprimer de nombreux conflits entre usagers et installant l'insécurité des droits et des usages au niveau de tous les types de foncier (rural, urbain, classé, etc.).

Ainsi, les processus de réforme foncière et d'élaboration d'outils de gestion en cours visent la sécurisation des acteurs : sécurisation des usages, sécurisation des droits ou les deux à la fois.

Qu'il s'agisse d'identifier les différents usages et les acteurs qui les pratiquent, les différents droits et les acteurs qui les détiennent, les zones ou les parcelles qui font l'objet de conflits ou encore matérialiser des choix consensuels retenus, la cartographie peut et doit intervenir comme un puissant outil de clarification, de connaissance et d'aide à la prise de décisions.

Ceci est encore plus intéressant pour le foncier rural qui fait l'objet de préoccupations accrues de la part des réformateurs eu égard à l'option (toujours largement partagée en Afrique) selon laquelle l'agriculture doit être la base du développement. C'est au niveau de ce type de foncier, objet de notre analyse, que le problème de la cartographie dans la mise en place de SIF s'avère être le plus le complexe ou délicat, mais aussi le plus intéressant. En effet, c'est à ce niveau :

- que les lois sont les plus ignorées,
- que les coutumes sont plus prégnantes avec une forte base sociale,
- que des pratiques nouvelles et non reconnues d'accès aux terres ont émergé pour,
- qu'un marché foncier souterrain se développe en contournant la loi ou en l'ignorant,
- que les problèmes environnementaux se posent le plus directement par rapport à la terre,
- que les conflits à propos de limites de parcelles (et même de frontières entre territoires),
- que des affectations, de différents droits ou de différents usages aboutissent à des actes de violence.

Nous voulons, à travers cet article, rendre compte de l'expérience d'utilisation de la cartographie dans le processus actuel de mise en place d'outils de gestion foncière et de constitution d'un SIF dans le contexte sénégalais de la vallée du fleuve Sénégal (VFS) en la comparant avec celles des autres pays ouest africains. Nos réflexions sont largement inspirées par l'élaboration des Plan d'Occupation et d'Affectation des Sols initiées par la Société Nationale d'Aménagement des Eaux et des terres du Delta (SAED) en partenariat avec les Conseils Ruraux de la VFS. Ces POAS sont un exemple de démarche utilisant une cartographie participative pour faciliter la concertation entre acteurs et les amener à produire des consensus sur les usages et des règles de gestion efficaces, applicables par ces instances locales (les CR).

Les Dynamiques Foncières Actuelles en Afrique

Aujourd'hui, les politiques de décentralisation initiées dans plusieurs pays africains impliquent la recherche d'une gestion décentralisée du foncier. En fonction des différences historiques, de l'intensité des conflits, de l'existence préalable ou non de lois et règlements, des processus sont déroulés pour rechercher une sécurisation foncière. A travers ces processus, plutôt participatifs, on tente de réconcilier le légal et le légitime, de rapprocher des lois peu utilisées à des pratiques non reconnues. Généralement aussi, ces processus vont avec la mise en place d'outils de gestion foncière visant à sécuriser les usages, sinon les droits. Derrière toutes ces constructions, l'objectif poursuivi est l'adoption d'un régime foncier «modernisé» avec des lois et des règlements applicables.

L'analyse des différentes expériences permet, malgré la différence des contextes historiques, politiques et institutionnels, de retrouver des éléments transversaux concernant les objectifs, les contenus et les formes des projets de réforme foncière et d'élaboration d'outils de gestion.

Les Coutumes et Réformes Foncières

Les droits initiaux sur les terres relèvent des coutumes qui confèrent le contrôle direct (droit réel) de certaines terres à des chefferies, consacrent (quelques fois) des zones de propriété collective exploitées par usufruit et des terres sacrées, etc. A ces droits coutumiers correspond une gestion foncière organisant la pratique des différents usages (élevage, cultures, etc.) et les possibilités de redistribution des droits.

A l'avènement des indépendances les gouvernements ont affirmé une volonté politique de remettre en cause les droits coutumiers au profit de l'Etat et pour un accès plus équitable des citoyens à la terre. Quelques fois ces premières réformes se sont appuyées sur une législation coloniale également pré existante.

Au Sénégal, l'élément essentiel de la loi du domaine national (LDN) promulguée en 1964 est la définition d'un domaine national[10] (plus de 90% du territoire) disposant que la terre est un patrimoine commun inaliénable dont on ne peut s'approprier qu'au prix d'une longue procédure étroitement contrôlée par l'Etat. Le domaine national est divisé en quatre zones : les zone de terroir (terres « régulièrement exploitées pour l'habitat, les cultures et l'élevage" - 60% du domaine national), les zones classées (forêts, réserves, etc., avec un régime particulier de protection, les zones pionnières (terres délimitées, par décret, en faveur de l'Etat et devant abriter des projets de développement, les zones urbaines (terres du domaine national situées dans les territoires des communes).

La gestion des zones de terroir est confiée à des Conseils Ruraux (CR) mis en place par la loi sur la décentralisation de 1972. Ces conseils composés d'élus et bénéficiant du statut de personne morale dotée de l'autonomie de gestion dirigent les communautés rurales (*«un certain nombre de villages appartenant au même terroir, capables de trouver les ressources nécessaires à leur développement»*). Ils affectent des droits d'usage aux résidents selon leur capacité à les exploiter.

Aujourd'hui, on a fini de constater que ces lois sont, non seulement, très peu appliquées (résistance des coutumes, défaut d'outils de gestion foncière, pauvreté des services fonciers), mais posent des problèmes en rapport avec les exigences du développement économique actuel en rapport avec la mondialisation, les nouveaux besoins des économies nationales et, par conséquent, la nécessité de les réformer et d'outiller les instances en charge de la gestion foncière.

Ainsi, une deuxième génération de réformes est mise en œuvre un peu partout avec le soutien, plus ou moins appuyé, de la Banque Mondiale ou d'autres bailleurs de fonds.

- En Côte d'Ivoire une nouvelle loi sur le domaine foncier rural est adoptée en 1998 pour remplacer la législation héritée de la colonisation. Une opération test de délimitation des terroirs villageois est en cours. Il est prévu, par la suite, de valider les droits acquis selon les coutumes par des titres de propriété. La loi n'est donc pas encore appliquée.
- A Madagascar un Programme National Foncier a mis en place des guichets fonciers pour exécuter les procédures

10 A côté du domaine privé de l'Etat, du domaine public de l'Etat et des terres privées (titres fonciers existants avant l'indépendance en vertu du droit colonial)

d'immatriculation des terres au niveau des communautés locales qu'on cherche à impliquer dans la gestion foncière. Préalablement, des commissions locales d'identification et de reconnaissance des occupations sur terrain émet des procès verbaux à partir desquels les guichets fonciers établissent des certificats fonciers validés par le Maire après une procédure d'affichage. Le processus intègre la mise en place de Plans Locaux d'Occupation Foncière (PLOF) comme outil de la gestion communale.

- Au Niger des principes d'orientation d'un code rural sont adoptés en 1993. Le code qui sera élaboré à travers un processus pragmatique, participatif et itératif a comme principaux axes la sécurisation des acteurs ruraux, l'organisation du monde rural, la gestion durable des ressources naturelles et l'aménagement du territoire. Il sera associer à la politique de décentralisation déjà mise en place.
- Au Bénin des plans fonciers Ruraux au niveau des collectivités locales se réalisent avec une démarche systématique d'identification des droits pour établir des certificats fonciers individuel ou collectif traduisant une reconnaissance légale et un droit réel (transmissible et cessible). Une procédure simplifiée de passage du certificat foncier au titre foncier est créée avec, cependant, une obligation de mise en valeur sous peine de mise en bail forcé, après 10 ans de carence.
- Au Sénégal un plan d'actions foncier élaboré en 1996 a identifié trois scénarii : le statut quo (LDN), l'option libéral (privatisation complète des terres) et l'option mixte (intermédiaire) permettant une privatisation partielle des terres des zones de terroir. Le débat ouvert, par la suite, a permis aux acteurs sociaux du monde rural (Association Nationale des Conseillers Ruraux et Conseil National de Concertation et de Coopération des Ruraux) de montrer leur préférence pour l'option mixte; les acteurs non ruraux (patronat, ministères, etc.) ont signalé un désir de faire tenir en compte leurs intérêts. Il faut dire que la position des autorités coutumières est, relativement, contenue dans celle de l'association des conseillers ruraux dont le personnel est composé, dans une large mesure, de leurs représentants. Jusqu'ici, la plan n'a pas été soumis à l'assemblée nationale pour adoption du fait de la grande sensibilité sociale et politique du dossier.

Mais, dans une Loi d'Orientation Agro – Sylvo – Pastorale (LOASP) votée en 2004 après une longue concertation avec tous les acteurs ruraux, s'engage à préparer une loi de réforme foncière sécurisant l'agriculture familiale, favorisant sa modernisation et l'incitant à l'investissement privé dans l'agriculture. Parmi les principes retenus figurent la cessibilité encadrée de la terre, leur transmissibilité successorale et la reconnaissance du pastoralisme comme mode de mise en valeur.
Depuis 1996 une deuxième loi d'approfondissement de la décentralisation a transféré aux CR des pouvoirs nouveaux dont la gestion des ressources naturelles, l'aménagement du territoire, le développement économique.

Partant de cette loi la SAED a initiée dans la VFS, en partenariat avec les CR et d'autres acteurs (administration territoriale, institut de recherche, université, services techniques locaux), une expérience d'élaboration et de mise en œuvre d'outils de gestion foncière: les Plans d'Occupation et d'Affectation des Sols (POAS) et la Charte du Domaine Irrigué (CDI).

Les Contenus et les Modes d'Elaboration des Projets de Réforme

On note, à travers la revue des expériences, des éléments transversaux dont il faut tenir compte dans la réforme foncière et l'élaboration d'outils de gestion.

- Il ressort que les réformes doivent il est traiter minutieusement les rapports entre l'agriculture familiale des autochtones et l'agriculture commerciale (ou agro-industrie) relevant, majoritairement, d'investisseurs allochtones.
- Quels que soient les problèmes juridiques et institutionnels des marchés fonciers sou jacents, et quelques fois apparents existent dans la réalité.
- Il apparaît une capacité locale à définir ou redéfinir des règles de gestion des usages et des droits fonciers ; ce qui recouvre un enjeu de proximité, de contrôle local, de simplicité et d'efficience
- Quel que soit le type de sécurisation recherché il est d'usage de dérouler un processus (plus ou moins long) de consultations/concertations pour associer les populations et les instances locales à l'orientation, la mise en place et l'exécution des

politiques de gestion foncière. On constate diverses formes d'articulation entre l'élaboration des lois d'une part, la mise en place d'outils et la démarche participative d'autre part : consultations puis loi ou loi d'orientation puis consultation ou processus parallèles et simultanées.
- Partout, les projets de réforme ont une articulation forte avec la décentralisation.
- Une nouvelle forme de droit réel, le « certificats fonciers » individuel ou collectif, assure la sécurité foncière et constitue une solution suffisante pour la majorité des ruraux.

Le SIF et ses Composantes

La planification du développement exige une clarification des situations foncières. Dans ce cadre, il est primordial d'avoir une cartographie fiable, des informations d'ordre sociale, économique et juridique sur le foncier, une gestion rigoureuse de l'outil cartographique et des données socio-économiques. Tout cela peut se présenter sous forme d'un Système d'Information Foncière (SIF) qui doit avoir, au moins, trois composantes : une Base de Données (BdD), un Système d'Information Géographique (SIG) et un plan cadastral actualisables.

La Base de Données (BdD)

Il s'agit de BdD socio – économique pouvant s'intégrer dans un Système de Gestion de Base de Données Relationnel (SGBDR). Ce type de système permet le stockage, la gestion et l'analyse des informations attributaires d'ordre techniques et socio-économiques relatives à un espace géographique donné. Dans la BdD, les informations sont constituées d'un ensemble de tables qui sont reliées par un système d'identification unique (clé). La base de données qui est le support indispensable pour la production de statistiques peut être interrogé à travers des requêtes (SQL).

Concernant la base donnée foncière l'essentielle de ces informations viendrait du Livre Foncier. L'architecture du modèle logique du Système de base de données foncière doit donc tenir compte du type d'informations consignées dans le Livre Foncier. D'habitude, ces informations tournent autour du bâti, du parcellaire, la localisation, le périmètre, l'occupation des sols, la mise en valeur, les droits d'usage, l'impôt, les taxes, etc. Il est indispensable que ces informations soient exhaustives mais aussi de qualité.

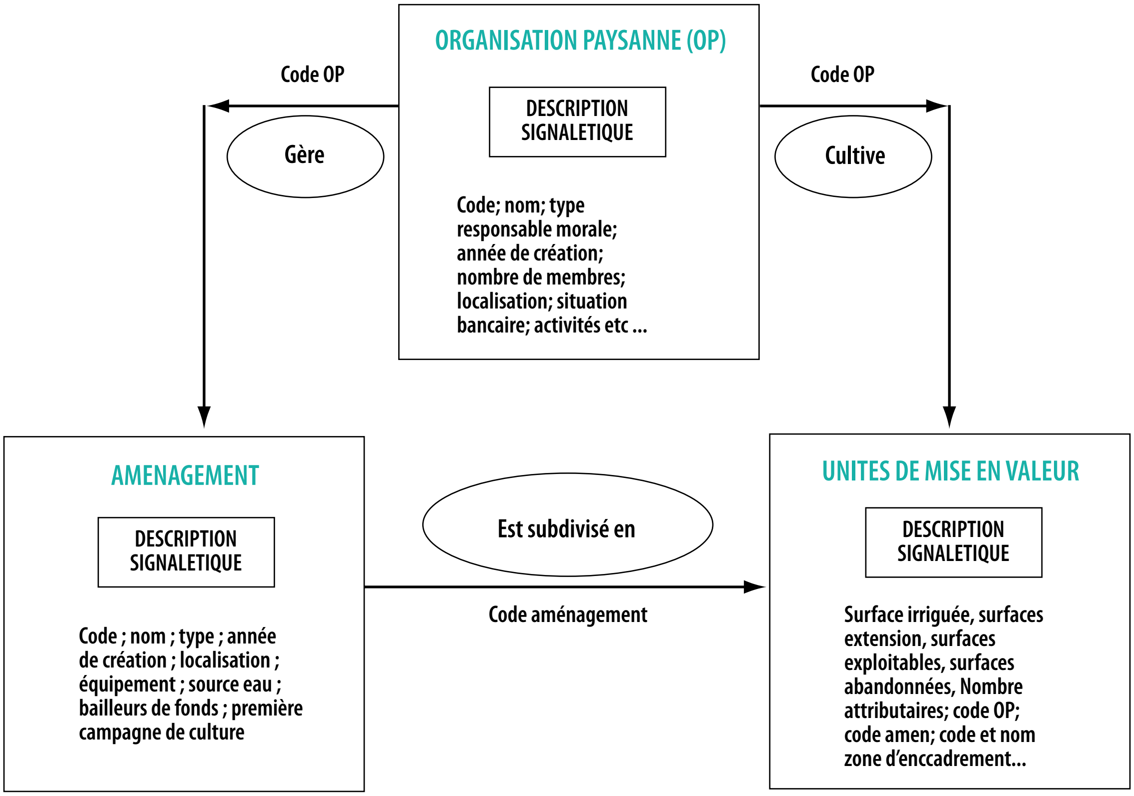
Partant des informations contenues dans le Livre foncier, un Modèle Conceptuel de Données (MCD) est programmé dans l'environnement d'un programme informatique de gestion de base de données. Après le logiciel ACCESS de Microsoft qui a constitué pendant très longtemps à travers le monde la référence en matière de gestion et d'exploitation de base de données, d'autres programmes informatiques sont en train de faire leur preuve d'opérationnalité. C'est le cas avec le programme ORACLE qui malgré sa complexité, dispose d'un environnement complet et sécurisé pour une gestion optimale de Base de données. Ce programme est conçu pour une gestion d'une masse de données diverses.

Dans les pays en développement, particulièrement en Afrique, la gestion du foncier étant souvent à la charge de services techniques peu équipés, avec un personnel peu qualifié, il serait plus raisonnable d'opter pour l'utilisation des systèmes moins lourds, peu compliqués et performants.

Dans la vallée du fleuve Sénégal, la Base de données socio-économiques mise en place par la (SAED) a évolué de l'environnement informatique D BASE III, FoxPro vers ACCES de Microsoft. Actuellement, une réflexion est en cours pour la faire migrer d'ACCESS vers ORACLE. Cette BdD a une organisation tripolaire des unités d'observation et de suivi : les unités sociales (regroupant les divers acteurs du développement), les unités géographiques spatialisées (essentiellement à caractère hydraulique) et le croisement des deux types précédents avec les parcelles attribuées aux acteurs (Passouant et al., 2000). En interrogeant cette base de données par le biais des requêtes, il est possible d'avoir une information synthétique sur la situation foncière, sociale et économique des différents acteurs privées ou publics, etc.

La liaison entre la Base de données foncière et le Système d'Informations Géographiques permet de visualiser ou de spatialiser des informations variées et multi-sources contenues dans le Livre foncier.

Figure 1 : Modèle conceptuel de base de données de la vallée du Fleuve Sénégal

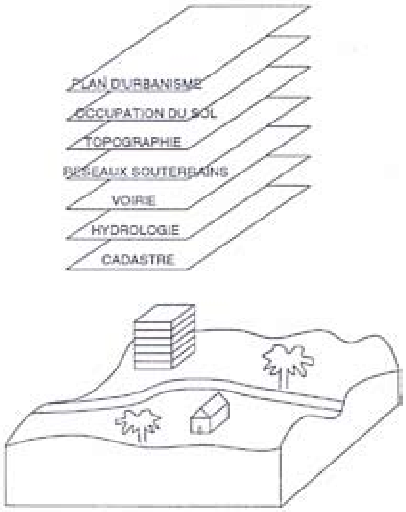


Le Système d'Informations Géographiques (SIG)

La deuxième composante du Système d'Information Foncière à savoir le Système d'Informations Géographiques (SIG) se définie comme « un ensemble de données repérées dans l'espace, structuré de façon à pouvoir en extraire des synthèses utiles à la décision ».

La construction d'un SIG nécessite plusieurs étapes dont, la définition du modèle conceptuel, l'acquisition, la saisie et la gestion des données, l'analyse spatiale et la production cartographique. Le SIG dédié à la production d'informations sur le foncier comprendrait un ensemble de cartes thématiques géoréférencées suivant des paramètres (Projection, Datum, Ellipsoide) bien définis.

Figure 2 : Couches d'information dans un SIG (Laurini, 1993)



Pour ce qui concerne la cartographie du foncier en milieu urbain, la grande échelle est plus appropriée, c'est-à-dire entre le 1/200 ème et le 1/10 000 ème. A ces échelles des images satellites de très hautes résolution sont disponibles (QuickBird, Ikonos, EROS, etc). En milieu rural, où la structuration de l'espace est moins accentuée, les échelles de réalisation de produits cartographiques sur le foncier peuvent varier entre le 1/10 000 ème et le 1/50 000 ème.

Une bonne partie de ces cartes est obtenue à partir de levés directs sur le terrain par des méthodes classiques de photogrammétrie, de positionnement par satellite (GPS), d'interprétation analogique de photographies aériennes, d'analyse numérique d'images satellites à haute résolution radiomètrique et spatiale.

Pour ce dernier type de données, le problème de leur acquisition se pose moins en Afrique. En effet, des couvertures de données satellitaires notamment Landsat et SPOT existent sur presque la totalité des terres émergées. Seuls les coûts parfois onéreux de ces données satellitaires limitent leur utilisation à des fins cartographiques sur de très grandes superficies.

Dans la VFS les images satellitaires sont régulièrement utilisées comme données de base dans l'étude sur la mise en place des Plans d'Occupation et d'Affectation des Sols (POAS). Ces POAS sont en fait, un tremplin vers la création du cadastre rural pour la gestion du foncier.

Le SIG de cette zone Nord du Sénégal contient une multitude d'informations relatives aux limites administratives, aux localités, aux infrastructures, aux aménagements agricoles, aux unités de mise en valeur ou parcelles, aux données biophysiques, etc. La combinaison BdD et SIG permet aux services sénégalais en charge du développement rural dans cette région de connaître la situation économique des différentes organisations socio - professionnelles, l'occupation et l'utilisation de l'espace en milieu rural.

Le rôle principal du SIG dans un Système d'Information Foncière (SIF) est de faciliter la réalisation des plans cadastraux.

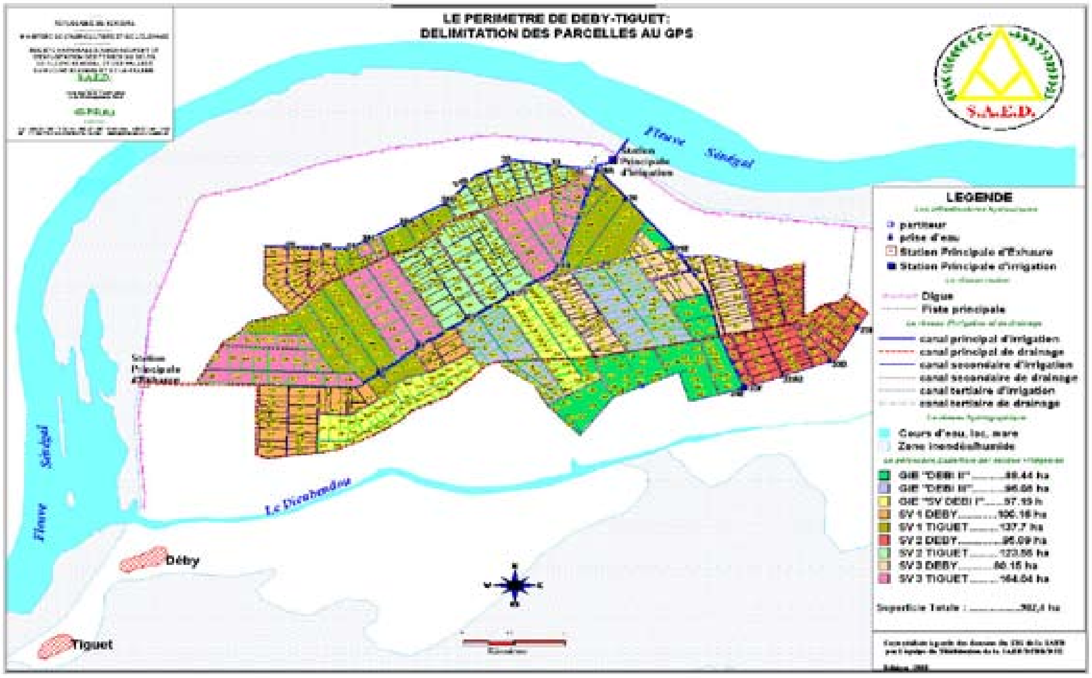
Le Plan Cadastral

Il participe à la maîtrise de l'espace, l'utilisation optimale des terres, la régularisation et la sécurisation foncière. En fait, le cadastre permet de localiser les parcelles, de les identifier, de les immatriculer et enfin de délivrer des titres fonciers ou des baux (cadastre juridique) ou pour estimer la valeur des terres à des fins de calcul de taxes (cadastre fiscal). Le plan cadastral s'accompagne nécessairement d'un livre foncier où sont consignées diverses informations notamment l'historique de la parcelle et son statut juridique, l'identité des propriétaires etc.. Le plan cadastral est indispensable pour une bonne gestion foncière.

Les éléments fondamentaux du cadastre sont : les planches cadastrales (identification, localisation, superficie, limites); les cartes thématiques (occupation du sol, potentialités du sol) ; titres de propriété (droits d'usage, bail, titre foncier) ; feuille d'impôt (économique, valeur, impôt, taxes).

Généralement, on considère que le plan cadastral doit se présenter, comme dans les pays développés d'Europe et d'Amérique, sous forme de produit fini, référence opposable à tout ; en fait un cadastre juridique ou fiscal centralisé (modèle napoléonien) procédant par l'immatriculation pour aboutir à la propriété privée individuelle attestée par le titre foncier. Mais, en Afrique (particulièrement en milieu rural) plusieurs contraintes ont, jusqu'ici, empêché la réalisation d'un tel cadastre. Parmi les contraintes on peut citer :

Figure 3 : Cartographie du périmètre de Débi-Tiguet pour la clarification de la situation foncière



- la crise de référence découlant de l'incertitude caractérisant les droits fonciers du fait de l'existence simultanée i) de la forte prégnance, ii) des droits coutumiers à côté des droits issus de la législation moderne et iii) des pratiques qui ne se réfèrent à aucun des deux registres précédents;
- le conflit des usages résultant i) des changements introduits dans le milieu (types d'exploitation, irrigation, etc.) et ii) de la crise de référence comme décrit au point précédent ;
- le coût du plan cadastral devant être totalement pris en charge par l'Etat dont les ressources budgétaires sont très limitées;
- les données de base notamment cartographiques ou des plans fonciers font souvent défaut;
- les conflits non résolus à propos des limites de parcelle, de frontières entre territoires des collectivités locales, d'affectation multiple de parcelles, souvent causée par l'absence d'outils de gestion.

Dans ce contexte il est utile de réfléchir sur les objectifs et les types de plan cadastral à mettre en place, un cadastre alternatif apportant des solutions aux contraintes indiquées ci dessus. En effet, le caractère participatif des processus de réforme foncière et d'élaboration d'outils de gestion présentés plus haut permet répondre à la demande de sécurisation foncière, à des coûts et dans des délais acceptables, prenant en compte les intérêts de divers acteurs.

L'Intérêt de la Cartographie

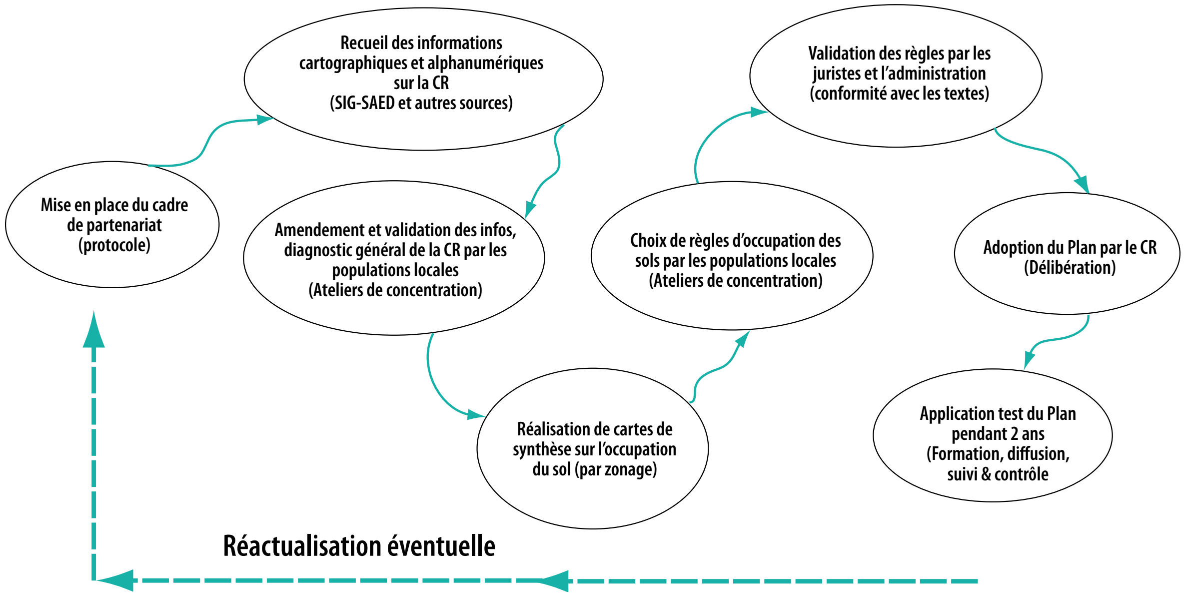
En rapport aux processus de réforme et d'élaboration d'outils d'une part, aux démarches plus ou moins participatives utilisées pour associer tous les acteurs (en particulier, les populations rurales et leurs élus) et à la nécessité de disposer de SIF valables d'autre part, la cartographie recouvre un intérêt tout particulier. En rapport aux différentes expériences présentées, elle s'avère être un outil opératoire à plusieurs niveaux: diagnostic, concertation, clarification des usages, zonages, identification des occupations, identification des droits, suivi des mutations, etc.

A l'image des démarches initiées, il s'agit de procéder à une cartographie participative qui est normée au fur et à mesure de la maturation sociale, politique et économique des processus mettant au point les outils de gestion foncière.

Dans la VFS l'opération POAS fait largement recours à la cartographie à travers les étapes de l'élaboration que voici :

- Une phase de recueil des informations cartographiques et alphanumériques au niveau du SIG de la SAED et d'autres sources (services techniques régionaux, etc.).
- L'amendement et la validation des informations cartographiées par les populations lors d'ateliers de concertation au niveau des différents terroirs de la collectivité locale, réalisation de cartes de synthèse des contraintes d'occupation du sol sur la base du diagnostic général effectué au cours des ateliers de concertation.
- Le choix des règles d'occupation des sols selon une logique de compromis lors d'une 2ème série d'ateliers de concertations, représentation cartographique des choix retenus, validation par les juristes et l'administration territoriale (analyse juridique des propositions issues des ateliers de concertation et discussion des résultats avec le CR), adoption du POAS par le CR à travers une délibération officielle l'intégrant dans le corpus légal.
- Formation d'animateurs locaux, traduction du document POAS en langues nationales, édition du document (qui renferme la base de données de la collectivité locale sur l'occupation de l'espace), restitution du POAS dans chaque zone de gestion et installation officielle du comité de zone), application test du POAS pendant une période de deux (2) ans.

Figure 4 : Etapes de déroulement d'une opération PAOS

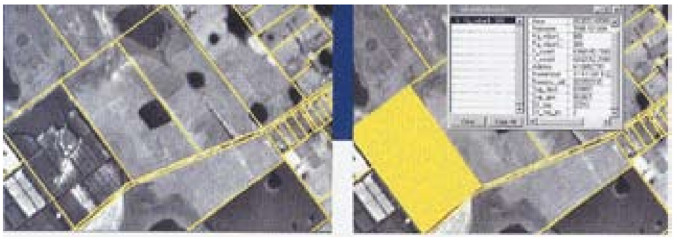


Ainsi, dans l'élaboration des POAS la cartographie participative a fonctionné comme un outil puissant :

- de clarification - essentielle quand il s'agit de processus de concertation entre plusieurs acteurs aux intérêts divergents – par la visualisation, par exemple, de tous les usages en présence, de l'occupation actuelle et passée du sol, etc. ;
- d'animation de la concertation car c'est un outil pédagogique au sens où, en quelques minutes, l'analphabète devant une carte de son terroir peut, moyennant quelques explications, contribuer aux discussions, amender les informations de la carte, faire des propositions, etc.) ;
- de connaissance et d'aide à la prise de décisions car elle a pu amener les acteurs à mieux comprendre la situation et produire des consensus et des règles de gestion efficaces, applicables par les instances locales; l'exemple en a été donné par représentation des choix (vocation des terres, usages réservés ou prioritaires, nouveau tracé des pistes de bétail, etc.);
- de gestion des problèmes environnementaux avec, par exemple, la représentation de l'état de dégradations du sol et des ressources naturelles ou de la comparaison des états de dégradation à des périodes différentes, etc. ;
- d'apprentissage du personnel local (ceux là mêmes qui ont participé activement l'exercice d'élaboration du POAS : animateurs, élus, responsables des organisations paysannes, techniciens locaux, etc.) pour prendre des rôles dans la mise en place et le fonctionnement d'un SIF.

Des exemples peuvent être cités, notamment en Amérique du Sud où des cadastres ruraux sont en train de voir le jour. En Argentine et au Nicaragua, la Société SPOT Image a pu aider à la création de cadastres ruraux numériques complets qui s'appuient essentiellement sur l'imagerie satellitaires couplée aux enquêtes de terrain.

Figure 5 : Cadastre numérique rural en Argentine (Spot Image, 1998)



Ces cadastres informatisés ont permis de clarifier la situation foncière, d'enregistrer les terres et de délivrer des titres de propriétés. Dans la gestion urbaine, il y le cas du Système « SIGGIL » de la ville sainte de Touba au Sénégal. Ce système d'information permet le recensement et la gestion du parcellaire, la gestion de la propriété, l'imposition et l'établissement de titres d'occupation du foncier (STC, 2006).

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Land Information Management Considerations for Low e-Ready Jurisdictions Aspiring to a Knowledge Economy

By Michael Sutherland, Ph.D.

Introduction

There is an increasing awareness that the ability of jurisdictions to create, utilize, and disseminate knowledge is linked to wealth creation and higher standards of living (United Kingdom Department of Trade and Industry 1998; Organization for Economic Co-operation and Development 2001a). Human capital (the resource of human competencies) is also a key component of knowledge economies (Department of Finance Canada 2006). The knowledge economy recognizes the importance of information technology's role in producing accessible and useable information about resources that are necessary to fuel an economy (Houghton and Sheehan 2000). There is also the requirement in a knowledge economy for innovative research and development to support improvements in knowledge processing and dissemination, as well as the economic market that is based upon intensive use of knowledge (Inter Departmental Committee on Science, Technology and Innovation 2004). In other words, the knowledge economy seeks to manage processes that create and organize knowledge through the intersection of information technology, business strategies, and changing social and economic conditions so that objectives targeting the creation, distribution and consumption of wealth may be achieved (Task Force on the Future of American Innovation 2005).

The reality of the global village is such that it is now undeniable that occurrences in one part of Earth can very quickly be transmitted by many means to other remote locations on the Globe. It is therefore easy for currently low e-ready economies to be lured by the perceived benefits of knowledge economies, and too quickly expend economic resources without achieving the perceived social, economic, and political objectives for all (Drahos and Braithwaite 2002). If the benefits of a knowledge economy are to be shared by more than just a small segment of a low e-ready economy then it is advisable that transitions to knowledge economies are done with due consideration given to contemporary social, economic, and political realities.

Land is among the most valuable and fundamental of an economy's resources, and therefore land information management (LIM), land administration, and land management are of vital importance to any economy. This is certainly true with regard to Africa where half of its population is living below the international poverty line, and approximately 75 percent of Africa's poor derive a livelihood from the rural agricultural sector (International Food Policy Research Initiative 2005). The provision of relevant and useable land information ought therefore to be a prominent objective any knowledge economy. This paper deals with, especially in the African context of people-land relationships, the potential of certain African social, economic, and political realities to incorporate information technologies towards the achievement of LIM in knowledge economies.

The Knowledge Economy

A knowledge economy is comprised of components with specific characteristics. According to the Task Force on the Future of American Innovation (2005) a knowledge economy is measured by six benchmarks. These benchmarks are:

- **Education:** the number of persons trained at institutions of higher learning who are potential participants in knowledge creation and use in the technology realm contributing to economic growth;
- **Workforce:** the proportion of workers retained in the science, engineering, and information management workforces;
- **Knowledge creation and new ideas**: the proportion of new knowledge and ideas created and employed in activities that positively impact upon a jurisdiction's economic growth;
- **Research and development investment**: the amount of economic resources invested in research and development that potentially positively impact a jurisdiction's economic growth;

- **High-tech economy**: the measure of a jurisdiction's trade deficit in terms of its high-tech exports and imports;
- **Technology sector**: the vibrancy and production levels of a jurisdiction's technology industries.

The World Bank identifies four pillars that are "critical requisites for a country to be able to fully participate in the knowledge economy" (The World Bank 2006a). They are:

- **Education & Training**: a population that is educated and skilled in the creation, sharing and use of knowledge;
- **Information Infrastructure**: a dynamic and comprehensive information infrastructure ("ranging from radio to the internet") that facilitates the effective management and dissemination of information;
- **Economic Incentive & Institutional Regime**: a regulatory and economic environment conducive to the free flow of knowledge, supportive of investment in Information and Communications Technology (ICT), and motivates entrepreneurship; and
- **Innovation Systems**: a network of research facilities (i.e. government, academic, private, and hybrid research organizations), private enterprises and community groups that together is able to "tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new knowledge".

Common among the foregoing with regard to the knowledge economy are a high level of educational capacity, developed information and ICT infrastructure, and a socioeconomic environment conducive to knowledge sharing and innovation (Nwokeabia 2001).

Land Information Management and the Knowledge Economy

The characterization of a people's relationship to land as legal or customary, represents narrow perspectives since, for instance, the persons whose relationship to land that is described as customary may not themselves view their relationship in that manner. They may simply be living lives as dictated by their traditions, as is everyone else. Regardless, every community requires knowledge and information about land and the resources attached to land that are at its disposal, in order for that community to pursue its social, economic, political, and environmental objectives. Confidence that one has the right to use land resources in acceptably defined ways is one motivation to take advantage of social, economic, political and environmental opportunities to improve the quality of one's existence. Of course land tenure information and management (as implied by the foregoing) is not the only important land information needed by a jurisdiction. Land use, land suitability, geomorphology, topography, as well as information on other phenomena with spatial dimensions such as habitat, crime, disease, population distribution etc. are just a few of vitally important land information needed by jurisdictions to achieve their political, social, economic, and environmental objectives. The fact that LIM, land administration, and land management are of vital importance to any economy is true regardless of whether the economy is developed, developing, or under developed. The provision of relevant, accessible and useable land (and related) information ought therefore to be an important objective any economy. This is true of the knowledge economy.
LIM is accomplished via land information systems (LIS). To think of LIS purely in terms of computer hardware, software and infrastructure is narrow. Land information systems are comprised of data and information, computer systems (i.e., hardware and software), information infrastructure (i.e., physical and spatial data infrastructure), institutional arrangements, appropriate laws and policies, efficient organizational structures with highly trained personnel, efficient administrative and operational procedures, and affordable public access. From this perspective LIM represents a dimension of the knowledge economy.

However, developing LIM to meet the contemporary land information needs of a jurisdiction is often a separate issue from developing LIM as a move towards creating or improving a knowledge economy. This is especially true with regard to low e-ready jurisdictions. As stated in Section 2.0 the knowledge economy has a distinct set of components.

LIM Considerations for Contemporary Needs

Whether the jurisdiction is low or high e-ready there are certain ideal requirements for LIM that apply. These were mentioned in the previous section but will in this section be dealt with in more detail, and therefore bear repeating. They include:

- Appropriate and facilitating laws and policies;
- Appropriate, useable, accessible, accurate and current land information;
- Appropriate technology (i.e., hardware, software, database management systems, and information infrastructures including spatial data infrastructures);
- Spatial data standards and data models;
- Efficient organizational structures, and administrative and operational procedures;
- Trained personnel;
- Facilitative institutional arrangements; and
- Affordable public access where required.

All things considered important to the economic, social, political, and environment good of a jurisdiction tend to be the subject of policies, laws or regulations. Since land is among the most important resource within any jurisdiction, land information often is the subject of policies, laws, and regulations. There are, for instance, policies that determine who can manage certain types of land information and there are laws and regulations relating to how certain types of land information is collected, processed, and disseminated as well as who is legally responsible for performing those tasks (Government of New South Wales 1998).

Land information varies widely and land data has to be managed (i.e., collected, processed, and disseminated to a wide variety of government, private enterprise, and community users). Land data such as survey data for base mapping, geomorphology, land cover, land suitability, land use, real property and land tenure data, and habitat characteristics among others are needed in conjunction with data on phenomena with spatial dimensions such as flora, fauna, population distribution, crime occurrences, administrative units, mineral deposits etc. in order that jurisdictions can pursue its social, economic, political, and environmental objectives. Land and related information facilitate tax bases that allow governments to provide utility services, targeted health care, crime prevention, land use planning and infrastructure development among other things. Land and related information also facilitate land markets for personal and commercial economic development among other things. It is desirable that land information conform to the qualities of being current, useable, accurate, complete, and logically consistent among other things (Chapman 2005). There are significant costs associated with collecting and maintaining land data such as those associated with personnel, equipment, and overhead costs related to organizational operations facilitating the processing and dissemination of the resulting land information.

The foci of appropriate technology are both the technology itself and the users of the technology. Appropriateness is determined by a number of factors including (Co-Create International Business Development 2004):

- Accessibility of the technology in terms of affordability, ability to maintain the technology, market availability, cultural or social accessibility etc.;
- Functionality of the technology in terms of its capability to assist in the achievement of improved efficiency, ease of use, demonstration of design functionality;
- Quality of the technology in terms of durability, futurity, and reliability;
- Sustainability of the technology in economic, financial, social, and ecological terms;
- Manageability of the technology in terms of how easily it lends itself to quality control;
- The capability of the technology to contribute to stated goals and objectives.

In modern societies operating in the information age appropriate technology is necessary to facilitate the collection, processing, storage, output, and dissemination of land and related information. Computer systems (hardware and software) and computer networks (intranets and the internet) link land information providers and users. Geographic Information Systems (GIS), mapping and cartographic software, as well as specialized applications are required to process a variety of land information to serve various needs within a jurisdiction. There are costs associated with the acquisition, maintenance, and updating of hardware, software and land information infrastructures. However, it is entirely possible to process land information manually, or with limited modern or low technology.

Data standards and data models applicable to spatial data (including land information) are also relevant considerations for implementing LIM. Data standards for consideration include, for example, Open Geodata Interoperability Specification (OGIS) from the Open Geographic Information System Consortium (OGS). Data standards such as these facilitate easy sharing of spatial (land) information. Appropriate conceptual data models are also required to model various types of land or spatial information, as well as to manage various types of complex relationships such as various types of land tenure. Some types of conceptual data models include entity-relational, object-relational, and object-oriented models among others.

Many government, private enterprise, and community organizations collect, use, and disseminate land and related information. Government (and hence their agencies) is usually the biggest player in the LIM market. Specialized skills are required in many instances to deal with land information and LIM technology, and this requirement impacts upon organizational structures LIM agencies and departments in terms of the creation of specialized departments geared solely towards managing spatial information. Administrative and operational procedures are often required to efficiently comply with implement the directives of policies, laws, and regulations and therefore process reengineering often also becomes necessary (Greenberg 1996; Zhou 2003). There are economic costs associated with the creation and maintenance of these specialized departments in terms of investments in personnel, security for hardware and software, and physical infrastructure such as building construction, conduits and cables. There are also economic costs associated with process reengineering. Collecting and processing land information most often requires personnel with special training and skills. Postsecondary training is often required of personnel processing land information. Skills and training are needed in geomatics and the use of spatial information management software, as well as in many instances computer programming, database management, and network skills (Wadda 2000).

It is often the case that various types of land and related information are managed by specialized departments and organizations, while more appropriate and complete information can only be gained from the integration of the dispersed datasets. Institutional arrangements that facilitate vertical and horizontal integration of land information are sometimes a requirement if jurisdictions are to realistically achieve its social, economic, political, and environmental objectives (Food and Agriculture Organization 1998). Costs associated with creating and maintaining these institutional arrangements include those related to organizational, administrative and database management reform, and sometimes legal and policy reform.

In most jurisdictions governments are the holder of the largest amount of land and their organizations and agencies are the suppliers of the largest amounts of primary and secondary land information. These government organizations and agencies generally provide services to the public and other government organizations and agencies. There are significant costs associated with the management and dissemination of land information. Considerations for the implementation of LIM include data pricing and cost recovery. In certain jurisdictions such as those in the United States information collected with public money provided to the public free of cost, or at minimal cost. Most other jurisdictions provide land information services to the public at prices designed to recover all or portions of the costs associated with the management of land information. If land information produced through the implementation of LIM/LIS is priced out of the reach of ordinary citizens then a kind of information/knowledge feudalism occurs where the general public is de facto treated like trespassers in the knowledge and land information realm (Drahos and Braithwaite 2002; Government of British Columbia 2003).

LIM Considerations for a Knowledge Economy

LIM requirements for the knowledge economy are similar to those listed in the first paragraph of the previous section, except that the knowledge economy demands extensive use of modern information technology, a developed knowledge market supporting economic objectives, jurisdictional e-readiness, and societal e-participation to support the knowledge intensiveness that is the basis of the economy. A knowledge economy requires a population and workforce highly educated in science and engineering, policies that facilitate the free flow of knowledge, a dynamic and comprehensive information infrastructure, and facilities engaged in research, development, and the constant creation of new knowledge. All aspects of LIM in a knowledge economy should therefore conform to the criteria previously stated. For instance:

- To facilitate e-readiness and e-participation, appropriate and facilitating laws and policies should not only in place but be available online and accessible by a wide range of e-participating users, as well as incorporate the facilitation of free flowing knowledge related to land information;
- Appropriate, useable, accessible, accurate and current land information of all types should be available online and accessible by a wide range of e-participating users;
- Spatial information should comply with known spatial data standards, and be modeled using various appropriate conceptual data models to capture and manage complex relationships;
- To allow for a greater level of e-participation, appropriate technology (i.e., hardware, LIM software, digital LIM databases, and information infrastructures including spatial data infrastructures) should not only be in the possession of (or accessible to) land information providers but also in the possession of (or accessible to) a wide range of land information users including private citizens, private enterprises, and community groups; Implemented technology should be able to manage the unique and complicated land information associated with African regions. Concerns about implementing technology in low e-ready societies such as in Africa relate to gaining high returns on investment (usually high initial setup costs) plus all the concerns about maintaining systems (trained personnel; personnel retention; physical maintenance; ability to upgrade in order to access emerging technology avoid obsolescence etc.).
- E-government is an integral part of the knowledge economy concept. Many governments operating in knowledge economies offer e-government services. Through e-government models they offer online services to citizens, businesses, and other government departments. Transitioning from traditional government service delivery models to e-government models require administrative reform that will include process (re)engineering and organizational restructuring to efficiently incorporate the use of modern ICT and information technologies applied to providing LIM services. Organizational structures should facilitate e-readiness, and administrative and operational procedures should allow for e-participation in the knowledge economy;
- Both the users and producers of land information should be appropriately educated and computer literate, and especially the workforce of LIM organizations should be skilled in LIM technology use and development, as well as trained in science and engineering;
- Institutional arrangements should be supported by appropriate laws and policies, as well as by appropriate technologies (e.g. computer hardware, software, networks, and networked databases) that facilitate the sharing of land information among e-participating users, and that encourage innovational use of accessible LIM knowledge; and
- Affordable public access to quality land information should occur through such interfaces as web portals and other computer network interfaces.

Africa, LIM, e-Readiness, and the Knowledge Economy

Land (and therefore LIM) is very important to Africa and therefore the continent has attracted many projects related to land management, land administration or the management of spatial information. Figure 1 after Pavy (1994) demonstrates the World Bank's Sub Saharan African investments in this regard between 1988 and 1993. Other projects have been approved for this region since 1993.

It is understandable that many African nations seek to improve their LIM and access to land information through the implementation of LIS in concert with land tenure reform, land and agrarian reform, land titling, and land management projects. It is also understandable that these jurisdictions seek to benefit from the most modern technological tools applied to the management of spatial information. Also, being aware of the development of LIM in the knowledge economies of developed countries it is understandable that many African nations would aspire to emulate these developments. However, the socioeconomic and political realities in most developed countries support easier harvesting of the benefits of LIM in knowledge economies. The knowledge economy is characterized by more than the implementation of technologies applied to certain tasks. Most developed countries are characterized by features outline in Section 5.0 (LIM considerations for a knowledge economy) or have the technological, personnel, cultural, educational, political and economic resources to achieve and maintain knowledge economies. African nations must first develop and maintain these necessary features before they can achieve LIM in a knowledge economy. There are many hurdles to overcome and it is advisable that they proceed with caution to ensure that not just a few members of their societies benefit from the quick implementation of LIM technology.

Figure 1: World Bank Sub Saharan African Projects Related to Spatial Information Management (After Pavy 1994)

Countries	Number of Projects	World Bank funding (millions of $US)
Angola	2	1.08
Benin	1	1.65
Burkina Faso	4	2.97
Burundi	1	0.04
C.A.R.	1	4.80
Cameroon	2	3.74
Chad	1	0.50
Côte d'Ivoire	4	7.50
Ghana	4	7.50
Guinea	2	1.60
Lesotho	2	1.60
Madagascar	2	16.40
Malawi	1	0.40
Mali	3	0.81
Mauritania	1	0.10
Mauritius	1	0.64
Mozambique	3	2.87
Nigeria	6	12.55
Rwanda	1	0.33
Sao Tome & Principe	1	1.94
Senegal	1	4.30
Somalia	1	0.97
Sudan	3	1.30
Tanzania	1	5.88
Togo	1	0.39
Uganda	2	1.55
Zaire	1	0.03
Zambia	1	1.30
Total	54	86.68

The concept of the knowledge economy, and much of its existence, originated in rich developed economies where the necessary resources (information infrastructures and technologies, computers, technology awareness and education etc.) needed by all sectors (i.e., social, economic, and political) to partake in a knowledge economy is more easily accessible. These developed economies have a high state of e-readiness and a high and growing culture of e-participation. Therefore, in these rich economies the various sectors can more readily achieve the potential benefits of a knowledge economy. Low e-ready economies, on the other hand, are often a mix of non- to low technology readiness for transition to a knowledge economy, often with small occurrences of high technology readiness (along with the potential benefits) accessible only to small fractions of their populations.

In the case of Africa, according to United Nations (2006) Mauritius, South Africa, and the Seychelles are the top three with regard to e-readiness, with Mauritius scoring highest (.5317 on a scale of 0 to 1). South Africa and Seychelles score .5075 and .4884 respectively. By comparison and on the same scale countries like the United States, Denmark, Sweden, Australia, Singapore, Canada, Korea score .9062, .9058, .8983, .8679, .8503, .8425, and .8727 respectively. In terms of e-participation the United Kingdom, Singapore and United States score highest globally with scores of 1.0000, .9841, and .9048 respectively. Africa scores very low in terms of either e-readiness or e-participation and is the least e-ready on a global scale according to studies done up to 2005.

United Nations (2006) also points out that e-readiness seem related to the economic reality of national income levels with most of the top 50 e-ready countries being high income economies. According to figures derived from World Bank (2006b) Sub Saharan African countries comprise 88.9% of all African countries (Table 1). 100% of low incomes African countries are Sub Saharan. 34 out of 54 African countries are low income economies, 12 are lower middle income economies, and 8 are upper middle income economies. There are apparently no high income economies in Africa and this fact impacts upon the low e-readiness of that continent.

Table 1: Africa Income Levels

	Sub-Saharan	North African	Total
# of countries	48	6	54
Low income	34	0	34
lower middle income	7	5	12
upper middle income	7	1	8

The knowledge economy requires the social reality of high levels of education among populations in the knowledge market place, especially with regard to high levels of science and engineering proficiencies. According to World Bank (2006c) basic literacy in Sub Saharan Africa is about 70% for adult males and about 50% for adult females, an average rate of about 60%. Enrollment in secondary institutions is about 25% compared with about 60% in developed countries. With regard to postsecondary education enrollment rates in sub Saharan Africa are the lowest in the world and are rapidly falling behind the rest of the world (Bloom et al 2006). In addition to the paucity of educated people, Africa suffers a brain drain estimated to be about 20,000 skilled persons per annum (International Organization for Migration 2006). Education is one important component of capacity building which is therefore an important requirement for African nations aspiring to socioeconomic development as well as to knowledge economies.

The knowledge economy requires that there exists a sociopolitical cultural reality (supported by institutional arrangements) of governments reaching out to citizens, providing them with access to appropriate information. This is often evidenced by appropriate regulations that encourages and facilitates knowledge sharing (United Nations Economic Commission for Africa 2001; Cleaver 2002). According to the United Nations Online Network in Public Administration and Finance (UNPAN 2005 and 2006) Africa falls way behind the rest of the world in outreach to, and providing access by citizens to appropriate information.

The knowledge economy requires investment in research and development. This is directly related to investments in science, technology, and engineering innovations, and taking advantage of developments in other national or regional jurisdictions. According to Mugabe (2006) most African countries understand the benefits of increasing knowledge through inter-jurisdictional cooperation and have entered into science, engineering, and technology bilateral agreements. However, Mugabe (2006) also states that most of these countries have not implemented local/national institutional arrangements to ensure that the benefits flow to the benefit of local socioeconomic situations.

Conclusions and Recommendations

All of the foregoing implies that Africa, especially Sub Saharan Africa, is nowhere close to developing a knowledge economy. African countries are the least e-ready in the world, and e-participation is the lowest in the world. This hints at least at a lack of information technology infrastructure, but may be exacerbated by a lack of appropriate information access policies. Education and income levels are low and these hinder access to economic and intellectual resources that would allow large percentages of African populations from participating in knowledge markets in the information age as either members of an appropriately educated workforce or as savvy knowledge economic clients. Institutional arrangements facilitating government outreach and citizen access to appropriate information is lacking, as are initiatives to improve this situation. Many projects have been implemented in African jurisdictions that directly or indirectly impact upon the acquisition, processing, and dissemination land and other spatial information. Therefore steps are being taken to improve LIM and reap the well documented known and expected benefits.

However, for those low e-ready African jurisdictions that are implementing or improving LIM, as well as aspiring to a knowledge economy it is recommended that a holistic perspective be considered. Technology by itself brings only limited benefits in addition to costs associated with implementation and maintenance. Furthermore, in those societies where only small proportions of the populations have access to, and are capable of taking advantage of available information technology, it is likely that only that small proportion of the population will obtain the associated benefits (Organization for Economic Co-operation and Development 2001b). Many (if not all) of the socioeconomic indicators for building public sector capacity apply to developing and maintaining LIM systems, especially within the framework of a knowledge economy (World Bank 2005). Socioeconomic indicators of a country's capacity building potential are education, health (e.g. life expectancy), information and ICT connectivity, skills retention levels, health, economic growth, and population growth. Capacity building happens at both the individual and institutional levels. It is therefore recommended that LIM be implemented within frameworks of jurisdictional socioeconomic development, where the incorporation of LIM systems is part of a holistic socioeconomic development strategy. In this way LIM is improved even as the socioeconomic environment is prepared to evolve into a knowledge economy. For instance, limited only by access to available economic resources, the following could be considered by low e-ready jurisdictions with regard to implementing or improving LIM while they aspire to knowledge economies:

- **Education & Training**: Invest in the education of a jurisdiction's population (also as part of jurisdictional capacity building). In particular invest in higher education related to science and engineering. Step ought also to be taken to retain skilled personnel, especially those lost to international migration. Emphasis should be placed on building capacity in formal education at the post graduate level and special skills development. To implement LIM require many and varied skills: computer programming; database management; many dimensions of geomatics including GIS, cartography, mapping, spatial modeling etc. If low e-ready jurisdictions are to implement LIM as well as move towards the knowledge economy then they will have to invest in higher education of its population as well as attempt to solve the socioeconomic conditions that encourage its skilled human resources to migrate to "greener pastures".
- **Information Infrastructure**: In addition to investments in LIM systems, invest in dynamic and comprehensive information infrastructures (including spatial data infrastructures and ICT that facilitates the effective management and dissemination of land information);
- **Citizen access**: The knowledge economy has implications with regard to jurisdictional e-readiness and e-participation. Even if governments provide LIM e-services, the concern is how much of a population will benefit. A digital divide can persist if economic resources are unavailable to a majority of the population to obtain access technology, and also low educational realities prevent the population en mass from appropriate use of information technology. In tandem with investments in education, information infrastructure and ICT, take steps to ensure that a wide range of citizens have access

to the technology in order to ensure that the digital divide is as small as possible, and that information feudalism and its negative consequence is avoided;

- **Innovation Systems**: Build upon current initiatives and encourage and support the development and networking of research and development facilities (i.e. government, academic, private, and hybrid research organizations), private enterprises and community groups with the aim of building capacity to utilize the expanding wealth of global knowledge for local needs with regard to LIM;
- **Appropriate technology**: Limited only by access to economic and human resources, invest in LIM technology that conform to the criteria of accessibility, functionality, Quality (i.e., durability, futurity, and reliability), sustainability, manageability, and capability to contribute to stated goals and objectives. It is to be kept in mind that acquired technology also has to be maintained to remain relevant and avoid costs associated with obsolescence;
- **Land Information**: Continue to encourage investment in the collection, management, and dissemination of all forms of land information with the aim of making the information available via use of ICT. Data collected managed should as much as possible be conform to data quality standards. Land information should be modeled to appropriately manage various types of, and complex land information (e.g., customary land tenure);
- **Administrative reform:** Invest in administrative reform (e.g., policy reform, regulations, organizational restructuring and process reengineering) that aims to improve the efficiency of LIM agencies and departments. Step could include such things as (Zhou 2003):
  - ¤ *Eliminating layers of traditional management;*
  - ¤ *Compressing job categories;*
  - ¤ *Creating work teams;*
  - ¤ *Training employees in multilevel skills;*
  - ¤ *Shortening and simplifying various business processes;*
  - ¤ *Streamlining administration and Management.*
- **Socioeconomic institutional arrangements:** Take steps to foster political, social and economic environments where the free flow of knowledge and entrepreneurship is encouraged with the support of appropriate policies, regulations and ICT.

All of the items in the above list require significant economic investment to implement and maintain, and acquiring adequate economic resources is a continuing challenge for the low income and underdeveloped economies of Africa. However, the knowledge economies of developed countries were built over time, and that is why the low income, low e-ready, and developing economies of Africa are admonished to proceed with caution and learn from the experiences of developed economies. Capacity building takes time. It is to be ensured that Africa's future is seeded with investments in both information technology and qualified human resources who are capable and will take advantage of the technological advances for the continent's benefit.

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L’Apport de l’Extraction de Connaissances pour la Mise en Place des Bases de Données Foncières en Afrique

By Sami Faïz[11] and Sami Yassine Turki[12]

Résumé

Cet article présente une approche que nous avons développée pour l’alimentation automatique des bases de données foncières en utilisant la technique d’extraction de connaissances. L’approche vise, en premier lieu, à constituer une base de données géographiques à partir d’une image satellite et à l’enrichir avec des données exogènes. Ensuite, il est procédé à l’utilisation de l’extraction de connaissances pour produire des règles d’association spatiales permettant de mettre en évidence les différentes corrélations entre les objets contenus dans la base. Les règles d’association spatiales générées et jugées pertinentes sont ensuite appliquées au contenu d’autres bases de données foncières ce qui permettra de les enrichir.

Une étude de cas relative au quartier El Khadra situé à Tunis a permis de vérifier l’apport de notre approche en produisant des données sur l’occupation du sol.

Mots-clés : extraction de connaissances, règles d’association spatiales, bases de données foncières, occupation du sol, Tunis.

Introduction

Les données foncières sont très utiles pour les prises de décisions, soit d’une manière directe lors d’actions de gestion ou de planification du territoire, soit en servant pour des simulations. Cependant, la phase de collecte et de recueil des données foncières occupe souvent une durée importante et engendre un coût financier également élevé (Faïz 1999).

Ce constat est encore plus vrai en Afrique. En effet, pour le cas de l’Afrique, l’effet majeur à prendre en considération est la difficulté de trouver l’ensemble des données, les systèmes d’information foncière, quand ils existent, ne sont pas suffisamment développés et ne favorisent pas, alors, la production d’une information suffisante sur le foncier. Le deuxième trait majeur concerne la prédominance informelle de tout élément foncier qui échappe aux mécanismes réglementaires mis en place par les autorités. Cette situation, liée souvent à une mauvaise gestion du patrimoine foncier, implique une méconnaissance de la situation réelle des terrains, une insécurité foncière, de la spéculation, un frein dans la gestion efficace et optimisée des infrastructures existantes et futures et un grand manque à gagner en terme de ressources pour les collectivités locales. Ces caractéristiques rendent encore plus longues, coûteuses et difficiles les actions de collecte de données foncières. La question de la constitution de bases de données foncières devient encore plus difficile dans le cas de l’inexistence de données géographiques de base sous la forme de référentiels, ce qui est assez répandu en Afrique (Ezigbalike et al. 2000).

C’est dans le but d’alléger les durées et les coûts engendrés par les techniques classiques (non automatiques) d’acquisition des données que nous nous intéressons à l’application des techniques d’extraction de connaissances comme approche automatique pour la collecte des données utiles à l’alimentation des bases de données foncières en Afrique.
Nous essayons à travers notre contribution de proposer une approche efficace pour la collecte de certaines données foncières permettant, de ce fait, de contribuer à la résolution du problème majeur de la gestion foncière en Afrique. En effet, parmi les difficultés rencontrées dans la mise en place de bases de données foncières figurent la méconnaissance du découpage cadastral, des propriétaires des terrains et des modes d’occupation et d’utilisation du sol qui restent souvent non-conformes aux réglementations en vigueur. Nous nous intéressons essentiellement à ce dernier point.

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Ainsi, notre approche s'insère dans les courants de recherche visant à produire de nouvelles méthodologies pour la constitution de systèmes d'informations urbains (Dureau et al. 1995) et pour la production de données à partir des images satellites à très haute résolution (Donnay et al. 1993, Voorde et al. 2002) adaptées notamment au contexte des pays en voie de développement (Dureau 1995, Renard et al. 1995, Weber 1997, Renard et al. 1997).

Nous nous intéressons, dans le cadre de ce travail, essentiellement aux données sur l'occupation du sol par des activités urbaines : habitat, services, industrie, artisanat, etc. Notre contribution peut concerner ainsi les aires urbaines et péri-urbaines des agglomérations. Ce type de données est très utilisé en matière de gestion urbaine et foncière ainsi qu'en matière de planification urbaine et de planification des transports urbains (Turki 2005).

Nous préconisons l'utilisation des techniques d'extraction de connaissances, dites également de fouille de données ou « datamining » comme approche capable d'extraire des informations à partir de sources potentielles (Han & Kamber 2001, Faïz 2005).

L'utilisation de ces techniques dans le domaine des bases de données géographiques, plus précisément les bases de données foncières, est d'un grand intérêt, étant donné le volume et la complexité de ces données. Outre ces aspects, les données sont multi-échelles, changeantes dans le temps et hétérogènes.

Un exemple montrant l'importance de ces techniques pour la collecte des données est également présenté dans ce travail. L'exemple présente comment, à partir de l'examen de différentes situations réelles et en utilisant la technique d'extraction de connaissances, générer un ensemble de règles montrant une certaine corrélation entre la densité des voitures en stationnement et la fonction principale des îlots urbains.

Dans le présent document, nous présentons tout d'abord l'approche que nous avons développée pour l'extraction automatique de données sur l'occupation du sol par utilisation de l'extraction de connaissances. Nous exposons ensuite, une étude de cas relative au quartier Cité El Khadra, situé à Tunis. Nous présentons enfin, en guise de conclusion, quelques perspectives de généralisation de l'utilisation des techniques d'extraction de connaissances pour la production d'autres données foncières.

Approche Proposée

Le datamining spatial ou géographique consiste à extraire des connaissances, notamment, des règles d'association spatiales, des modèles et caractéristiques spatiaux, des rapports généraux mettant en jeu l'information spatiale et/ou descriptive, ainsi que d'autres caractéristiques qui ne sont pas explicites (Faiz 2001, Faïz 2005, Zbidi et al. 2006).

Ces connaissances peuvent être puisées à travers des traitements automatiques (dites de fouilles) sur différentes ressources comme les images satellites, les bases de données existantes ou les connaissances d'experts (Bâazaoui et al. 2005).

Dans le cas de la constitution de bases de données foncières, le recours principalement aux images satellites peut constituer, à cet effet, une source de données intéressante. Ce recours passe par les actions suivantes, comme illustré par la figure 1 :

- Il s'agit, en premier lieu, de construire des bases de données géographiques à partir des images satellites. Différentes techniques peuvent être utilisées à cet effet : classification automatique, classification assistée, image-interprétation, etc. Le choix de la technique appropriée dépend de l'image utilisée (notamment la résolution), de l'aire géographique couverte (urbaine, péri-urbaine, rurale) et des données à extraire (parcellaire, occupation du sol, réseaux routiers, etc.). Les bases de données construites sont ensuite enrichies de données exogènes à partir de sources multiples (visites sur terrains,experts, études et cartes existantes, etc.).

- Des règles d'association spatiales sont extraites de ces bases de données par application du datamining spatial. Ces règles montrent des corrélations entre les entités présentes dans l'espace considéré.
- L'idée est alors de construire des systèmes qui aillent scruter la base de données, forger des hypothèses et, si elles sont vérifiées, les remonter à l'utilisateur sous forme de règles dites règles d'association. Les règles d'association spatiales ont la forme suivante :

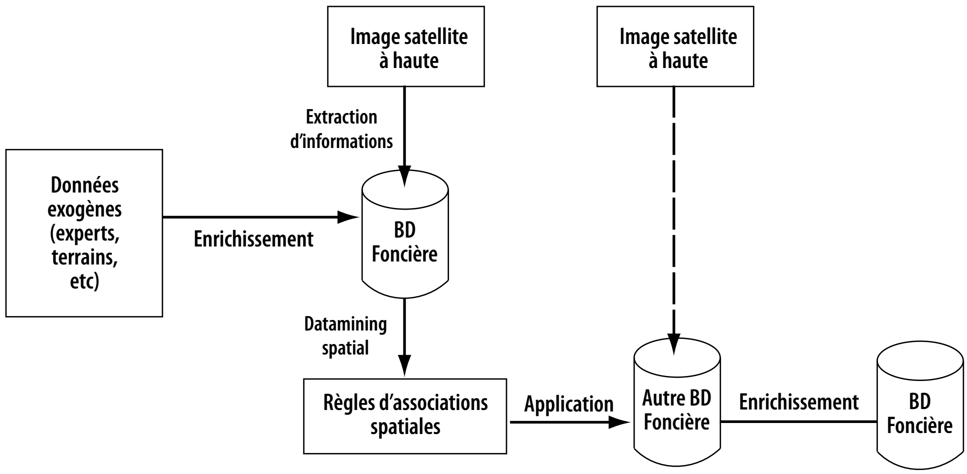
$$(c\%) \qquad P1 \wedge \ldots \wedge Pm \rightarrow Q1 \wedge \ldots \wedge Qn$$

où au moins un des éléments Pi ou Qi est de type spatial. c% étant le taux de confiance de la règle qui indique que c% des objets satisfaisant l'antécédent de la règle vont satisfaire la conséquence de celle-ci. t% étant le support qui indique le pourcentage de transactions qui vérifient P et Q parmi toutes les transactions de la base.

En fixant le seuil de confiance c et le taux d'occurrence t à de grandes valeurs, on peut après filtrage diminuer le nombre de règles générées. Malgré cette opération de filtrage automatique, le processus de génération de règles peut produire encore de grandes quantités de relations sans qu'elles ne soient toutes intéressantes et significatives pour le contexte de travail. Dans ce cas, nous permettons à l'expert humain, d'examiner les relations produites et de ne garder que celles qu'il juge valides, pertinentes et non triviales selon son domaine d'intérêt.

- Les règles les mieux classées sont retenues et appliquées sur le contenu d'autres bases de données extraites d'images satellites et couvrant d'autres espaces et pour lesquelles il existe peu de données exogènes.

Figure 1. Approche pour la production de données sur l'occupation du sol par extraction de connaissances

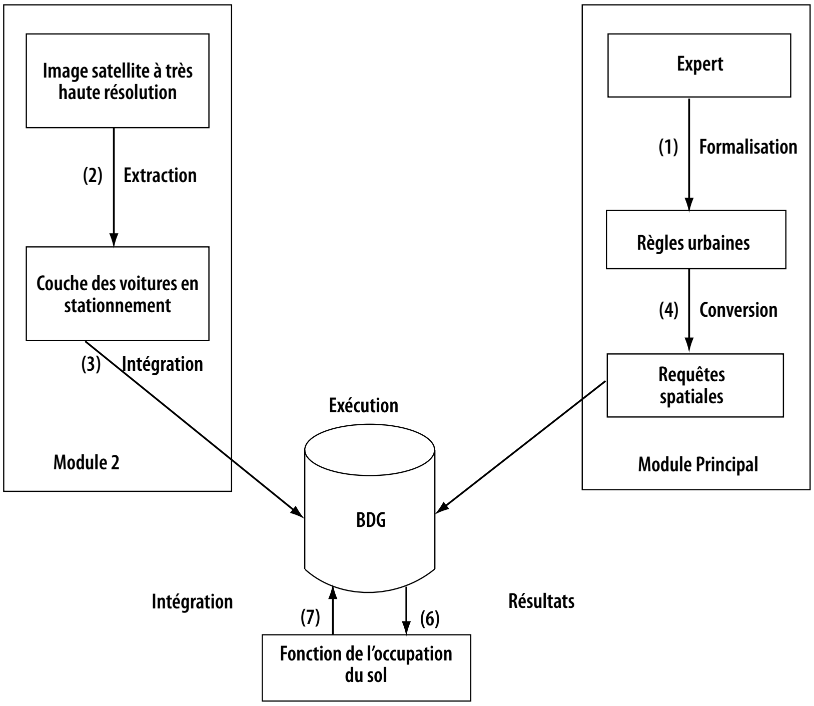


Nous pouvons ainsi à partir de différents examens de situations réelles et en utilisant la technique d'extraction de connaissances, générer un ensemble de règles d'association spatiales et par la suite appliquer ces mêmes règles sur d'autres espaces et générer automatiquement les données foncières utiles à l'alimentation de la base.

Pour extraire les données de l'image satellite et pour paramétrer les règles à utiliser, nous avons utilisé un outil que nous avons conçu et développé et que nous avons baptisé OSRU (Occupation du Sol par application des Règles Urbaines). Cet outil comporte un module pour introduire, paramétrer et appliquer les règles d'association spatiales en les traduisant en requêtes spatiales qui seront exécutées sur le contenu de la base de données (cf. figure 2). L'outil gère également la concurrence entre les règles.

Cet outil comporte également un module permettant l'extraction automatique d'informations qui serviront pour la génération des règles d'association spatiales, tel que, les densités de voitures en stationnement à partir d'une image satellite à très haute résolution (cf. figure 2). Notre outil permet le stockage des données extraites dans une base de données géographiques.

Figure 2. Architecture de l'outil OSRU



Application pour le Cas de la Cité El Khadra

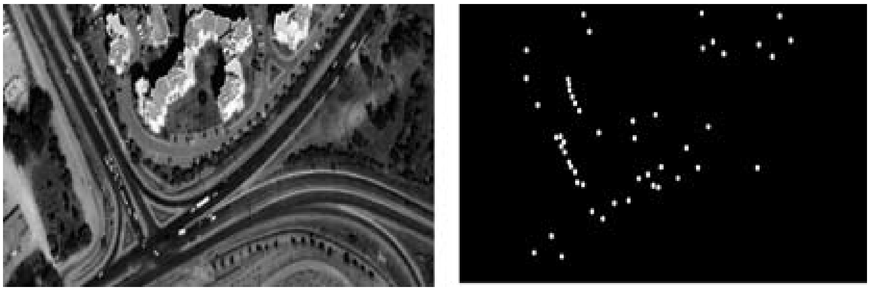
Le jeu de données utilisé pour la génération des règles d'association spatiales est relatif au centre de Tunis et correspond à une superficie de 100 ha. Une image satellite Ikonos de résolution 1 m datant de 2004 et couvrant la région du Grand Tunis a été utilisée. Des données sur l'occupation du sol produites par l'Agence d'Urbanisme du Grand Tunis (AUGT 2004) ont également été utilisées. Des visites sur terrain ont été effectuées afin de compléter le contenu de la base de données.

Les règles d'association spatiales produites par utilisation de datamining spatial mettent en relation les densités des voitures en stationnement et le type d'occupation du sol (résidentiel, emplois, polyfonctionnel). Ces règles dépendent de l'horaire de prise des images satellites. Durant les heures de travail, la densité des voitures en stationnement est plus importante dans les zones d'emplois et de services que dans les zones résidentielles. Cette tendance s'inverse dans les zones résidentielles. Les zones polyfonctionnelles sont caractérisées par des valeurs moyennes de densités de voitures en stationnement quelque soit la période de la journée.

Une application des règles générées sur une autre base de données extraite à partir de la même image satellite mais relative à un espace différent, celui de la Cité El Khadra a été effectuée. La Cité El Khadra est un quartier situé dans le péricentre de l'agglomération tunisoise et couvre 150 ha. Il est délimité par une route nationale et une route régionale et est traversé par l'une des cinq lignes de métro léger de l'agglomération tunisoise. Il est composé d'opérations d'habitat réalisées par des promoteurs publics et privés ainsi que des particuliers. Ce quartier comporte également des établissements industriels, des zones de services et des équipements universitaires. La multitude des fonctions est expliquée par la position de ce quartier aux limites du centre ville et par le niveau satisfaisant de la desserte routière et par le transport en commun.

Le résultat de l'utilisation de cette approche pour le cas de la Cité El Khadra (cf. figure 3) a fait ressortir la fonction "zone polyfonctionnelle" avec un indice de confiance de 86 %. Ceci veut dire que les îlots urbains situés à l'intérieur de ce quartier comportent en même temps la fonction d'habitat et des activités avec des proportions importantes.

Figure 3. Extrait des résultats de l'extraction des voitures sur une zone de la cité El Khadra



i) ii)

L'analyse d'une carte d'occupation du sol du même quartier produite à travers des visites sur terrain effectuées dans le cadre de l'étude du bilan de l'urbanisation du Grand Tunis (AUGT 2004) a permis de constater et de confirmer le caractère polyfonctionnel de ce quartier.

Conclusion

Nous avons développé une approche permettant de disposer rapidement d'informations foncières sur l'occupation du sol à partir de l'application de règles d'association spatiales produites par extraction de connaissances à partir d'une base de données géographiques produite à partir d'une image satellite à haute résolution.

Cette approche est conçue essentiellement pour le contexte des pays en voie de développement et des pays africains en particulier, caractérisés par l'insuffisance des données existantes et par des moyens de production de données foncières et urbaines limités. L'intérêt est qu'elle permet de réduire la durée et les coûts de réalisation des cartes d'occupation du sol, très utiles dans de nombreux domaines : gestion foncière, gestion urbaine, planification urbaine, planification et organisation des transports urbains, etc.

La fiabilité des données produites dépend du type d'utilisation. Les données sont ainsi plus utiles lorsqu'elles sont agrégées et lorsqu'elles sont utilisées dans des analyses macroscopiques au niveau de l'ensemble de l'agglomération. Par ailleurs, l'indice de confiance de la règle utilisée indique sur la validité de cette règle. Plus l'indice est élevé, plus la règle est susceptible d'être valable.

L'outil OSRU que nous avons développé favorise une application encore plus rapide de l'approche en produisant les données nécessaires à l'exécution des règles à partir d'une image satellite à très haute résolution et en facilitant le paramétrage et l'exécution des règles sur le contenu d'une base de données.

L'expérimentation effectuée à travers des données relatives à la cité El Khadra à Tunis a montré l'intérêt et l'apport de l'approche.

L'approche que nous avons développée peut être étendue à d'autres données foncières. Il serait ainsi intéressant d'étudier les associations spatiales entre taille des parcelles, utilisation des parcelles, position spatiales des terrains et part urbanisée des terrains. La connaissance des relations entre ces éléments est très importante pour caractériser l'occupation des terrains. Ce qui permettra, en outre, d'approcher cette question dans des zones où il existe peu de données sur ces éléments.

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The Development and Management of Services to Facilitate Pro Poor Land Management and Land Administration Systems

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Introduction

Customary and social tenure has to be integrated in land administration systems. There is a need for decentralized land administration systems. On the other side standardization is a requirement to integrate cadastral data with other data. This requires a more central support in Land Administration systems.

This paper contains a set of recommendations, requirements and attention points which could be of importance for the development of Land Administration Guidelines for Africa as far as ICT is concerned.

Land Administration

The definition of 'land administration' as 'the process of determining, recording and disseminating information about ownership, value and use of land, when implementing land management policies' has proven to be a guiding principle in policy documents, research programmes, and education and training (UN/ECE, 1996). Although other definitions are used (e.g. Dale & McLaughlin, 1999), and also the definition is challenged (e.g. Fourie, Groot & van der Molen, 2002), the definition still stands firmly especially when the concepts of 'ownership', 'value', and 'use' are interpreted in a broad sense.

The concept of 'ownership' should -in our view- be understood as a relationship between people concerning land within any jurisdiction, so the mode in which rights to land are held, and therefore based on statutory law, common law, and customary traditions. 'Value' should be understood as all the values that could be assigned to land, depending on the purpose of the value, the use of the land, and the method of valuation. 'Land use' should be understood as both the use to which the land can be put, depending on the purpose and nature of the land, classification, methodology, and land cover according to defined classification systems (e.g. FAO Land Classification System, 2000). The concept of 'land' should be understood as the surface of the earth, the materials beneath the surface, the air above the surface, and everything attached to the surface – i.e. it should be perceived as more than just the 'land' as such.

The definition reveals that land administration is a process, which brings application of *process-modelling and related topics (e.g. workflow management, process re-design, and system-support)*, within the scope of land administration.

Finally, the definition makes very clear that the land administration activity is not an end in itself, but that it facilitates the implementation of land management policies. So, the way land administration should work depends on the requirements defined by the various instruments, which are at the disposal of governments in order to allow appropriate implementation of its land policy.

Unlike many other geographic information systems, which provide information about geographical objects and their attributes, land administration systems reflect in principle the social relationship between people concerning land, as they are recognised by a community or a state. Therefore such a system is in no way just a 'GIS'. Data recorded in a land administration system have a social and legal meaning, and are based on accepted social concepts. That concerns both to owners, rights and land objects. It is not relevant whether these concepts are laid down in the law or in unwritten customs. In both cases the way how rights to land, the right-holders and the land itself is understood by the individual people, determine the content and meaning of the land administration system. These rules, constituting the basic principles for the system and justifying its existence, form the institutional context for land administration. Without rules land administration is not possible, as it will be without a societal and legal meaning. By consequence it will be a meaningless activity, not worth to put any effort in.

Institutional aspects are therefore of paramount importance, The legal framework for land issues, and the mandates and tasks as they are allocated in the public administration to perform the land administration function, determine how the system should function. Other institutional measures also do, although they might be more specific and down to earth, like a requirement to the financial conditions that the government wants to apply on the land administration activity for example that the work should be executed under a cost recovery regime. Rules for investments in the system, the way it should operate, the way the government wants to keep control, all of these can form operational constraints.

Land administration serves various functions in a society. Documents like Agenda21, Habitat etc. relate the land issue very much to poverty reduction, sustainable housing, sustainable agriculture and the strengthening of the role of vulnerable groups in society, like women, farmers, and indigenous groups. Land administration systems are –as said earlier- not a purpose in them. They are part of such a broader land policy.

Land policy reflects the way governments want to deal with the land issue in sustainable development, or as the Guidelines say 'land policy consist of the whole complex of socio-economic and legal prescriptions that dictate how the land and the benefits from the land are to be allocated'. That of course depends on the culture, history and attitude of a people. It is worthwhile to draw up a picture of the support land administration systems give to the implementation of (the most important) land policy instruments, as there are -at least- (GTZ, 1998):

- improvement of land tenure security
- regulation of the land markets
- implementation of urban and rural land use planning, development and maintenance
- provision of a base for land taxation.

Concerning the *improvement of land tenure security,* the legal framework of land administration systems (related to the registration or recording of rights and interest in land) is determining the nature of the security provided. Within the context of the definition of these rights 'in rem' (as an institutional prerequisite), deed-systems provide a different (in casu: less) security compared with title systems. The combination of a strong notary-system (*e.g. Latin Notary*) and a deed registration might however provide as much security as the combination of non-authentic (underhand) documents with a title registration (strong role of the registrar).

Concerning the regulations for the *land market,* land administration *systems* provide *transfer procedures* of a different nature. On one hand there are plain procedures of submission of a transfer document and a recording after a minimum of formalities (*e.g. simple deed registration*). On the other hand there are more complex procedures regarding investigations prior to the approval of the legal impact of the transfer (*e.g. issuing of a title certificate*). Some countries require approval by a chief surveyor, a chief planner or another authority. Advantage is that e.g. a building permit is granted together with the title, while in the first case the procedure for planning- and building permits starts just after the transfer. The process-time necessary for the transfer procedure (for example from the obligatory agreement to the official recording or registration, that is often used as a benchmark) therefore might result in a different 'value' for the applicant.

Concerning *urban and rural land use planning, development and control*, the support of land administration systems lies foremost in the phase of development and control of a given land use. This activity is to be seen as an intervention by the government in private rights to dispose. Without knowledge about who owns what and where (also in customary areas) land management will be hardly possible for the government. From the landowner's point of view, intervention by the government specifically limits his private right to dispose on the actual parcel, being the legal object of his private rights. The intervention takes an ultimate form in the execution of pre-emptive rights and expropriation. Regarding protection of third parties in good faith, pre-emptive rights and expropriation decisions should therefore be recorded in the land administration system.

Concerning the support of *land taxation*, the fact is that land tax is an outstanding example of local tax. Without knowledge about taxable persons, taxable objects and land values (all data to be provided by the land administration system), the generated revenue can not be high. Land taxation in many countries is based on land administration systems.

The *management of environmental resources* is of increasing importance. The measures a government can take, are in many cases executed by imposing restrictions on the use of land. A good example is soil sanitation, where governments can impose to owners of land a compulsory soil cleaning, and can give such measures the status of real right, which means that these orders have legal power against third parties (e.g. new owners). Therefore these public encumbrances are eligible for registration.

Africa's land administration systems are still essentially of the nature of what is referred to as a *dual system of land tenure*, i.e. their systems encompass a variety of types of land tenure concepts within one specific country. These countries combine Western-style ownership based on an individual relationship between man and land (although often based on feudal relationships) with customary concepts of tenure based on the ownership of land by communities – a village, family, tribe or clan – of which each individual is a member. In the customary concept the relationship between an individual and the group to which they belong dominates their relationship with the land. Although the majority of African countries have adopted western-style legislation, experience has revealed that this does not exert an influence on the conduct of their populations with respect to their existing normative system – i.e. what is referred to as *legal pluralism* (von Benda-Beckmann, 1991). It has been established that 31 of 44 African countries have implemented individual ownership as the official form of land tenure and at least 9 possess a combination of individual and customary forms of land tenure, whilst customary tenure is the de facto form in 36 countries (Bruce, 1998). It is an interesting question as to whether people in these non-registered areas perceive themselves as possessing security of tenure. Bruce & Migot-Adholla (1993) studied land tenure security in Africa in collaboration with the World Bank, the International Crop Research Institute, and the Land Tenure Centre of the University of Wisconsin (USA). Their study revealed that people governed by customary rights to land possess a feeling of security with respect to the strength and duration of the tenure of their land, as well as with respect to the assurance provided for their title. These people are cognisant of the unwritten traditional rules, and they can anticipate and predict the impact of their conduct. The unwritten customary-tenure rules can provide for a normative system that is sufficiently transparent, reliable, predictable and practicable. The study cited the example of Burkina Faso, where the problems began on the government's introduction of new land-tenure legislation that was vague with respect to the relevant definitions; as a result of the debates on and discussions about these definitions the legislation was not implemented. However the proclamation of this legislation did immediately result in uncertainty. In Ghana the flimsiness of the existing cadastral system resulted in an increased amount of litigation about overlapping rights to land. In Uganda the land law transformed landowners into holders of leases issued by the government, in turn exposing them to new risks of losing their land (new legislation has since been introduced, although there are problems with enforcement) (Worldbank, 2002).

For example, in Ghana 80% of the land is governed by customary tenure, whilst the remainder is government land and private land. Registration pertains primarily to urban land, whilst work has now begun on the registration of rural land (Abu, 2001). In Zimbabwe 42 % of the land is communal land, whilst the rest is freehold (large farms) (Chimhamhiwa, 2000).

Africa has adopted an extremely innovative approach to the creation of new forms of land tenure that are intended to speed the land-registration process. Well-known examples of these forms include village titles (Tanzania, Zimbabwe) (Lugoe, 1996), certificates of occupancy or rights of occupancy (Tanzania, Nigeria) (Sule, 2000), group ranches (Kenya) (Waiganjo, 2001), flexible titles (Namibia) (Juma, 2001)(de Vries, 2000), customary rights issued by Land Boards (Botswana, Uganda, Namibia) (Toulmin, 2000), co-ownership (Mozambique) (Worldbank, 2002), communal titles for Community Property Associations (South Africa, which will probably be replaced by the customary commonhold system) (van den Berg, 2000) (Cousins, 2002)(Durand-Lasserve & Royston, 2002).

Pro Poor Land Management

The subject of land in Africa is both a critical and a sensitive one. UN-HABITAT's global mandate covers all human settlements, and the organization is known as the agency for cities and other human settlements. (Augustinus, 2005) In the cities of the developing world, slum upgrading is one of UN-HABITAT's key tasks, where security of tenure and land are of critical concern. In 2001, 924 million people, almost one-third of the world's population, lived in slums. The majority of these people are in the developing regions, accounting for 43 percent of the urban population. Sub-Saharan Africa had the largest proportion of the urban population living in the slums in 2001 at over 70 percent. It is projected that without serious mitigating action in the next 30 years, the global number of slum dwellers may double to about 2 billion.

There is growing concern about slums, as clearly stated in the year 2000 United Nations Millennium Declaration (Augustinus, 2005). In light of the increasing numbers of urban slum dwellers, governments have recently adopted a specific target on slums. It is contained in the Millennium Development Goal 7, Target 11, which aims to significantly improve the lives of at least 100 million slum dwellers by the year 2020. Given the enormous scale of predicted growth in the number of people living in the slums, the Millennium Development target on slums should be considered as a bare minimum that the international community should aim for. Because land is literally at the base of slum formation, addressing the slum challenge means taking the land issue seriously. Given that experience has shown that it takes 15-25 years to change a country's land administration system, we cannot afford to wait if we wish to improve the lives of slum dwellers now and to meet the Millennium Development Goals.

Many people think that the way to solve the problems of insecurity of tenure, homelessness and the development of slums is through large scale land titling. While this approach is of course important and necessary, it is not enough on its own to deliver security of tenure to the majority of citizens in most developing counties, especially in Africa. The best figures available indicate that less than 30 percent of the land in developing countries is titled. In many countries of Sub Saharan Africa, this drops to one percent. There are many reasons for this, such as the fact that customary tenure has a very strong influence. This means that family and group rights are important to ordinary people. Land titling programmes are generally based on the privatization of land and the awarding of land titles to individuals. Individual land titling therefore often works against the needs and aspirations of ordinary people, including in urban Africa where informal form of land tenure are often adaptations of rural customs.

To reach the Millennium Development Goal of improving the lives of at least 100 million slum dwellers by 2020 will require the development of innovative approaches to security of tenure that are not based on land titling alone. UN-HABITAT's Global Campaign for Secure Tenure, has a focus on advocating change and assisting Member States to introduce innovations which strengthen the tenure security of majority of people, especially the urban poor. The focus of the Campaign is unambiguously aimed at promoting a set of policies, strategies and (technical) tools that will directly benefit the urban poor throughout the world. It addresses the issues of forced evictions, secure tenure for both men and women and, equally important, the right of women to equal inheritance. It enables UN-HABITAT to engage with organizations of civil society, local authorities, professionals and policy makers in order to promote policies and practices favorable to the urban poor.
There is an urgent need to have a land information system that works very differently from the conventional land information system. (Augustinus, 2005)

It is likely that in most countries in the developing world there is less than 30 percent cadastral coverage that actually conforms to the situation on the ground. Instead there vast slum developments of up to 70 percent in some cities, as well as customary and/or rural areas that remain untitled. Given that the cadastral parcel is conventionally the core data set in the land information system to which other attributes are linked, this means that all those areas outside of the cadastre are outside of the land information system, at a micro level. Where there is no or little land information, with the attributes linked to it, this means that there is no or insufficient management of the land etc in these areas (Augustinus, 2005). In this moment the Global Land Tool Network is starting operations.

As indicated above, we have known that conventional land information systems cannot service non cadastral areas adequately for a long time. A start was made in outlining the problem by (Fourie, van der Molen, Groot, 2002). Further debates followed in the framework of the core cadastral data-modeling (FIG/COST, 2004; Lemmen et al). At this point the issue has not yet been addressed by the writing of software, let alone the experimentation with this software in a pilot project in a country which has slums, customary communities and over lapping and non polygon rights and claims, or in a post conflict society. That is, there is still a long path to walk to get to the point of implementation.

The key issue here is that, in the technical field, there is *often an insufficient focus on pro poor technical and legal tools*. In the development of the Core Cadastral Domain Model CCDM (Lemmen, van Oosterom 2006) efforts are being made to avoid such criticism; a lot of useful functionality has been developed but the name of the Model, class names and used terminology is still too much aligned to formal systems. For that purpose the Social Tenure Domain Model (Augustinus et al, 2006) is being proposed as the next step for research, which could be a specialization of the CCDM based on Domain related terminology. This approach is called the re-use of functionality, which is a normal approach in information systems development. The related requirements are presented in paragraph 5, first we look the problem from a more institutional perspective in the next paragraph.

Unconventional Approaches to Land Administration

There is a need for the development of a variety of land administration arrangements that better fulfil the needs of a particular society. Some recommendations in relation to this have been presented in a paper called "Unconventional Approaches to Land Administration – A Point of View of Land Registrars and Land Surveyors" (Van der Molen, Lemmen, 2005). Those recommendations are based on the observations as presented in paragraph 2 and 3 above and provide in our opinion relevant input for the definition of requirements for ICT services to facilitate pro poor land management. A summary of those recommendations is presented in this paragraph.

Recommendation 1: *The legal and technical system specifications differ dependent of the purposes of the system (van der Molen, 2003). Land registrars and land surveyors should design land administration systems that are not more complex and accurate than strictly needed for the purposes that have to be served.*

This can imply that systems with different levels of complexity and accuracy are introduced for different area's/regions in one territory. Societies develop. Firstly a society will develop with regard to the above mentioned land policy instruments. Where no land market existed before, a market might develop. Where no land use planning took place, the authorities might take interest in planning and developing land use. Where people experience secure land tenure, there might occur deterioration of security for various reasons. That means that the functions of land administration systems might develop in correspondence with those developments. Apart from that, land administration systems are anyhow operating in dynamic environment. This goes further than the regulated changes caused by transfer of property rights, and parcel subdivisions. It pertains to new forms of rightful claimants, new rights to land and new forms of spatial units.

Recommendation 2: *Starting with a simple system could be an appropriate approach in system design. The dynamic nature however causes extra requirements to flexibility and scalability. This safeguards the sustainability of the investments in such systems.*

Land tenure arrangements are both complex and locally determined. They cannot readily be replaced by statutory forms of land tenure. Many examples are known of populations which continue to exhibit their traditional conduct even after their government has introduced new statutory forms of land tenure and the registration of land (von Benda-Beckmann, 1991) (Bruce & Migot -Adholla, 1993). In other words, these new forms of land tenure are alien to the population, probably because they are not compatible with the country's traditional societal structure.

Recommendation 3: *The reform of land tenure needs to take account of the prevailing standards and values in the country's society.*

The allocation of duties, responsibilities and competencies in public administration (inclusive of land registration and cadastral systems) is not always commensurate with the public's understanding of the structure of their society, as a result of which they do not always feel an affinity with the organisation of their government.

Recommendation 4: *Land administration agencies need to take account of the population's perception of their governance structure.*

Some governments fail to enforce their (land) legislation with the appropriate stringency, which in turn results in uncertainty and insecurity in society with respect to their rights to and interests in land. Careful consideration should be given to new forms of land tenure, since they will need to be maintained for a long period of time. Land-tenure reforms that are carried out without due caution can have a devastating effect on the confidence of the population.

Recommendation 5: *Land-tenure reform is not without risks, and it is imperative that new systems can be implemented without a need to make subsequent amendments to correct errors in the system.*

Some governments immediately endeavour to achieve the ideal objective of a land administration system, i.e. individual state-guaranteed titles to land together with accurate demarcations of the boundaries of the parcels of lands. However an endeavour to achieve such an objective will impose a heavy and long-term burden on the government's policy and budgets.

Recommendation 6: *An approach based on the introduction of a simple system followed by a gradual migration to the more complex ultimate system is manageable.*

The World Bank states that 'it now is widely recognised that the universal provision of secure land rights within a country does not require uniformity of the legal arrangements, and that there is some form of consensus on the desirability of having legal recognition for customary forms of tenure and land right for the indigenous people; the Bank recently devoted greater attention to the sustainable management and evolution of customary tenure systems; communities should be allowed to choose between different types of tenure' (Worldbank, 2001).

Recommendation 7: *Land administration systems should be able to accommodate various land tenure arrangements.*

Experience reveals that some countries develop land legislation, which endeavours to integrate customary tenure within the formal system.

Recommendation 8: *Land administration systems should cope with new forms of statutory tenure.*

The recognition of customary rights also devotes attention to rights of sheep and cattle farmers. The problem of overlapping rights has yet to be resolved in many countries.

Recommendation 9: *Land administration should not neglect rights of others.*

This brings us to the issue of the nature of the spatial unit, which forms the basis for registration. Objects on which customary rights are exercised are not always accurately defined (Neate, 1999). Within this context Österberg (2002) advocates a flexible and non-traditional approach to the spatial component. Land rights might pertain to a relationship with the land that is in accordance with the standards and values of the relevant community, although these rights will need to be defined to provide third parties with meaningful information. In these situations the parcel of land, i.e. the object on which the rights are exercised, might be defined in a manner other than accurate land surveys and geometrical measurements. Österberg (2002) shows pro's and con's of various perspectives.

Fourie (2002a, 2002b) notes that non-cadastral information should be integrated in spatial information systems since 'the high accuracy's and expensive professional expertise associated with the cadastre has meant that there is too little cadastral coverage in Africa'.

Recommendation 10: *Land administration systems should be able to accommodate a variety of spatial units.*

In essence it is possible to register or maintain records of relationships between man and land irrespective of the nature of the country's jurisprudence; this ability offers opportunities for the integration of statutory, customary and informal arrangements within land administration systems. In fact the converse is actually true; the registration and recording of relationships between man and land will be meaningless when those relationships are not accepted and the standards and values pertaining to those arrangements lack transparency, reliability, and predictability. In such situations the system is comprised of nothing more than the maintenance of records of the persons who make use of the land, i.e. records of a form of pseudo-physical attribute of specific parcels of land. The land administration system will then contain solely factual information without a legal basis.

Recommendation 11: *A land administration system is more than a GIS because it represents social relationships which are meaningful in a society, and not attributes to a geographical object only.*

In some situations it may well be necessary to replace these native/customary rights, i.e. in the event of the collapse of customary structures as a result of population pressures resulting in the implementation of personal forms of land tenure or the scarcity of land, thereby rendering the traditional allocation of land impossible. See further examples in Bruce & Migot Adholla (1993). In such situations preference is given to an inter-disciplinary approach to the formulation of land administration policy in which land surveyors, for example, co-operate closely with sociologists, anthropologists and lawyers (Fourie, 2002a).

Recommendation 12: *Land registrars and land surveyors should work together with social scientists.*

The Social Tenure Domain Model

A further set of relevant requirements for the development and management of services to facilitate pro poor land management is presented in the paper 'The Social Tenure Domain Model' (Augustinus, et al, 2006). Land administration results in an extensive set of paper based, or digital, data to be maintained. Efficient access to this data is a relevant issue, and there are many examples of paper based administrations which cannot really be accessed. In our opinion Pro-Poor Technical tools need to include both data- and process modeling. Such models are of importance for the development of land management systems, including statutory, customary and informal systems. Standards are useful in designing such models as long as they facilitate extensions and adaptations to the local situation.. Also, cadastre-less approaches should be able to be supported.

A main characteristic of land tenure is that it reflects a social relationship between people and land which is recognized as being a valid one (either formal or non-formal). Land management and land administration systems should be designed to take into account the whole variety of such social relationships. Information technology is of strategic importance to be able to deliver systems that can underpin this variety of tenures, meet changing customer demands, reduce land disputes, assist in upgrading informal settlements, and improve agricultural production through better land management.

Standardization is a well-known subject which started with the establishment of cadastral systems. In both paper based systems and computerized systems standards are required to identify objects, relations between objects and persons (also called subjects in some countries) for accessibility and information supply purposes.

The Social Tenure Domain Model would most likely be implemented as a distributed set of (geo-) information systems, each supporting the maintenance activities and the information supply of parts of the dataset represented in this model (diagram), thereby using other parts of the model. The model can also be implemented for one or more maintenance organizations operating on national, regional or local level. This underlines the relevance of this model; different organizations have their own responsibilities in data maintenance and supply and have to communicate on the basis of standardized processes .

Reports of a number of United Nations Expert Group Meetings have been analysed to provide input for a user requirement analyses for the Social Tenure Domain Model. Some of these reports include:

- An Expert Group Meeting held at the United Nations Economic Commission for Africa, Addis Ababa, Ethiopia, 23-26 November 1998 on Integrated Geo-Information (GIS) with emphasis on Cadastre and Land Information Systems (LIS) for decision makers in Africa, (UNCHS, 1998);
- An Expert Group Meeting held at UN-HABITAT, Nairobi, Kenya, 11-12 November 2004 on Secure Land Tenure: New Legal Frameworks and Tools (FIG, 2005);
- An Expert Group Meeting held at the United Nations Conference Center in Bangkok, Thailand, 8-9 December 2005 on Secure Land Tenure: New Legal Frameworks and Tools in Asia and the Pacific (FIG, 2006).

The requirements presented below are derived from the 'research questions' in (Augustinus, 2006).

System should include information that covers the whole spectrum of formal, informal and customary rights, e.g. the continuum of rights from UN Habitat. Further it should be possible to merge urban and rural cadastre in one environment.

Requirement 1:	*It should be possible to merge formal and informal tenure systems in one environment (system)*

Computer based technology is faced with human resource constraints; the same is valid for modern survey technology. Computer based systems are expensive to implement and maintain. In case of disaster, crises or post conflict situation there may be no or insufficient hardware or other resources.

Requirement 2:	*Reversibility from database to paper based systems must be guaranteed.*

Many new reference systems are under development world wide. One example from Africa is AFREF which is a planned surveying reference system for all 53 African countries. The impact of this development, and similar developments in other regions is that existing co-ordinates in existing frameworks are expected to be transformed to new 'versions' of these co-ordinates in the future. This means that it should be possible to represent one point in two co-ordinate systems or may be even three co-ordinate systems if local co-ordinate systems have to included too. Of course only one co-ordinate pair is the 'actual' one, but a conversion from local to existing national to new national reference system is expected to be a requirement which has to be supported.

Requirement 3:	*It should be possible to represent spatial data in several reference systems*

Spatial Data Infrastructure provide environment where spatial data from different systems can be linked and coordinated. In the past this linking has been proved to be very problematic. Unique object identification is of importance here, see (UN, 2004).

Requirement 4:	*Spatial data in Land Administration Systems should be linkable with other systems containing spatial data. There should be optimal flexibility in linking all types of attributes and identifiers*

Where information exists, it is often spread among several government departments and accessing it is difficult. Most developing countries, and Africa is no exception, need to reduce the excessively high number of institutions involved in land management and information flows. A land management system should serve decision makers at national, regional and local level, with the emphasis on decentralized decision making. Such decentralization should allow the creation of better vertical coordination between 'bottom up' information and local interest and 'top down' information and policy guidance which can harmonize overall national development policy with local programs. So: the organisational structure can change continuously.

Requirement 5:	*Land Administration Systems should be implementable in a decentralized and distributed environment*

Data acquisition is related to accuracy of spatial data.

Requirement 6:	*It should be possible to manage spatial data with different accuracies and from different sources*

The data should be easy to access and to understand. The land data should be accessible at local level and friendly to the poor, often uneducated people.

Requirement 7:	A user friendly user interface is required.

The need for different types of spatial units has been discussed above.

Data bases should accommodate a range of identifiers, geo-referenced parcels, un-referenced parcels, lines and points. It should be possible to represent parcels/spatial units as single points, geo-codes (sometimes known as dots on plots), lines and polygons; polygons can have accurate, less accurate or fuzzy boundaries. Parcels/spatial units can be poorly surveyed, non geo-referenced and geo-referenced. Another example is approximate boundaries of the informal settlement and the customary areas.

Requirement 8:	Representation of a broad range of spatial units should be possible.

There can be overlaps in tenure systems

Requirement 9:	It should be possible to represent overlapping tenure systems

Conventional basic concepts of land administration are affected in three ways:

- the subject: group ownership with non-defined membership (person can be Natural Person, Company, Municipality, Co-operation, a Maried couple,Group, Group of groups, Ministry, etc)
- the rights: the recognition of types of non-formal and informal rights (possibility to include different Customary tenure types, Indigenous rights, Tenancy, evolutionary titles: e.g. starter-landhold-freehold, Possession, Mortgage, Usufruct, Long Lease, Miri- Milk-Waqf, Restriction Types, State lands, Informal land, lands with Unknown rights, lands with overlapping claims: Disagreement or conflict, Occupation, Uncontrolled privatisation,
- the object: units other than accurate and established units. Apart from Parcel, Apartment, Building it should be possible to represent Spatial Unit's as One Point (GeoCoding), a set of Lines, a Polygon (low accuracy) or a Polygon (high accuracy). Quality labels have to be included for this purpose.

Please note that the gender issue has been modelled in the CCDM (and STDM as a specialization of the CCDM).

ICT and Land Administration

All land administration organisations face similar challenges: they need to become less bureaucratic, simpler, cheaper and more transparent. Design and implementation of traditional approaches is so time-consuming that land laws are adapted to provide for simpler procedures. Unconventional approaches are urgently needed, both conceptual and technological. The author reviews recent examples of both.

Technology is a major facilitator for process acceleration. Countries now at a more advanced stage of development enjoyed the benefits of IT application at an earlier stage. Many now face renewal of their IT architecture to cope with evolving customer demand and IT opportunities.

All land-administration organisations expend much effort in determining, registering and disseminating information on ownership, value and use of land. The large amount of data involved is subject to many changes, needs to be kept up to date and must be accessible for retrieval. Consequently, operations can only be carried out efficiently and effectively with ICT support. However, what is the appropriate approach to organisational objectives in relation to the opportunities offered by ICT? The 'strategic alignment model', as developed by Henderson and co-workers at the Massachusetts Institute of Technology in 1992, is of use in choosing an approach. The strength of this model is that it relates strategic and operational aspects of an organisation's objectives to its ICT policy.

In the past, organisational objectives were specified prior to selection of the technology requisite for achieving these. In contrast, today developments in technology in part determine the objectives. Examples are the:

- rapid supply of land information to customers enabled by internet technology
- daily maintenance of up-to-date information enabled by database technology
- rapid and on-line delivery of notarial deeds and title documents enabled by digital signatures and the associated security measures.

The formulation of objectives is thus a duty shared by general and ICT managers, or more precisely by those with sufficient insight into both types of management: the geo-information managers. The strength of the model thus also lies in its explicit indication of the need for changes in strategy (referring to both objectives specified for the organisation and for the ICT marketplace) to be accompanied by changes at operational level.

Recent developments in Geo-Information and Communication Technology (ICT) have a serious impact on the development of cadastral systems and geo-spatial data infrastructures (GSDI). Both theoretical and practical developments in ICT such as the ubiquitous communication (Internet), data base management systems (DBMS), information system modelling standard UML (Unified Modelling Language), and positioning systems will improve the quality, cost effectiveness, performance and maintainability of cadastral systems. Furthermore, users and industry have accepted the standardisation efforts in the spatial area by the OpenGeo-Spatial Consortium and the International Standards Organisation (e.g. the ISO T211 Geographic Information/Geomatics). The comprehensive OGC set of OpenGIS standards on spatial-data management is adopted by the GIS and database industries and their support for interoperability, data access for warehouses and easy data exchange create new perspectives for existing and new cadastral systems. The first internet-GIS applications are already operational within a cadastral context.

This has resulted in the introduction of new (versions of) general ICT tools with spatial capabilities; e.g. eXtensible Mark-up Language/ Geography Mark-up Language (XML/GML), Java (with geo-libraries), object/relational Geo-DBMS including support of simple geographic features.

It is the first time ever that such a set of worldwide-accepted standards and development tools are available (UML, XML, Geo-DBMS, Open Geospatial Consortium standards). This creates new perspectives in both the development of new cadastral systems and in the improvement of or extension of existing cadastral systems – also in Africa. The latest technologies and methods can be used.

At the moment, the first Internet-GIS applications are already operational in a cadastral context. In the near future this will be extended to mobile GIS applications based on cadastral information (sometimes also called location-based services). Imagine mobile phone or PDA (personal digital assistant) users, such as a civil servant of the municipality, a real estate broker, or a policeman, with their mobile using up-to-date cadastral information for their day-to-day tasks in the field: 'who is the owner of this building?', 'when was this building sold and what was the price?', etc.

Recent developments in Geo-ICT have important implications for the development of cadastral systems and GSDI surrounding cadastral systems. The developments in ICT in general, and specifically the Geo-ICT can improve the quality, cost effectiveness, performance and maintainability of cadastral systems.

Standardisation of the Cadastral Domains is relevant because computerised cadastral systems can support a customer and market-driven organisation with changing demands and requirements. Customers require an efficient online information service linked to the database(s) of cadastral organisations. The application software for support of cadastral processes is in many countries being continually extended as a result of changing requirements. In the future the volume of cross-border information exchange is expected to increase, particularly within the European Union.

On the 'software side' the following can be observed. Spatial functionality (data-types, data-indexes and operators) are available in the main stream databases as Oracle and IBM/Informix or IBM/DB2. PostgreSQL is advanced Open Source database software with sophisticated spatial functionality, including 3D, history tracking and spatial clustering. The MySQL database server is a popular open-source database and includes spatial functionality. Apart from Open Source databases, GIS and platforms such as Linux are available. Indexes of Open Source/Free GIS-related software projects are published on the Web with references to OSRS, FreeGIS.org, Metalab Linux Archive and Fresh Meat.net, and webmapping with Scalable Vector Graphics. Sweden's Lantmäteriet and ESRI have co-operated to develop ArcCadastre, a tool adapted for cadastral and mapping activities. It makes use of different kinds of spatial management in different situations and extends mapping functionality with survey and cadastral functionality. Companies such as Caris, Intergraph, and Bentley now also provide software for cadastral applications. The number of tunnels, cables and pipelines, underground parking places, shopping centres and the like have increased greatly over the last forty years. Is traditional cadastral registration, as based on the 2D-parcel concept, able to register all situations that present in today's world? Although a 3D approach to cadastre is new, some countries have already solved (the legal aspect of) the problem of 3D-cadastral registration. Note: open source software provides a good basis for learning and understanding the principles of the software.

GISs are used within (local, regional, central) governments, utility and other companies to support their primary business, which often depends heavily on spatially referenced data. Until recently the spatial data management was handled by GIS software outside the DBMS. As DBMSs are being spatially enabled, more and more GISs (Arc/Info, Geomedia, Smallworld) have been migrated towards an integrated architecture: all data (spatial and thematic) are stored in the DBMS. This marks an important step forward that took many years of awareness creation and subsequent system development. It can be observed that many organisations are currently in the process of migrating towards this new architecture. This is a lot of work and will still take many years. The next step will be the creation of a common GSDI for related organisations; the so-called information communities. Instead of GSDI the term Cadastral Infrastructure could be used. This can replace, in the long run, the exchange of copies of data sets between organisations. It requires well-defined protocols, standardisation such as the Open Geospatial Consortium web mapping specification. But also the role of the Geo-DBMS gets more important, because not a single organisation depends on it, but a whole community. The main use will be query oriented (and less update oriented, only the owner of the data is doing updates, others are only doing queries). An important component is the network infrastructure (bandwidth) itself.

The data acquisition can be supported with technologies providing digital data. Earth Observation Satellites such as Landsat 5 and 7, Ikonos, SPOT 5, Radarsat-1 and Quickbird provide geo-referenced, high-resolution images used in mapping, city planning, GIS updating, agriculture, land-use monitoring and land administration. New approaches should be investigated in relation to Lidar (Airborne Laser Altimetry). These are multisensor systems operating from aircraft or helicopter and consisting of a reflectorless laser range system and a positioning system. Combination of the results with tape measurements (street-level) and GPS (inner side of street blocks) could result in cadastral maps produced in an efficient way. Experiments with handheld GPS using point positions to relate property identifier number, land cover, crop type, soil condition and number of structures etc have been performed. Combinations of digital video, GPS and GIS derived from rapid ground-data capture from a car have been tested. See further the use of the Cyclomedia system in some European cities or the use of video cameras for mapping from planes.

Technologies for 3D Lasermapping (Terrestrial Laser Scanning) are rapidly evolving for capture from ground stations of objects such as 3D point-clouds. Here there are relations to developments in 3D Cadastre. In the near future Galileo will double the number of positioning satellites, resulting in improved efficiency, better positioning in urban areas and enormous new impetus behind location-based services. These developments deserve much more attention on the part of the cadastral community.

Technically, digital land-information products offer considerably more possibilities for perfect reproduction and fast, inexpensive and easy distribution. Variation in product range is possible in many ways. Customers want to be served in a professional way, with user-friendly tools and one-stop-shopping (integrated service delivery). The information on offer should be timely, up to date, reliable, complete, accurate, relevant and, if necessary, customised and well-integrated with other relevant datasets from other suppliers. The systems should also be compatible with customer's working procedures. Customers want electronic conveyancing techniques such as electronic signatures, encryption, hash values and measures against bit-loss. Workflow management techniques will become applicable which will have a positive impact on the management of daily fluctuating supply and demand as allocation of workload becomes possible at the site at which a work force is currently available.

Further Requirements for e-Land Administration

The UN/ECE Land Administration Guidelines highlight the importance of addressing user requirements. Before altering an existing system or introducing a new one, it is essential that the requirements of those who will use or benefit from the system are clearly identified. Naylor (1996) relates this to the current market oriented approach applied to land information. Products and services must certainly satisfy the user needs. The UN/ECE Guidelines state that users can be anyone who is interested in land matters. A wide variety of user communities will need to be consulted in order to understand their requirements and the constraints under which they currently operate. The assessment of user needs should be made not only at the outset of the development of a new land administration system, *but also throughout its lifetime*. Questions need to be asked about the *categories (domains) of data* that will be required in the future. It may be an attractive idea to collect some types of data for some possible use in the future but if it is not necessary to do so at present, then few resources should be allocated for that purpose. A *step-by-step* approach may be more cost-effective.

In the UN/FIG Bathurst Declaration the importance of ICT for the development of land administration systems is underlined. Information technology will play an increasingly important role both in constructing the necessary infrastructure and in providing effective citizen access to information. Finally, there must be total commitment to the maintenance and upgrading of the land administration infrastructure.

The information society has become prominently visible over the past few years (Magis, 1998). The use of information and communication technology (ICT) for *management, transactions and communication* is becoming increasingly popular. Customers are taking up a much more directive role. Organisations are becoming more dependent of each other and are in fact forced to openness (of systems) and exchange (of data). Developments such as *chain-orientation, digitisation and new technologies* are leading to the fading of physical product concepts. Information products are becoming flexible combinations of digital data components and additional facilities and services.

Standards

To speed up the development of cadastral systems standardised (but extendable) data models and standardised inter-organisational work processes combined with standardised functionality should be developed. The link to surveying processes has to be included.

Data Collection

Combinations of data collection methods and technologies for cadastral purposes should be used.

Quality Aspects

As a geospatial data infrastructure evolves over time, there needs to be a system for ensuring the quality of the spatial data. The ISO 19113 standard defines five elements for quality control:

- completeness
- logical consistency
- positional accuracy
- temporal accuracy
- thematic accuracy

There is a need to obtain a quality management system that deals with the above elements both from a technical point (e.g. automated, manual control) and a managerial point (responsibilities, time frame, ...).

Legal Aspects

Legal aspects become more and more important both in ICT and especially in GICT. In ICT, topics such as privacy, security and authenticty became extremely important. In addition to them, the geoinformatio aspect raises even more questions such as the legality of spatial data gathering; e.g. electronic signatures and electronic conveyancing. E-governance is underdevelopment in many countries, a legal basis for this may be required.

Data bank legislation and authentic registrations are coming more and more relevant, also under political pressure.

The basic idea behind data infrastructures is that it provides for tools giving easy access to distributed databases to people who need those data for their own decision making processes. Although data infrastructures have a substantial component of information technology, the most fundamental asset is the data itself, because without data there is nothing to have access to, to be shared or to be integrated. Last decade it was understood that the development of data infrastructures not only provided easy access to distributed databases, but also gave good opportunities for re-thinking the role of information supply for the performance of governments. Based on this starting point, the 'Streamlining Key Data' Programme of the Netherlands' government took the lead in the development and implementation of a strategy for restructuring government information in such a way that an electronic government evolves that:

- inconveniences the public and the business community with request for data only when this is absolutely necessary
- offers them a rapid and good service
- can not be misled
- instills the public and the industrial community with confidence
- is provided at a cost that is not higher than strictly necessary

Jointly with 5 other government registers, the property registers & cadastral maps & topographic maps of the Netherlands' Cadastre, Land Registry and Mapping Agency are formally appointed in 2002 as 'base registers' of the governmental information infrastructure. The baseregisters will be the core of a system of so- called authentic registers, which might be any register that is maintained by a single government body and used by many others as the authentic source of certain data. If a register is formally designated as an authentic register, all other government organisations are strictly forbidden to collect the same data by themselves. In their budget allocation they will not find any money for data collection at this point. (van der Molen, 2005)

Who has to pay if incorrect geoinformation is provided?

Customers want one-stop-shopping (integrated service delivery). Electronic conveyancing techniques such as electronic signatures, encryption, hash values, measures against bit-loss, are applied increasingly. Expertise to define the new legal prescriptions concerning the authenticity of electronic documents (the certification authorities that are empowered to issue digital keys) is available now. As land registers and cadastres play an increasing role in the knowledge regarding the legal status of land according to public law (the so- called public encumbrances) as a complement to the status according to private law, the submission and recording of government documents concerning government decisions on land with an effect on third parties, are within reach. This will contribute to the development of e- government.

There are a number of legal issues involved in geospatial data-gathering that habve to be cleared up. These issues include the security and privacy both public and private entities.

Business Alignment

Business alignment within land administration organisations can be worked out into a strategic business alignment vision now as follows:

Business

The developments within land administration organisations are expected to be in the following directions:

- The land administration organisation will be a customer and market oriented organisation. Adequate and continuous communication with customers on (ICT) developments within the land administration organisation will be a priority. Users/customers will be involved in product and service development. Finally the customers will have access to a well performing on line information service to the central data base(s) with legal, administrative and spatial data.
- The costs and revenues will be in balance. Costs are compensated by the revenues from the maintenance of land registry and cadastral data and from the (geo-)information dissemination. The operationalisation of this could require enterprise resource planning and financial systems which can be related to workflows. The impact is that primary business processes and supporting processes will be linked.
- The web based application software and related database and GIS technology to support cadastral and land registry processes will extend continuously, more and more new functionality will be required. The same is valid for financial systems, office automation and support of enterprise resource planning activities. This implies a simultaneous (substantial) growth of the supporting ICT organisation (ICT Policy and Projects and ICT Services).
- The availability of a computerised cadastral data set, including legal/administrative, cadastral geometric and addresses/spatial units data, will increase the demand for those data significantly.

This means that, in the near future, the business of land adminsitration will fully depend on the availability of ICT services and products.

Business Processes

A critical success factor is the conversion of analogue (spatial) data to a computerised environment. Scanning of cadastral maps can be a first step, vectorisation of cadastral spatial data and scanning of other documents, e.g. transaction documents can be expected as a logical next step. Workflows will be managed. New workflows will be developed. Performance will be measured and related to indicators, tools will be available to check quality of produced data. A substantial part of the production can be performed by private companies and conveyors. All employees will be trained several times to be competent to work in this new environment. Human Resource Management will be developed to keep a highly motivated and flexible staff.

ICT Policy

The business of the land administration organisation will fully depend on the availability of Information and Communication Technology. The information supply aligned to land administration organisation business needs to be improved by an efficient and effective use of Information and Communication Technology. An 'organisation-wide' ICT policy will be developed and maintained based on the ICT Strategy. Implementation of this policy will be project based in a step-by-step approach being aware that a well performing nationwide communication network will not be implemented synchronic to organisation requirements. Innovations within the organisation will be initiated based on proven technologies and sustainable standards in partnership with system integrators, hard- and software suppliers and facilitators. Mission critical activities will not be outsourced. Complexity in the existing ICT environment will be reduced by redesign and of outdated systems. New functionality will be provided in a user- friendly and standardised web-based interface to serve external users and to support internal business processes.

Quality-, risk- (e.g. fall back) and communication management will be integrated in the ICT policy. The same is valid for other management systems, e.g. based on the balanced score card, where financial systems, customer relations, internal processes and innovations and learning are integrated.

Communication with users/customers is an integral part of the ICT policy. Customer dissatisfaction can be expected in case software solutions are not implemented in time or in case solutions do not comply with specifications.

<u>**ICT Services**</u>

Priority in the near future is a continuous availability of ICT services, The organisations primary business depends on it. High quality ICT Services will be provided on the basis of Service Level Agreements. ICT Services will be concentrated and centralised in the future. A helpdesk will be available for internal and external customers.

Technical Aspects

At data dissemination side it looks that a thin client approach in a 3-tier architecture with a web based seems to be the recommended approach today. Data protection and secure remote access, is of vital importance (https, firewalls, virus scanning). Data dissemination includes electronic conveyancing.

Information Architecture

Architecture is about designing, unifying, coherancy and structuring. A lot of architectures exist and one of them is the information architecture.

When applied to an organization the information architecture models and describes all information within the organization and the relations between it.

The information architecture describes information in terms of entities (which describe things in the real world), attributes (describing elements of entities) and relations between entities and attributes.

The description is on a logical, conceptual, semantical level so it is not technically oriented. Together with a business proces model which describes the processess in the organisation a model of the information flows and resulting information products is created. The CCDM could be the basis for such an architecture.

ICT-Governance – Organisational Aspects

Governance has to do with decision rights and accountability. It concerns the assignment of decision rights, responsibilities, criteria, goals to be achieved and measures that support the governance.

ICT governance concerns good control and management of the ICT within the organisation; it specifies the position of ICT-operations within the perspective of business strategy, and it encourages desirable behaviours in the use of ICT.

In order to create an ICT-organisation that can maintain ICT-operations and make it operate in a sustainable way, proper ICT-governance measures must be implemented; taking into account the corporate strategy and the corporate goals, customer needs and cost effectiveness.

e-Land Administration

At the *output* side of Cadastre and Land Registry organisations e-Land Administration contributes to better transparency in the real estate market. It improves B2B activities, it improves efficiency and could decrease transaction-costs representing an economic value. e-Land Administration, as core of SDI supports in easy access to data, increasing use of the data and thus generating more revenues. It attracts new services and new registrations. A single window contributes to improved customer satisfaction, the same is valid for value added products. For this purpose new business models and pricing models have to be developed in close co-operation with the private sector.

In relation to *throughput* it provides opportunities for the introduction of Workflow Management. Furthermore an easy access can be given to digital archives with deed, title and other legal documents. One more opportunity is in the future development of fully automated updating by customers or professionals.

On the *input* side various forms of e-Land Administration have been recognised: e-conveyancing, e-registration and e-lodgement. This enhances transaction procedures in the land market and (again) makes this market more transparent, it resolves chain of titles and allows a quicker transfer of purchase prices.

The *link* between e-Land Administration and SDI is a prerequisite to implement the single window policy. The single window increases customer satisfaction. This link will offer a good opportunity for value added products where the private sector opens the market, on the basis of a public-private partnership or (better) a public-private co-operation. The link between SDI and e-Land Administration increases the use of data and so increases return on investments. For this purpose the mechanisms of data-sharing based on standards have to be enhanced. SDI with integrated land registry and cadastre may flourish well as base registers as part of a governmental policy, where guaranteed quality in relation to the registers is an item. Apart from parcels the addresses are key to access the information.

e-Land Administration involves *stakeholders*. The development of e-Land Administration can not be done in isolation.

e-Land Administration and *technology*: technology is not a restriction. A good cooperation with IT industry is required, one example here are the efforts being made in core cadastral domain modelling.

e-Land Administration and *political* support. e-Land Administration is only possible in a context of national information policy resulting in new laws (legal framework) and arrangements of the public administration. Evidence has to given of the benefits in terms of economic justification and customer satisfaction.

e-Land Administration and impact on *organisations* is expected to be substantial: re-engineering IT and workflows, this goes with re-structuring of the organisation and re-skilling of the employees.

Conclusions

Developing countries face the challenge of pro-poor land management and administration and are aiming for as prompt as possible enhancement of authority services. These countries face the issue of how to organise land information in support of their governance. The World Bank, an important funder of Land Administration in many countries, and other international organisations, see low-cost approaches as sometimes conflicting with ICT. This vision may be challenged: low-cost approaches will probably eventually require high technology. Many leaders of land-administration organisations are kept away from strategic issues and are too busy with the daily problems they experience in service delivery. However, leadership is necessary to develop the future in accordance with clearly set government requirements.

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Land Management Information System In The Knowledge Economy: Semi-Arid Regions of Baringo/ Bogoria, Kenya

By Marimba Fednance

Abstract

This presentation looks into Land Management Information Systems in the Knowledge Economy with a focus on the Semi-Arid regions of Baringo/Bogoria in Kenya (Fig 1). It revolves around various land resource use systems that causes zonations/demarcations leading to communal/individual land ownership.

The semi-arid areas of Baringo and Bogoria reserves are under the management of County Councils of Baringo and Koibatek. The major land use activities by the pastoralists in this region are; livestock herding, crop farming, tourism, biodiversity conservation, bee keeping, fishing and settlement.

General observations made, informal interactions with the locals, use of remotely sensed Landsat satellite images and manipulation via analytical softwares such as ArcView and ERDAS gave a clear picture of land changes in this region. They clearly showed changes in wetlands (including lakes) decreasing in sizes, shrubs and grasslands eating into areas that were previously occupied by wetlands, exposure of rocky zones in areas that were previously occupied by shrubs and grasslands. Climatic changes have seen formation of new water bodies such as Lake Kichirtich via El Nino rains.

Observations and studies have shown that the entire vast area of Baringo/Bogoria that was initially under shrubs and wetlands cover have been individually occupied and demarcated, paving way for economic activities such as agriculture and tourism, with agriculture contributing to soil erosion in the region and hence heavy siltation of the two major lakes (Baringo and Bogoria). These activities have had great impact on land thus calling for immediate information generation to keep records of these changes that will be easily referred to.

Incorporation of LMIS will ensure generation of information/data and management of public and private land use activities such as; infrastructure development, natural resource management, land planning/zoning/development systems, environmental protection and conservation, emergency and social services provision.

RS: Remote sensing, GIS: Geographical Information systems, GPS: Global Positioning Systems, KWS: Kenya wildlife Services, WWF: World Wide Fund for Nature

Introduction

Land ownership, management and administration in Kenya has always been a sensitive and complex issue to handle. Land has grown to be a very rare and precious commodity in both urban and rural areas due to its high subjection to developmental projects geared towards livelihood improvement.

The semi-arid Baringo/Bogoria region is at an average elevation of 965m above sea level and located between 0.200N and 0.750N and between 35.750E and 36.40E. The region has two major lakes: Lake Baringo and Bogoria, which derive their waters from rivers Kuamara, Nessuit, Rongai, Waseges (and Emsos and Majimoto springs to Lake Bogoria).

This region consists of pastoralist communities and land has mainly been used for agricultural (crop farming, livestock herding, bee keeping, fishing and fish farming), tourism (wildlife and eco-tourism) and biodiversity conservation. These have resulted into subdivision of land into small segments for individual ownership via inheritance, purchase and rent/hire that will require development of a land information management system to ensure easy land resource use, management and administration.

Kenya lacks an elaborate National Land Policy and that land records are generally stored in physical forms such as topomaps on papers standing a risk of physical damage due to mishandlings, and will mostly be found in bad shapes upon retrieval. Manual access to land information has proved to be time consuming and tiring hence inefficiency to information receipt. These has also lead to creation of inaccurate land records with error accumulation and enhancing problems in land administration and computerization process. There is a need to digitize this information and make them available in soft copies that will give an assurance of good physical condition upon any retrieval and also help save time in updating of these documents in cases of land demarcation or merger and to decrease in inconsistency.

Agriculture

Livestock Herding

Being a pastoralist community highly surviving on herding of large number of cattle, sheep and goats, there were cases of overgrazing in the region dating back as early as 1972 with the trend increasing at a rate of 5.4% by 1990. Land was initially owned communally and, with current increased pressure on grazing lands due to overstocking, there were calls by the community to control grazing fields. It was vital to map the entire region used for grazing, control grazing pattern and livestock numbers. Information is required on highly productive vegetative regions favoured by herders such as the Kesubo and Loboi Swamps. Demonstration via construction of a comparative study plot by WWF showed that if there can be controlled grazing then the depleted vegetation will easily recover in a short time translating to increased livestock production via controlled population.

Application of GIS technology in mapping of the grazing fields would enable controlled grazing by allowing livestock in permitted areas over a given time while allowing inaccessible areas regenerate. In addition, a database should be created and maintained of livestock owners and the number of animals an individual own. This is because new entrants (who come via inheritance of livestock from there parents usually have the urge to keep more livestock without considering availability of fodders).

Crop Farming

Land that was communally owned and used for livestock herding is now being converted rapidly to agricultural use. Huge chunks of lands have been subdivided and demarcated into small plots for individual ownership. Unfortunately, when all these are being done, information never reaches the land office since its 'simply' taken to be a communal/clan/family affair. It is only when a land is being sold that legal procedures are taken into consideration mostly triggered by the buyer and information reaches the land office. These lands are mostly used for agriculture and settlement purposes.

Encroachment by farmers to initially traditionally conserved swamps (Fig. 7) for agricultural use has also gone unrecorded. This call for immediate land surveys and mapping to protect these areas and the surveys/mapping procedure be done participatory with the local community since they clearly know the boundaries of the swamps. Environmental changes caused by el nino rains that saw the creation of Lake Kichirtich (Fig. 6) also had effect on land ownership and agricultural activities. While people who owned the land covered by the lake lost there land, those around the lake converted there grazing fields into agricultural lands. Data on these changes need to be acquired and made available.

Persons holding lands should be supplied with certificates/deeds to ensure their land rights. Unfortunately, these procedures are usually very slow, tiring, lengthy and expensive in the long run. As a result, people tend to just posses the land with simple trust between them (buyer/seller, father/son). Implementation of computerized systems will see a faster land registration system that will easily lead to information generation on land ownership history and use changes to ensure effective management.

Unrecorded land ownership changes results into lack of land boundaries/demarcation updates on administrative maps held by the government. It is at this point that RS and GIS application tools is required since digital maps are easy to produce, changes rectified and information stored. These information will not only contain parcel size, but also other information such as the land owner, date of inheritance/purchase and will help give history of ownership to avoid clashes. The data can also be moved a step higher by including the types of crops grown and with crop update every season (this will also help monitor soil productivity with agrochemical fertilizer application for example in the Pekera Irrigation Scheme and Sandai -Kenya Seed- maize farming).

Increased agricultural activities (intensive farming) have resulted to excessive use of water from rivers and water inlets draining into lake Baringo and Bogoria affecting their water levels. As a result, there is need to gather information on water use, rivers and lakes' depths fluctuation over time since this has effect on wildlife and livestock depending on the waters. Though wide range of information on qualities and quantities on the rivers supplying water into lake Bogoria have been gathered and analysed by World Wide Fund for Nature (WWF-Lake Bogoria Community Based Wetland Project), there is need to make these information available to various land and water stakeholders and users to ensure exchange of the information and formation of concrete land/water use policies and their implementation (via water users associations). Satellite picture can be used to show changes in water depth as depicted by exposed water shores and coastlines that were initially covered by water such as areas around Lake Bogoria Hotsprings.

Tourism

Presence of Lake Bogoria and Lake Baringo National Reserves makes tourism be a core income generating activity in this region. Tourism forms a major revenue contributor to the County Councils of Baringo and Koibatek. Hence, the community having realized high-income generation from tourism, they have now resulted into eco-tourism activities. Cultural centers and community campsites have been set up, but the most significant to land use and generation of vital information has been the resent development of community sanctuaries (Chiune and Majimoto sanctuaries) where individuals have merged their pieces of land to form an entire vast land coverage for conserving vegetation and hosting wildlife. Such ventures require a clear survey, demarcation and mapping of individual lands with information on their sizes, boundaries and details of the owners to avoid possibilities of future conflicts and ensure equitable distribution of revenue generated – GIS forms an elaborate tool for this as it will ensure safe storage of data and easy access. Alternatively, the land can be registered as a trust land among individuals involved and a single deed issued.

Cultural changes (erosion of African religions and traditions) need to be monitored since they have always formed a strong basis in conservation of biodiversity. GPS information on sacred points, worshiping sites and right-of-passage secluded areas needs to be recorded and kept. These will help monitor changes on land use especially when these areas are cleared to pave way for agricultural activities (or trees logged for sale and fuel).

For wildlife that tend to migrate in search of grazing and browsing fields in dry seasons such as the Greater Kudu in Lake Bogoria National reserve, there is need to map there migratory patterns (as done by MSc students Yego and Jirma, 2005). GPS technology should be applied by conservation bodies such as the County Councils of Baringo and Koibatek. A GPS route obtained on the migratory paths of Kudu should be overlaid on topographical map of the region. Information obtained relating to the land owner and migratory path of Kudu will be of great importance to the County Council on improving their efficiency in anti-poaching campaigns since they will know whose land the Greater Kudus are at one particular time and hence reducing poaching and cases of human wildlife conflicts.

Talks by the Endorois community in Loboi, Kapkuikui, Sandai, Emsos and MajiMoto regions, compensation of land by the KWS was not satisfactorily done when the reserve was gazetted. Some claim that they were not overwhelmingly compensated. It is at this point that information on land size and original owners of the land converted to reserve (now under County Council of Baringo and Koibatek) are required. Well elaborate digital data will form an important tool to the locals interms of compensation as the council will strive to relocate the locals to areas that will match their original land size and preferences.

Human Settlement

Cadastral surveys help provide land information by determining village field boundaries and land areas especially in town centers. This result into preparation of field registers with detailed information on field boundaries, land area sizes, ownership and even land classification type.

Increase in population has resulted into increased land pressure in major town centers such as Marigat, Kabarnet, Loboi and Kampi Ya Samaki. As a result, there is dire need to develop cadastral maps to monitor land development activities taking place. Immediate urban spread planning is required to help manage the entire population increase that will definitely need housing. Pieces of land both developed and underdeveloped need to be mapped and their information stored digitally. High resolution RS imagery such as SPOTS and IKONOS be used to monitor increase in housing structure which will also help in other aspects such as construction of sewage systems , recreation facilities, monitor pollution and plan for basic facilities such as health centers and schools.

Information on human population statistics needs to be frequently updated and made easily available to land planners. This will help monitor changes in population and relate this to land pressures hence, effective/efficient land management and administration that will see utilization of resources to a sustainable level with a consideration to future generation and averting possibilities of conflicts over land allocations and border irregularities.

Zoning of land forms a major basis for data generation in LMIS as it help monitor various upcoming land use activities that will influence land development and land cover types such as; agriculture zoning maps in Pekera Irrigation scheme in Marigat and Sandai Kenya Seed maize farming in Sandai and Loboi; urban development zoning in rapidly growing towns such as Marigat, Loboi and Kampi Samaki; forestation and reforestation zoning such as the introduction of invasive *Prosobis julifolia*; fisheries development zoning shown by resent construction of fish ponds in Emsos, Maji Moto, Kapkuikui. With latest technological advances, the zoning should be done digitally to ensure spatial information attained and stored.

Conclusion

Though satellite images are expensive to acquire especially by the local community based organizations in developing African countries, there is dire need to collaborate with big organizations (such as European Space Agencies ESA and United Nations in installation of mobile ERS receiving stations) that have been assisting development countries in natural and human resource management techniques via Remote Sensing. An example includes installation of ground station in Gabon by the DLR (German Aerospace Establishment) to acquire images.

To ensure an effective and efficient land information system, an establishment of a spatial reference framework is required. Digital maps form a powerful medium for land information analysis, management, planning and monitoring. Maps forms a strong base for decision makers, policy makers, planners and administrators to come up with land management and development strategies that will ensure regular and efficient information generation, storage, easy access and retrieval. Cadastral maps of urban centers and towns form powerful tools for guidance in land development and production of accurate high level maps.

Digital information are mainly held by big international organizations, established private firms and certain government departments such as the Land Department. This information should be shared interactively with other land stakeholders. There is need to place the information in www to allow easy access and even downloads at affordable fees. Data holders should also be easily accessed and be willing to offer these information even in hard copies especially to people not in access to internet facilities and in situations where internet services are expensive and image downloads process are extremely slow.

An interlink between the Land department, Local government and community land-based organizations/boards would form a very vital platform for LMIS via establishment of standard integrated data models, contents and ensure management of land generated data in immediate time. Implementations via World Wide Web (www) would also see stakeholders access zoning, demarcation and land boundaries information at any internet accessible points and time. This would also see sharing of land information data among land policies makers, planners, managers, administrators and developers derived from both public and private sectors.

Remote Sensing and GIS have proved to be very important and useful tools in land information system management. Remote sensing technologies have helped in production of high-resolution earth surface satellite images. High-resolution images from satellites such as the LandSat ETM, IKONO, Quickbird and SPOTS have been used to give details of the earth surface hence helped in land management and development. Spatial analysis via GIS has helped give better visualization of remotely sensed images as it integrates both spatial and non-spatial data and enables querry.

It is of importance that the government embraces and invests heavily on various information technology developments. There is need to formulate, review and implement laws on digital authentication/certification and accessibility and that these laws be readily and easily accessible to all land stakeholders intending to acquire information on their resource. The current shift to e-governance can only be achieved with availability of vast regular spatial digital data and information generation. Information availability over a large period of time forms an important asset to the government since it is through these information that substantial micro and macro policies and decisions on management and development are made. Hence, there is need to have land data information centers at various local government levels of management. Presence of data information centers make it easy for information gathering, storage, manipulation and retrieval hence policy makers and land managers/administrators tend to have an easy time in developing land policies and management strategies interactively. It is from these information centers that information such as parcel size, land boundary, parcel owner, inheritance record and history, crop type and yield, and revenue details should be kept for future references. Information centers will also help in easy issuance of land deeds and avoidance of multiple issuances of a single deed and duplication.
Capacity building of local land government officials, county council staffs, local NGOs, village elders on basic computer applications such as introduction to GIS will help them understand produced digital maps of their areas. Government officials will be in a position to handle digital information handed to them via community elders without entirely depending on IT experts and use of sophisticated image analysis tools. Since local people find it easy to contact local NGOs, capacity building of these NGOs staffs will lead to easy dissemination of land information changes to the locals and in exchange, the locals to pass them information on changes of land ownership incases of inheritance. Collaboration between government land department and local NGOs will also help prevent land information data duplication and redundancies. There is need to ensure continuous trainings of government staffs on sophisticated and user-oriented interface computer technologies so that cases such as transfers, resignation, or even death of staffs will not interfere with the smooth running of LMIS procedures.

Acknowledgement

I would like to acknowledge Jirma Ali Molu for his contributions in the paper; and the Ramani Communications for having given me time off to attend the symposium.

Figure 1. Map of Kenya showing the study area

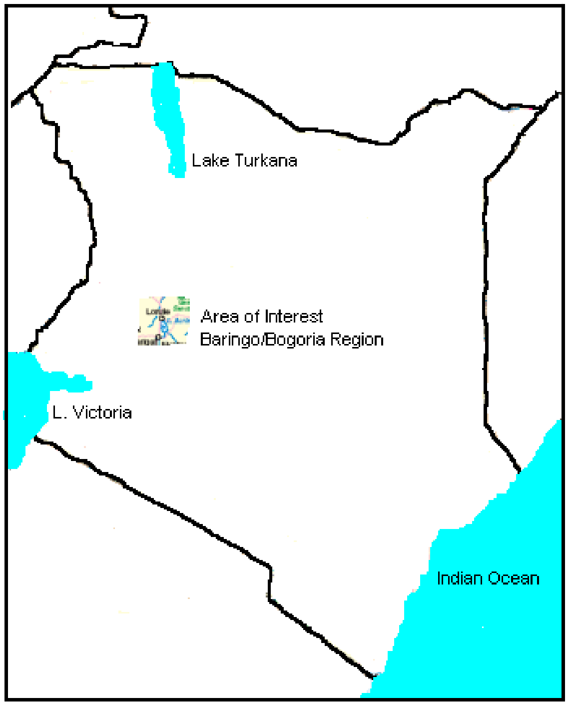


Figure 2. 1985 LandSat TM Image of Baringo/Bogoria region

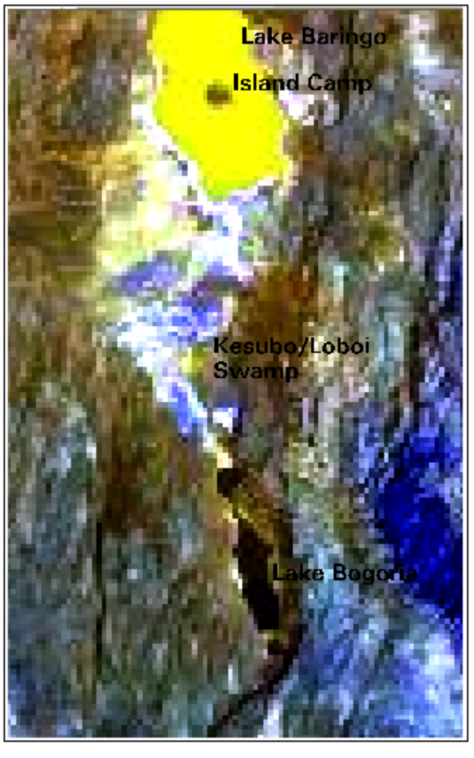


Figure 3. Classified 1985 LandSat TM Image of Baringo/Bogoria region

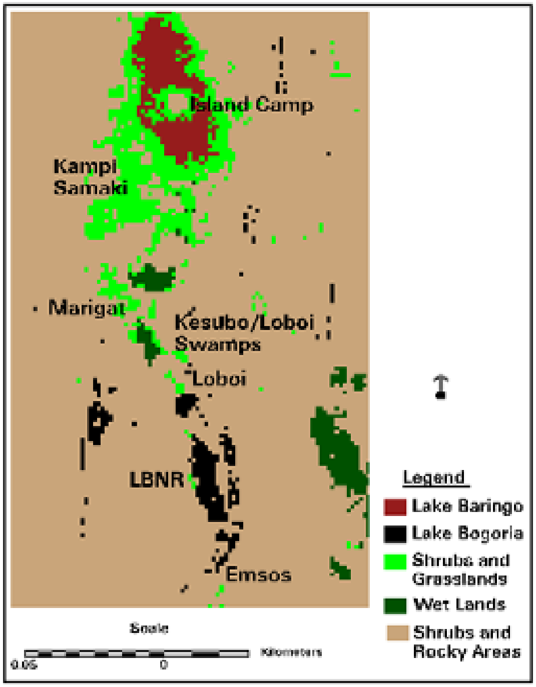


Figure 4. 1995 LandSat TM Image of Baringo/Bogoria region

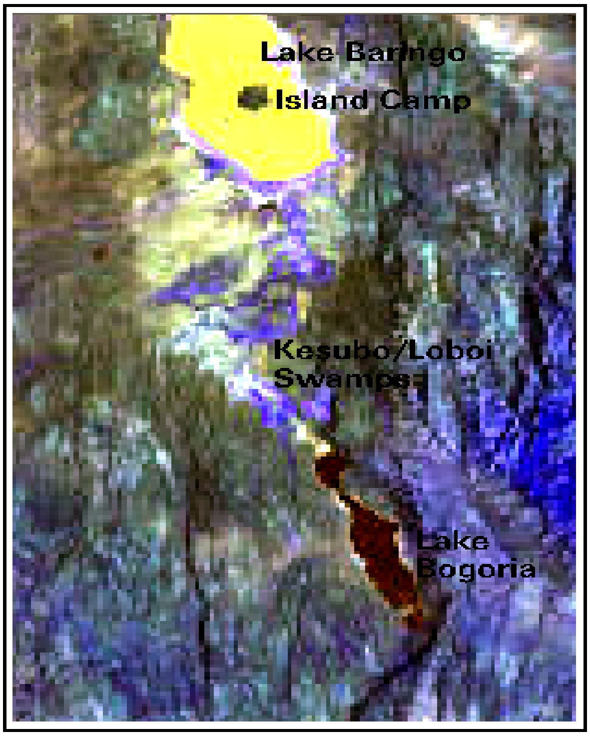


Figure 5. Classified 1995 LandSat Image of Baringo Bogoria region

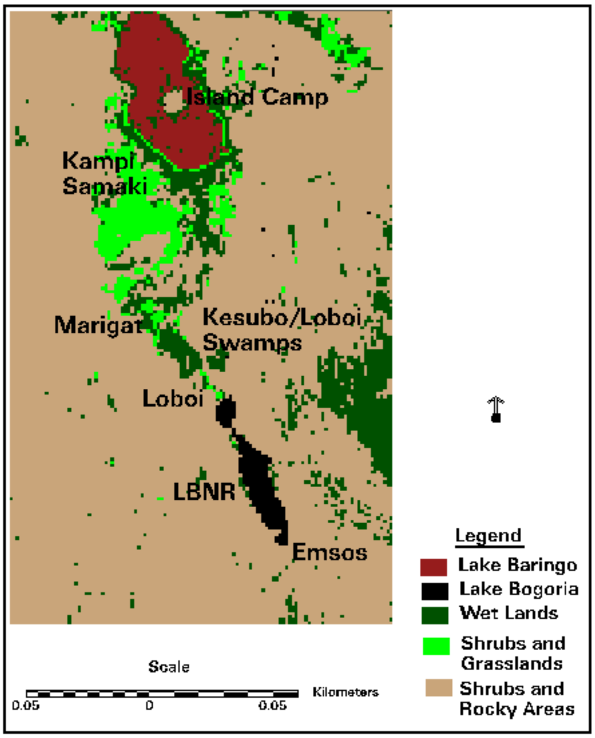


Figure 6. 2003 LandSat ETM Image of Baringo/Bogoria region

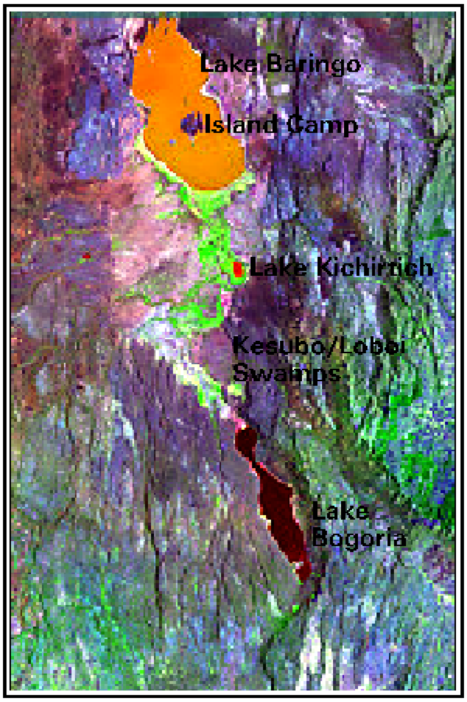
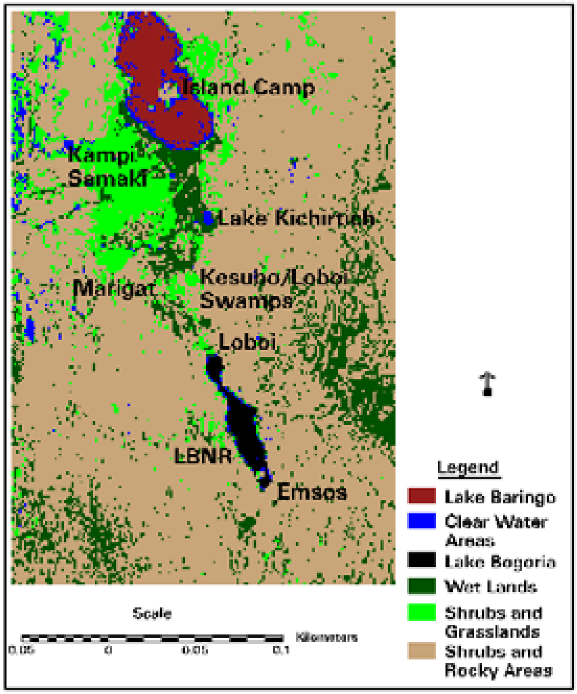


Figure 7. Classified 2003 LandSat ETM Image of Baringo/Bogoria region



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Managing Land Information Using Canadian Exemplars and Cautions: Legal Pluralism, Rigour and Environmental Determinism

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Preamble

The challenge of land management information system (LMIS) reform is merely a sub-set of the challenge of land tenure reform, which, to a large degree, is the challenge of slums (UN, 2003). In the African context, the challenge of LMIS is capacity – expertise, budgets, institutions, knowledge, models, principles (Ezikbalike, 2000). This you know, much better than me.

Indeed, it would be the height of arrogance to tell you about LMIS reform in Africa; such debate requires the humility to recognize that the reform must be sensitive to context – social, legal, financial and environmental. Such debate should also refrain from re-inventing the wheel. The wheel was well defined, if not invented, by at least 1990 in the rural sector (Powelson & Stock), and by 1992 in the urban setting (Farvacque & McAuslan), and continues to be refined by people with significantly greater expertise in Africa than me (Fortin, 2005; Nyamu-Musembi, 2006).

Indeed, I take as my starting point the injunction from the *Task Brief* for this Symposium to not "attempt to propose a one size fits all land management regime for all of Africa" and to avoid "rehashing the old arguments over the advantages of customary and individual tenure systems." (UN ECA, 2006). Rather I have embraced the invitation to discuss "different cognitive models of land management information and the philosophical systems that inform them."

What follows is a pot-pourri of legal and institutional models, drawn from recent Canadian law relating to aboriginal peoples, from Canadian alternative dispute resolution (ADR) principles, and from my experience working with land registries for aboriginal peoples in Canada. These models are preceded by a discussion of the three premises upon which they depend: that legal pluralism permits the discussion of Canadian legal models in the African context; that any analysis of LMIS reform must be rigorous; that LMIS reform must be determined by the local environment. I harbour no illusions that these models are a panacea for LMIS in Africa. I simply offer them to you; feel free to browse.

Premise 1 - Legal Pluralism

The principles proffered from international and Canadian law are not intended to be post-modern colonial institutions foisted upon Africa. Rather, they represent one thread of legal pluralism, as explicitly advocated by McAuslan: "Seminal judicial decisions in Australia, Canada and South Africa have recognized that the original, customary rights of indigenous inhabitants do not disappear because no notice is taken of them by the government of the day" (McAuslan).

Legal pluralism refers to the multiplicity of laws, legal principles and legal institutions that inform land tenure in general, and thus, for our purposes, LMIS. Tenure dualism - imported systems of statute and common law together with existing systems of customary law – is now recognized as a resource (not an obstacle) in assisting poor people in Africa (Adams & Turner). One way of empowering poor people in their dealings with land is to permit, indeed to encourage, forum shopping, "by which different parties base their claims on whichever legal framework best fits their situation" (Meinzen-Dick & Pradhan, 2002).

Forum shopping, as part of legal pluralism, means that negotiation and dispute resolution become more important. This is not to say that customary laws should be accepted without scrutiny, any more than imported law should be used will-nilly, because "local laws can be highly inequitable" (Meinzen-Dick & Pradhan, 2002). Moreover, it is sometimes difficult to define customary land tenure. Land owners and regulators have sometimes retained elements of custom, sometimes reinvented custom, and sometimes abandoned claims to land based on "past identities and values" (Cousins & Claassens, 2006).

However, the failure to define, demarcate and allocate rights to aboriginal/customary land can be a breach of international human rights and environmental law (Bankes, 2004). The Inter-American Court of Human Rights found that Nicaragua failed to "carry out the delimitation, demarcation and titling of the territory belonging to the Awas Tingni" (2001). Such failure meant that Nicaragua had violated their aboriginal rights by granting a timber concession within their territory. The Inter-American Commission of Human Rights (2003) found that Belize breached Article XXIII of the American Declaration of the Rights and Duties of Man. Article XXIII provides that "every person has a right to own such private property as meets the essential needs of decent living and helps to maintain the dignity of the individual and of the home." The Commission found that Belize had breached the Article by failing "to delimit, demarcate and title or otherwise establish the legal mechanisms necessary to clarify and protect" the Maya territory. Furthermore, the Maya right to equality before the law was breached because Belize had provided third parties, but not the Maya, with land titles.

There is a rich heritage of interplay between Canadian and African law. The Supreme Court of Canada has used land law principles arising from at least four African disputes; disputes that wound their way to the Privy Council and thus to Canada's notice. Between 1929 and 1948 three Canadian decisions used AG of Southern Nigeria v. John Holt (1915) for the rule of "general convenience and security" that gradual accretion enures to the land which attracts it. Three decisions since the 1970s dealing with aboriginal rights and the fiduciary duty of the Crown to aboriginal peoples (that is, to the people who were on the ground first) relied upon Amodu Tijani v. Secretary of Southern Nigeria (1921) for the principle that aboriginal title is an independent legal right that can be recognized and affirmed by the Crown, but is not created by the Crown: "There is a tendency, operating at times unconsciously, to render that title conceptually in terms which are appropriate only to systems which have grown up under English law. But this tendency has to held in check closely."

To further illustrate the interplay between African and Canadian legal principles, the Amodu Tijani decision, itself, referred to the Canadian decision of St. Catherine's Milling v R. (1888) for "getting rid of the assumption that the ownership of land naturally breaks itself up into estates, conceived as creatures of inherent legal principle." That is, customary rights, as enjoyed by both aboriginal Canadians and indigenous Africans are distinct from rights created in European law. This principle had been been explored in Re Southern Rhodesia (1919), which held that "there are indigenous peoples whose legal conceptions, though differently developed, are hardly less precise than our own." That is, it was presumed that a newly-arrived peoples respected pre-existing aboriginal rights and did not diminish or modify them.

The final strand in the African-Canadian influence is Watcham v. AG of East African Protectorate (1919), in which a land certificate issued by the Crown contained a patent ambiguity. The Privy Council held that six pieces of extrinsic evidence could be relied upon to in interpret the parcel description, even though the Crown certificate had been issued only 15 years before the dispute arose; this principle is used in interpreting Canadian parcel descriptions.

Finally, Samson Indian Nation v. Canada (2005) illustrates the more modern interplay of legal and policy principles. One of the plaintiff's witnesses was Jean Chretien, Canadian Minister of Indian Affairs in the 1960's, who testified that the government of the day had the temerity to criticize land policy in South Africa. The African response was that Canada's policy and legislation relating to Indian lands was also worthy of criticism. This criticism was duly noted, leading to Indian Act consultations in 1968, after which the government offered to abolish the legislation.

Premise 2 - Fidelity to Rigour

It should go without saying that the debate on LMIS reform must be rigourous. It must be informed by empirical analysis, whereby questions are asked or theories are posed, a methodology is devised, results are scrutinized, and the implications of the answers are examined. It is a difficult process. For instance, apparently it is very difficult to identify the benefits of a spatial data infrastructure to the public and private sectors (Giff et al, 2006). It is also a necessary process, even if subtly denigrated: "Experiments of this kind, which aspire to the rigour of a clinical trial, are the height of fashion in scholarly circles" (Economist, August 26 2006, p.66).

Rigour means debunking conventional wisdom, a term coined by the Canadian economist Galbraith (Economist, May 6, 2006). He recognized that we associate "truth with convenience, with what most closely accords with self-interest and personal well-being or promises best to avoid awkward effort or unwelcome dislocation of life" (Levitt & Dubner, 2005, p.90). Thus, conventional wisdom is simple, convenient, comfortable and comforting – but not necessarily true. Let us avoid conventional wisdom. In land tenure reform that means questioning the assertion that access to credit is a function of title to land in the developing world generally (de Soto, 2000). Recent empirical evidence that discredits such conventional wisdom includes:

- Strengthening property rights in urban slums in Peru (through titling) increases housing renovation by two-thirds. However, the bulk of the increase is financed without the use of credit, meaning that the reduced threat of eviction encourages renovations (Field, 2006). It is ambiguous whether land titling reduces credit rationing, given other barriers to borrowing, such as ability to re-pay.
- Banks are not enticed to use collateral to reduce moral hazard problems and information assymetries for people with legal title to their parcels. Rather, there is "a clear relationship between probability to access credit and poverty level" (McKechnie, 2005).
- A "natural experiment" since 1981 of an informal settlement in Buenos Aires, Argentina is most revealing. Out of 1082 parcels that were settled, 672 were formalized (because the original owners of the land allowed the expropriation process to proceed). The remainder – 410 parcels - were not formalized. Families that gained title to land increased housing investment, reduced household size and improved their children's education. However, they only modestly improved their access to credit, and their labour income was unchanged (Galiani & Schargrodsky, 2005).

Rigour also means being impartial, and not merely advocating a particular argument or policy in lieu of analysis. It is critical that LMIS experts, like all experts, be intellectually honest, objective, question all assumptions, appeal to reason rather than to prejudices, identify and then debate the issues, and be able to identify all facts and point to any authority which supported their view. In the absence of such rigour, the Courts often prefer the evidence offered by the other side (Johnson v. Alberta, 2001; Ballantyne, 2001). Thus, an expert must form an opinion that best fits the facts and refrain from questioning an opponent's character, so as to evade threats of expert bias (Anderson, 2004).

Premise 3 - Fidelity to Environmental Determinism

In addition to being analytical, it should go without saying that we must be faithful to context. Environmental determinism means that the social, political, financial, legal and biophysical environment must dictate LMIS reforms. The African context might well include increased Chinese investment as an alternative to the Western development model (Economist, October 2006) and as a panacea to Africa's serious financial constraints in funding spatial infrastructure activities (Ezikbalike, 2000); remote sensing playing a significantly smaller role in cadastral mapping over the next decade (NOAA, 2005); protecting property from those with coercive power in order to allow markets to function (Greif, 2005). Given such a context, LMIS reforms should not be driven by technological determinism; that is, according to vendor promises or technical specifications. Nor should reforms ignore ethical considerations; simply because something can be done technically does not necessarily mean that it should be done (Ballantyne, 1994).

Fidelity to context in Africa means that outsiders (such as myself) enter the fray with humility. Humility has been recommended within land tenure reform since at least 1989: "There is a need for more modesty among professional consultants; there is a need to occasionally admit that they do not always know the answer or that their system may not be appropriate" (McLaughlin & Nichols, 1989). Thus, the agricultural practices in the Tamil Nadu region of India it is not a beacon of hope for agriculture in the Sudano-Sahelian region of West Africa. Despite superficial bioclimatic similarities, the significant differences in soil fertility render the India model inappropriate for West Africa (Gunnell, 1997).

It takes knowledge of the environment before models, systems and explanations can be proffered. The introduction of GIS to the forestry sector in India led to significant tension between distant geo-spatial technicians, comfortable with both hard-copy and digital maps, and community field officers, more comfortable in dealing with people in face-to-face meetings and who disdained maps (Barrett et al, 2001). Likewise, communities in Africa may well prefer land information records on paper and available at a local level, as opposed to centralised digital records (Fourie, 2001).

Finally, environmental determinism means that we must recognize the large role that uncertainty and ambiguity play in the debate about LMIS in Africa. There are unpredictable fluctuations in the natural resource base (owing to drought, for example), livelihood uncertainties due to fluctuation in employment (as caused, for example by changes in commodity prices), knowledge uncertainty owing to incomplete understanding of the differences between statute law, project regulations, customary law, and religious rights, and social uncertainty, as caused by wars, for instance (Meinzen-Dick & Pradhan, 2002). Thus, although political rhetoric abounds with the use of "custom" and "tradition", the precise meaning of these terms is often contested, meaning that "the term 'customary' is of limited use as an analytical tool" (Cousins & Claassen, 2006).

Model 1 - Canadian Aboriginal Law Principles

There have been a series of decisions of the Supreme Court of Canada dealing with aboriginal title, aboriginal rights, the Crown's fiduciary duty, and the need for meaningful consultation with aboriginal peoples, which might well have some resonance for land in Africa, as suggested by McAuslan. Thus, they might have some resonance for the management of information about such land. Again, I would not be so bold as to assert that these principles apply to Africa; they might, at best, be only mildly persuasive. I merely offer them as part of the eclectic mix of Canadian experiences from which you can choose, as appropriate.

Delgamuukw v. British Columbia (1997) set out that aboriginal title is a real property right, which enjoys constitutional recognition and protection. Aboriginal title is founded on the exclusive occupation and use of a parcel of land by a defined group of Aboriginal peoples since the time of colonization; occupation and use that has continued in a more-or-less unbroken chain to the present. If aboriginal title has been infringed, then the Crown must justify its infringement in a two-stage process. First, the Crown must establish that the infringement is in furtherance of a compelling and substantial legislative objective. Second, the Crown must establish that the infringement is consistent with its special fiduciary relationship with aboriginal peoples. Finally, Delgamuukw set out that oral evidence can be used in litigation to establish the link with the land.

Such litigation also illustrates the fiduciary duty owed to aboriginal peoples. A fiduciary duty arises in situations where one party (such as a First Nation) is in a particularly vulnerable position vis-à-vis another party (such as the federal government), as set out in Guerin v. R (1984). As it relates to land surveying, aboriginal peoples were held in Halfway River First Nation v. BC (1997) to be in just such a vulnerable position, so that the Crown owes a fiduciary duty to an Indian band when it participates in the removal of land from an Indian Reserve. The duty to consult, and to make decisions about additions or deletion to Indian Reserves, requires that the Crown inform itself of the Band's traditional uses for the land and provide a Band with all the information with respect to proposed decisions and their impact. More significantly, Osoyoos Indian Band v. Town of Oliver (2001) established that the taking of Indian Reserve lands by the Crown must follow the principle of minimal impairment. The Crown must demonstrate that the infringement of the spatial extent of the Reserve is in the public interest, and the Crown can only take the minimum legal interest in the Reserve land.

In order for an aboriginal right (such as the right to hunt, fish, or to profit from such hunting or fishing) to be protected by the Canadian Constitution, "an activity must be an element of a practice, custom or tradition integral to the distinctive culture of the aboriginal group claiming the right" (R v. Vanderpeet, 1996). Part of the test as to whether an aboriginal right exists is whether the right had been exercised at the time sovereignty was asserted for a sufficient length of time to become integral to the aboriginal society. The onus of establishing such a right rests with the aboriginal group. If established, then the onus swings to the Crown to show that the right has been extinguished. If the Crown fails, then the onus swings back to the aboriginal group to show that the right has been infringed. If infringement is shown, the final onus on the Crown is to demonstrate that the infringement is justified.

Since 2004, the Supreme Court of Canada has refined the Crown's duty to consult with aboriginal peoples, even if claims to aboriginal title and rights have not been established by the courts. If a good prima facie case exists – as for the Haida's claims to title and to the right to harvest red cedar, then there is heavy burden on the Crown to consult and accomodate before granting resouce rights to third parties (Haida Nation v. British Columbia, 2004).

Finally, Mikisew Cree First Nation v. Canada (2005) addressed the procedure by which lands within a treaty area may be moved from category 1 (lands where the aboriginal peoples retain the treaty right to hunt) to category 2 (lands where the right to hunt is lost). It set out that the Crown, pursuant to a treaty with aboriginal peoples that cedes land, has the right to take land for various purposes (such as a road). However, the duty to consult and to accomodate aboriginal rights in taking such land are located in the honour of the Crown, and must be followed (Bankes, 2006).

Model 2 – Alternative Dispute Resolution (ADR) Principles

In the context of the determination and demarcation of parcel boundaries in the developing world, we must question the premise that cadastral surveying prevents boundary disputes: "The cause, frequency, and nature of disputes over land need to be analyzed, and a distinction made between those that genuinely relate to boundaries, those that relate to the ownership and use of some feature near the boundary, those that are essentially breakdown in neighbourly relationships, and those that concern a substantial area of land as a whole" (Dale & McLaughlin, 1988).

There are precedents for such analysis. A recent assessment of land conflicts in Guatemala developed a tripartite typology of disputes over competing property rights, occupation of parcels owned by others, and boundary disputes. These three categories were further subdivided into 21 sub-types of dispute, of which there were five types of boundary disputes (Brown et al, 2005). In the South African context, it is likely that the transfer of communal land from the state to communities, in conjunction with surveying the boundaries of such parcels, will increase boundary disputes (Cousins & Claassen, 2006). Formal title in Eastern Kenya reduces boundary disputes, but only to the extent that a community-based procedure has evolved for dealing with such disputes. A buffer strip 6m in width is established along the disputed boundary. Each neighbour fences off 3m of each parcel, effectively creating a new narrow parcel and eliminating the common boundary (Nyamu-Musembi, 2006).

Litigation is Inappropriate

The experience in Canada and elsewhere is that the courts are inappropriate in resolving such boundary disputes for three reasons. First, the value of the land that is in dispute, at least as measured in economic terms, is often dwarfed by the financial cost of litigation. Robertson v. Wallace (2000) was a dispute over some scrubby riparian land in Canada; it involved seven parties, each with their own legal counsel, three expert witnesses, and two weeks of court time, for a total estimated cost of $450,000. The land had marginal utility to the two adjoining landowners for running cattle, and a market value of less than $10,000. A dispute over a strip of land six feet in width in rural Staffordshire, England was litigated over an 11-year period as far as the House of Lords (Wibberly v. Insley, 1999), with legal costs exceeding $500,000, leading one "bemused onlooker" to ask: "Is this the way our expensive legal system should be deployed and should the taxpayer be funding it?" (Dyer, 1998).

The courts are also inappropriate because disputes that are ostensibly about boundaries of parcels are often, at a fundamental level, about something else. In Sutton v. O'Kane (1973), litigation about the boundaries of an unregistered easement in New Zealand was motivated as much by racism (Caucasian landowners were incensed that their new neighbours, who were using the easement as a driveway to get to their parcel, were Asians) as about asserting or denying rights in land. The courts are also designed simply to react to disputes and not to serve in a proactive or preemptive role. Thus, although Bea v. Robinson (1977) was well-placed to address the issue of whether a hedgerow as a conventional boundary can exist within a land titles system, it was unable to prevent the chainsaw attack by one party when the neighbour attempted to remove the hedge.

Third, the courts create procedural difficulties. Adverse possession claims must go before the courts, and they are limited by the requirements to be met, by no such possession being allowed against public land, and by all prescriptive rights (rights of mere use as opposed to exclusive possession) having been eliminated. Moreover, claims to land through encroachment and estoppel must be dealt with by the courts (Flello v. Baird, 1999). The doctrine of conventional boundaries is of no use for resolving boundary disputes, because, by definition, the doctrine is invoked only in the absence of a dispute and when both parties have agreed to a boundary. Finally, although claims of ambulatory natural boundaries need not necessarily be dealt with by the courts, the standard of care that the courts have established for the claimant, and the rather small probability that adversely affected landowners will agree to the claim, mean that the courts will often be asked to resolve the claims.

The need for alternatives to litigation to resolve disputes over rights in property has a noble lineage. Flood damage to nineteenth-century Canadian riparian parcels led to many disputes; legislation responded by establishing a hearing rather than a formal trial, and judges were "encouraged to proceed in a manner that will best facilitate the ends of justice and cause the least trouble and expense" (Benedickson, 1983, p.379). To the extent that conflict originates from disputes over limited or scarce resources (such as property), then ADR would seem well-suited to addressing the shortcomings that result from an overwhelming reliance on the courts. Boundary disputes are concerned with title to a piece of a neighbouring parcel, and can, therefore, be "resolved by an agreement over the distribution of the disputed resources, rather than by either party accepting the moral arguments of the other side" (MacFarlane, 1999, p.35).

Boundary Disputes

Conflict over boundaries is analogous to many types of conflict dealt with at the community level. For many people in possession of land, their rights have more than merely economic value, but serve as a form of biocentrism, linking them to time and place. Conflict over the same piece of land (that is, land beside or astride a boundary) is less a manifestation of individual deviance or social illness, and more a characteristic of wanting to belong to a community (whether urban or rural). Certainly, boundary conflicts are frequently a function of the vagaries of nature (as for a natural boundary) or of simple ignorance about the spatial extent of one's rights in the parcel. As in neighbourhood justice systems, such conflict need not be regarded as aberrant or of simply having negative value; conversely, the peaceful, voluntary resolution of such conflict at the community level can have positive value.

A second way of characterizing boundary disputes is by analogy with aboriginal land claims in Canada, insofar as all parties are concerned about determining the spatial extent of real property rights. Because of differences of opinion on questions of fact (for example, the length of time that a neighbour's parcel has been occupied and the uses to which the land has been put) and law (for example, the character and location of the boundary between the two abutting parcels), neither productive dialogue nor a neutral facilitator is "enough to persuade the parties to reconsider the merits of their position" (Coyle, 1999, p.468). An alternative is an independent adjudicator, whose respected recommendation can be either binding or non-binding.

Indeed, the largest land claim settlement in Ontario owes much to using an independent fact-finder to resolve the location of the northerly boundary of the Mississauga First Nation. The fact-finder was required to make a non-binding recommendation as to the northwesterly corner of the reserve. The First Nation interpreted "waterfall" in the treaty to mean waterfall on the river, whereas the provincial Crown interpreted "waterfall" to mean "rapids." The finding accorded with the First Nation interpretation. The adjudicator, in this example, also assisted with informing the local community as to the basis of the claim.

This is not to say that ADR is without its limitations in resolving disputes involving real property or access to resources. It was long argued that an alternative to resolving environmental disputes was to increase public participation, because "greater public participation in the decision-making processes of the federal government would lead to qualitatively better environmental decision-making" (Rounthwaite, 1998, p.515). However, it has become apparent that participation by the public does not necessarily lead to better decisions, and, indeed, that the cost and delay of increased participation can rarely be justified.

Nor has mediation been successful in resolving environmental disputes, if success is defined as having the parties reach a consensus. As land use planning has shifted from the quest for the most technically efficient method of segregating land uses towards a concern for fairly allocating public resources, consensual approaches to handling resource allocation conflicts have drawn both praise and criticism. Supporters of mediation and assisted negotiation claim that it is more efficient, addresses underlying issues, allows for longer-lasting outcomes, and increases confidence in the process from the marginalized. Critics respond that mediation is neither faster nor less expensive than litigation, can lead to bad agreements that often lead (rather ironically) to litigation, and cannot overcome the intrinsically competitive nature of land use planning.

However, as a cautionary tale, such mediation has a greater chance of success if three criteria are met. First, all affected interests must be invited to participate. For a typical boundary dispute the interested parties are merely the two neighbouring landowners, although other parties such as tenants, licensees, the local community and the State (or Crown) might also be included. Second, there must be a balance of power among the participants, which is often the case if the dispute involves a boundary between two parcels in a residential subdivision or between two parcels of land used for agricultural purposes. Third, the dispute must be a structural conflict, resolution of which does not mean that fundamental values about land are compromised (Susskind et al, 2000).

Case Study

The Metis Settlements Appeal Tribunal of (Alberta) Canada is an exemplar of successful ADR, because, among other things, it deals with disputes over the use of settlement lands. Metis are defined in legislation as people of aboriginal ancestry who identify with Metis history and culture, commonly characterized as the integration of Indian and French-Canadian culture. The Metis Settlements Act (1990) created a corporation for each of the eight settlements: Buffalo Lake, East Prairie, Elizabeth, Fishing Lake, Gift Lake, Kikino, Paddle Prairie, and Peavine. Metis title to individual parcels within each settlement is subject to certain interests, including the natural rights of light, air and support, traditional community pathways, and recognized uses such as berry picking.

The potential for boundary disputes exists between individual Metis, of course, but much more likely are disputes between Metis and resource extraction companies with rights to explore and use settlement land: "The Tribunal decides disputes between the settlements and resource companies, most of whom are large and have considerable sophistication in land dealings. The legislation attempts to establish a level playing field in often imbalanced power relationships" (Allred, 1998, p.335). Although Tribunal decisions can be appealed to the Alberta Court of Appeal, the intention is to resolve disputes at the local level, using mediation and negotiation.

Over the period 1991 to 2001, the Tribunal heard 122 appeals, of which 23 explicitly involved boundary disputes. McKenzie v. Belcourt (1995) involved a dispute as to where the fence should be placed between Lots 6 and 7, Block 3, Gift Lake Settlement. The procedure differed significantly from that followed by conventional litigation. Section 189 of the Metis Settlements Act allows the Tribunal to hear disputes only if all the parties and the Settlement Council agree that the Tribunal should decide the matter. The hearing was held at the Gift Lake Metis Settlement community hall, and each party represented themselves in the absence of legal counsel. The Council was represented, and a settlement member and a land surveyor were also present to give evidence. After hearing the four submissions and reviewing a series of survey plans, the hearing ended.

The decision was handed down 10 weeks later in favour of Belcourt: "the boundary between lot 6 and lot 7 ... shall be a straight line following nearly as possible the location of the existing fence constructed by Gordon Belcourt in late 1991" (para. 35). There was a prima facie reliance on principles of boundary law as referred to in texts and essays, and the Alberta Surveys Act was paid lip service. However, most reliance seemed to be placed on equitable principles and on the consensus reached by the two parties: "The Tribunal has therefore determined that the most equitable decision would be to leave the boundary in question in its present location (as established by the Belcourt fence) which is favourable to the McKenzies's and is also agreeable to Mr. Belcourt" (para. 39).

This appears to be an excellent example of ADR principles being implicitly followed, so as to allow the Tribunal to meet its mission of contributing to the "self sufficiency of Metis life by providing resolution to issues that would threaten the progress of settlements and individuals."

Certainly one of the common types of dispute dealt with by the Tribunal involve structures (such as fences and buildings) that are built across boundaries.

Summary

The focus must not be on only one technique within the ADR arsenal, because boundary disputes, as with many conflicts, are best approached from several directions (Goss, 1995). There are five ADR principles that best address boundary disputes:

- First, use an independent adjudicator, whose recommendations need not be binding, but who has much expertise in land tenure, real property law, boundary surveying and land use planning.
- Second, ensure that the adjudicator is based in or near the local community in which the dispute exists, so as to know the natural ecosystem and the human dynamics, and to ensure that all affected parties are credulous.
- Third, and conversely, full public participation is not required and should be discouraged in the interests of an efficient process. We might assume that any public interest in land will be guarded if a representative of the local community, the State (or Crown) is present.
- Fourth, the outcome should be one of compromise, and not one of win-lose, so as to ensure that all parties participate fully in the resolution. Compromise might take the form of sharing fencing costs, having one neighbour compensate the other for the latter's loss of land, or dividing Solomon-like the area of land in dispute.
- Fifth, it should prove beneficial to have the adjudicator explain the nature of the dispute, the methodology used, and the recommendations to the community, after the process is completed. This encourages the disputants to feel part of the larger community and discourages other similar disputes (or at least encourages the resolution of such disputes) in the area.

Model 3 - Land Registry Principles from Yukon First Nations

If the transaction costs associated with land registries in Africa are expensive, time-consuming and frustrating, and if such registries provide little security of ownership, then formalized titles quickly go informal again. In the Kilosa District of Tanzania and the Suba District of Kenya, "registration has not worked as an empowerment tool, rather the reverse" (Cross, 2005). Security of tenure has been reduced, owing to the onerous process of registering title to land and to the need to respect land use planning by-laws. Perhaps there are some exemplars and cautionary tales from the Canadian experience of land registries on aboriginal lands.

Aboriginal peoples have lived and prospered in Yukon (in northern Canada) for thousands of years, and like aboriginal peoples everywhere, they "feel an attachment to their land, a sense of belonging to a part of the earth, that we can scarcely comprehend. For native people, their land is not a commodity but the heritage of the community, the dwelling place of generations" (Berger, 1991, p.xi). The land and waters were used for hunting, fishing, berry-picking, traveling over, and living upon. Even in the absence of survey, subdivision and transfer of land, "they did recognize ownership of plots used for village sites, fishing places, berry and root patches and similar purposes" (Duff, 1991, p.149).

Over the past 150 years the aboriginal peoples' links with the land have been disturbed, but not broken, by various gold and silver rushes, the extraction of other minerals and of petroleum, highway construction, an oil pipeline, tourism, the creation of national parks, and the growth of various towns. However, this non-aboriginal development ethic arose in the absence of any treaties with the aboriginal peoples that ceded land or that affected the inherent right of self-government enjoyed by the 14 First Nations, who now represent some 7,000 Aboriginal citizens.

Umbrella Final Agreement

Negotiations began in the 1970's between the federal government, the territorial government and the Council of Yukon Indians, that resulted in an Umbrella Final Agreement (UFA) that was signed on May 29, 1993. The UFA set out, among other things, that title to some 16,000 square miles (about 40,000 square km) of land would vest individually in the 14 First Nations. The UFA states that "each Yukon First Nation, as owner of Settlement Land, may "...establish a system to record interests in its Settlement Land."

Neither the UFA nor any of the individual agreements explicitly set out specifications for such an aboriginal registry. The agreements do give some indirect indications of what a system of recording interests in Settlement Land needs to take into account. Settlement Land is of three kinds: Category A, for which the First Nation has aboriginal title to the surface plus Fee Simple title to the mineral rights; Category B, with aboriginal title to the surface but without the mineral rights; and Fee Simple, without mineral rights. Thus aboriginal title is retained for Category A and Category B Settlement Land but relinquished otherwise, including for Fee Simple Settlement Land.

Registration in the Yukon Land Titles Office (LTO) of a less-than-entire interest in a parcel of settlement land results in that interest taking precedence over aboriginal rights upon that parcel. Registration of an entire interest (i.e. Fee Simple) in the LTO results in the permanent relinquishment of aboriginal title and the parcel ceasing to be Settlement Land. From the viewpoint of the First Nation, therefore, the Land Titles Office is not the most desirable vehicle for recording interests in Settlement Land.

Fundamental questions

Three fundamental questions must be answered in designing any land registry for the First Nations of Yukon. First, what is the purpose (or raison d'etre) of a First Nation registry? Is it to allow for the conveniences and protection of a system that ensures security of title, enhances conveyancing, and reduces transaction costs? Or, is it to allow a First Nation merely to keep an accurate inventory of its Category A and B and its fee simple settlement lands? Second, what should be the effect of registration in such a system? Third, should such a system be characterized by registration of title (more correctly, title by registration) or registration of deeds and encumbrances? These are thorny questions, precisely because the First Nations are both legislators and proprietors of their settlement lands, and thus have an interest in both assisting their beneficiaries and in monitoring their holdings.

In any discussion of land registries for aboriginal peoples in Yukon, there are a couple of other considerations. First, what should be the nature of the title on first registration? Experience has shown that "legally unimpeachable titles" are unnecessary at the outset of any registry system, and that time is the test of the validity of uncertain titles (Simpson, 1976, p.213). For instance, all land was brought onto the New Zealand register between 1924 and 1944 by allowing titles to be issued that were: limited as to title, limited as to parcels, or limited as to both title and parcels. Limitations as to title are automatically extinguished after 12 years, if the title were unchallenged. Limitations as to parcels are extinguished only upon deposit of a plan of survey. By relying extensively on the physical features that demarcated the parcel on the ground, the limitation as to title proved to be an insignificant inconvenience: after 35 years, 97% of the landowners had not removed the limitation from their titles.

Second, what is the place of land registration within the governance framework? On the one hand, "land is, of its very nature, the most rigidly local of all subjects" and its administration should be entrusted to local authorities, such as First Nations (Simpson, 1976, p.293). On the other hand, there is merit to reducing duplication in administration by allowing for a uniform system of registration across all 14

First Nations. Thus, uniformity at the level of a central agency has been advocated, so as to avoid duplication, minimize infrastructure, and benefit from efficiencies of scale.

Methodology

I consulted widely over a two-year period, particularly with the First Nations, as both a means to an end, and an end in itself. In the first case, site visits and interviews were essential in order to gather all existing constitutions, land rights legislation, and instruments used by the First Nations to allocate rights in land, and to talk with lands administrators about their needs and concerns. This process allowed an inventory of community needs, legal tools and institutional issues to be compiled. Just as important, the consultation reflected the reality that there is a constitutionally-based duty to consult owed by the Crown for any project that affects the rights of First Nations (Ross, 2001). To the extent that this study was funded by the Crown, and to the extent that the focus was on registering First Nations' interests in lands, then there was a duty to consult. Finally, the very act of consultation served to educate and train many of the respondents, and so enhanced the capacity (albeit, only incrementally) of individual First Nations.

The methodology involved examining registry principles, interviewing First Nations and others, reviewing legislation, and assessing existing aboriginal registries. The overall finding was that a flexible land registry system that allows for a phased approach to interests and surveys should be adopted in Yukon for five reasons:

- First, although a land registry system is allowed for in the UFA, and despite six First Nations making specific provision for a registry in their legislation, there is not widespread acceptance of the need for, nor understanding of the characteristics of, a registry.
- Second, the merits of a centralized registry are not accepted; indeed, there is wide divergence on what form a registry should take and where it should be located. Thus, a viable prototype would examine the relative advantages of either one central registry (as exemplified by the existing Land Titles Office), or a limited series of four or five regional registries, each serving a group of First Nations. The group could be defined by cultural affiliations (as suggested by the Northern Tutchone peoples), by geographic proximity, or by level of sophistication in land use (as exemplified by the Teslin Tlingit and the Champagne and Aishihik First Nations).
- Third, the prototype and capacity building in support thereof should follow the lead of those First Nations who have developed good relationships with the lending institutions by negotiating lease and non-disturbance agreements that are agreeable to all. Again, the Teslin Tlingit and the Champagne and Aishihik First Nations serve as models in this respect. Much effort can be saved by heeding lessons already learned in system development and implementation.
- Fourth, the prototype should be a deeds system, because the systems that are extant, proposed, or merely referred to all anticipate that title to the land will not be a function of registration. Like the Crown registries used to administer the disposition of various resource rights, each First Nation will grant rights in land through its Council or Assembly (or a delegate), and will then merely record the grants (such as a lease or a Certificate of Allocation) in a registry. That is, although the registries may require that instruments be registered, the registries themselves do not confer title to land; nor do they guarantee the rights; nor do they offer compensation through an insurance mechanism. The rights in land are determined through a good root of title.
- Fifth, there is now much diversity among the First Nations in terms of how land rights are allocated; only one has a functioning registry (and it has records for only four parcels), and the banks are still working out their own lending and security policies. Thus, the prototype registry must recognize the need for a phased-approach to rights, where provisional allotments might mature to full allotments. This applies to a spectrum of land descriptions (from initially relying on the surveys that are part of the land claims process to subsequently expecting that all new parcels be surveyed), and for rights evolving from merely being recorded to actually being registered. Finally, such a phased approach means that linkages with existing registries, such as LTO or the mining recorder, should be pursued only when they are considered useful by the First Nations. Linkages should not be the determining factor in structuring a First Nations land registry.

Summary

The main function of the register is to disclose information about the ownership of land and interests in land. Interest has two meanings; it refers both to legal interests and to the preferences (or informal interest) that citizens have shown in specific parcels of land. There is sufficient disclosure of a legal interest if it is recorded by recording the document that creates the interest. For instance, a Certificate of Allocation will not be granted to a FN Citizen by the registry or the Registrar. It will however, be recorded in the registry so as to disclose to the world that Citizen X has a legal interest in Parcel Y. It is for any third-party investigation title to Parcel Y to decide what interest, if any, the recorded document (Certificate of Allocation) has conferred.

However, if a legal interest is recorded simply by recording a summary of the transaction upon which it is based, the summary may be insufficient to disclose the nature of the interest. Thus, if the registry contains only a summary of a lease that was granted by the FN to a non-citizen for farming purposes, and not the lease itself, then the nature of the interest (length of term of lease, annual rental value, type of agriculture, restrictions on other uses) would not be disclosed, and the true nature of the lease-hold interest would not be disclosed.

If the document is not recorded, but only a summary of the transaction is recorded, then it is imperative that the summary expressly describes the legal interest. If the summary describes less than the whole of an interest, the recording should not be effective as to the remainder of the interest. Such summaries should therefore be limited to recording a FN citizen's preferences in specific sites, and not to recording legal interests.

For example, over the nine-year period of March 1994 to March 2003, the parcel known as Specific Land Selection C-3 B of the Tr'ondek Hwech'in First Nation had recorded against it 18 preferences by citizens. The citizens had received no Certificates of Allocations, Leases, or Permits from the its government, and so no documents could be registered that conveyed legal title. Nevertheless, the following summaries set out which families have which preferences (informal, non-legal interests) in which land and for which purpose:

- "___________ would like to make a land selection within C-3 for residential purposes, looking at 5 ha;" or
- "___________ 150m x 200m, just town side of dump".

The recording of summaries is an invaluable function of the registry, particularly if a priority of registration philosophy is followed, and certainly as human memories are fallible. In the former case, if two families have expressed a legitimate preference in one parcel of land, then the family that first records the summary of its preference in the registry might well have a better right to the land than the other family. In the latter case, many sites have particular emotional, spiritual and economic importance to a citizen or a family; an important purpose of the registry is to enable the protection of such ties to the land. If the ties are not recorded, then, as time passes, it becomes increasingly difficult to determine which family used which parcels, to justify those family/land links to the FN government, and to resolve disputes between families competing for the same parcel of land.

Conclusion

It is difficult to argue with the various assertions that abound in the literature about LMIS reform: That "African countries should try and create an environment where scientists and other professionals can find challenging and adequately rewarding jobs at home" (Nkwae & Nichols, 2002); that "a land administrator, with legal and geographic knowledge, as well as conflict management and public administration skills, can increase formality and limit informality" (Fourie, 1998); that "with simple commodities such as land parcels, all commodities require quantification and precise definition" (Williamson, 2005).

I am not suggesting that experts ought not be advocates. Advocacy coupled with rigour is a good thing. Argument based on empirical analysis is exactly what is needed. However, people working with land information in general, and with LMIS in particular must be cognizant, socially-aware actors, with a responsibility to consider the ultimate disposition of their efforts (Miller, 1992). What is to be avoided are platitudes, unsubstantiated assertions, rhetoric, political agendas disguised as analysis, and sophistry; what the Economist refers to as "pious entreaties" (Economist, May 29 2004, p.73).

Also, avoid the Snark Syndrome (Byrne, 1993). As the intrepid, and yet unsuccessful, protagonists hunted the snark in Lewis Carroll's poem, it was merely enough to say "snark" three times for the creature to appear. However, saying something three times does not make that proposition true, and unsubstantiated assertions remain just that. For instance, contrary to some assertions, de Soto readily concedes that it is a "misconception" that "real estate assets are not held legally because they have not been properly surveyed, mapped and recorded" (de Soto, 2000, p.154).

Legal pluralism also calls for humility in policies and programs, and a recognition that rights to land and other resources "will be determined through messy, dynamic processes" (Meinzen-Dick & Pradhan, 2002). Such processes in Africa might well be informed by the cautionary tales and exemplars from the three sets of Canadian experiences discussed here. The discussion does not mean to foist the principles upon Africa. However, I trust that there are "some broad commonalities in underlying principles that can inform attempts to secure land rights in law" between Canada and Africa, just as there is across Southern Africa (Cousins & Claassen, 2006, p.21.). I also know that acceptance of such principles must be determined by the African environment or context, for "history followed different courses for different peoples because of differences among peoples' environments, not because of biological differences among people themselves" (Diamond, 1997, p.25).

The Canadian courts have done much to define both aboriginal title and rights, to lower the hurdles to aboriginal peoples in claiming such rights (by allowing, for instance, the use of oral evidence), and to increase the onus on the Crown in extinguishing or infringing such rights and in consulting with and accommodating aboriginal peoples. The legal principles rest on the foundation that people lived on the land and exercised rights in the land long before colonists arrived, and that any laws imported by the latter must respect the legal rights of the former.

Alternative dispute resolution principles have been used in Canada at the community level in recognition of the courts not being a viable means for resolving many disputes involving rights in land, particularly in the case of boundary disputes. To the extent that boundary disputes are problematic in Africa, either because of land titling or in the absence of clearly demarcated parcels, then such principles might well be applicable. Certainly the community-level process followed on Metis settlement land in Alberta appears to offer some guidance.

There is little discussion, at least in Canada, about what happens after aboriginal title is affirmed and recognized in agreements, judgments and legislation. Land claim agreements are a necessary, but not a sufficient, condition to ensure that aboriginal title has some meaning. The nascent land registries for aboriginal land in Yukon move beyond fine words from both the courts and commentators. After negotiated agreements confirm (among other things) aboriginal title, there must be capacity-building among local communities and the creation of mechanisms (such as rudimentary yet appropriate systems of registering rights in land) that allow First Nations to benefit from aboriginal title. So too, must LMIS ultimately benefit people in Africa; res ipsa loquiter ("the thing speaks for itself").

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Remote Sensing for Land Management

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Introduction

A basic problem for any country or region in economic planning, environmental studies, or land management is accurate, current spatial information. The need for basic information about surface characteristics, such as land use and land cover, is critical to both scientific analysis and decision making activities. Without accurate information, scientists cannot complete valid studies and decision-makers often fail to make correct decisions. Sound decisions depend on accurate information yet every country faces competing demands for the financial and human resources necessary to staff an information system equal to its policy-making requirements. This is especially true for nations with limited resources.

In many countries the inadequacy of land management information may be the result of difficulties in accessing remote regions perhaps because of limited or failed infrastructure, or civil and military disturbances, lack of trained personnel, equipment, or funds to support data collection or rapid changes in the resource base. Often changes may not be detectable by traditional data collection methods, as with the high rate of deforestation in many area of the world caused by increased population pressures. In these areas population statistics may only be updated once every ten years and natural resource surveys even less frequently.

Remote sensing techniques may be useful in this regard. Remote sensing is the collection of information by use of such instruments as cameras, radar sensors, acoustic sensors, seismographs, magnetometers, and sonar. All of these can be useful in providing current, reliable information about land and related resources. A narrower but more conventional definition of remote sensing is the practice of data collection without direct contact between the sensor and subject area in the ultraviolet to the microwave regions of the electromagnetic spectrum thus neglecting acoustic, seismic and some other sensors. Medical imaging is also a type of remote sensing now using many areas of the spectrum; and traditionally it specialized in the use of X-ray technology.

Remote sensing has an extensive history based in aerial photointerpretation and photogrammetry, both areas remain extremely important in current practice. Aerial photography, together with ground surveys, is frequently used to obtain land management information (De Bruijn, 1987; Lutchman, 1987). However, aerial photos may be of inconsistent quality, out of date, or simply not available. Where they do exist, acquisition has usually required a large investment of time and money.

Recently, data acquired by satellite-borne sensors have become available at relatively modest cost and studies have demonstrated the value of these data for land management and resource mapping. Space borne remote sensing began in 1960 with the successful operation of the first meteorological satellites and this continues to be an important activity. Non-meteorological space borne systems have been systematically acquiring earth surface information since the launch of the first United States Landsat satellite in 1972, providing over 30 years of globally available data. Since the first Landsat system, there has been a progression of improved space borne remote sensing platforms and sensors (Campbell, 2002).

Space borne remote sensing provides a synoptic view of large areas including full country coverage that frequently includes information for areas which are difficult to access. The data, usually in a manageable number of images or photographs, create a permanent record of conditions at the time of acquisition (NAS, 1977; NRC, 1995; NRC, 2002). These records are extremely useful for monitoring the extent, type, and location of land surface changes.

Remotely sensed data are capable of providing information about the location and condition of a wide range of resources at different spatial resolutions (Brooner, 2002; Haack, 1982; Hass and Waltz, 1983; Dottavio and Dottavio, 1984; Kenk et al., 1988). Remote sensing has been used to map small areas such as wetlands, protected forests, or towns at large scale in great spatial detail and other systems provide information at small scales, for continental and even global coverage of land surface properties with spatially coarse information (Figures 1 and 2).

The use of remote sensing for resource assessment and basic mapping has a considerable history and increasing use in Africa (Adeniyi, 1985). There have been regional and national centers for remote sensing established in many countries. Some of these have existed for almost thirty years, and a few even predate the availability of space borne imagery. A number of these centers were established under international assistance programs directed at remote sensing technology transfer. The United States Agency for International Development was quite active with these centers, including the establishment of regional centers in Nairobi, Kenya and Ouagadougou, Burkina Faso (Paul and Mascarenhas, 1981). There is still, however, a need for more awareness and application of this information source for land management in Africa.

Figure 1. Space borne image of a rural area in Kenya. Copyright GeoEye

Figure 2. Remote sensing mosaic of Africa

The purpose of this document is to examine remote sensing as a tool useful for improving land management information. This document will describe remote sensing, the availability of space borne remote sensing data, methods of extracting information via remote sensing, and present discipline applications, including some specific case studies, of remote sensing for land management in Africa.

Remote Sensing

Remote sensing can be defined as the detection, recognition, or evaluation of features by means of distant recording devices. Remote sensing is a broad term which incorporates numerous subfields. Foremost among these subfields is aerial photointerpretation. Aerial photographic interpretation is the oldest and most frequently employed aspect of remote sensing. Another aspect of remote sensing is photogrammetry, the science of extracting quantitative information via remote sensing. Photogrammetry is primarily concerned with the spatial accuracy of remote sensing data or derived images and the extraction of elevation data.

The use of aerial photographs is widely understood but aerial photographs are generally expensive and not collected frequently in many locations. For these reasons this manuscript will not include a discussion of aerial photography or photogrammetry, but will focus on the use of space borne remote sensing data for land management.

There are currently about 40 operational satellites systematically collecting data that are made available to a wide clientele. The number of such satellites will increase dramatically over the next decade. The following sections will provide some introductory concepts and vocabulary on remote sensing followed by a description of the primary types of available satellite sensors and data.

Platforms and Electromagnetic Spectrum

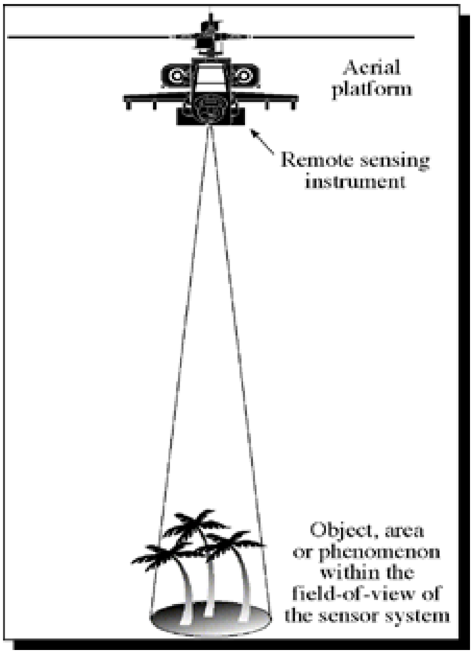
There are generally two parameters by which one can categorize all remotely sensed data and acquisition systems. The first is the distance between the feature of interest and the sensor location, also known as the platform elevation (Figure 3), and the second is what types of energy are being collected.

Platforms are generally either air borne or space borne. The primary air borne platforms are aircraft which can operate at a range of elevations from very low to above 15,000 m. Other airborne platforms are balloons, kites, and unmanned drones.

Space borne platforms operate at much higher elevations than aircraft. A typical elevation is 900 km but some meteorological systems are at 35,000 km. These platforms may be in an orbit constantly imaging different areas of the earth or may be geostationary relative to the earth's surface.

Typically, platforms at different altitudes trade off spatial detail for larger footprint or a synoptic perspective. Platforms close to the earth generally have fine spatial resolution but a very small footprint. These systems would be difficult to use for regional or national areas because of the large number of individual scenes and the cost. Satellite platforms generally have coarser spatial resolution but a large footprint. They are more appropriate for large areas. Space borne platforms were generally not developed to duplicate information more appropriately obtained from aircraft. There are exceptions to these general statements and relatively recently there is now fine spatial resolution data, about 1 m or less, from satellites but still with a small footprint. Properly employed, there are great advantages to combining remote sensing data of different spatial resolutions and footprints in a detailed analysis using spatial statistical procedures and models.

Figure 3. Diagram of remote sensing platform.



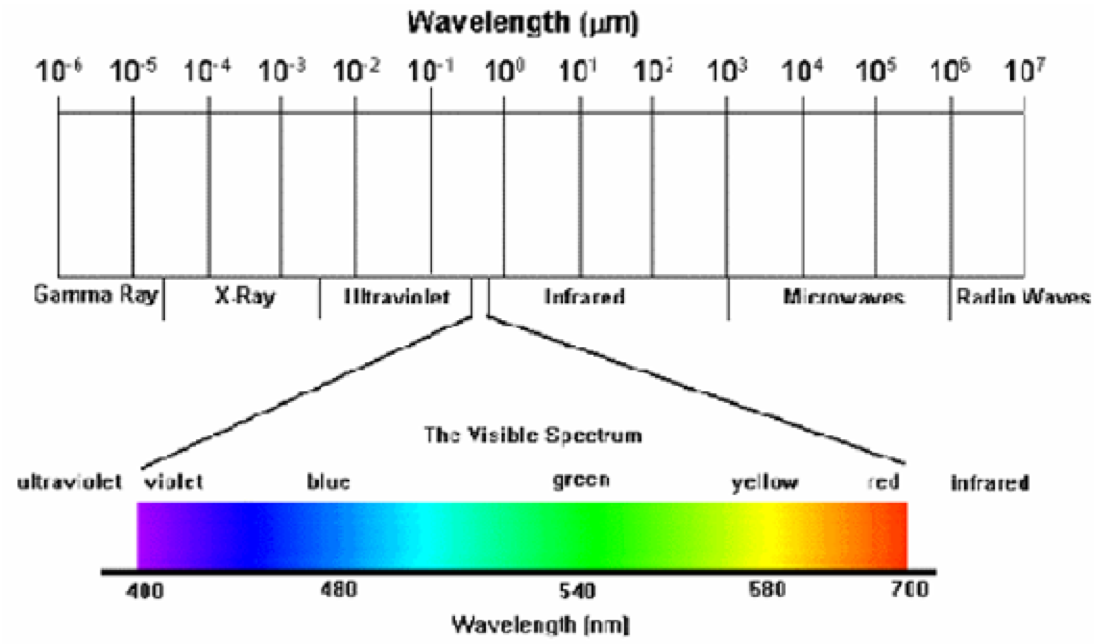
The second parameter by which remote sensing can be categorized is the type of energy employed by the sensors. In remote sensing, it is assumed that energy is transferred through space in wave form. This energy is typically described by wavelength, the measured distance between successive crests. This length is typically expressed in micrometers, one-millionth of a meter. A second descriptor of energy is wave frequency, the number of wave crests past a point per unit time (Jensen, 2007).

In remote sensing, wavelength is most commonly used to classify energy. Occasionally frequency is employed. There is an inverse relationship between wavelength and frequency. Short wavelength energy has a high frequency and long wavelength has a low frequency.

The electromagnetic spectrum (EMS) is use to classify energy in remote sensing. The EMS is a continuum of wavelengths from short to long (Figure 4). Portions of the EMS are designated by names and separated by wavelength boundaries. There are, however, not truly distinct boundaries between sections but transitions.

Most remote sensing employs the sun as the energy source. This solar energy is received by a sensor after reflection from the earth. Occasionally energy emitted from the surface of the earth as a function of surface temperature and emissivity is examined. Both reflected and emitted energy are passive remote sensing because the senor simply records what exists. Active remote sensing is the term used when the sensor transmits its own energy which interacts with the area of interest and a portion of it is returned to the sensor, the level of backscatter. The most common active space borne sensor is radar. Different portions of the EMS are utilized for reflected, emitted, and active remote sensing.

Figure 4, The Electromagnetic Spectrum (EMS)



The portions of the EMS typically used in remote sensing include ultraviolet (.04 to .4 mm); visible (.4 to .7 mm); three aspects of infrared, near or photographic (.7 to 1.3 mm), mid (1.3 to 3.0 mm), and far or thermal (3.0 to 300mm); and microwave 300 mm to 1 m).

There is very little use of ultraviolet radiation in remote sensing because these wavelengths are absorbed by the atmosphere. The visible wavelengths are divided into the visible blue (.4 to .5 mm), visible green (.5 to .6 mm), and visible red (.6 to .7 mm). These are very commonly used wavelengths in remote sensing, in part because of their familiarity. The near or photographic infrared energy can be recorded on film along with the visible spectrum; longer wavelengths cannot be recorded on film. Color infrared (CIR) film is commonly used, particularly for vegetative assessment. The mid infrared is very useful but does contain both reflected and emitted energy which at times can be a difficulty. Far or thermal infrared reveals primarily variations in temperature and thus emitted energy and has specific applications. The last portion of the EMS of interest in remote sensing is the microwave. Most remote sensing in these wavelengths is active; Radar is a typical active microwave system and it is increasingly used (Lillesand et al., 2004).

Current Operational Systems

Even in limiting this manuscript to space borne remote sensors, there are more platforms and sensors than can be presented in any reasonable way. The focus of this presentation is on operational systems, those which are ongoing, will continue, are basically global, and make their data available. These available systems can be classified into five major categories. These categories are:

1. Fine spatial resolution (< 10 m) multispectral or panchromatic
2. Medium spatial resolution (10 – 100 m) multispectral
3. Coarse spatial resolution (>100 m) multispectral
4. Radar
5. Hyperspectral

Each of these categories will be briefly described and in most cases, one of two of the primary sensors representative of the category presented. Since three of the five categories are multispectral systems (MSS), that term requires a definition. Multispectral means collecting energy in discrete portions of the EMS. Each collected type of energy is referred to as a band and typically MSS sensors collect between three and eight different bands. Each band may be examined independently as a black and white image or three bands can be combined to provide a color product, either natural color or more frequently a false color composite. Most often the bands are combined to a false color product similar to color infrared (CIR) film. One characteristic of CIR is that healthy vegetation is red as seen in several figures in this manuscript.

Of course, in digital processing, all bands can be employed. In fact, much of the theoretical basis for MSS is to be able to identify features by matching the information in various bands to the known spectral signature for the feature. A basic premise in remote sensing, but one with many variations and complexities, is the concept of unique spectral signatures for all features. The following summarizes, with sensor examples, these five categories.

Fine Spatial Resolution (< 10 m) Multispectral or Panchromatic

The availability of operational very fine spatial resolution data from space is relatively new, really only effectively since 1998. Currently there are about five systems collecting data in these resolutions. The finest resolution data are often single band black and white but often merged, (pan sharpened), with slightly coarser spatial resolution data to combine good spatial detail with spectral information. This type of data is very similar to aerial photography and generally information is extracted in the same way, by visual interpretation. Not only are the spatial resolutions similar to aerial photography, the footprints are also similar, quite small. Footprints of approximately 12 km per side are common. An exception to this is the French SPOT system which can collect 2.5 m data over a 60 km footprint.

There are several sensors collecting fine resolution data including IKONOS, QUICKBIRD, and Orb-View among others (Figure 5). One company, GeoEye, is expected to have a sensor with approximately 0.6 m spatial resolution operating in 2007. The limited footprint and costs make these data difficult for most land management issues, particularly for regions of any larger size. Because the data are so similar to aerial photography, little discussion will be included in this manuscript. There are, however, some very effective spatial sampling techniques incorporating this fine spatial resolution data for small areas with coarser resolution data over large regions.

Figure 5. IKONOS image of Addis Ababa ECA building. Copyright Geoeye.

Medium Spatial Resolution (10 – 100 m) Multispectral

These are the most widely utilized operational space borne sensors, other than meteorological sensors, and very effective for land management applications. These systems have existed since 1972 which means there is an historical record of almost 35 years of data for most locations. There are a number of satellites operated by different countries with this type of sensor including the United States, France, Japan, China, and India among others. The most widely used for land management have been the US and French systems which are described in the following sections.

There have been six successful United States Landsat platforms launched since 1972 with several different sensors. The primary earlier sensor was the four wavelength Landsat Multispectral Scanner (MSS) with 80 m spatial resolution, a 185 km footprint, and a temporal resolution of 16 or 18 days. Since 1982, the primary sensor has been the Thematic Mapper (TM). This is a seven band sensor at 28.5 m spatial resolution and the same 185 km footprint. There is also a 15 m panchromatic band in the more recent TM sensors (Jensen, 2007). The Landsat series of systems provide an extensive archive of imagery for almost all surface areas and are extremely useful sensors for many land management applications (Figure 6). Unfortunately, there have been sensor difficulties with the most recent system since 2002 greatly reducing the usefulness of the data and because of delays in launching a new satellite, there will most probably be several years without a functioning Landsat sensor, most likely from 2008-2010. Many users of Landsat have already employed other systems and fortunately there are a number of alternatives.

The French SPOT system is also a near globally available system in operation since 1986. There have been five SPOT satellites with a considerable range of sensors and capabilities. The SPOT systems have been very innovative being the first system to have off-nadir viewing to provide stereoscopic coverage and SPOT was generally among the earlier systems with finer spatial resolutions. The primary SPOT sensor collects four wavelengths at 10 and 20 m spatial resolution but has a relatively small footprint of 60 km (Figure 7). SPOT systems also recently added 2.5 and 5.0 m spatial resolution capabilities in panchromatic modes. Most of the land management applications in this discussion use either the Landsat or SPOT data. There are, however, other platforms that have similar moderate spatial resolution multispectral sensors (Lillesand et al., 2004).

Figure 6. Landsat image of the Guinea coast.

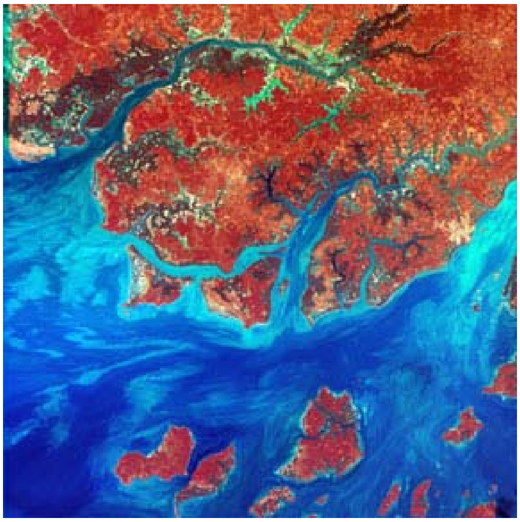


Figure 7. SPOT 10 m image of Angola.

Coarse Spatial Resolution (>100 m) Multispectral

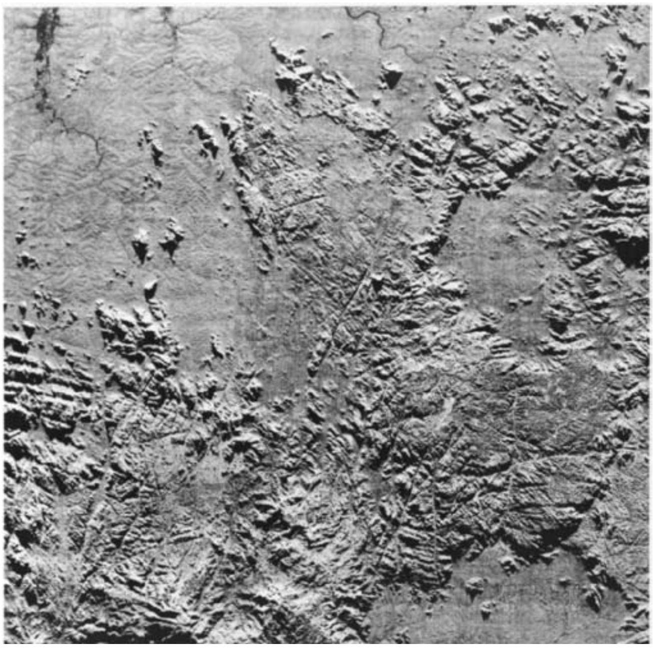
These systems are primarily the meteorological sensors. They typically collect about five wavelengths, have coarse spatial resolutions, but very high temporal resolutions. They can often collect two images per day globally and the geostationary systems can collect repeat images on the order of minutes. They also collect day and night time data. The night time thermal infrared is useful for cloud cover and weather monitoring. These systems provide inexpensive data with very large footprints, a 2000 km swath is common. These sensors also have applications beyond meteorological. They are used for desertification studies over large regions, observations of ocean currents, and for crop monitoring and forecasting (Prince and Justice, 1991; Tappan et al., 1992). There are several countries that operate these sensors. The oldest is the US system typically referred to as the NOAA platforms and the primary sensor is AVHRR.

Radar

Radar has a long history in remote sensing but is more limited in operational remote sensing. The first research radar satellite was in 1978 but effectively the only current operational system has been the Canadian RADARSAT system functioning since 1995. RADARSAT-2 is scheduled to be launched in 2007. RADARSAT is a single wavelength, single polarization system which means it provides one black and white product. As an active sensor, radar has a number of advantages, particularly the ability to collect imagery day or night and to penetrate clouds. It is especially useful in high latitudes with limited daylight and coastal or tropical regions with frequent cloud cover, such as the low latitude regions of Africa.

Radar also interacts very differently with the surface than optical systems in that it is excellent for evaluation of form and structure but not as useful for feature composition or materials identification. Because radar imagery is collected at an angle to the surface, not perpendicular, it provides an image with the appearance of shaded relief making it excellent for locating landforms, topography, and often faults (Figure 8). It is widely utilized by geologists. Radar has some very effective uses such as deforestation, oil spills, ice flows, and geology, as mentioned, but there is still a great amount of information needed to understand its wider applications. At this point in our knowledge of radar and for the purposes of this manuscript, there will be few presented examples of radar for land management in Africa (Henderson and Lewis, 1998).

Figure 8. Radar image in Cameroon showing geologic and landform features.



Hyperspectral

These systems collect a large number of contiguous but very narrow bands of data. Typically these systems collect hundreds of wavelengths. They were primarily developed by geologists for detailed spectral signature collection similar to what is done in a lab for minerals with spectrometers. Airborne research sensors have existed for decades but there has been limited availability of hyperspectral data from space. There are two current systems, MODIS and Hyperion, but MODIS is only 36 bands and very coarse spatial resolution while Hyperion has a very limited swath width. The utilization of hyperspectral data is generally complex requiring specialized software and knowledge. At this time, there is little likely application of these data for land management in Africa.

Analysis Methods

There are two basic methods of the extraction of thematic information from satellite-based remotely sensing data. Those are visual interpretations from hard or soft copy photographic-like images or computer based analysis using the actual digital numbers collected by the sensor. These two approaches have respective advantages and disadvantages and require different capabilities and infrastructures (Lillisand et al., 2004). They both also have subjective components and neither is necessary more accurate, more scientific, or more consistent.

For visual analysis, the data are radiometrically and geometrically corrected including rectification to a geographic grid such as Universal Transverse Mercator (UTM). Sometimes the data are simply annotated with Latitude and Longitude or "Georeferenced". From these images, qualified interpreters map the surface features. This is the traditional method of air photo interpretation and is referred to as manual, optical, or imagery analysis. This method is often applied and can be extremely effective when conducted by a good analyst familiar with the features and/or the location. Visual interpretation often incorporates a field visit component to better understand the landscape or verify features.

Visual interpretation is typically from a three band color product but not normally natural color. The images are frequently created to resemble a color infrared film product where there is overall clarity, good land-water delineations, and the healthy vegetation is bright red. The added middle-infrared wavelengths of many optical sensors, such as Landsat TM, has provided the opportunity for greater variety of false color products often using one visible, one near infrared, and a middle infrared band.

In the second method of thematic feature extraction, the remote sensing digital values are directly manipulated by a computer to identify surface features such as bare soil, urban areas, wetlands, forest, or specific crops. This is the process of automated classification, digital processing, or numerical analysis. It requires a procedure of spectral signature extraction and then the application of a statistical decision rule for typically each pixel (Jensen, 2005).

Digital classification normally relies only on the spectral reflectance values for each pixel and does not include the texture and context parameters which a human analyst can so effectively integrate. There are methods to include these parameters and other existing spatial data sets, which are very promising and in some situations, very effective. Appropriate large area mapping also requires considerable cartographic generalization, more easily accomplished by visual interpretation than pixel-by-pixel digital classification and spatial filtering. These methods require appropriate hardware, software, infrastructure, and trained staff. Computer analysis has advantages and disadvantages in remote sensing and does not necessarily provide more efficient or accurate results than visual analysis.

Geographic Information Systems (GIS)

A related problem to the availability of current, accurate land management and other spatial information is data format. Existing data may not be stored in a form which facilitates comparison and integration. Very few management or planning decisions are made based on one type of spatial information. For example, land use data generally needs to be considered in context with existing infrastructure, population density, soil type, and land tenure. By developing an integrated system, which contains a variety of spatial data, duplication of effort can be prevented, costs reduced, and efficiency increased to provide better land policy and other decisions (Bassole et al., 2001).

A Geographic Information System (GIS) can integrate a selection of data types into a common spatial format, to provide for easy reference and comparison. Historically a GIS was a series of manual cartographic overlays but currently, a GIS refers to a computer based software and hardware system. The rapid development of small stand-alone computer systems has greatly expanded the availability of GISs. These systems are relatively inexpensive and can store large amounts of data, perform a wide range of data manipulations quickly and accurately, and provide data output in map or statistical format. In addition, the GIS can create information on change over time and develop many models such as land suitability or capability, and future conditions. A GIS is an extremely valuable technique for any process which incorporates spatial information (Savitsky and Lacher, 1998; Aronoff, 2005; Bolstad, 2006; Longley et al. 2005).

Using a GIS to manage spatial data with associated geographic analysis techniques is often very useful in providing current, reliable spatial information. Such information has many possible land management uses. By comparing historic and current data, areas of change such as deforestation or loss or gain of agricultural lands may be identified. Models of trends may extend this to projections of future conditions that can be very valuable for management purposes. This may assist the allocation of resources for projects such as roads or new agricultural management or conservation and erosion prevention initiatives. The data may also be useful in selecting economic development sites for irrigation schemes, hydro-electric dams, or factories. The following sections present applications of remote sensing and GIS for land management.

Applications

Paul (1978) identified eight resource needs critical for land management. Those needs were: (1) national inventory mapping, (2) forest monitoring (3) land use planning, (4) the identification of sub-surface water sources, (5) the encroachment of urbanization on agricultural lands, (6) transportation planning, (7) land utilization, and (8) soil capability mapping. Paul did not contend that remote sensing can meet all these needs but did believe that remote sensing can make some contributions to these areas, more in some cases than others. The improvements in sensors since his study have increased the ability to collect information via remote sensing for these and other applications. The following sections examine by subject areas some specific applications of remote sensing data to land management using examples from Africa.

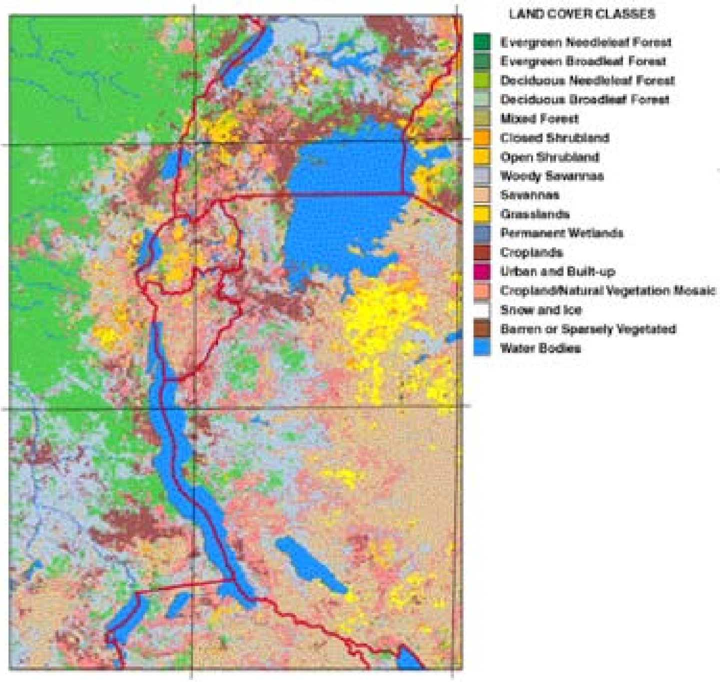
Land Use/Cover

There have been many uses of remote sensing to provide images at various scales and formats for the extraction of thematic or land use/cover information. This information is often in digital, computer compatible format and capable of being integrated directly into a GIS. Often these efforts will be complemented by the generation of other spatial data layers such as administrative boundaries, transportation, hydrology, soils, and elevation for land management and planning (Haack and English, 1996) (Figure 9).

Countries for which remote sensing national land use/cover mapping has been or will be implemented include Tanzania, Mozambique, and Nigeria. These projects require extensive planning as they are complex, costly, and time consuming. The following sections present several examples of remote sensed based land cover/land use mapping projects.

Mundia and Aniya (2006) mapped land use/cover with multi-temporal Landsat images (1976, 1988, and 2000) together with physical and socio-economic data in a post-classification analysis with GIS to analyse factors influencing the land use/cover changes for Nairobi. Land use/cover in Nairobi City is changing rapidly because of the increased interactions of human activities with the environment as population increase. Land use/cover statistics revealed that substantial land use/cover change has taken place and that the built-up areas have expanded by about 47 km2 over the study period (1976-2000).

Figure 9. Land use/cover map for East Africa from remote sensing data.



Forests have decreased substantially while agricultural lands have been on the increase. Rapid economic development together with increasing population are major factors influencing rapid land use/cover changes. Urban expansion has replaced agricultural farmlands and other natural vegetation, thereby affecting habitat quality and leading to serious environmental degradation. The random, unplanned growth of environmentally degraded squatter settlements was noted to be emerging in the rural fringes. Successful planning of Nairobi's development will require reliable information about land use/cover changes. Factors influencing such changes can be studied by remote sensing and for urban areas, the recently available high spatial resolution data appear to be very effective.

Braimoh and Viek (2005) characterized and identified the spatial determinants of agricultural land cover change trajectories in northern Ghana using land cover maps prepared from Landsat TM data sets acquired in 1984, 1992, and 1999. Population densities generally increased along the continuum of land cover intensity, whereas distance from market, and roads generally decreased along this continuum. Apparently, roads and market serve as incentives for settlement and agricultural land use. An increase in population density is an important spatial determinant only for trajectories where the dominant change process is agricultural extensification. The models provide a means for identifying functional relationships for in-depth analyses of land-use change in Ghana incorporating remote sensing methods for data collection.

Forestry, Rangeland and Other Natural Vegetation

The conversion of forests to farmland and the demand for fuel wood and other forest products are depleting the world's forests by many millions of hectares per year. Most of this loss is in the tropical region. The impact of forest destruction on food, fuel, soil, and the global climate is tremendous. Other natural vegetation types such as woodlands, wetlands, and grasses or rangelands also are changing and these features can by observed and mapped using remote sensing. The three aspects of remote sensing applications to vegetation are detection, identification, and monitoring. Satellite remote sensing can contribute to each of these components but particularly to monitoring forest changes because of its global coverage and high frequency of repetitive imaging.

Muyed (1978) summarized the following components of using space borne remote sensing for the conservation and management of forest resources and relevant to other natural vegetation:

1. Surveying and mapping. Space borne imagery can best be used for surveying and mapping. As is the case for all resource management, surveying, and mapping are essential for making an inventory or working plan for forests. Although forest boundaries are easy to define because of their high contrast to adjacent areas, it is difficult to observe ground features. A proper combination of ground truth and space borne imagery can produce very good results.
2. Soil classification. The spatial distribution of soils can often be delineated on imagery. This enables the forester to determine correctly the species which should be planted in a particular area.
3. Aerial photography or high spatial resolution space borne imagery site selection. Coarser spatial resolution satellite imagery can be used to help decide where finer spatial resolution data should be collected. This reduces the cost of selecting areas for detailed survey or for laying out sample plots.
4. Delineating forest types. Delineating broad forest types, and in some cases detailed or specific species, is possible with the help of remote sensing. This delineation is necessary for preparing management plans and location of industries based on raw materials such as softwood or bamboo.
5. Large area volume estimates. Although forests are in theory a renewable resource, once they are exploited beyond their capacity of renewal they can never attain their previous state. Therefore, before determining the allowable cut, it is essential that an estimate of the standing stock is made. Multistage sampling can be successfully used for estimating timber volume in a forest.
6. Comparative studies. Because remote sensing provides coverage of the same area over a short span of time, it is possible to make comparative studies, particularly for erosion, accretion, and encroachment.
7. Detection of flowering disease and fire. Gregarious flowering of trees, epidemic diseases, large-scale insect damage, and forest fires can be detected on imagery. The extent of damage by other natural causes may also sometimes be assessed by imagery.
8. Wildlife management. Imagery is useful for studying wildlife habitat.
9. Composition studies. By studying multitemporal imagery from different times in the phenological cycle in which some species may be leafless or dormant, as assessment of the composition of a forest can be made.
10. Undergrowth. This kind of study is very often difficult with space borne remote sensing. However, by studying the top canopy and obtaining adequate field information, a model may be developed which will determine the relation between the ground flora and the top canopy.

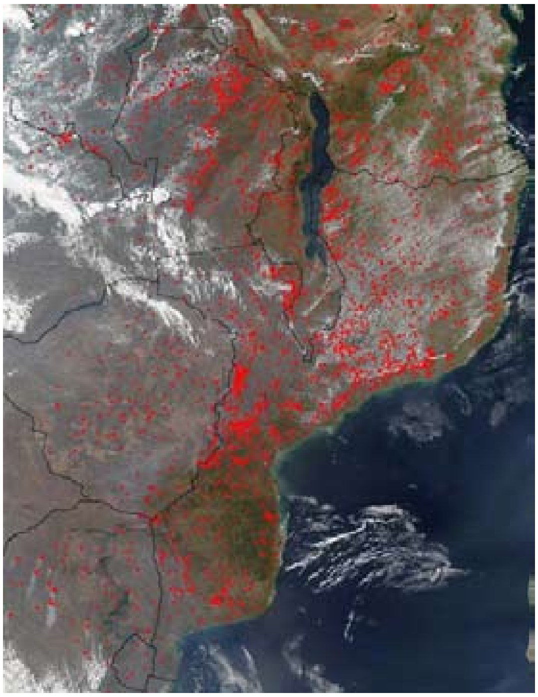
Remote sensing is very effective for acquisition of many natural vegetation features. The ability to collect data during the different vegetative states and also determine long term trends is very useful for management (Hamilton, 1984). The following are examples of vegetative analysis in Africa using remote sensing.

In Tanzania, well-defined land tenure and resource protection apply in forest reserves which account for 30% of forested land, while the remaining 70% (mostly miombo woodlands) are village and general lands with very limited protection. Luoga et al. (2005) determined local people's ownership rights, knowledge, and institutional capacity for sustainable management of resources in forest reserves and general lands. Data were collected using participatory rural appraisal, structured and semi-structured interviews, as well as aerial photographs and Landsat images. In general, woodlands declined by 50% between 1964 and 1996, bushlands and croplands increased by 599%, and settlements and homegardens increased by 277%. These land use and vegetation structure changes are attributed to harvesting for charcoal production and shifting cultivation.

Verlinden and Laamanen (2006) developed a cost-effective method to map fire scars on Landsat TM imagery. A long time series of fire scars was developed using all available Landsat between 1989 and 2001 for an area of 63,000 sq km in north-east Namibia. Between 27 and 51% of the study area burned annually, while only 10% of the area did not burn between 1989 and 2001. Not-burned areas were mainly settled areas and permanent wetlands. Thirty-three percent of the area burned between 5 and 7 times during the 13 years indicating a high frequency overall. In 1996 formal fire management started in a portion of the study area consisting of building firebreaks and holding awareness programs. A comparison of burned areas before and after the intervention started allowed evaluating its effectiveness. The area where the formal fire management program was undertaken showed a significant decrease in burned area (Figure 10).

LeMarie et al. (2006) used remote sensing techniques to identify and quantify mangrove forests in two selected areas of the Incomati estuary of Mozambique. Five satellite images covering a period of 20 years (1984-2003) showed that the area covered by non-degraded mangroves significantly decreased on both islands, by 25% in Xefina Pequeña Island and 40% in Benguelene Island. Possible causes of these changes include natural rainfall trends, modifications of the river flow regime, and increasing harvesting levels of mangrove woods. The study shows that mangrove forests are relevant indicators of the state of the estuary.

Figure 10. Remote sensing image locating fires in East Africa



Agriculture

The continuous and frequently intense problem of food shortages is a priority issue for decision makers and land managers. Any contribution of remote sensing to better management of agricultural systems or more timely information on food production may be very useful in understanding and ameliorating the global food crisis. Possible agricultural applications of remote sensing are: (1) crop identification, (2) crop acreage determination, (3) crop condition assessment, and (4) yield forecast and estimation. The advantages of remote sensing over other agricultural data collection techniques include greater accuracy, more timeliness, and lower costs per unit area.

The greatest benefit of remote sensing in agriculture may well be in those countries without well established crop inventory and analysis systems. The Famine Early Warning System (FEWS) supported by the countries of the Sahel and UN/FAO has been using satellite data received at the intergovernmental Agriculture, Hydrology and Meteorology Center (AGRHYMET) in Niamey, Niger for many years and other regions of Africa have participated in the FEWS program. It is in these areas of greatest need for information that satellite data are difficult to use because of the often small irregularly shaped fields and the use of intercropping and other heterogeneous crop patterns. Additionally, these often tropical areas have frequent cloud cover making collection of timely data difficult, and because of no dormant vegetation seasonality, frequently have the same crop at many stages of growth at any given time. Even under these conditions remote sensing can be useful in collecting agricultural information by providing a stratification of cropping practices. Such stratification can be the basis for a multistage area frame sampling scheme incorporating various spatial resolutions of remote sensing with field examinations. This type of agricultural sampling procedure has been demonstrated to be highly successfully in providing accurate and relatively low cost agricultural information including crop types, hectarages, and yields (NAS, 1977).

Colwell (1977) formulated the following conclusions concerning the use of remote sensing for agricultural statistics:

1. For most areas that are not satisfied with their present data on agricultural production, use of remote sensing (especially combinations of spatial resolution imagery) will undoubtedly enable them to get better information in a cost-effective way.
2. Remote sensing does not replace existing agricultural data collection procedures where they exist, but should be used as one element of a total agricultural information system. Field observation continues to be required to interpret and verify information derived from remote sensing technology.
3. Historically remote sensing data were most useful for crop identification and area determination. Yield estimation using remote sensing is more challenging but increasingly has been effectively accomplished.
4. Key to effective use of remote sensing data is the design of an appropriate agricultural sampling strategy. Multistage and double sampling procedures incorporating ground observations and different spatial resolutions of remote sensing imagery have proven effective in studies in many countries.
5. Remote sensing imagery provides a relatively low cost form of large area agricultural data. When used appropriately, space borne remote sensing is extremely cost effective on a per unit area basis.
6. Satellites potentially can furnish very timely information concerning such dynamic phenomena as field preparation and crop maturation. However, historically delays in data handling and delivery hindered these activities. Institutional developments have reduced the delivery time and thereby increased the value of the data for crop monitoring purposes.
7. Advanced remote sensing technology should not be used simply for technology's sake. A considerable amount of useful information can be obtained from remote sensing by relatively unsophisticated methods, including image interpretation. The introduction of more advanced technology should occur when it can and will be utilized, and when it is shown to be cost-effective.

Yemefack et al. (2006) investigated the statistical relationships between land use/land cover (LULC), Landsat-7 ETM+ imagery, and landscape mosaic structure in southern Cameroon where the conversion of tropical rain forest to shifting cultivation leads to dynamic processes, acting on the spatial aggregation of various LULC types. The study provided a LULC map with an accuracy of 81 percent. Landscape metrics computed from this map showed a high level of patch diversity and connectivity within the landscape and provided input data that can further be used to simulate predictive maps as substitute to cloud-covered sensor imageries. Landsat-7 ETM+ imagery proved to be useful in discriminating the most dynamic LULC types such as cropped plots and young fallow patches (shifting every season) and the extension front of the agricultural landscape.

Water Resources

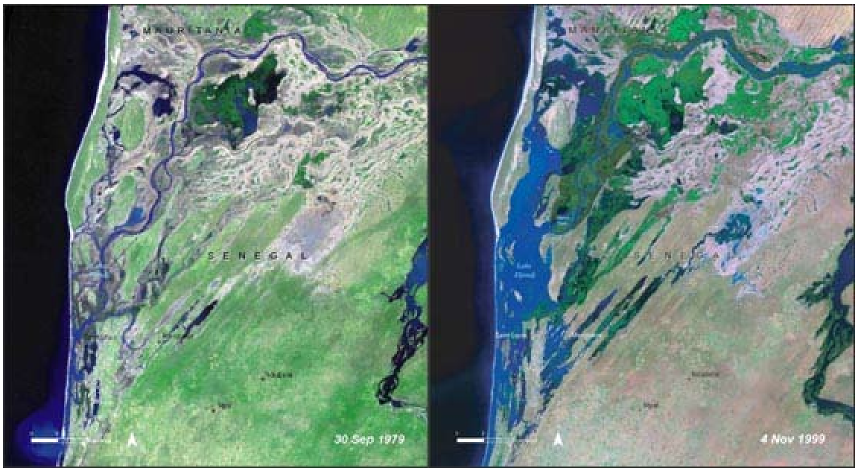
Remote sensing has been demonstrated to be very useful in the examination of some water resources and has the potential to be useful to others (Engman and Gurney, 1991). One possible application of remote sensing to water resources critical to many regions is the identification and analysis of ground water.

Moore (1978) concluded that the general principles of photography interpretation may be applied to space borne images to recognize features that are favorable for ground water occurrence. These features are landforms and landform patterns, drainage characteristics, snowmelt patterns, vegetation types and associations, outcrop patterns, soil tones, lake patterns, and land use/cover characteristics. Some detected features directly imply the presence of shallow sands and gravels; other features indicated rock types or the presence of folds and fractures. A number of studies have shown a good correlation between lineaments detected by remote sensing and the occurrence of ground water in dense, fractured limestone. There is good reason to believe that many lineaments are related to ground water occurrence in other types of dense, fractured rocks. The ability of radar under the right conditions to penetrate dry soils has also been useful in detection of possible ground water sites.

MacLeod (1973) examined the application of Landsat to resource management and development in the Republic of Mali where water is probably the most important resource. He obtained imagery of the maximum flood state on the Niger and Bani River watersheds and assessed the size, timing, and aerial extent of the annual flood data of particular interest to nomadic herdsmen who bring their cattle to the Inland Delta each year to forage, to fishermen who harvest tons of fish from the Niger each year, and to cultivators in the Delta. MacLeod determined that stream beds, lake beds, lineaments, and drainage patterns can be observed on Landsat imagery and used for mapping potential groundwater resources. In one area of Mali, he found no surface drainage ways of any substance, indicating very porous soils for this region. The absence of surface ways may suggest the presence of shallow aquifers which could be developed for livestock watering points for nomadic herds.

Remote sensing can be a very important tool for the examination of water resources. Simple location of surface water can be done very effectively with multispectral imagery containing near infrared wavelengths. The difficulty of surface area delineation is simply that of available cloud free imagery. Mapping of floods and water course or body changes for map updates can be easily accomplished with remote sensing (Figure 11). In areas of cloud cover, radar can obtain images and is also very effective in surface water detection as well as landforms. Repetitive coverage of remote sensing may determine if a stream is in continuous or intermittent flow. These data can be effective in providing data on stream networks for drainage maps.

Figure 11. Landsat image locating flooded areas in Lakd Djoudj, Senegal

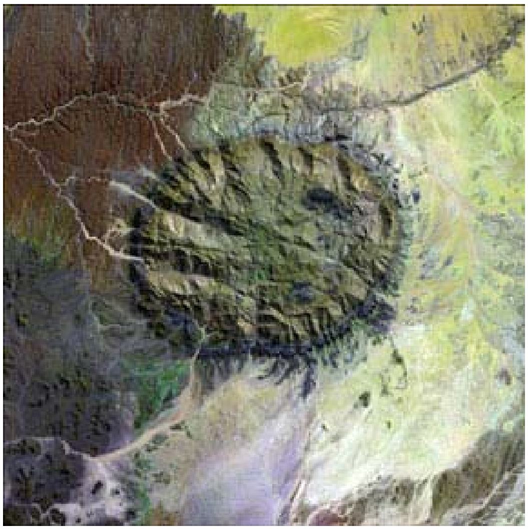


Geology

Geologic applications of remote sensing data can be with static features such as the distribution, character, and structure of rock bodies or with dynamic phenomena such as landslides or fluvial processes. The synoptic view provided by space borne images may identify structural elements which are perhaps irregular or even discontinuous with smaller areas, as lineaments of regional extent.

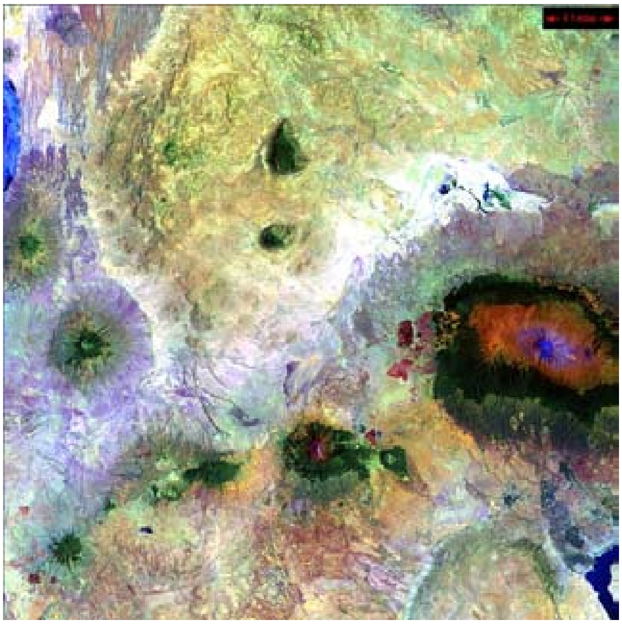
Geologists can use these data to trace prominent rock units across an entire fold belt without trying to piece together many individual photographs which may differ in scale, exposure, or light angle. Satellite examination of static geologic features may be important in improving geologic mapping and providing more efficient geologic resource exploration (Figures 12 and 13).

Figure 12. Brandberg Massif in Namibia on a Landsat Themater Mapper image



Remote sensing may be useful in evaluating the accuracy of existing geologic maps and locating additional features such as faults not previously mapped. In some areas, national or regional geological maps have been produced with space borne remote sensing more efficiently and more quickly than by traditional means. A plan to make a new geologic map of Egypt at a scale if 1:1,000,000 in 10 years at a cost of $2.4 million US using black and white aerial photographs was altered when satellite imagery proved to be more satisfactory. The later offered more geologic detail and could accomplish the task more quickly and at less cost.

Figure 13. Landsat Thematic Mapper image of geologic features near Mount Kilimanjaro in Tanzania



Wanke (2005) recognized four subparallel faults with remote sensing in the Eiseb Block in the field and in Landsat TM scenes. Their extension into Botswana's Gomare and Kunyere faults, which delineate the Okavango Rift, Botswana, was traced. In the Eiseb Block, abrupt termination of Kalahari dunes corresponded with northeast-southwest trending tectonic lineaments, whereas a second set of north-northwest to south-southeast orientated lineaments was evident from the orientation of rivers. The fact that Kalahari dunes are displaced since their last active phase indicates their age or formation. The Eiseb Graben and associated lineaments seem to be a long-lived, probably reactivated structure that follows the pre-existing structures of the Damara inland branch, Karoo trough, and basin structures of the Kalahari. This is one of many examples of remote sensing for geologic analysis.

The repetitive coverage of many sensors allows the examination of dynamic phenomena. Dynamic geologic phenomena which may be examined with these tools include river course changes during or after floods, coastline changes, sand dune encroachment, earthquake or landslide damage. The National Academy of Sciences (NAS) (1977) summarized the following possible geologic application of remote sensing from space:

1. Develop geologic maps of areas not previously covered and evaluate existing geologic maps to determine their accuracy and completeness.
2. Identify large- and medium-scale structural and geologic features and correlate them over separate areas that may be widely spaced from one another.
3. Provide preliminary planning bases for siting of transportation, communication, irrigation, energy, and industrial projects.
4. Select potential geological resource areas worthy of more detailed examination by high spatial space borne sensors or aircraft and by ground observation.
5. Provide a base for specialized studies, such as of stream geochemistry.
6. Provide an opportunity to monitor, through use of repetitive coverage, altered or transient geologic features, such as changed stream courses and sand dunes.

Pedology

Aerial photography has been an important technique to the soil scientist to plan and operate field activities as well as to delineate soil boundaries. Remote sensing techniques, other than aerial photography, including thermal and radar sensors and satellite platforms have been also utilized by pedologists. Advantages of spaceborne data to the soil scientist include; (1) availability for some areas where not other data exists, (2) synoptic coverage to identify regional soil patterns, (3) repetitive coverage to provide data under wet or dry soil conditions and when vegetation cover is minimal, and (4) multispectral or hyperspectral capabilities because different spectral regions have different functions in soil analysis.

Effective soil and water conservation programmes require the concentration of resources on limited areas. For that purpose regional-scale assessments of erosion risk are required. However, availability of good-quality spatial data for such assessments is often limited. Vrieling et al. (2006) conducted a study to evaluate the potential of analysing regional erosion risk using remote sensing for a 70 km2 Baga watershed in the West Usambara Mountains, Tanzania. Principal data sources were a Landsat image and a satellite radar based digital elevation model (DEM). Two qualitative mapping methods resulting in five erosion risk classes which were evaluated against field-based erosion risk estimates. One method derived slope classes from the DEM and fractional vegetation cover classes from the Landsat image. The second method did not apply field data for the map construction, but combined five equally sized Landsat derived green vegetative index classes and five slope classes. The resulting maps showed a high and comparable accuracy, 80 per cent for Method 1, and 81 per cent for Method 2. Spatial patterns of erosion risk were well represented by both methods and high erosion risk areas can be properly identified within the Baga Watershed indicating the value of space borne remote sensing for soil erosion assessment.

El Shazy (1978) mapped soils for an extensive areas (over 100,000 sq kms) in central Egypt by the interpretation of Landsat imagery associated with field examination of soil profiles. The maps were at a scale of 1:500,000 and classified soils according to their potential land use as either arable or non-arable. Soils were further classified into seven grades. This basic soil delineation prioritized areas for agricultural development which should be more closely examined.

The usefulness of reflectance data from surface features as provided by most remote sensors for soil mapping is limited because conventional soil series are differentiated by both surface and subsurface properties. Reflectance data alone can not discriminate between soils which are differentiated only by subsurface features. The ability to delineate soil characteristics from these data is a function of the correlation between the spectral properties and important physical or chemical properties of the soils. Soil colour is obviously important in soil reflectance, but variations in soil moisture, surface roughness, crusting or cultural practices also affect reflectance. These data can frequently identify variations in organic content, salinity, and soil moisture.

The interference of surface vegetation in examining soils is often a problem. In some case this problem can be minimized by use of temporal data when the vegetation interference is minimized. In other situation, the relationship between soil and vegetation is such that an identification of vegetation types or densities is an indicator of soil type. Satellite data are seldom sufficient to identify the same spatial and functional detail as tradition soil mapping but may be very effective in determining broad soil characteristics and soil patterns over wide areas in a short time, particularly for reconnaissance surveys.

Other Disciplines

The application of space borne remote sensing is not limited to the previously discussed disciplines. These data have some value to probably all land management issues. As a cartographic tool, remote sensing data can map previously unmapped areas quickly and inexpensively and can update existing maps. Information can be obtained from this data source for regional or transportation planning. Range inventory and analysis to assess the livestock capacity or an area, identify areas where range improvement techniques may be most appropriate, and monitor grassland burning events can be obtained from satellite sensors (Cahoon et al., 1992). Urban planning and disaster assessment are other utilizations.

Perhaps the greatest potential of these sensors is a result of their applicability to many resource features. Land management activities are increasingly multi-disciplinary requiring the integration of many data types such as forests, population, climate, hydrology, transportation, and soils among others. Remote sensing can not only be useful in collecting some of these data types but because of its planimetric aspects, may be a useful base to compile a wide variety of spatially identifiable data. The contribution of satellite data to the construction of GIS to serve the needs of land managers in many disciplines and promote the use of comprehensive multidisciplinary analyses may be one of this tool's greatest values.

Summary

Improved land management without excessive environmental damage is necessary to provide an acceptable quality of life for current and future generations in most areas of the world. Good management decisions concerning resource utilization necessitates accurate and current information on the location, quantity, and condition of the resources – information not currently available to many decision-makers. Remote sensing satellites can often provide this land management information useful to scientists and decision makers.

Satellite data are available for essentially all habitable land areas of the earth, collected very frequently, readily available, easily utilized, and relatively inexpensive. It has been demonstrated to be useful in the study and analysis of many resource types. Remote sensing can not be useful in all situations and has some limitations but anyone involved in land management should be aware of the existence and possible utilization of this data source.

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Projet de mise en place d'un Système Moderne de Gestion du Patrimoine Foncier

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Contexte

Touba, Ville Singulière, s'Impose dans le Réseau Urbain Sénégalais

Par un taux de croissance de 15 % par an depuis près de 30 ans, Touba est devenu, la deuxième ville du Sénégal après l'agglomération de Dakar-Pikine-Guédiawaye, avec son million habitants environ. Entre 1988 et 1998, le taux de croissance est même passé à 19 % par an environ et la population a plus que doublé. Son extension spatiale est considérable : la superficie de la ville est passée de 575 ha à 3900 ha entre 1970 et 1990 et atteint aujourd'hui près de 30 000 ha.

Figure 1: Carte de localisation : échelle env 1:6 000 000

Touba émerge ainsi dans un semis urbain marqué par la relative stagnation des villes secondaires et constitue ainsi la première ville de l'intérieur du pays. Au moment où on parle de villes secondaires stratégiques, l'armature urbaine sénégalaise, essentiellement tournée vers la côte, s'enrichit ainsi au centre du pays d'une autre grande ville pouvant jouer un rôle moteur et structurant du développement économique et social d'une vaste zone rurale du bassin arachidier et du ferlo.

Une Agglomération qui doit Gérer sa Croissance

La fondation de Touba, il y a bientôt 120 ans représente la réalisation des prières adressées à son seigneur par Cheikh Ahmadou Bamba pour construire autour de sa grande mosquée, une référence spirituelle, religieuse et scientifique et constituer le lieu de recueil des grâces obtenues par le Cheikh.

Le principe d'anticipation par les lotissements massifs a permis de donner à Touba un espace urbain soudé à partir de quartiers créés ex nihilo ou de villages satellites intégrés et valorisés dans le sens du symbole. La logique d'anticipation pour satisfaire la demande en parcelles des nombreux mourides cherchant à l'acquérir a produit un gigantisme extraordinaire.

En dehors des milliers de parcelles loties par Serigne Cheikh Mbacké Gaindé Fatma, Serigne Falilou Mbacké et Serigne Abdoul Ahad, près de 150 000 parcelles ont ainsi été produites sous la direction de Serigne Saliou Mbacké ces dernières années. L'objectif de distribuer le patrimoine foncier de manière équitable et selon des règles éthiques et conformes à l'Islam dont il est un fervent défenseur constitue la principale préoccupation du marabout.

Le Temps des Ruptures : Un Nouveau Mode de Gestion est Nécessaire Touba ne Peut Plus Etre Géré Comme Avant

Touba connaît ainsi un développement qui se traduit par diverses difficultés de gestion :

- Les types de titres de propriétés sont tellement nombreux dans la ville selon les quartiers, les marabouts donateurs, le mode d'acquisition qu'une grande confusion s'était installée dans ce domaine.

- Les nombreux conflits fonciers et la spéculation se développent dans la ville, heurtant ainsi certains principes sacro-saints de droiture et d'équité prêchés le guide religieux et constituent des risques pour la communauté.

- Par ailleurs, se pose pour la ville de Touba en général un grave problème de fiabilité des données démographiques et cartographiques réduisant l'efficacité des interventions et services. Les intervenants dans la ville sont souvent face à un vide : la SONATEL, la SENELEC, les services de l'hydraulique, les services de sécurité, etc. travaillent toujours à partir de plans sommaires et incomplets.

Figure 2: Limites du titre foncier

L'autorité de la ville a très tôt perçu les enjeux et risques liés au manque de maîtrise par les responsables de la communauté, du manque d'information fiables sur le processus de développement de la cité, si des mesures ne sont pas prises dans l'immédiat. c'est pourquoi il a décidé d'engager les ruptures nécessaires et de conduire un saut qualitatif en introduisant des innovations pour que Touba soit géré autrement. ce saut qualitatif passe selon la vision de SSM, par la maîtrise des connaissances et instruments les plus modernes, les plus en avance/ conformément aux enseignements de l'Islam et de la philosophie de Serigne Touba qui recommande de « chercher le savoir là il se trouve même en Chine »

En dotant de Touba d'un instrument le plus avancé au monde, et le premier a être mis en œuvre au Sénégal, en Afrique de l'Ouest voir dans les pays en développement, Sergine Saliou MBacké, s'illustre ainsi comme un pionnier de la modernité et du développement urbain et fait de Touba une cité à l'avant-garde de la modernité.

SIGGIL : la Vision, le Protocole et les Résultats

Un Dispositif Inspiré par le Khalife et Elaboré Selon un Protocole Adapté

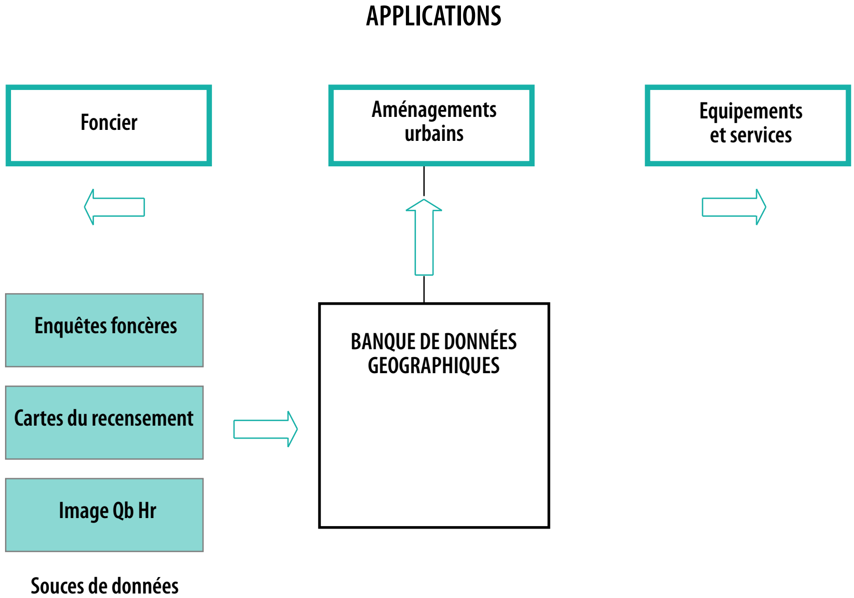
C'est la décision du khalife d'engager un grand programme de lotissement dépassant les limites de la ville de Touba qui a certainement donné le signal de départ d'une réflexion sur les problèmes fonciers de la ville rendus très difficiles par la demande nombreuse et multiforme de la part des populations.

Le point de départ de l'élaboration du Système SIGGIL est la décision prise par Serigne Saliou Mbacké, Maitre d'ouvrage, d'en confier la réalisation à un Comité de pilotage et un comité technique chargé de la conception d'un protocole et de sa réalisation. Le comité technique a travaillé sur la base des orientations et directives du marabout en identifiant des compétences au niveau national et international.

Les Objectifs du Système

L'objectif du projet était avant tout de faire l'état de la situation foncière pour apporter les correctifs nécessaires avant d'entreprendre les grands programmes de modernisation de la ville. Il s'agissait aussi, dans un premier temps de redonner de manière uniforme et systématique des titres de propriété aux personnes qui ont des maisons à Touba et de sécuriser ainsi la propriété tout en régularisant les transactions foncières.

Figure 2: Schéma global du système



Le système d'information qui serait mis en place permettant de faciliter ces processus tout en dotant la ville d'un outil moderne d'aide à la décision en matière de gestion urbaine.

Le Protocole qui a été mis en Œuvre :

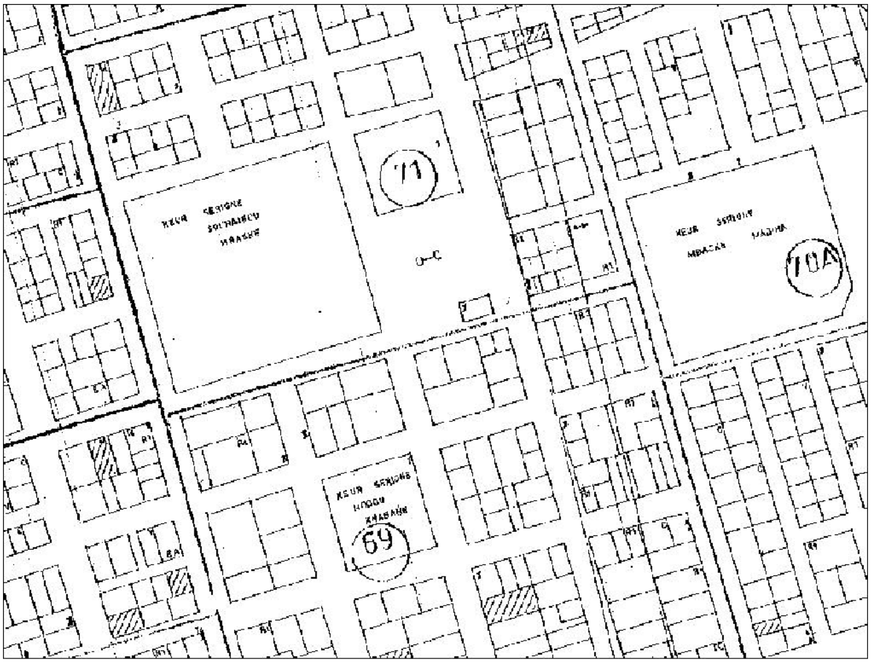
Les Enquêtes

Les enquêtes ont été réalisées sur la base d'un questionnaire élaboré par le comité technique. Elles ont concernées tous les quartiers de Touba sans exception. La centaine d'enquêteurs et leurs superviseurs ont travaillé pendant trois mois pour couvrir la ville. Cette phase a été suivie par la saisie des données.

La Cartographie

Elle a été la phase la plus longue et la plus difficile étant donné l'insuffisance des données cartographiques et leur caractère disparate.

Figure 2: Extrait des cartes de rencensement



Les plans de la DPS complétés par ceux des services régionaux du cadastre et de l'urbanisme, et d'autres plans retrouvés çà et là ont constitué les premiers supports du travail d'enquêtes. Ils ont été mis à jour pendant plusieurs semaines par une équipe de cartographes. Enfin, l'imagerie satellitaire QUICKBIRD de résolution 0,60 cm, a permis de réaliser des fonds cartographiques d'une qualité exceptionnelle avec l'expertise du Centre de Suivi Ecologique.

Figure 2: Extrait de l'image QuickBird utlisée

L'Interface Systémique

Le croisement des données cartographiques et statistique par un logiciel spécialement conçu par une compagnie américaine, la Scientific Technologies Corporation, (STC), une société de référence aux USA a permis de mettre en place un système de gestion fonctionnel qui constitue un outil incontournable d'aide à la décision dans tous les domaines qui concernent la ville.

Les Résultats

Les résultats du projet concernent plusieurs secteurs d'application dans le domaine de la gestion urbaine, dont principalement :

- la gestion du patrimoine foncier de la ville,
- la planification de la croissance urbaine,
- la gestion des infrastructures et équipements
- l'aide à la décision

Une base de Données Géographiques

Cette banque de données comprend des couches d'informations sur le parcellaire, la voirie, les infrastructures et les équipements socio-économiques.

Une Base de Données Foncières

Issue de l'enquête exhaustive réalisée durant l'année 2004, cette base contient les données sur la parcelle, notamment les noms des propriétaires, le mode et l'historique de l'acquisition, l'état de la parcelle et l'usage des parcelles, etc.

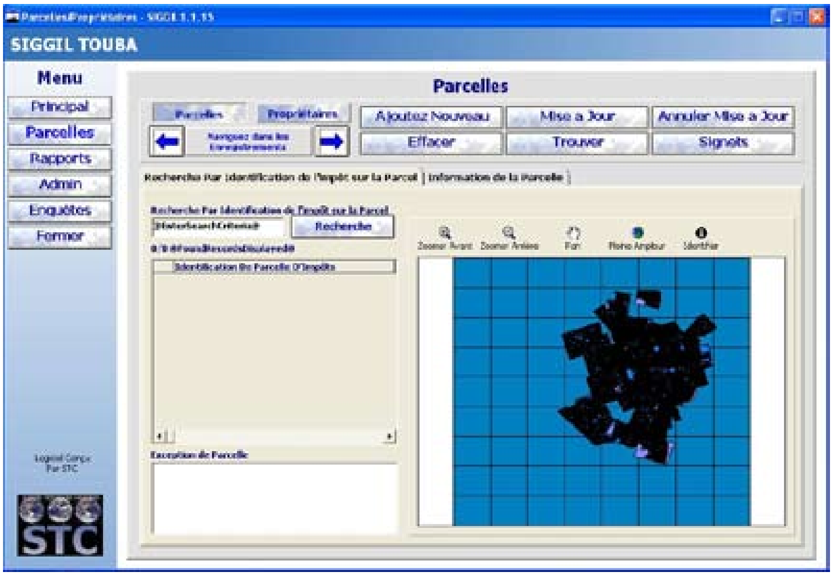
Mise au Point d'une Application Informatique

Pour atteindre le premier objectif assigné par le Khalife qui est la maîtrise de l'assiette foncière de la ville, une première application dénommée **Système d'Information Géographique pour la Gestion foncière** a été développée par le comité technique avec l'appui technique de STC.

Cet outil qui sert déjà r à la mise en œuvre de la nouvelle politique d'attribution des parcelles à Touba permet :

- la gestion informatisée des procédures de délivrance de permis d'occuper,
- le suivi du recouvrement des redevances
- le suivi des transactions foncières
- la gestion des réserves et des espaces publics

Figure 3 : Interace du système



La base de données qui la supporte comporte les informations relatives aux parcelles, leur localisation et leurs propriétaires. Chaque parcelle est identifiée par un numéro unique et une adresse physique qui peuvent être, par la suite utilisées par les différents usagers notamment la poste, la SENELEC ou la SONATEL etc. Les numéros simplifiées sont d'ores et déjà inscrits sur des plaques déjà en cours de pose sur les maisons de Touba. Des machines de fabrication de plaques ont été acquises dans ce sens par le khalife.

Un certain nombre supports peuvent être produits en fonction des besoins exprimées par des acteurs dans la gestion de la ville dans les domaine de la sécurité, de l'hydraulique, de la santé et de la gestion des évènements comme le Magal annuel, etc. Cette modularité garantissant la souplesse d'utilisation et la facilité de maintenance pour accompagner la croissance de la ville et des besoins en matière d'aide à la décision.

Perspectives

Avec le déploiement du SIGGIL, la ville se dote d'un nouveau mode de gestion. Les applications déjà développées en plus du système de gestion foncière sont nombreuses couvrent plusieurs domaines :

- **Mise en place d'un programme d'investissement et de développement durable de la cité**

  Le système permet désormais de collecter des redevances pour mobiliser les ressources nécessaires au financement des projets de développement sur une base transparente et durable. Des secteurs prioritaires comme l'assainissement, l'hydraulique, les voies de communication pourront être financées sur une base plus large et prévisible de collecte des contributions citoyennes.

- **L'adressage**

  Toutes les rues et parcelles ont été identifiées et un système d'adressage mis en place

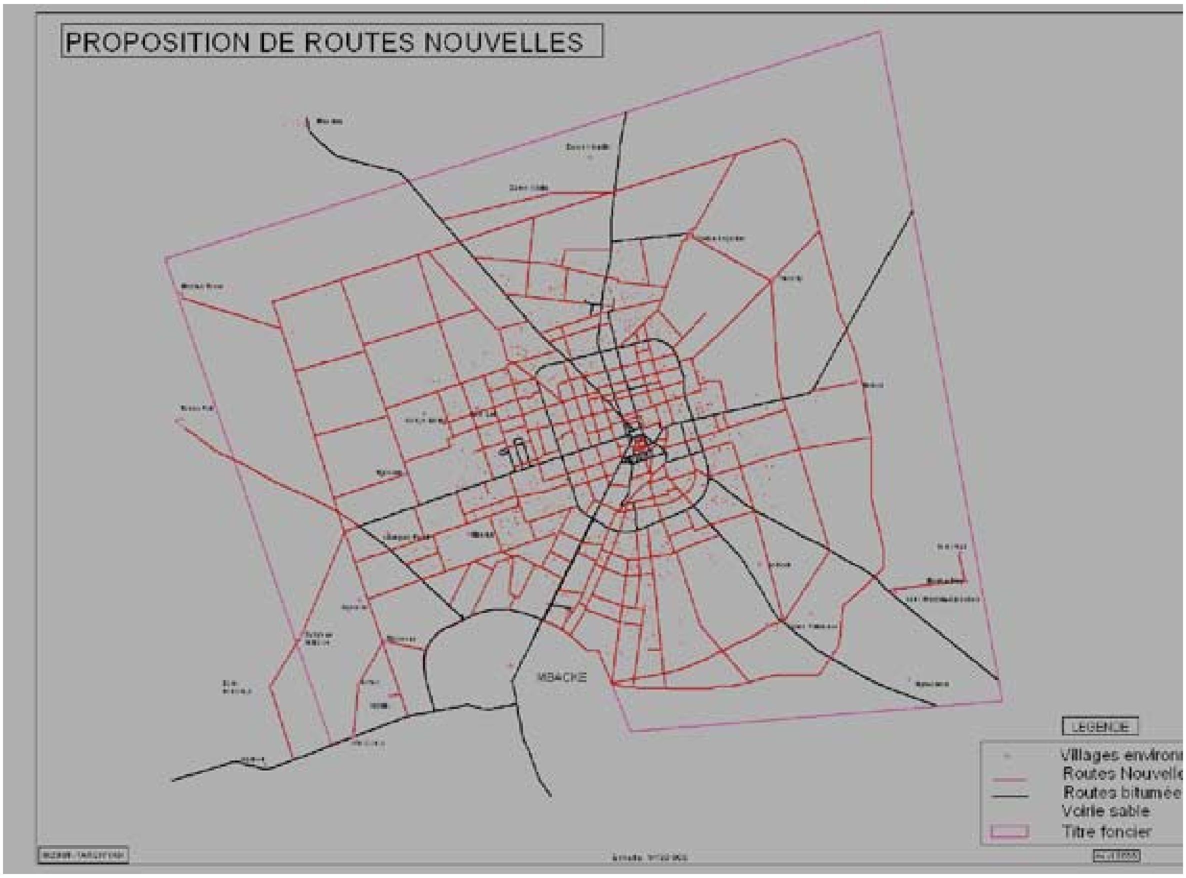
- **La planification de l'Occupation du Sol**

  Le système est un outil puissant de planification participative qui permettra de définir sur la base d'analyse spatiale et de visualisation, les besoins en infrastructures et d'orienter le choix d'implantation.

- **Elaborer et mettre en œuvre un plan de circulation de la ville**

  Le programme de construction de route qui a commencé en 2006 a été facilité par le système d'information.

Figure 3 : Proposition de 200 Km routes à bitumen



Pour anticiper sur les problèmes de circulation qui se posent déjà dans la ville notamment à l'occasion des grands rassemblements, le système permet des plans alternatifs de circulation. Avec les possibilités qu'offrent les NTIC, il peut être mis en place un système d'information et de guidance des usagers de la route notamment pour les services de sapeurs pompiers, les ambulances etc.

Conclusion et Leçons Apprises

La première montre comment l'initiative privée peut être un grand levier de développement pour l'intégration des nouvelles technologies dans les processus de gestion foncière dans un contexte traditionnel.

Elle montre aussi que, contrairement à une idée assez répandue, l'investissement dans des données de très haute résolution (souvent très chères) est très rentable et se justifie amplement, pourvu que la vision qui la sous-tend soit orientée vers des objectifs très claires.. Pour Touba par exemple, un investissement privé de 200 000 000 Francs CFA, le potentiel de retour sur investissement plus de 4 milliards de franc CFA. Ce qui permet la durabilité du système à travers son autonomie de financement.

Au total, le projet de mise en place d'un Système d'information sur le patrimoine foncier, est un exemple qui peut intéresser l'ensemble des collectivités chargé de gérer ou d'administrer d'organisation spatiale (municipalité, communautés rurales régions). Il met en évidence l'intérêt d'investir dans les nouvelles technologies pour prendre en charge le développement des citées.

Land Management Information Systems in the Knowledge Economy: What Options are there for Kenya?

By David N. Siriba and Hussein O. Farah

Abstract

What constitutes a good land administration and management system is the central question that this study hinges on. Kenya's land administration and management is presented and evaluated on the basis of a conceptualized evaluation framework for land administration systems. From the evaluation, the study shows that Kenya's land administration is faced with a host of challenges including systematic breakdown in management, over-centralization, lack of participation by communities, high costs, unnecessary delays and corruption and let alone being least understood. The study concludes by suggesting a range of solution alternatives to manage the spatial data associated with the maintenance of multi-purpose cadastral information in digital and internet-enabled environment in line with the government's e-government strategy. Some of these suggestions include: adopting satellite navigation systems (e.g., GPS) for cadastral surveys in establishing a single and uniform network of ground control points of adequate density, placing of fixed boundaries, fixation of general boundaries, fixation of the adjudication surveys and for fixation of group ranches; to consider employing orthoimagery maps instead of line maps and to consider using geodatabases instead of CAD files.

Keywords: Land Administration, Spatial Data Infrastructure (SDI), Evaluation, Land Management Information Systems (LMIS), Cadastral Systems

Introduction

Current and reliable land information is necessary for many applications such as land planning, infrastructure development and maintenance, environmental protection and resource management, emergence services, social service programmes and so forth. To exploit the potential in land information, several strategies have been used to ensure that land information is well managed, and the strategies have evolved from mere computerization of cadastral records through computerized land information systems (LIS) to the current e-government and Spatial Data Infrastructure (SDI) initiatives, which are expected to enhance efficiency in land registration and transfer. While SDI plays a much broader role than supporting land administration, land administration could be considered a key driver in SDI evolution. When implementing a land administration management strategy, it is important to consider the social-economic realities of the jurisdiction, if the strategies are to fulfill their objectives.

It has been observed that the transaction time, costs and even corruption have been high in the current land administration process in Kenya and this is mainly due to such systems being out of date, expensive to maintain, inefficient or largely ineffective in practice and irrelevant to modern conditions and requirements. The introduction of computerized land information systems is generally accepted as the most appropriate technology in the reformation of the cadastral system. Although the introduction of LIS will not automatically induce development, it is part of the institutional development that must be combined with other resources such as planning controls to give high quality results. Towards realizing this, the provision of online databases for cadastral information by governments is seen as the ultimate reformation of a cadastral system within the framework of the Spatial Data Infrastructure, one of the technological infrastructures necessary in the realization of the e-government strategies.

This paper reviews what a good land administration and management system should constitute by reiterating the importance of land information. The current land administration and management systems in Kenya are discussed and evaluated against a conceptualized evaluation framework. The paper further discusses Kenya's experience so far with regard to the incorporation of land information as an essential component in the implementation of Spatial Data Infrastructures, and concludes by presenting a number of solution alternatives for managing spatial data and information associated with the maintenance of multi-purpose cadastre in digital and internet enabled environment.

The Need to Manage Land Information

Cadastral data are defined as the geographic extent of the past, current, and future rights and interests in real property including the land information necessary to describe that geographic extent. Rights and interests are the benefits or enjoyment in real property that can be conveyed, transferred, or otherwise allocated to another for economic remuneration (Stephen 1997). Rights and interests are recorded in land record documents. The land information necessary to describe rights and interests includes surveys and legal description frameworks such as parcel-by-parcel surveys and descriptions. Land information forms the foundation of almost all other geospatial data and is used by most departments of the government and the geospatial industry and provides support for a wide range of applications such as land planning, infrastructure development and maintenance, environmental protection and resource management, emergence services, social service programmes. The development of land information is taxing to all nations, particularly straining the capacity of developing nations. It is important, therefore, that national information management infrastructure is developed as efficiently as possible, to serve both the tactical and strategic needs (WCMC 1996).

Though land information in Kenya is produced by both government and private surveyors, it maintenance lies with the government and there are four main arguments for retaining government control over the functions of cadastral surveying and land registration. These are: systematic and accurate records of boundary definition and ownership of land are of general public interest; government guarantee of indefeasibility of title (but not boundaries) to private land; the need for systematic and accurate recording for land taxation purposes as a source of important state revenue; and, government needs to protect and administer public land to ensure against encroachment.

What Constitutes a Good Land Administration and Management

The relationship between humankind and land is dynamic and the chief reason why this is so, is because the relationship is embedded in a society's culture, which is itself dynamic. A society's culture is very dynamic particularly nowadays because of the need for sustainable development, globalization, economic reform and information and technology, which together are referred to as the global drivers for change (Ting and Williamson 2001).

A society's humankind/land relationship perception is captured by the kind of land administration system employed, and is different from one part of the world to the next. Therefore, to define what a good land administration and management for the entire world should constitute, is only an interesting academic exercise, which however is not practical given the diversity in cultural, social, economic and environmental realities. Steudler, Rajabifard and Williamson (2004) developed an evaluation framework for land administration systems based on a conceptualized land administration system. A conceptualized land administration system, which forms the basis for implementing an operational one, is developed using the input from the existing land administration system and the global drivers for change.

The framework is developed based on a number of principles espoused by Williamson (2001) as "best practice" for re-engineering land administration systems, which then are considered as the major components of land administration toolbox. The toolbox principles address the key aspects of a land administration system, which include: land policy (e.g., existence of a national land policy); land tenure (e.g., recognition of indigenous and informal tenures, recognition of appropriate land tenure principles); land administration and cadastre (the cadastral concept, national land management information system); institutional arrangement (government, ministerial and department structures, decentralization, professional organization)s, Spatial Data Infrastructure (SDI) (e.g., role of SDI in supporting land administration); technical, human resource development and capacity building (e.g., user friendly solutions, level of computerization). The toolbox principles are meant to ensure that the juridical, fiscal, regulatory and information management functions of a land administration system are achieved.

Land Administration and Management in Kenya

The following table presents Kenya's land administration and management using the cadastral template format.

EVALUATION OF LAND ADMINISTRATION AND MANAGEMENT IN KENYA	
A. Country Context	Kenya
Geographical Context:	Kenya is located in the Eastern part of the African continent lying between latitudes 5° North and 5° South and between longitudes 34° and 42° East, with a total land area of about 582,650 square kilometres of which about 569,250 square kilometres constitutes dry land while water takes the rest of about 13,400 square kilometres. Approximately 80% of the land area is arid or semi-arid, and only 20% is arable. It is almost bisected by the equator, and shares borders with Ethiopia and Sudan to the North; Uganda to the West; Tanzania to the South; Somalia to the North East; and the Indian Ocean, the natural boundary to the South Eastern side. The coastline is about 536 kilometres. Topographically, the country has diverse physical features, which are a major source of tourist attraction. These include: vast plains which are home to the world's famous game parks and reserves; the Great Rift Valley, which runs north to south; Mount Kenya, the second highest mountain in Africa rising to about 5,199m above sea level; Lake Victoria, the largest freshwater lake on the continent; Lake Nakuru, a major tourist attraction because of its flamingos; Lake Magadi, famous for its soda ash; and a number of rivers, including Tana, Athi, Yala, Nzoia and Mara. Most parts of the country experience an equatorial kind of climate especially the central highlands, whereas along the coastline it is mainly tropical. Rainfall and temperatures are influenced by altitude and proximity to the lakes or the ocean. There are four seasons in a year: a dry period from January to March, the long rainy season from March to May, followed by a long dry spell from May to October, and then the short rains between October and December. Kenya's projected current population is 30.4 million and the current annual growth rate is 2.9 percent; the country has a relatively youthful population with 48% of the population under 15 years of age and only 2.79% over 65 years (GoK 2001). This has resulted in high dependence ratios placing high demands on social services such as primary education and health care. The country's population is characterized by high mortality rates, low and declining life expectancy, slightly increased fertility rates (from 4.7 children per woman between 1995 and 1998 to 4.8 between 2000 and 2003), high infant mortality and death rates and declining population growth rates which could be attributed to the HIV/AIDS pandemic. All these reflect the enormous challenges to be expected in achieving the Millennium Development Goals (MDGs). Despite rapid urbanization, Kenya is still mainly a rural society with around 80% of the population living in rural areas. Regional population densities vary enormously with almost 75% of the population occupying approximately 20% of the country considered high or medium potential.
Historical Context and Current Political and Administrative Structures:	In 1963, Kenya attained its independence from British colonial rule and became a republic in 1964. In accordance with the doctrine of separation of powers, the government is divided into three organs: the Executive, the Legislature and the Judiciary. Each organ is responsible for a different function of the government. The legislative branch is responsible for making laws that are implemented by the executive and interpreted by the judiciary branch. The real power is held by the elected government, based on a unicameral parliament with 210 elected and 12 nominated Members of Parliament (MP). The country has 210 Constituencies and the political parties based on their representation in parliament nominate the extra 12 MPs. The country is currently governed through a democratically elected central government, for a five-year term after which it is required to seek a fresh mandate through an election. For administration purposes, the country is divided into eight provinces namely: Central, Coast, Eastern, Nairobi, North Eastern, Nyanza, Rift Valley and Western. These provinces are further sub-divided into districts and divisions. Over time, the country has experienced a proliferation of political parties with more than ten registered ones. The main one is the currently ruling (coalition) party NARC, and KANU, which is the main opposition party. In addition, there have also been a growing number of political pressure groups in the areas of human rights, labour unions, and religious groups, non-governmental organizations (NGOs) and international organizations among others. There is no doubt that there has been a significant opening of democratic space in the country over the years. The challenge however is to translate this space into a positive environment that would contribute to human development.

EVALUATION OF LAND ADMINISTRATION AND MANAGEMENT IN KENYA	
Historical Outline of Cadastral System:	Cadastral surveying was first introduced in Kenya when a survey section was established and a chief surveyor appointed in 1903 to superintend the demarcation and survey of plots that had been alienated in Nairobi (Njuki, 2001). Over the years, cadastral surveying in Kenya has undergone changes due to various programmes that were initiated. Prior to the World War II, cadastral surveying for the Land Adjudication programme at the Coast and the European settlement on the "white highlands", was concerned with alienating crown land to white community, under the provisions of the Survey Ordinance of 1923, and under the Registration of Titles Act (RTA). The surveys were of very high standards, described land unambiguously and resulted in few boundary disputes; other forms of surveys, which were slow, expensive and low accuracy, were done under the provisions of the Land Titles Ordinance. After the Second World War, the cadastral surveys were carried out to support the various land reforms that had been initiated. The Land consolidation programme, which involved the adjudication and fragment gathering of small plot sizes, was done for some time and for some areas, referred to as consolidation areas. The survey for this programme was done to ascertain the sizes of individual fragments and the general size of the adjudication section and to demarcate the replanned plots and to produce the demarcation maps and the Registry Index Maps (RIM). The Land Consolidation programme was replaced by the Land Adjudication programme and is still going on and the areas where this was implemented are referred to as enclosure areas. Cadastral surveys in enclosure areas were carried out to map the property boundaries in the adjudication section and to prepare the Preliminary Index Maps (PIDs). These surveys involved the identification of boundaries on unrectified aerial photographs. The Rangelands, where group ownership was preferred to individual ownership were inhabited by nomadic pastoral communities, were registered in the name of the group representative on behalf of the rest of the group members under the provisions of the Land (Group Representatives) Act Cap 278. Surveys in Rangelands involve the identification of group ranch boundaries on 1:50,000 topographic sheets and simple ground surveys to map the missing boundaries. After independence, the major land reform was to convert communal land tenure in trust land into individual ownership through adjudication, to transfer land from the white settlers to native Africans through Land Settlement programmes and cooperative societies and to transfer land from group or company ownership to individual ownership. In the group ranches, surveys are carried out under the provisions of the Survey Act Cap 299, while in all settlement areas, apart from one, surveys involved the demarcation and survey of plots by ground survey methods. Currently, however, the majority of cadastral surveys are done for the purposes of first registration; change of lease; and conveyancing, using either fixed boundaries or general boundaries. The surveys are registered under the provisions of the Registered Land Act (RLA) or the Registration of Titles Act. Kenya maintains a centralized land administration office in Nairobi with some functions decentralized to the Districts. Land administration is a government responsibility performed under the Ministry of Lands and Settlement. Kenya practices a juridical cadastre supporting the registration of land for legal ownership, registering the rights, restrictions and responsibilities pertaining to land through precise surveying methods regulated by government licensing. Though initially intended to support land registration, the cadastre currently supports more applications than originally purposed. These include facilitating: in a legal capacity, the registration of ownership of land; in a fiscal capacity, valuation of land sales and taxation; and more widely, in multipurpose functions in land management and planning for local government, emergency response, environmental risk assessment, and business planning.

EVALUATION OF LAND ADMINISTRATION AND MANAGEMENT IN KENYA	
B. Institutional Framework	
Government Organizations:	The agencies responsible for land registration and cadastral surveying fall under the Ministry of Lands and Settlement. They include the Department of Lands; the Department of Surveys, the Department of Land Adjudication and Settlement and the Department of Physical Planning respectively headed by the Commissioner of Lands and the Director of Surveys and Director of Adjudication and Settlement and Director of Physical Planning. The Department of Surveys' headquarters is located in Nairobi and there are 57 District Survey offices. The headquarters is responsible for coordination of official surveying and coming up with strategies, while the District Survey offices are essentially the implementation of the legislation at the District level, and verification. In total there are about 102 Government Surveyors in the department. The Department of Surveys has six branches namely Administration, Geodetic and Computer Services, Cadastral, Mapping, Adjudication, Hydrographic (new) and the Kenya Institute of Surveying and Mapping (KISM). The cadastral branch and the adjudication branch are the two braches in SK exclusively charged with the responsibility of managing cadastral information within the republic. Whereas the cadastral branch manages cadastral information related to fixed and general boundaries, the adjudication branch manages cadastral information related to general boundaries only. The cadastral branch maintains a systematic arrangement of the inventory of all surveyed land parcels within the republic. The inventory is based on the survey of parcel boundary information and the designation of a unique parcel identifier represented on a large-scale map. It is also the responsibility of cadastral branch to ensure that the integrity and the quality of the cadastral information are maintained. The functions of the cadastral branch are performed through its various sections namely: Registry, Survey Records Office (SRO), Deed Plan checking and drawing office, Preliminary checking, Final Checking, authentication Office and the Senior Assistant Director Office for cadastral.
Private Sector Involvement:	Holders of the license for cadastral surveyors are entitled to carry out official cadastral surveys throughout Kenya and to use the professional designation 'licensed surveyor'. The licensing of the cadastral surveying professionals in the country is undertaken by the Land Surveyors Board, which comprises of the Director of Surveys as the chairman, 7 licensed surveyors employed in the public service, 4 licensed surveyors from private practice, a secretary and examiners. Some of the requirements that an individual must fulfill in order to be licensed as a licensed surveyor include: Full membership with the Institution of Surveyors of Kenya (ISK); passing the Land Law Examinations and undertaking required practical survey jobs.
Professional Organization or Association:	Professional land surveyors have to register with the Institution of Surveyors of Kenya (ISK), registered under the Societies Act of Kenya. The cadastral surveying professionals are registered under the Land Surveyors Chapter (LSC) of ISK, other chapters being Valuation and Estate Management Surveyors, Building Surveyors and Land Management Surveyors. There are now over sixty licensed surveyors practicing in Kenya (ISK 2003).
Education:	The Department of Geospatial and Space Technology (formerly, Surveying) at the University of Nairobi has been the only institution offering a degree course in cadastral surveying to students from Kenya and the neighbourhood since mid 1960s, until the establishment of the Department of Surveying at the Kenya Polytechnic, to offer diploma and Higher National diploma in the discipline. Other institutions that offer courses and training in cadastral surveying include the Kenya Institute of Surveying and mapping (KISM) established in 1994, and Dept. of Geomatic Engineering and Geospatial Information Systems (GEGIS) at Jomo Kenyatta University of Agriculture and Technology launched in 2001. The degree course offered at the University of Nairobi has included in its new curriculum more course units on land and infrastructure management like land registration, land information systems and land tenure systems. There is now an average of 50 students graduating with degrees and about 50 with Diplomas every year from these institutions.

EVALUATION OF LAND ADMINISTRATION AND MANAGEMENT IN KENYA	
C. Cadastral System	
Purpose of Cadastral System:	In Kenya, cadastral surveys are carried out to support registration of interests in land and they usually result in the preparation of land registration documents and they conform to different requirements depending on the registration legislation in place. Although meant to facilitate land registration, the cadastral information is now used for multiple purposes like valuation, taxation, physical planning, acquisition and delivery of land, infrastructure development, population studies etc.
Types of Cadastral Systems:	Cadastral surveys in Kenya are carried out in urban and rural areas; however, most cadastral activities are done in the urban areas. In either case the surveys and parcel registrations are largely sporadic. Cadastral surveys are carried out in conformity with the Survey Act Cap 299 and according to the regulations contained in the Survey Manual. Most cadastral surveys in urban areas are carried out on the basis of approved Town Planning layouts and registered under RTA, supported by fixed boundary surveys. Cadastral surveys in the rural areas are carried out and registered under the RLA supported by general boundaries surveys.
Cadastral Concept:	The main elements of the cadastral system in Kenya are the cadastral parcel (an ambiguously defined unit of land within which tenure interests are defined), the cadastral record (e.g., survey plans) and the parcel number. The majority of the cadastral surveys are undertaken for the purposes of first registration, change of user, subdivision and conveyancing. Approximately 3,127,862 titles had been registered by 2000 (MLS 2001).
Content of Cadastral System:	The cadastral system in Kenya is based on two principal pillars: the Land Register and the legal surveying. The land register (cadastre) contains detailed description (who and how) of the parcels either in the form of Registry Index Maps under the Registered Land Act or Deed Plans under the Registration of Titles Act. The land records are maintained by the Commissioner of Lands, in addition to a land register at each of the District land registries. The records include mainly the register of each parcel of land and a register for each lease that is required to be registered under RLA. Legal surveying on the other hand concerns the survey plans and description of the territory (where and extent). There is a 2/3 national coverage of control points (about 650, 721, 1391 and 3068 first, second, third and fourth order points respectively; though about 80% are destroyed) (Rotich, 2006). The RIMs and Deed plans are the end product of cadastral surveys, and together with the corresponding field notes, computations and survey plans constitute records which are managed as a land information resource by the Director of Surveys. There is an archive of the legal survey measurements and the cadastre is updated daily. The Registry Index Map (RIM) and the survey plans are not yet computerized.
D. Cadastral Mapping	
Cadastral Map:	The main item that supports land registration is the cadastral map, which is based on the type of land registration system being practiced. Under the Registration of Titles Act (RTA), land registration is supported by field survey records (field notes, computations and survey plan), together with a deed plan, prepared by the Director of Surveys; while under the Registered Land Act (RLA), land registration is supported by a general boundary survey with the corresponding amendment of the Registry Index Map (RIM). The Deed plan contains the district, the locality, the meridional district, the scale of the plan, the land reference number (L. R. Number), Deed plan Number; I Area of land; geometric measurements and the parcel edged in red together with details of adjoining parcels.; the Date and Signature of the director of Surveys.
Example of a Cadastral Map:	The cadastral map includes survey plans, deed plan, RIMs.
Role of Cadastral Layer in SDI:	The establishment of the National Spatial Data Infrastructure (NSDI) is included in the National Development Plan (2002 - 2008) as one of the measures of enhancing proper management, development and productivity of the land resource in Kenya (GoK 2002). Though having not been implemented, cadastral information is one of the ten datasets recommended for adoption as framework datasets (Owino 2006) in the NSDI and also regarded as being fundamental for most public and private activities in the world and therefore fundamental for any NSDI development (Osundwa et al. 2005). Though not being used within the framework of NSDI, cadastral information is being used for resource management; the raising of rates and taxes.

EVALUATION OF LAND ADMINISTRATION AND MANAGEMENT IN KENYA	
E. Reform Issues	
Cadastral Issues:	The Kenyan Cadastre has some deficiencies: Firstly, The different forms of cadastral surveys result in the preparation of certain registration documents namely the deed plans, Registry Index Maps and Interim Registry Index Maps. The deed plans, which result from very accurate surveys and provide the highest security of tenure and boundary disputes are resolved by a mathematical reestablishment of the original boundary and are only applicable to some urban areas. For RIM and the Interim RIM the boundaries are not accurate and result in many boundary disputes. The interim RIM are particularly inaccurate and therefore do not allow for adequate integration with other spatial information, discrepancies exceeding 50% in parcel areas are detected compared to those from more accurate survey. This technical challenge has to be overcome first if the value of the cadastre is to be exploited by computerization. Secondly, there are multiple reference systems in use. In fact, there are at least four map projection systems upon which coordinates are declared in different parts of the country, which pose the challenge of spatial integration Thirdly, the fact that Kenya supports two registration systems, i.e., fixed boundary and general boundary system. It is also noted that procedure for land registration is extremely time consuming, for example, no subdivision can take place legally until permission is obtained from all the relevant authorities. Again the procedure is complicated by the long approval requirements, some of which are not necessary As a consequence of the above deficiencies, a seamless digital cadastral coverage of all land parcels and administrative boundaries does not exist in Kenya.
Current Initiatives:	The establishment of the land management information systems is one of other measure proposed in the current national development plan (2002 – 2008) (GoK 2002) for the better management, development and productivity of the land resource. The other reform issues in the cadastral system are addressed in first ever national land policy (draft) launched recently (Standard 2006). The issues include the land as a constitutional issue, land reform issues, land tenure issues, land use management issues, land administration issues and the land issues requiring special attention, for example, historical injustices, coastal region land issues, the land rights of the minority and marginalized, the land rights of the vulnerable groups and the land rights of women.

Evaluation of Land Administration in Kenya

Evaluating or measuring the performance of a process or a system is a basic prerequisite for improving productivity, efficiency, and performance, because if you cannot measure it, you cannot manage it (Steudler et al. 2004). Though there is no standardized method for evaluation, using the toolbox principles outlined in section 3 above together with toolbox indicators presented by Steudler, land administration and management in Kenya as generally presented in section 4 above evaluate. The following section presents an evaluation of land administration in Kenya.

Policy Level

Land Policy

i) A codified national land policy doesn't exist though there are very many laws which are incompatible. The draft national policy formulated by the Ministry of Lands and Settlement, which has been unveiled and will be presented to the cabinet for approval before being tabled in Parliament for debate.
ii) District Land Boards exist, the establishment of National Land Commission, the District Land Boards, and Community Land Boards are proposed in the draft policy.
iii) Land Administration System role statements:
   - Alienation of Government and trust land
   - Control of land use and development
   - Preparation and issuance of titles and registration of land transactions and other legal documents
   - Generation and collection of revenue
   - Custody and maintenance of land records
   - Provision of advisory and technical services on land matters
   - Reservation of fragile eco-systems, historical monument sites and national parks, beaches, marine reserves, wetlands and water catchment areas for purposes of conservation
   - Resolution of boundary and land disputes
   - Valuation for purposes of land allocation, acquisitions by government for public purposes, e.g., roads schools hospitals etc., rent apportionment and rating purposes
   - Ascertainment of existing land rights of individuals and groups
   - Identification and acquisition of suitable land for settlement
   - Collection of government revenue
   - Provision of basic infrastructure
   - Arbitration of land disputes
   - Regularization of squatters and administration of group ranches
   - Formulation of national, regional and local physical development policies, guidelines and strategies
   - Preparation of all regional and local physical development plans
   - Checking and verification of all surveys carried out for registration and other purposes
   - Preparation and maintenance of maps and plans for various uses
   - Maintenance of boundaries

Land Tenure Principles

i) The land tenure regimes are fragmented, complex and pluralistic
ii) There is insecure tenure for the urban poor and arbitrary evictions
iii) There is incongruence between the law and the social reality

iv) There is lack of harmony between statutory and customary laws
v) There is marginalization of women and children
vi) Complex and protracted mechanisms for dispute settlement and lack of effective and expedition systems of dispute resolution
vii) Inherent corruption in dispute resolutions, which are themselves many and are based on alien laws and practices

Economic and Financial Factors

i) There is inequitable land distribution
ii) Inadequate funding and poor financial resource allocation criteria for various activities

Management Level

Cadastral and Land Administration Principles

i) There is inefficient operation of the land markets
ii) Unclear arrangements for urban land delivery
iii) The procedures are expensive/high cost
iv) Poor land information systems

Institutional Principles

i) Multiple institutions handling land administration and management
ii) There is a highly centralized organizational structure
iii) Many poorly performing agencies dealing with land administration and management
iv) Inadequate stakeholder involvement in decision regarding land administration and management particularly at the local level.

SDI Principles

i) In the on-going SDI development efforts, the Standards Working Group is responsible for the development of framework data and development of standards of geospatial data.
ii) So far, the development of Cadastral Data Model exists only at a conceptual level
iii) Pricing of data products and services developed by SoK
iv) Dissemination Working Group under the SDI secretariat is responsible for development of the clearinghouse

Operational Level

Technical Principles

i) Data capture methods, quality and accuracy requirements for cadastral surveys are provided for in the survey Act, which however is limiting on the adoption of new technologies and methods in the survey manual.
ii) Cadastral and land records are dynamic and it takes sometime to update the records.

External Factors

Human Resources

i) The professional association responsible for land administration and management is the institution of Surveyors of Kenya (ISK) with a membership of about 1000.

Capacity Building

i) In Kenya there are two universities offering degrees in cadastral surveying: the University of Nairobi and Jomo Kenyatta University of Agriculture and Technology. An average of 50 students graduate every year; the Kenya polytechnic (Department of Surveying) and Kenya Institute of Surveying and Mapping (KISM) offer diploma courses in cadastral surveying and a total of about 50 students graduate every year.
ii) The Government embarked on the formulation of national land policy since the launch of the National Land Policy Formulation Process (NLPFP) in February 2004 culminating in the unveiling of the draft land policy in October 2006.
iii) Progress on the Kenya National Spatial Data Infrastructure (KNSDI) was reported during the 5th workshop held in March 2006.

Research and Development

i) There is no national institute for land administration

Technology

i) The Survey Act tends to restrict the methods and systems of surveys; however it gives the Director of Surveys the power to approve any new and innovative methods.
ii) There is no regular review and assessment for fitness of new technologies on the market.
iii) Kenya has an e-government readiness index of 0.299, which is a combined index of web measure, telecommunications index and human capacity index, which are respectively 0.157, 0.021 and 0.72.

Review Process

Assessment of Performance

i) There is alack of reliable and evaluation procedures

Land Administration and Spatial Data Infrastructures

The future objectives of any land administration systems involve the development of communication and information technologies and applications to enhance the efficiency of land registration and transfer and support the wider roles that cadastral information plays in spatial data infrastructures (SDI).

The key fundamental layer underpinning land administration within the SDI model in any country is the parcel based cadastral layer. In most cases the cadastral layer provides the most distinctive, legally defined and unambiguous occupation and use of land on which to base a land information system. Data is linked to standard parcel identifiers in the cadastral layer thereby correlating information from each of the data sets through indexing to other parcel identifiers used by valuation, local government or utilities organizations, amongst others. Increasingly the focus in many countries is on the development of core spatial data sets that provide the basic infrastructure to support the use of spatial information across a broad range of areas. While these vary from country to country, most core spatial data sets organized in layers include: cadastre, topographic, imagery, elevation, transport network, geodetic network, administrative boundaries, property addressing, and geographic names.

It is expected that in Kenya the cadastre and the SDI will support electronic conveyancing activities, online delivery of vendor statements certificates, town, rural and urban planning and provide databases for activities in various authorities and public sector agencies, such as emergency response, and environmental risk assessment mapping.

Issues Involved in Land Information to Support Economic and Social Development and Good Governance

Kenya practices the English Land Titles Registration system in which only the proprietors and any persons authorized by them, in writing may inspect the register. To support economic and social development, good governance and transparency in the envisioned future land administration systems, policies on privacy, access, accountability and authentication issues must be developed. This is in addition to adopting international conventions and laws that apply to Information Technology related and cyber crimes.

Options Available for Kenya and Other Countries

Generally, the government is the biggest player in geospatial information, so it is appropriate that it reviews the role it currently plays and may want to play in the future; a partnership with other stakeholders is also important in ensuring effective and sustainable land administration and management. To afford overall and effective land administration and management, the first step is to ensure that the land issue is addressed as a constitutional issue by setting out the general principles of a functional and effective national land policy, which among others should include: equitable access to land, secure land ownership, effective regulation of land development, sustainable land use, access to land information, efficient land management, vibrant land markets and a transparent and democratic administration of land.

The national land policy should address among other things the reformation of the institutional structure for land administration (for instance, by decentralization), and other land administration issues like land survey and mapping, land adjudication procedures and processes, land rights delivery, land delineation, the land market, resolution of disputes and the land management information systems. In order to disseminate land information and encourage sharing, the information should be available via the National Spatial Data Infrastructure (SDI) in a format that is easily understood. Since land information is a fundamental framework data in a SDI, a digital and seamless cadastral coverage of all land parcels and administrative boundaries should be prepared. In Kenya however this is not the case because the use "general boundaries" surveys have resulted in inaccurate documents which will definitely pose a challenge in spatial integration. To overcome this, the following alternative solutions are suggested:

i) To adopt satellite navigation systems (GPS) for cadastral surveys in establishment one and uniform network of ground control points of adequate density, for placing of fixed boundaries, fixation of general boundaries, fixation of the adjudication surveys and for fixation of group ranches.
ii) To consider employing orthoimagery instead of line maps. Orthoimagery can be obtained by rectifying and mosaicing aerial photographs or by rectifying (and if necessary mosaicing) satellite imagery. Orthophoto technology offers new possibilities for economic solution for determining cadastral boundaries, but the adjudication of boundaries using orthophoto in the field is necessary. In areas where there may be large parcels, high resolution satellite imagery offers a quick and economic solution.
iii) To consider using geodatabases instead of CAD files. Geodatabases provide a uniform repository of both the geospatial data, and allows many users to edit the data simultaneously.

In conclusion, this paper has highlighted that land management is a necessary step toward sustainable development and that for proper Land Management a modern cadastre is required. The study has shown that the problems facing land administration and management in Kenya is largely due to a lack of a codified national land policy. This can only be achieved by instituting legal measures to maintain a modern cadastral system and to do away with methodoligally antiquated and overly restrictive accuracy specifications, techniques and procedures.. The technologies are there today to establish a cadastral system rapidly and inexpensively and they include the satellite navigation systems and the emergency of high resolution satellite imagery combined with modern database technology can be used as an intermediate step.

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The Role of the Office of the State Surveyor General in Operating the Land Use Act in Nigeria

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Abstract

The Land Use Act stemmed from the Land Use Decree promulgated in March 1978. This hailed revolutionary legislation made land and its resources available to every Nigerian and will play a major role in minimizing bottlenecks encountered in the acquisition of land by the various Arms of Government and its subsidiaries. At the State level the State's Surveyor General is fully involved and expected to implement its survey contents. Part of the Act provide for registration of rights to land (for various purposes) to be accompanied with a sketch / plan. The Surveyor General whose office should provide the necessary information for land registration, unfortunately was omitted and not given adequate recognition in its formulation. Surveyors Council of Nigeria (SURCON) in collaboration with the office of the Surveyor General of the Federation and the Federal Ministry of Housing and Urban Development is continuing in her efforts to extract the Act from the Constitution to make it available for easy amendment.

However, in Nigeria, State Surveyors General play the following roles in coordinating activities necessary for the data gathering in the successful implementation of the Land Use Act.

- Preparation, Interpretation and updating of base maps and master plans for all planning purposes
- Designation of urban and rural areas.
- Establishment of network of controls – primary, secondary and tertiary to facilitate demarcation of land parcels
- Establishment of a modern cadastre – from the controls a unique identification as to use of land is ensured for appropriate Purposes e.g. grant of rights, licenses, titles and compensations.
- Determination of land area limitation depending on the use or purpose – residential, industrial, commercial, agricultural is adhered to.
- Maintenance of survey beacons / land marks for which land is sought / granted
- Representation in the Land Use and Allocation Committee with adequate representations of its staff at the various committee / local levels – advisory.
- Identifying positions of social utilities – cables, underground pipes etc.
- Guard / advice against improper super imposition of coordinates on intelligence map sheets.

The office of the State Surveyor General is still faced with certain land management and administrative obstacles for effectiveness in its functions, especially in ICT procurement and compliance in our modernizing world of work.
This paper attempts, to adequately elaborate on these issues / points raised.

Introduction

Land, an indispensable and indestructible asset has many socio-economic benefits derived from it that touches on peoples lives. It is the basic natural resources of any nation from which economic resources are derived. Simpson(1996) sums up the importance of land to human beings when he observed that land is the source of all material wealth. From it we get everything of value that we use, whether it be food, clothing, fuel, shelter, metal or precious stones . We also live in the land and from land and to land, our bodies or our ashes are committed when we die. The availability of land is the key to human existence, hence its distribution and use are of importance. Although land can be held in modules by individuals, communities and States, the greatest advantage is realized when its administration is coordinated with a clear understanding of individual limits of stakeholders (NTDF, 2006). In earlier years in Nigeria (late 1800's), description of land with sketches or diagrams showing approximate chain length of boundary lines were used for registration of deeds on land. Later J.J. Hunter from Her Majesty's Land registry in 1928 changed the process. From then on, plans for land registration became registrable instruments after only being endorsed or signed by a surveyor, thus the term "given eyes" to the deeds which were previously regarded as completely "blind" register.

Since this basic natural resource cannot be renewed it must be well managed for the use and good of all. It is for this reason that different countries over the world have evolved different land tenure systems to protect various "interests" in land. In the recent past, the system of land tenure in Nigeria differed between the Northern and Southern states.

In the North, all lands were regarded as owned by the State. All lands were also regarded as "native lands" under the control and subject to the disposition of the Governor (see land and Native rights Act 1916). This Ordinance was repealed and replaced by the land Tenure Law 1962 with no major changes. This(Land Tenure Law) declared that all lands in each of the states in Northern Nigeria, whether occupied or unoccupied as native lands were placed under the control and were subject to the disposition of the Minister responsible for land matters, who held and administered them for the use and common benefit of the "natives", that is to say persons whose fathers were members of any tribe indigenous to each state in Northern Nigeria. All other persons who were not indigenous to each of such states were "non-natives". No title to the occupation and use of any such lands by a non native was valid without the Minister's consent. A certificate of occupancy would be issued in evidence of every grant of land.

The situation was different in the Southern States. Apart from a small proportion of land held as State lands, land had been held in the following ways:

i. As stool lands.
ii. As communal land
iii. As family land
iv. Chieftaincy land
v. Individual (privately owned land)

With time ownership of land became a great economic venture as speculators made it very difficult for other land users and even various governmental agencies to acquire land for developmental purposes.

In order to halt this process and see to it that the right of all Nigerians to the land of Nigeria be asserted and preserved by law and in order that the rights of all Nigerians to use and enjoy land in Nigeria, with the natural fruits thereof in sufficient quantity to enable them provide for the sustenance of themselves and their families to be assured protected and preserved, the Federal Military Government promulgated the land use Decree of 29th March, 1978.This hailed and revolutionary Decree which took effect from March, 29th 1978 altered the land tenure system in the country, especially in the Southern States. The decree abolished private and total ownership of land in the Southern States and existing government ownership of land in the Northern States.

The Land Use Act (Land Use Decree-military era) clearly nationalized all land in Nigeria through the combination of two approaches. First it vested all land in the State to Governors and abolished private ownership of it which was accomplished by making a right of occupancy (the largest interest capable of existing in land) in favour of a citizen and, or any private person. It provided explicitly that no greater interest than a right of occupancy can pass to any person or body under any existing instrument. Section 2 of the Act provides that any transaction entered into or instrument drawn up after the commencement of the Act whereby ownership of land is purported to be created in favour of any person is null and void for any matter pending at the commence of the Act, no court can grant or recognize in either of the parties any greater intense than a right of occupancy.

With the exception of land belonging to the Federal Government or its agencies at the commencement of the Act under sections 49 and 50, all other land comprised in the territory of each state including land already owned by the government, is declared under section 1 to be vested in the Governor of the State to be held in trust and administered for the use and common benefit of all Nigerians. Apart form vesting all land in the State (governor) the Act also laid out guidelines as to the formation of various bodies to be charged with the control and management of land both in urban and rural areas. The implementation committees have been the States Land Use and Allocation Committee for land in areas designated as urban and. the Land Allocation Advisory Committees for each Local Government for lands in rural areas. The committees advise the governor on management of urban and rural government land such as resettlement and payment of competitions With the introduction of the Act also land in urban areas came under the control and management of the State governor and those in the Local Government Area placed under the management and control of the Chairmen. The act made provision for 2 estate surveyors and a legal practitioner in the committee. Unfortunately the office of the State Surveyor General is not represented in this all important committee thus leaving off a surveyor who is suppose to be a chief implementer of the Act. The Surveyor's Council of Nigeria {SURCON} in collaboration with the office of the Surveyor General of the Federation and the Federal Ministry for Housing and Urban Development is continuing in her effort to extract the Act from the Constitution {Nigerian} to make it available for easy amendment.

Further collaboration by the Act states that, where land, being developed in an urban area is more than half hectare in extent, then the occupancy right over the land is automatically extinguished and transferred to the State. Furthermore, any occupancy right over land in non –urban area is also extinguished if at the commencement of the Act, the land was not being used for agricultural purposes or it is not developed. Most part of the country is under unpublished sheet and with the active involvement of the office of the State Surveyor General it would be impossible to enforce this aspect of the land use Act. The other provision of the Act relates to the designation of urban areas, statutory and customary rights of occupancy, issue and revocation of certificates of occupancy and sundry matters on land {Land Use Act, 1978.}.

Objective of the Act

The objectives of the Land Use Act can be summarized as follows.

i. to remove the controversies generated by land
ii. to simplify management and ownership of land
iii. to assist all citizens in owning land and
iv. to enable government to plan and zone land for particular uses e.g. to farmers, industrialists.,nomadic cattle rearers etc. It must be noted that the Act is unique and absolutely reconciliatory as it did not involve the confiscation of developed property nor set a time limit within which all title existing before its commencement must be converted to certificates of occupancy.

Objective / Purpose of the Paper

The overall objective of this paper focuses on the various functions of the State Surveyor General in the practical implementation of the survey contents of the Act. Specifically, the paper hopes to :

- Explain elaborately the acquisition of data and other survey information necessary for the successful implementation of the Act.
- Show clearly the generation of precise system of control points for cadastral survey and boundary monuments as an extension of the nation wide geodetic control network.
- Potray need to ensure that all land in the State are surveyed and connected unambiguously in a nationwide coordinate system.
- Ensure preparation of cadastral maps showing different land parcels and land use pattern.

The Role of the State Surveyor General

If all the land in the state is vested on the Governor for the general interest of all and the Survey office of the State Surveyor General of the State is responsible to the State Governor for all survey matters, it then devolves on the state Surveyor General to provide him (the State Governor) with all necessary information relating not only to the relative location of the land but the variety of physical features and attributes of all land that is vested in him. Without this basic information, administration of land in the State would be difficult and the impression would be created that the land use Act has failed.
In other word, for the effective implementation of the Land Use Act, the State Surveyor General must provide the Governors with

i. Full and accurate knowledge of the natural resources of all land in the State
ii. Information of all human relationships with the land in the State
iii. Make available large-scale maps showing existing interests in land there on

The paper hopes to discuss the above in detail as well as the other duties of the Surveyor General as provide in the Act enumerated in the already submitted extended abstract of my paper.

The Role of the Office of the Surveyor General in the Operation of the Land Use Act could be classified as follows:

1. Designation of Urban and Rural Areas: For the effective execution of the Land Use Act, the entire land area within a State is categorized into two; namely Urban and Rural areas. It is the duty of the office of the Surveyor General to define areas within the two categories clearly and represent them in their correct position in the map of the State for easy referencing.
2. Establishment of Network of Controls: Survey control points may be defined as identifiable positions on the earth's surface whose coordinates are determined with respect to a defined reference system with a national, state or local origin, Asoegwu (1991). It is the responsibility of the office of the Surveyor General to ensure the Establishment of these networks of controls (primary, secondary and tertiary), which are later broken into lesser order to facilitate demarcation of parcels of land within the State.
3. Establishment of a Modern Cadastre: With the aid of the control so established, the land parcels within the State can be demarcated and uniquely identified depending on the use to which such parcels are to be used or put to vis– a–vis; residential commercial, industrial, agricultural, public use plots etc for the grant of occupancy titles as prescribed by the Land Use Act. It is the office of the Surveyor General that will ensure that, these land parcels are clearly demarcated and stored in a data base with unique identifiers such as ownership, purpose etc for the following purposes:

    a. Grant of right of occupancy – statutory or customary
    b. Grant of licenses for prospecting, mining leases or rights
    c. Payment of compensation for improvements on land and agricultural / economic trees.
    d. Revenue Collection / Planning: Proper revenue collection is ensured in terms of adequate taxation, collection of property and tenement rates which will enhance planning and providing for basic services such as street cleaning, garbage collection and provision of drinking water and other amenities.
    e. Determination of Land Area Limitation for Grant of a Particular Right of Occupancy: The Land Use Act provides for a limit to area of land for grant of occupancies depending on the use or purpose clause – residential, commercial, Industrial, agricultural or grazing. For example, the Act further collaborated that where land being developed in an urban area is more than half hectare in extent, the occupancy right over the excess is automatically extinguished and transferred to the State. For this purpose, all undeveloped land owned by or occupied by a person in the urban area are to be put together. Any attempt to evade or circumvent this limitation as by subdividing the land into plots for sale is punishable as a criminal offence. Furthermore, any occupancy right over land in non- urban area is also extinguished as such if it is not used purely for purpose granted, usually agricultural or is not developed.

f. Maintenance / Protection of Survey Beacons: it is the office of the Surveyor General that will establish or emplace, moderate or supervise survey beacons and other land marks defining properties for which a right has been granted or sort. There must be well-placed permanent pillars and monuments to ensure system of control point's generation for cadastral survey and boundary monuments. This will enhance and ensure as an extension of the nation wide geodetic control network. The position of these control points must be accurately known. Such controls established for cadastral survey as well as boundary monuments must be well maintained. All land in the State must be surveyed and connected to the system of control points. Thus the position of each parcel of land is defined unambiguously in a nationwide coordinate system. Maintenance of such beacons or marks is the responsibility of the same office, as well as charging and collecting re-establishment fees from occupiers of properties where the beacons might have been tempered with or destroyed.

g. Preparation, Interpretation and Updating of Base Maps and Master Plans for all Planning Purposes: with the aid of the controls so established 2.2 above identifiable in either aerial photographs or satellite imageries as the case currently acquired. Using ace other available controls in collaboration with his office cartographic or GIS expert the Surveyor General converts the data so captured to digital form or production of Base maps and other details needed for maps. The master plans from these are further coordinated by the department of Town Planning of the Ministry with contribution from other professional like engineers, architects, estate officers ... etc. Updating of the Base map / master plan is achieved by charting of individual surveys done after the base map is in place.

h. Identifying Position of Social Utilities _ The Surveyor Generals' office ensures that the position of underground utilities like underground cables, water pipes, electricity and communication likes are accurately identified and shown clearly in the master plan to safeguard them against destruction during construction works. (Double Allocation of Same Parcel of Land: Plans produced by both government and private practicing surveyors are usually checked and charted on the master plan of the area. This is to avoid duplication and double allocation of plots.

i. Issuance of Survey Beacons / Marks: It is the duty of the State Surveyor General to issue all survey beacons both for public and private surveys. Surveyors are required by law to make returns of pillars used or unused at the end of every month. This helps the Surveyor General to control practice in the State and check illegal surveys that may result in litigations.

Representation in the Land Use and Allocation Committee

In view of the very important role of the office of the Surveyor General in operating the Land Use Act, it is pertinent then that the office be represented adequately in the Land Use and Allocation Committees as stated here under.

1. State Land Use and Allocation Committee – the office of the Surveyor General should be represented by two registered surveyors (not less than ten years post qualification and possibly one each from the public and private sector).
2. Local Government Land Allocation Advisory Committee – the office of the Surveyor General should be represented by one registered surveyor (not less than five years post qualification in experience). The Land Use Act already made provision for two estate surveyors and a legal practitioner.

Conclusion

In the light of the above, the role of the office of the Surveyor General in operating the Land Use Act is very important. Infact the Land Use Act cannot be effectively implemented without the involvement of the Surveyor General of the State. His omission in the Land Use Act of 1978 is unfortunate and regrettable.

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UN-HABITAT

Reducing Urban Poverty through Pro Poor Approaches on Land Governance, Spatial Units and Land Registration

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Extended Abstract

Some time during the course of next year, demographers watching urban trends will mark it as the moment when the world entered a new urban millennium with the majority of people living in towns and cities for the first time in history (UN-HABITAT, 2006a). The year 2007 will also see the number of slum dwellers in the world reach the 1 billion mark – when on average one in every three city residents will be living in inadequate housing with none, or few basic services. It is still unclear how this will influence government policies and actions, particularly in relation to Millennium Development Goal 7, Targets 10 on water and sanitation, and 11 aimed at improving the lives of slum dwellers (United Nations, 2005b).

It is very difficult to stop the flow of people into cities and towns. Urbanisation is one of the most powerful, irreversible forces in the world. It is estimated that 93 percent of the future urban population growth will occur in the cities of Asia and Africa, and to a lesser extent, Latin America and the Caribbean. However, cities make countries rich. Countries that are highly urbanised have higher incomes, more stable economies, stronger institutions. They are better able to withstand the volatility of the global economy than those with less urbanised populations. Urban-based economic activities account for up to 55 percent of Gross Nation Product in low-income countries, 73 percent in middle-income countries and 85 per cent in high income countries (UN-HABITAT, 2006a).

Therefore we need to continuously improve our tools and approaches to govern our cities to also include the urban poor as full-fledged citizens. The information central and local governments use to govern our cities needs to be of adequate quality and accuracy but still be affordable both in terms of data collection and management. Managing the relationships between people and land as a basis for land administration is of a complex nature, especially when trying to incorporate informality such as customary land tenure systems, informally arranged land use or conflicting claims to rights, and whose objects might not be clearly identifiable (Oosterom, van, P. et al., 2006).

This is where professionals face a real challenge in developing a flexible infrastructure and standard which can be extendable and adaptable to local circumstances and support both cadastral and non-cadastral approaches. Non cadastral approaches are needed to include a move to land management, e.g. for slum upgrading, to manage conflicts or to allocate land to Internally Displaced Persons (IDPs) and refugees. This means that some level of (non parcel based) object identification has to be supported (Augustinus, C., Lemmen, C., Oosterom, van, P., 2006).

UN-HABITAT has been facilitating the creation of a Global Land Tool Network (GLTN) for the development of pro-poor and gendered land tools. At the global level there has been a lot of good land policy work done in both urban and rural areas. However, the key problems are implementation and going to scale. Partners in GLTN have identified some of these obstacles such as poor land records, poor regulatory frameworks, the lack of gender considerations in land governance and land use planning and management, and inequitable land taxation systems. They have also agreed to develop specific tools to address these blockages.

There are few more contentious and complex problems in the world than those dealing with land and secure tenure. If we do not deal with this most politically sensitive and difficult agenda we will fail to address a root cause of poverty in many countries, especially in Africa. A recent World Bank study entitled 'Land Policies for Growth and Poverty Reduction' (World Bank, 2003) underscores the importance of land reform for achieving the economic growth required for sustainable human settlement development. Many countries with large poor populations will find it hard to break out of the vicious circle of overdue land reform, chaotic urbanisation and poverty without international support. This requires that we exploit every opportunity to raise the profile of the poor, thereby enhancing the mo mentum for international action to fulfil past promises and to meet newer challenges such as the Millennium Development Goals.

GLTN provides a public space for all stakeholders including those disciplines that use and develop spatial technologies and databases and working with policy-makers at local, regional and global levels. In summary, UN-HABITAT, through the Global Land Tool Network is ready to bring some key contributions for furthering the land agenda issue within the international community to better serve the urban poor and the implementation of the Millennium Development Goals.

The global urban challenge

Some time during the course of next year, demographers watching urban trends will mark it as the moment when the world entered a new urban millennium with the majority of people living in towns and cities for the first time in history (UN-HABITAT, 2006a). The year 2007 will also see the number of slum dwellers in the world reach the 1 billion mark – when on average one in every three city residents will be living in inadequate housing with none, or few basic services. It is still unclear how this will influence government policies and actions, particularly in rela tion to Millennium Development Goal 7, Targets 10 on water and sanitation, and 11 aimed at improving the lives of slum dwellers (United Nations (2005b).

It is very difficult to stop the flow of people into cities and towns. Urbanisation is one of the most powerful, irreversible forces in the world. It is estimated that 93 percent of the future urban population growth will occur in the cities of Asia and Africa, and to a lesser extent, Latin America and the Caribbean. However, cities make countries rich. Countries that are highly urbanised have higher incomes, more stable economies, stronger institutions. They are better able to withstand the volatility of the global economy than those with less urbanised populations. Urban-based economic activities account for up to 55 percent of Gross Nation Product (GNP) in low-income countries, 73 percent in middle-income countries and 85 per cent in high income countries (UN-HABITAT, 2006a).

Today, there are approximately 998 million people, almost one-third of the world's urban population, living in slums. UN-HABITAT estimates that, if current trends continue, the slum population will reach 1.4 billion by 2020. The vast majority of slums – more than 90 percent – are located in cities of the developing world, which also are absorbing most of the world's urban growth. Annual slum and urban growth rates are highest in sub-Saharan Africa, 4.53 percent and 4.58 percent respectively, nearly twice those of Southern Asia, where slum and urban growth rates are 2.2 percent and 2.89 percent, respectively. In Western Asia, slums and cities are growing at similar phase. Northern Africa is the only sub-region where slum growth rates are declining, largely due to positive measures taken by individual countries to address the plight of slum dwellers (UN-HABITAT, 2006a).

Sub-Saharan Africa has the highest prevalence of slums in the world – 71.8 percent of its urban population lives in slums – and in the last 15 years, the number of slum dwellers in the region has almost doubled, from 101 million in 1990 to 199 million, in 2005. Given the high slum growth rates in the sub-region, the number of slum dwellers in projected to double by 2020, reaching nearly 400 million, and overtaking the slum populations of both Southern Asia and Eastern Asia, where slum populations are projected to rise to 385 million and 299 million, respectively. In terms of absolute numbers, Asia still has the largest share of the world's slum population; in 2005, the region hosed more than half the world's slum dwellers, or 581 million people.

Because land is literally at the base of slum formation, addressing the slum issue means taking the land issue seriously. Given that experience has shown that it takes 15-25 years to change a country's land administration system, we cannot afford to wait if we wish to improve the lives of slum dwellers now. There are few more contentious and complex problems in the world than those dealing with land and secure tenure. If we do not deal with this most politically sensitive and difficult agenda we will fail to address a root cause of poverty in many countries, especially in Africa. A recent World Bank study entitled 'Land Policies for Growth and Poverty Reduction' (World Bank, 2003) underscores the importance of land reform for achieving the economic growth required for sustainable human settlement development. Many countries with large poor populations will find it hard to break out of the vicious circle of overdue land reform, chaotic urbanisation and poverty without international support. This requires that we exploit every opportunity to raise the profile of the poor, thereby enhancing the momentum for international action to fulfil past promises and to meet newer challenges such as the Millennium Development Goals.

UN-HABITAT's Land Mandate and the Global Land Tool Network

UN-HABITAT has for many years been the urban land focal point in the United Nations system. Land has been a central focus of UN-HABITAT since it was established after the first UN Conference on Human Settlements in Vancouver in 1976. The importance of land was re-emphasized in Istanbul in 1996 with the adoption of the Habitat Agenda and its twin goals of "shelter for all" and "sustainable human settlements development".

The next milestone was Istanbul + 5, and the adoption of the Declaration on Cities and Other Human Settlements in the New Millennium in 2001. More recently in 2004, the General Assembly adopted a resolution that encourages governments to support the Global Campaigns for Secure Tenure and Urban Governance, as important tools for promoting the administration of land and property rights (Resolution A/59/484).

Furthermore the 2005 World Summit outcome Document (GA 60/1 Paragraph 56 (m) summarized earlier resolutions by the General Assembly mandates for UN-HABITAT and recognizing the urgent need for increased resources prioritizing slum prevention and slum upgrading.

Finally, UN-HABITAT was designated as the focal point for the Millennium Development Goal 7 Target 11 (MDG 7/11), which aims to significantly improve the lives of at least 100 million slum dwellers by the year 2020. Given the enormous scale of predicted growth in the number of people living in slums, the Millennium Development target on slums should be considered as a bare minimum that the international community should aim for.

UN-HABITAT has been facilitating the creation of a Global Land Tool Network (GLTN) for the development of pro-poor and gendered land tools. The Network was launched at the third session of the World Urban Forum in July 2006. At the global level there has been a lot of good land policy work done in both urban and rural areas. However, the key problems are implementation and going to scale. Partners in GLTN have identified some of these obstacles such as poor land records, poor regulatory frameworks, the lack of gender considerations in land governance and land use planning and management, and inequitable land taxation systems. They have also agreed to develop specific tools to address these blockages.

GLTN aims to establish a continuum of land rights, rather than just focus on individual land titling; to improve and develop pro poor land management as well as land tenure tools; to unblock existing initiatives; assist in strengthening existing land networks; to improve global coordination on land; to assist in the development of gendered tools which are affordable and useful to the grassroots; and to improve the general dissemination of knowledge about how to implement security of tenure.

GLTN provides a public space for all stakeholders including those disciplines that use and develop spatial technologies and databases and working with policy-makers at local, regional and global levels. In summary, UN-HABITAT, through the Global Land Tool Network is ready to bring some key contributions for furthering the land agenda issue within the international community to better serve the urban poor and the implementation of the Millennium Development Goals.

However, we are all aware that some of these tools could take years to develop and even longer to be applied where they are most needed. A long-term approach is therefore required and the long-term commitment of our partners needs to be matched with equal perseverance by donors and by Member States. The intention by UN-HABITAT is that GLTN and its partners should provide this long-term commitment.

Furthermore, UN-HABITAT has the global mandate to monitor the implementation of MDG 7/11. Therefore, UN-HABITAT and its partners are currently working on the preparations of a global monitoring system that could in the future provide a framework to assist governments at local and national levels to produce estimates at household level on how many people have secure tenure, using an agreed-upon methodology in terms of definitions, indicators and variables (UN-HABITAT, 2006b). Importantly, one of the key indicators to measure the achievements in attaining MDG 7/11 is the 'Proportion of households with secure tenure.' Incidentally, this is the only indicator in the MDGs that refers directly to tenure security. While indicators for security of tenure linked to land titling exist, to date there are no sufficiently robust global indicators for security of tenure not associated with titling. Yet the majority of people in the developing world do not have land titles. Therefore, for monitoring purposes, when creating information for land management, land tenure holdings, both formal and informal, needs to be included.

Land Governance and the Use of Pro Poor Spatial Data Infrastructure

Tenure issues cannot be divorced from the broader issues of governance. UN-HABITAT governance campaign defines good governance as characterised by sustainability, subsidiarity, equity, efficiency, transparency and accountability, civic engagement and citizenship and security. It recognises that the quality of urban governance is the single most important factor for the eradication of poverty and for prosperous cities. Tenure policies which satisfy these criteria can therefore contribute substantially to meeting the objectives of the governance campaign. In addressing this issue, it is necessary to recognise that although land tenure raises important technical and procedural questions, it is ultimately a political issue, since rights over land cannot be isolated from packages of rights in general.

Tenure policy needs to be considered as part of urban governance, spatial planning and infrastructure provision to ensure that security and rights are balanced with improved access to livelihoods, services and credit. There are five commonly adopted approaches to achieving these objectives:

a. The first option concentrates on asserting the need to implement master plans and regulations and generally involves the eviction and relocation of unauthorised settlements with, or without, compensation or alternative shelter. Such approaches invariably reflect a concern for visual order rather than meeting the needs of the poor.
b. The second option advocates the granting of full individual property ownership in the expectation that this will enable the poor to obtain credit, realise the potential value of their property assets and lift themselves out of poverty, whilst also raising revenues from property taxes. It may be undertaken as part of the first approach by granting titles to relocated households. Due to high land costs in areas near employment centres, such relocation projects are often outside the urban area and impose high transport and infrastructure costs on the poor.

c. The third option emphasises the need to introduce or expand 'intermediate' forms of tenure, such as community land trusts, Temporary Occupation Licenses, shares in land-buying companies, shared titles or land leases, etc to provide medium term security at prices lower than formal titles would command. These enable low-income groups to live in areas which would otherwise be unaffordable.

d. The fourth option focuses on the need to increase rights of occupancy, use, development, etc, for all households in unauthorised settlements, especially for women. Once the situa tion has been stabilised, emphasis can then move to building on existing local tenure systems with which people are already familiar, before importing new options.
e. Finally the last option involves integrating tenure policy with urban planning and infrastructure provision policies. Ideally, it involves combining forms of tenure which provide security and access to credit with efficient and flexible land use planning based on the priorities and perceptions of the residents, not just the professionals.

Therefore we need to continuously improve our tools and approaches to govern our cities to also include the urban poor as full-fledged citizens. The information central and local governments use to govern our cities needs to be of adequate quality and accuracy but still be affordable both in terms of data collection and management. Managing the relationships between people and land as a basis for land administration is of a complex nature, especially when trying to incorporate informality such as customary land tenure systems, informally arranged land use or conflicting claims to rights, and whose objects might not be clearly identifiable (fuzzy) (Augustinus, C., Lemmen, C., Oosterom, van, P., 2006). Government at all levels requires information in order to govern. For example information on people and on the land where people live and work; information on the location of administrative boundaries and of objects (like buildings, roads); information on land tenure (including the continuum of rights); information on land value and information on land usage (past, present and future). This type of core data/information can help governments to determine how they deal with land in their policies to combat poverty, to achieve sustainable settlement goals and to manage natural resources as well as to improve on security of tenure for the majority.

This is where professionals face a real challenge in developing a flexible infrastructure and standard which can be extendable and adaptable to local circumstances and support both cadastral and non-cadastral approaches. Non cadastral approaches are needed to include a move to land management, e.g. for slum upgrading, to manage conflicts or to allocate land to Internally Displaced Persons (IDPs) and refugees. This means that some level of (non parcel based) object identification has to be supported (Augustinus, C., Lemmen, C., Oosterom, van, P., 2006).

Through building in mechanisms to ensure grassroots and women's participation in developing land tools the democratic deficit arising from the exclusion or under-representation of these groups in public decision-making bodies can be tackled. Similarly, the GLTN's training and capacity building tools work toward creating greater transparency and accountability of land management systems, as well as sensitizing professionals and other stakeholders in the importance of broad participation in the formation of as well as accessibility to these processes. Experiences from different regions have shown that a cross-cutting factor in determining the success or failure of implementation of pro-poor land tools is political will. Through linking processes i.e. land reform, to particular tangible products i.e. capacity building for government officials or the installation of computer software for facilitating information management for land registry systems; Governments can point to these products to show that they are taking action on these issues, which can help sustain political momentum for the reform on process whilst working towards the overall goal.

The GLTN and its partners recognize the need for taking the governance side of land governance seriously. Many aspects of land are governance-related and/or are directly affected by the governance context they are being implemented in. There is no robust conceptual framework for working with land governance at the moment, but land governance is a GLTN tool, which we are working on to further develop in close collaboration with our partners.

GLTN's focus on good land governance is based on experiences and lessons learned from the world over, which highlight the fact that the sustainability of change and reform in the land sector is closely tied to how the reform is managed and the governance structures supporting the reform.

As regards large-scale operations, taking an example from an Asian country, we have seen from large-scale reform operations that several issues have emerged as crucial in determining the success or failure of land reforms. One is that land policy implementation at the national levels needs to be flexible enough to take into consideration and maximize its effects on both rural and urban areas. Also the view on creating land administration information needs to be more flexible, parties should not operate under the assumption that a survey of an accurate cadastral parcel is necessary to create information for land management, and acknowledge that other options need to be taken into consideration. Pro-poor cost recovery policies and strategies need to be designed and put in place to ensure the currency and sustainability of the new/developing land administration system.

Prior to launching pilot programmes, situation analysis must be done, giving an overview of land law, land tenure, land administration and the land governance systems in place (including informal systems) and the existing institutions. Some short-term interventions are often necessary, as tangible results are needed to maintain political momentum for the process, however it is important that projects initiated by Governments or by donor agencies must be realized as part of a larger framework.

The institutional aspect of large-scale operations is of great significance. Several different government agencies, at several different levels, are usually involved in land-related issues. These different agencies and levels may have roles or hold information that affect land issues, but which risk being excluded if a reform is limited only to the land agency. When land agency reform is taking place, this may need to take place within a larger civil service reform i.e. decentralization or public-private function shifts, in order to create buy-in from the political side as well as the bureaucracy, for the sustainability of the reform.

The Need for Development of a Core Cadastre and Social Tenure Domain Model

During the past decade FIG and partners have been working on the development of a Core Cadastral Domain Model (CCDM). Lately this tool development has been supported by GLTN by the inclusion of the Social Tenure Domain Model (STDM) to also look at the informal arrangements and non parcel based approaches.

In regard to the standardized CCDM, covering land registration and cadastre in a broad sense, so called multipurpose cadastre, serves at least two important goals: a) to avoid reinventing and re-implementing but rather provide a extensible basis for efficient and effective cadastral system development based on a model driven architecture, and b) to enable involved parties, both within one country and between different countries, to communicate based on the shared ontology implied by the model. Besides the three well-known concepts, Parcel, Person and Right, at the class level the model also will include immovables such as Building and OtherRegisterObject (geometry of easement, like a right of way, protected region, legal space around utility object, etc.) and the following concepts: Source-Document such as SurveyDocument or LegalDocument (e.g. deed or title), Responsibilities, Restrictions (defined as Rights by other Person than the one having the ownership Right) and Mortgages. The heart of the model will be based on the three classes: (1) RegisterObject (including all kinds of immovables and movables), (2) RRR (right, restriction, responsibility), and (3) Person (natural, non-natural and group) (Oosterom, van, P. et al., 2006). But this needs to be adopted to the STDM and its requirements.

In regard this there is a need to rethink the UN Land Administration Guidelines (UNECE, 1996). The guidelines speak about land administration as the 'process of determining, recording, and disseminating information on ownership, value and use of land when implementing land management policies'. If 'ownership' is understood as the mode in which rights to land are held, we could also speak about 'land tenure'. A main characteristic of land tenure is that it reflects a social relationship regarding rights to land, which means that in a certain jurisdiction the relationship between people and land is recognised as valid rights or claims (either formal or non-formal).
The land parcel of the cadastre is the basic spatial unit used for land registration/recording. Conventionally cadastral systems have supplied spatial information for land administration, spatial planning, billing for cost recovery from services etc. Given that most developing countries have very little cadastral coverage, the emphasis should be on the generation of more appropriate forms of large scale spatial information, rather than on the production of a few accurate cadastral parcels (Augustinus, C., Lemmen, C., Oosterom, van, P., 2006). This is especially where people cannot afford registered rights.

It is not possible to use only cadastrally surveyed parcels as the only spatial unit for land management/administration for informal settlements because (Fourie, C., 1998):-

- The location of informal settlements on privately owned land does not always precisely match the cadastral parcels and is likely to cover many properties in one spatially contiguous unit.
- Often informal settle ment takes place on customary land and/or state land, which is generally not parcelled in developing countries;
- Often the boundaries of the informal settlers' properties do not accord with the cadastral layout, and this can vary across the settlement and between settlements.
- It is also impossible to use cadastrally surveyed parcels as the only spatial unit for land management/administration for rural areas with customary tenure because (Fourie, C., 1998):-
- The most commonly used geo-spatial references in the rural areas are the administrative units of the country. Agricultural census data, legal regulations, policy and centralized/provincial planning decisions are made in terms of the administrative unit
- Land management decisions are more often taken by socio-territorial units, such as chiefships, clans or extended families, rather than by administrative units. Rarely do the boundaries of the administrative units and those of the socio-territorial areas coincide. Most of the time there is no information on the boundaries of the socio-territorial areas, even at the level of chiefships, as they have generally not been mapped

Often the socio-territorial areas overlap each other, for example there might not be agreement about clan boundaries.

One potential approach in improving land governance in developing countries is the development of a flexible standard for the Social Tenure Domain Model (STDM). This tool is relevant because it can be used as a basis for data and process modelling for software to be used in customary area's and informal settlement areas, or as guidelines for the development of a paper based system. A flexible standard means that it can be extendable and adaptable to local circumstances and it can support both cadastral and non-cadastral approaches. Non cadastral approaches include a move to land management, e.g. for slum upgrading, to manage conflicts or to allocate land to Internally Displaced Persons (IDPs) and refugees. This means that some level of (non parcel based) object identificatio n has to be supported (Augustinus, C., Lemmen, C., Oosterom, van, P., 2006).

Adequate land governance and land administration results in an extensive set of paper based, or digital, data to be maintained. Efficient access to this data is a relevant issue, and there are many examples of paper based administrations which cannot really be accessed. Pro poor technical tools need to include both data-and process modelling. Such models are of importance for the development of land management systems, including statutory, customary and informal systems. Standards are useful in designing such models as long as they facilitate extensions and adaptations to the local situation.

The Importance of Sound Tenure Policies for Economic Development

Tenure reform can include confirmation in law of de facto land rights in order to verify and secure these rights for people who already have a demonstrable claim to the land and replace doubt and contention with positiveness and certainty and so inspire confidence and encourage investment and development (Adams, M., Sibanda, S. and Turner, S., 1999). In some countries, the proportion of people living in unauthorised settlements is already much higher than those in formal land and housing markets. This is a problem for governments seeking to harness the creative energies of their populations to achieve economic development and reduce poverty.

Excluding a significant proportion of urban populations from legal shelter reduces the prospects for economic development. People who fear eviction are not likely to operate to their maximum potential, or invest in improving their homes and neighbourhoods. Also when people are excluded, local and central governments are denied the revenue from property taxes and service charges, which could help improve urban living environments and stimulate local and external investment. In addition to this, uncertainty associated with insecure tenure may hinder external investment and the improvement of other services such as improved water and sanitation, durability of housing etc (UN-HABITAT, 2004).

Information for land management needs to be created of land tenure holdings. Therefore, again the need for adequate land information management systems that also includes informal rights and supports both cadastral and non-cadastral approaches is of utmost importance for economic development in urban as well as rural areas.

Conclusion

For the first time in history, during the course of next year, the world enters a new urban millennium with the majority of people living in towns and cities. The number of slum dwellers in the world will reach the 1 billion mark meaning that on average one in every three city residents will be living in inadequate housing with none, or few basic services. Noting that it is very difficult to stop the flow of people into cities and towns since urbanisation is one of the most powerful, irreversible forces in the world. However, since cities make countries rich, we need to continuously improve our tools and approaches to govern our cities to also include the urban poor as full-fledged citizens.

The information central and local governments use to govern our cities needs to be of adequate quality and accuracy but still be affordable both in terms of data collection and management. Furthermore, to manage the relationships between people and land as a basis for land administration is of a complex nature, especially when trying to incorporate informality such as customary land tenure systems, informally arranged land use or conflicting claims to rights, and whose objects might not be clearly identifiable. This is where professionals face a real challenge in developing a flexible infrastructure and standard which can be extendable and adaptable to local circumstances and support both cadastral and non-cadastral approaches. Non cadastral approaches are needed to include a move to land management, e.g. for slum upgrading, to manage conflicts or to allocate land to Internally Displaced Persons (IDPs) and refugees. This means that some level of (non parcel based) object identification has to be supported (Augustinus, C., Lemmen, C., Oosterom, van, P., 2006).

GLTN provides a public space for all stakeholders including those disciplines that use and develop spatial technologies and databases and working with policy-makers at local, regional and global levels. In summary, UN-HABITAT, through the Global Land Tool Network is ready to bring some key contributions for furthering the land agenda issue within the international community to better serve the urban poor and the implementation of the Millennium Development Goals.

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African Experience of Tenure Reform and Cadastres: A Place in the Global Sun? [13]

By Chukwudozie Ezigbalike and Qhobela Cyprian Selebalo

Abstract

Governments in Africa have intervened to change the land tenure system for various reasons. Some of the reforms which took place in colonial times deprived the African populations of their land. At independence, reforms have been initiated to correct these injustices. Apart from such reforms motivated by the need to redress past injustices, there are other reasons for reform. The most common reason is to create a favourable environment for agricultural development and economic activity. This paper discusses some of these reform measures, examining the reasons behind them and suggests the way forward.

Introduction

Land tenure reform is the programmed intervention by the state designed to change the human-land-human relationships in a society. There are two almost synonymous terms used for such state intervention in land ownership and use, viz., land reform and agrarian reform. Semantically, land reform conveys the impression of any reform in the institutions and procedures associated with access to and control of rights in land, while agrarian reform would suggest that emphasis would be placed on agricultural activities. However, concepts draw their meanings from their origins. Herrera et al (1997) suggest that land reform probably originated in the agrarian transformations that began in Denmark in the 1700s. Land reform and agrarian reform therefore tend to be used interchangeably, since land reform generally means "the redistribution of property or rights in land for the benefit of the landless, tenants and farm labourers" (Adams 1995). Adams (1995) suggests that agrarian reform is "a construct of the Cold War to counter communist land reform," embracing improvements in both land reform and agricultural organisation:

> Its policy prescriptions urged governments to go beyond redistribution: they should also support other rural development measures such as the improvement of farm credit, cooperatives for farm-input supply and marketing, and extension services to facilitate the productive use of the land reallocated.

The African experience of land reform is not always concerned primarily with agricultural production. They are usually concerned with the narrower objectives of "remodelling of tenure rights and the redistribution of land, in directions consistent with the political imperatives underlying the reforms" (Adams 1995).

Land reform programs usually have multiple objectives, and will usually include agricultural productivity. However, the most common land reform objectives in the African experience have been:

- To achieve a more equitable distribution of land resources in a country and redress social injustices of the past (e.g., Zimbabwe and South Africa);
- To streamline the procedures of land allocation, distribution and general management (e.g., Botswana); and
- To facilitate access to land by the government for development projects (e.g., Nigeria).

In addition to land and agrarian reform, there is a third type of tenure reform: cadastral reform.

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Cadastral reform is stated as being "concerned with improving the operation, efficiency, effectiveness and performance of the cadastral system in a state or jurisdiction" (Williamson 1990). The two main objectives, among many, are (Ezigbalike and Benwell 1994):

- To make land holdings more secure so that land owners can obtain development funds on the basis of secured land rights, and
- To facilitate the administration of land resources.

In theory, the introduction (or reform) of a cadastral system is not supposed to create new interests in land, nor abolish existing ones. However, Ezigbalike and Benwell (1994) have argued that cadastral reforms always impact on the land tenure system:

> … Components in a systemic relationship respond to changes in neighbouring components. The cadastral system is part of the overall land tenure system. … It therefore affects the administration of, and transfer of interests in land. It may lead to more secure title or faster land transactions. More secure title and easier transactions may translate into more economic activity on the land. It therefore provides more incentive and opportunities for landowners to invest, with pecuniary advantages. These in turn may translate into income redistribution and changes in power relationships derived from the ownership of land.

This paper examines the experience of Africa in land tenure reforms, without distinguishing between land reform, agrarian reform and cadastral reform. It argues that early reforms in Africa have adopted an approach described in Bruce (1998) as the 'replacement' paradigm. Recently there has been a shift to an 'adaptation' paradigm, due to less than satisfactory results from the replacement reforms. While the shift to the 'adaptation' paradigm is a welcome move, this paper will argue that these reforms have ignored the realities of globalisation of markets and that these have to be address for Africa to have a place in the global sun.

Background to Land Reform—Colonial Land Policy

Colonial land tenure was characterised by various policies. James (1987) characterised the three prevalent policies as dualism, paternalism and transformation.

Dualism

The policy of dualism allowed traditional tenure systems to coexist with introduced European tenure concepts. In some jurisdictions, traditional and statutory tenures are compartmentalised and were not allowed to mix. And example of such compartmentalised system was the reservation of the 'white highlands' of Kenya for introduced European tenure rights, while only customary rights could exist in the 'reserves'. In others, they exist side by side and land holdings are converted and reconverted between the two land systems. For example, in Nigeria where alienation land has gained acceptance, land acquired through individual effort could revert back to communal ownership due to traditional inheritance and succession rules which guarantees rights to all members of the deceased's family (though sometimes the result will be a fragmentation, rather than shared interests).

The disadvantages attributed to the policy of dualism are related to the uncertainty of rights in the customary sector and the resultant inability to raise money on the security of their land (James 1987).

On the other hand, it is attributed with the advantage of "possible evolution of a system presumably based on indigenous forms of social and economic organisation. Land reform, it is argued, should avoid any sweeping changes or a total transformation" (James 1987, 9).

Paternalism

Paternalistic policies regard the 'natives' as incapable of looking after their affairs, as it relates to land matters. Legislation was therefore passed to protect the indigenous population against the "wiles and trickery" of the "non-natives". Such reasoning were used to justify creating 'reserves' where land alienation was forbidden, especially to a non-native. Paternalistic land policies go the further step of the government assuming substantive title to all land, which it holds and manages for the benefit of all members of the society. From this pool of land, it then allocates rights of use and enjoyment to individuals, families and groups. It further stipulates that government must approve any rights created in land by any of the assignees for the rights to be valid.

This system of 'rights of occupancy' was introduced in Northern Nigeria in 1910, and in Tanzania in 1923. The two main objections to this system are its expropriatory nature and "the requirement of the governor's consent by the indigenous people in order to ensure the validity of their land rights"

Colonial administrators however hail the system "as being an effective attempt to protect the land rights of the peasants, and to secure for the community, present and future, the fruits of development" (James 1987, 11).

Transformation

This policy was first propounded in the report of the East African Royal Commission on Land and Population. Its long-term objective was to introduce a single system of registered holding by substituting traditional titles into fees simple. One of the features of African customary land tenure is the predominance of group interests in land. This presented several problems to administrators. There were strong suggestions, right or wrong, that customary land tenure does not offer landholders enough security and incentive for economic development of the land.

Its implementation involved

> … an adjudication process, which determines the existing rights in land and provides for the renunciation by rights holders of their land rights in favour of an individual or few individuals. Then follows consolidation of scattered plots into economically workable units and the demarcation of boundaries. The resultant title is then registered as a fee simple in an official register of titles.
>
> (James 1987, 12-13)

Several advantages are attributed to the transformation policy. These include security of tenure, reduced litigation in land matters and ease of disposition.

The disadvantages attributed to the policy include "a trend towards widespread landlessness of many persons" and a tendency towards fragmentation of holdings due to the persistence of customary rules of inheritance.

> One of the effects of consolidation and registration in Kenya, for example, has amounted to a form of expropriation, admittedly of "lesser rights not amounting to ownership," but nonetheless rights of members of the family "recognised under customary law to use a separate piece of land at their own discretion, such as married sons and widows"…
>
> (Apthorpe 1969, 116)

Colonial Land Grabbing

Another common feature of colonial land management, especially in parts of Eastern and Southern Africa where climatic conditions were more suitable for European settlement, and in the French colonies, was land grabbing. In several African colonies, the colonial administration adopted policies, at various times, that dispossessed the African landowners of much of their land, which were then allocated to immigrants from the colonising countries. This is usually achieved by declaring "unoccupied" land to be Crown or public land, which were then allocated to new settlers in fee simple or freehold tenure.

> The Portuguese (since 1856), the Belgians (since 1885/86), and the French (since the turn of the twentieth century) clearly articulated that "occupied lands" were to be governed according to local custom and all other lands were considered to be state property. . . . Widespread practices of itinerant farming and transhumant or nomadic herding common throughout West Africa resulted in the vulnerability of local populations to being confronted with state claims of ownership to lands exploited on a periodic basis. . . . Applications of such principles as mise en valeur and eminent domain, often resulting in the establishment of state-supported and long-term land claims on the part of nonlocal individuals and the accompanying displacement of local populations, is especially striking in the resource-rich regions today defined by the countries of Zaire, Congo, and Gabon.
>
> (Elbow et al. 1998, 4)

In Kenya, the rich highlands were at one time reserved for whites only. In Zimbabwe, Moyana (1984) reported that under the administration of the Royal South Africa Company, there was an explicit mandate to secure and prepare land for migration of Europeans into Zimbabwe. The immigrants were settled on Crown lands that had been acquired by moving the original occupiers to "reserves". The paternalistic argument that the indigenous populations should be protected from the more sophisticated settlers was used to justify these relocations, which are usually to less fertile areas.

Other notable examples of colonial and settler land grabbing include South Africa and Namibia. In South Africa,

> Past apartheid policies have resulted in an extremely racially-skewed and inequitable distribution of land, overcrowding and poverty. Until 1991, 80% of the population was prohibited from owning or leasing land in over 80% of the country. About 3.5 million black South Africans in urban and rural areas lost their land and rights in property through forced removals.
>
> (Adams 1995)

The experience of Namibia was very similar to that of South Africa

> Disposition of the indigenous people of Namibia was a central feature of colonial rule. The ethnic groups inhabiting the central plateau (principally the Herero, Nama, Samara, and San) were forcefully expelled to make way for colonial settlers. At independence, some 45% of the total land area and 74% of the potentially arable land was owned by white commercial farmers who comprised less than 2% of the total population.
>
> (Subramanian 1998)

Given the background outlined above, it is not surprising that many countries embarked on land reform programs at independence. One of the three-pronged responses of the South African land reform agenda is land restitution. Under this response, "cases of forced removals are being dealt with by a Land Claims Court and Commission established under the Restitution of Land Rights Act, 1994, which deals with individual or group land claims which originate since 1913" (Adams 1995). The Namibian Government has expressed "its commitment to redressing the injustices of the past in a spirit of national reconciliation and to promote sustainable economic development" (Namibia: Republic of Namibia 1998). The Agricultural (Commercial) Land Reform Act of 1995 gave the Minister powers to acquire agricultural land

> … in order to make such land available for agricultural purposes to Namibian citizens who do not own or otherwise have the use of agricultural land or adequate agricultural land, and foremost to those Namibian citizens who have been socially, economically or educationally disadvantaged by past discriminatory laws or practices.
> (Namibia: Republic of Namibia 1995)

Independent Kenya did not have to embark on a restitution program as the barriers to descendants of non-Europeans owning land on the White Highlands was removed by an order-in-council in 1960.

Reforming for Administrative Convenience

A common reason for land reform is the need to streamline land administration rules and procedures. Even where there is no politicised land question, by the time of independence, land administration problems usually result from attempts to combine differing land systems. At one level, indigenous land practices were mixed with introduced concepts. Even the protectionist laws under the British systems did not prevent this mixing as land is converted and reconverted between the two systems.

At another level, different indigenous land practices were mixed. Most modern African countries are a collection of several national or tribal groups, sometimes with very divergent customs, including land tenure practices. While these tribes had interacted with each other before the introduction of colonial rule, the impact on each other's customs had been limited (except possibly in cases of conquest). The colonial creation of "countries" out of neighbouring national groups catalysed the interactions. Metropolitan settlements were created to cater for the new administration and "strangers" became neighbours, mixing their customs to create new, more complex customs.

> Lack of uniformity in customary law may make the administration of the law, especially by non-African appellate or revisory courts or authorities, more difficult. In other words, the problems of the judicial ascertainment of customary law are greatly increased if there is a multiplicity of different tribal laws existing in a particular territory. … Multiplicity of tribal laws also renders more problematical the application of the appropriate law in urban areas and other areas with mixed populations. There is the problem of deciding which is the appropriate law to apply in a case where inter-tribal conflicts of law may arise.
> (Kanywanyi 1969, 170)

Even though most land in resulting urban areas were held under introduced statutory laws, rather than customary laws, the traditional rules of succession were generally applied on the death of the land owner, thereby bringing various customary land practices to the townships.

Another cause of mixing traditional land system is the forced relocation of indigenous populations to 'reserves' and the imposition of "customary" law on them. This is based on the fallacious assumption that African customary land law is homogenous. The result was new complex customs that borrowed from the customs of the people so relocated.

Mixing of land practices has not been limited to the accident of living with neighbours in urban areas and coercive relocations to reserves. With easy access to transportation, members of rural communities now move around freely, sometimes across the proverbial seven seas and seven landforms. As people travel, they imbibe new ideas, which are brought back to integrate into existing practices at home. These include land tenure ideas, along with ideas about clothing, food and religion, for example. The so-called traditional societies are therefore no longer that "traditional."

Just like "travellers" bring back aspects of foreign cultures when they return home, while they were "abroad", they also influence the cultures of their host communities. In the past, these outsiders stayed for relatively short periods and only needed limited rights in land. Now, these strangers stay longer and therefore have more opportunities to impact on the local customs. With modern statehood, some of them may now be entitled to more permanent land rights.

Mechanisms employed for administrative reforms include the establishment of new administrative structures (e.g., Land Boards in Botswana) and nationalisation of land (e.g., the Nigerian Land Use Decree, 1978).

Land for the Government

Though land reform is supposed to be for the benefit of the population, reform outcomes sometimes benefit the government more than it does the people. This is the case with the land reform introduced by the Nigerian Land Use Decree of 1978. Among the several reasons for promulgating the Land Use Decree (LUD), one that is often omitted in the literature on the LUD is the need to facilitate access to land by the government for development purposes. Prior to the LUD, customary land practices in rural Nigeria was characterised by a mixture of trustee lands in the North and communal and individual holdings in the South. Because of population pressures in the South, land holdings were, and still are, small fragments. During the oil boom in the 1970s, the government was in a hurry to execute several development projects. One of the sources of frustration in those days was dealing with the numerous owners of various rights in land being acquired for such projects.

The LUD vested all lands in the territory of a state in "the Military Governor of that State and such land shall be held in trust and administered for the use and common benefit of all Nigerians"(Nigeria: Federal Republic of Nigeria 1979). The law replaced all existing possessory rights in land with rights of occupancy, the statutory and customary rights of occupancy in urban and non urban areas respectively. The statutory right of occupancy is to be granted by the state governor, while the Local Government Council in whose territory the land is situated grants the customary right of occupancy.

The decree empowers the governor to "revoke a right of occupancy for overriding public interest" (s. 28). Though compensation is payable upon such revocation, the decree makes it easier for the government to acquire land for projects, especially since only land that is being used for agriculture, or that has been developed, qualifies to be treated as if a right of occupancy had been granted. However, Knox (1998) points out that the role of state governors as supreme authorities over land allocations has made it difficult for the federal government to acquire land from states, particularly when the offices are occupied by members of different parties. While most land laws have "public interest" provisions, the Nigerian provision stands out in that it has been used extensively, mostly for political purposes.

In Lesotho, the Land Act of 1979 introduced the concepts of Selected Development Areas (SDA) and Selected Agricultural Areas (SAA). This mechanism is to allow the Minister to declare public interest in areas where the government needs land to provide urban services or to improve agricultural production.

Economic Development Objectives

This is the single most cited reason for embarking on land reform programmes. Almost all reform programs include agricultural and general development objectives among the list of policy objectives to be achieved. Land is an essential economic factor and a form of wealth in all economies.

> First, it is the source of food stuff which enables man and other living creatures to survive; second it provides the minerals and other resources from which man may make another factor of production-capital, and other assets of consumption and enjoyment; and third it provides the foundation on which the infrastructure of society is built
>
> (Machyo 1969, 100)

Vogelgesan (1998) states that "in rural areas land performs an economic function. It is the primary production factor, source of employment and repository of personal wealth." Land reform has therefore been undertaken "to ensure that the Nation's land resources are as quickly as possible, utilised in the fullest possible manner in the best interest of the people (of Kenya) and the nation's economy" (Kenya: Ministry of Lands and Settlement 1969).

Access to and allocation of rights in land are key features of all land and agrarian reforms. Reform objectives usually have to balance between equitable distribution and efficient production. The equity considerations stem from the obligation a society has towards its members to provide them with a means of livelihood. Land being the primary source of sustenance, members of a society should be entitled to some of it for their subsistence. The egalitarian principles of many rural African societies dictates that every member be given an equal opportunity to enjoy the fruits of their common resources. The preamble to the Nigerian Land Use Decree of 1978 declares:

> And whereas it is also in the public interest that the rights of all Nigerian to use and enjoy land in Nigeria and the natural fruits thereof in sufficient quantity to enable them to provide for the sustenance of themselves and their families should be assured, protected and preserved…

Similar declarations are found in most land laws and policy documents.

However, there is a general acceptance that the nature of the rights a landholder has in land will affect their ability or otherwise to use the land in the most economic manner possible. The duration of the rights will affect the type of investments one would be inclined to make on the land. Also important are succession rules.

While African experience of land reform policy objectives includes economic development, they seem to have opted for caution in favour of the equity considerations. For example, the Presidential Commission on Land Tenure in Botswana stated as follows:

> Since the economy of Botswana is still largely agricultural, land is the only resource available to most of its citizens from which to earn a livelihood. Land tenure is thus a matter of grave importance and any change required must be made with care.
>
> "Care" in this context means primarily the close coordination of tenure change with developments in the economy and society generally.
>
> (Botswana: Presidential Commission on Land Tenure 1983, 3)

Obol-Ochola (1969b, 9) warns: "Land reform must necessarily accommodate the existing social, economic and political realities without which the reforms are doomed to failure." The Botswana Presidential Commission observed that:

> In every society new needs arise merging with or replacing old ones. In a developing society new needs often arise rapidly, without affording sufficient time for adjustment of existing concepts and social patterns. … There are new economic opportunities and needs which require to be accommodated. … Many of the needs for which the traditional land tenure system catered are still very important to a majority of citizens. On the other hand, new economic opportunities ushered in by economic growth are increasing and it is important that all citizens, wherever they live have access to them.

The challenge for land reform policy formulators is to balance the needs of citizens "with one foot in the traditional sector and the other in the developing cash economy."

On Security of Tenure and Land Titling

An important consideration in the economic use of land is the security of whatever right one has in land. Place et al (1994, 19) define land tenure as follows:

Land tenure security can be defined to exist when an individual perceives that he or she has rights to a piece of land on a continuous basis, free from imposition or interference from outside sources, as well as ability to reap the benefits of labor and capital invested in that land, either in use or upon transfer to another holder.

They explain that there are three aspects of tenure. The robustness or breadth of the right depends on which of the bundle rights the person holds. One of the important characteristics of the institution of property in land is the ability of several rights to co-exist in the same parcel of land simultaneously, vested in different people. Which of all the possible rights in land a person has at any time will also determine the way he or she will use the land. What other rights, apart from the ones already defined are possible and who can create these rights in the future? To feel secure, one needs to know that the rights he or she does not hold are not superior to those that they do hold.

The second aspect of the definition deals with the duration of the right. Place et al (1994) explain that this economic dimension requires that the time should be "sufficiently long to enable the holder to recoup with confidence the full income stream generated by the investment." The third aspect is the assurance that the right will not be interfered with during the duration of the right. The assurance aspect depends on the legal certainty of the enforcement provisions. If the enforcement arrangements are weak, the holder may not be able to enforce his or her rights against squatters, for example.

It is important to note that tenure security is based on the perception of the holder of the right. It is not based on some absolute measure of security. As such, it is jurisdiction dependent. It is also time dependent. Experience in the pilot schemes in Uganda "seems to indicate that what peasant farmers are more concerned with is not the paper title as such but safety from those who might grab their land" (Machyo 1969, 104). Obol-Ochola (1969a) referred to "security of use" and suggests that "it seems quite sufficient to tell a person that he owns a plot of land subject to certain statutory qualifications. . ."

Land registration has been used as a means of ensuring security of tenure. We contend that registration per se does not produce security. Like other aspects of governance, the registration system can be abused, or as is more commonly the case, neglected and become out of date and ineffectual, especially when the people do not really understand the concepts associated with it. Land registration laws usually go with such concepts as freehold, fee simple and leasehold. These are foreign concepts which rural people cannot relate to. Discussing the possible juridical interests that would be conferred by registering customary rights, Machyo (1969, 38-39) observed as follows:

i. The fee simple concept is alien and there does not seem to be any convincing reason or a necessity for its adoption.
ii. The fee simple idea being alien and very few, if any, understand it. This is an undesirable and purposeless creation of disparity between the rights of an owner of land in the "law books" and the actual right as conceived by the owner within his social and cultural context.
iii. Apart from being alien and unintelligible, the fee simple notion is unrealistic and meaningless if applied to customary holding because any statutory ownership conferred on an existing owner under customary law must, by virtue of social necessity, take into account all customary incidents and encumbrances.
iv. It is important that in any law reform a meticulous step should be taken to ensure that the content of the particular law reform is generally acceptable and is in harmony with contemporary economic and social values and attitudes and should not ignore the reality of the existing situations.

The Kenyan land titling project has been assessed as successful by some writers (and as a failure by others). Comparing its apparent success with the apparent failure of similar projects in Nyarubanja, Kato (1969, 312) suggested that certain circumstances must exist for such changes in land tenure to succeed.

> The way to go about it is to channel and re-channel them to suit the aims and purposes of both the legislator as well as the masses concerned. Secondly, in land reform the people must clearly be shown the profit of the proposed change. Leaving it to chance is likely to prove an obstacle in implementing legislation. The people are not impressed by reform of which profit is left to chance. Circumstances must be that the people themselves need the change in their tenure or, at least, are prepared to acquiesce in it. Thirdly, reform must be aimed at clear and recognised evil. Fourthly, in the absence of the peoples' consent to reform, then there must be circumstances which allow strict authoritarianism in order to carry it through. There is no half-way between these two alternatives. Furthermore, there must be adequate manpower to implement the reform on land. Without this the law reform measures will always remain book law, unpopular and ineffectual.

He found that in Kikuyuland, Kenya, the Kikuyu who had been agitating against the declaration of their land as Crown Lands while the white settlers got private property, had all along been "individualistic in so far as land ownership was concerned. . . . The second factor is that there was excessive soil erosion as well as fragmentation in the reserve, and to prevent these, consolidation was inevitable."

On Access to Credit

One of the most common arguments against customary land tenure, and in favour of individualisation of rights and land titling is to facilitate the ability to secure credit for investment with the land as collateral. The Presidential Commission on Land Tenure, after consulting lending institutions found that there are several constraints to securing credit apart from security of tenure.

The first constraint, with respect to residential properties in rural areas, was that the rural land markets are relatively small. Should the borrower default on the loan, the lending institution has no assurance that it will recover its investment in full and in time. The option of taking a business loan presents another constraint. The applicant must "have a viable business proposition . . . He must have an idea about how to use the money to make more money, and convince the bank that the idea is sound." And if the loan is for investment in property, then

> . . . the constraint may not be primarily lack of security but lack of credit worthiness. Foreclosure on land security is a last step and one which the lender hopes to avoid. The lender in the first instance relies on the borrower's apparent ability to pay back the loan. The lender examines his savings record, his credit record, if he has any, and attempts to form an estimate of his reliable income flow. If the applicant for the loan cannot satisfy the lender on these points, and many without modern sector employment will be unable to do so, he may not get the loan even if he can offer good security.
>
> (Botswana: Presidential Commission on Land Tenure 1983, 26)

But assuming that the credit can be raised, there is not guarantee that the capital can be invested economically. The operations in rural African farms are too small to realise the enough profit to service the loans. The farmers lack proper management know-how and business practices to manage the funds. Machyo (1969, 104) reports that in Kenya,

> . . . African farmers settled on the former European lands have experienced great difficulties in repaying their loans and some have in fact abandoned the idea of becoming rich over night through inheriting the whiteman's land rights. In Uganda, the Ugandan Commercial Bank as well as the Uganda Development Corporation where schemes of granting loans to "progressive farmers" and small industries have been carried on for some years, have had bitter experience of failure of businesses advanced.

And in Zimbabwe, Takaoma (1999) reported recently that over 80 percent of the 1200 indigenous commercial farmers throughout the country are facing foreclosures from the Agricultural Finance Corporation due to outstanding loans with some of the farms having already been auctioned at far below market prices.

So, even though "the new need is for capital to invest in new opportunities," and, at least in theory, "this may in part be obtained through loans extended against security of the land" (Botswana: Presidential Commission on Land Tenure 1983), land tenure reform alone will not ensure that lending institutions will lend on the security of rural land. The Presidential Commission further notes that "if land is to be good security for a loan, the lender must be able to sell it to recover his loan, in the case of default." But it has been noted that the size of the rural land market is too small. Moreover, most land reform programs place restrictions on sale of land.

The Land Market

A common feature of many African land reform programs is the restriction of the right of alienation of the rights. These provisions appear at odds to one of the main objectives of land reform: to stimulate economic and beneficial use of land. The market is expected to redistribute resources in favour of people who have more private initiative. The market is expected to entrench merit and individual effort as opposed to non-competitive birthright entitlements.

All these expectations may be true and have been observed to occur in other jurisdictions. But they may equally be wrong, and there is another set of very negative possibilities, which have also been observed. So, while a free market is expected to allow people who can afford it to acquire more land and create suitable economies of scale, they also present the possibility of land concentration and landlessness. Creating a landless class will result in social upheavals that will far outweigh the gains of whatever economic progress could have been made by allowing a few individuals to amass land. That is why the (Botswana) Presidential Commission cautioned against the "real possibility that the disadvantages of radical changes in land tenure may far outweigh, at least for the time being, any benefits resulting from such changes." African countries do not have comprehensive social welfare systems to cater for the disadvantaged citizens. Even if there were social welfare schemes, to create communities of landless welfare dependants would not be considered progress. And so ironically, our independent governments seem to use that the same paternalistic arguments the colonial administration used to restrict sale of land: that the natives were not sophisticated in real estate markets and will lose their lands to the new settlers.

However, there is an important difference. The colonial administration's motive was to create 'reserves' of cheap labour for their farms and estates. The independent governments, on the other hand, are trying to prevent the creation of disenfranchised communities of cheap labour for the landed elite.

Sale of land is not always completely outlawed, but rather controlled by requiring the consent of some designated official. Sometimes the restrictions only apply to alienation to foreigners. There are other more overt reasons for this control than the desire not to create cheap labour, which is never stated as such.

All reforms based on nationalisation require approval for sale of land. For example, the Nigerian Land Use Decree provides in Section 21 that "it shall not be lawful for any customary right of occupancy or any part thereof to be alienated by assignment, mortgage, transfer of possession, sublease or otherwise howsoever—without the consent of the Military Governor. . ." Section 22 provides the same restriction for statutory rights of occupancy. This is an obvious consequence of the nationalisation of all land. If all land is now vested in the Governor and citizens only have use rights, then the substantive owner needs to control the alienation of the right. It should be noted that we are not here making any arguments in support or against such provisions, but merely presenting the logic behind them.

Another common form of control is a restriction on sale until the possessor of the land satisfies some development covenants. These provisions follow from the fact that the stated objectives of land reform usually include the encouragement of land development and prevention (or at least, reduction) of land speculation. In more diverse economies, the land market may exist as an end in itself. That is, there are people whose contribution to the economy is just to buy and sell land. They are an important component of the economy.

Most rural African economies are mono economies, concentrating almost entirely on the production of unprocessed agricultural or other land-based resources. Land markets in such economies are small, with few activities. Incessant land sales in such economies can only be fuelled by speculation, with detrimental effects on productivity. The development covenant is therefore used as a mechanism to curtail land hoarding and speculation, and achieve a minimum level of development.

Formalisation of Rights

Like all land systems, African land tenure consists of several rights that can be vested in different people at the same time. These may include rights of access to, or through the land; withdrawal rights to take resources from the land; management rights to make decisions that affect the land's condition; exclusion rights to determine who may have access, withdrawal and management rights; and disposal rights to dispose of any or all the rights that one has. Structures exist in the community for enforcing one's rights against others, thus making these rights property rights. Such property rights are mostly de facto, having been accepted over time, rather than de jure—deriving from some legal instrument of the government. These de facto rights are normally simple and fluid. The small size of the community units, and the kinship relationship between members of the community make them easy to enforce, as there was little competition. The egalitarianism attributed to these customary tenure systems derives partly from the fluid and unspecified nature of the rights, which provides access to land for younger generations of the community.

Because of the simple nature of the rights, and the high-level of community cohesiveness and co-operation, as opposed to competition, there has not been the need to fully specify these rights. This non-specific state of rights should not be viewed negatively:

> … incomplete property rights need not be irrational, paradoxical or imperfect. There are good reasons why property rights are not always perfectly specified or enforced. Most important, it is costly to specify, monitor and enforce them. Goods have many characteristics; to be complete, rights would have to be established and enforced over every valuable characteristic of every good. However, in the real world, it is costly not only to determine which goods are valuable and should be protected, but also to police compliance and punish offenders. Because of these costs, … property rights are never completely specified and enforced, nor would it be cost-effective to do so.
>
> (Ensminger and Rutten 1993, 89)

However, with globalisation, especially of markets and information, communities that used to be isolated and remote are increasingly being integrated into the global community. Needs that used to be simple are becoming complex and the simple community structures are becoming less able to support the emerging system of rights and rules. At the same time, with the expansion of transport and communication infrastructure, the government is increasing its influence. Central government structures like administrative offices, courts and police are now resorted to for establishing and enforcing property rights. There is therefore a need for these rights and rules to be specified more clearly than was necessary so that "outsiders" with whom we have to deal will know what to expect and what is expected of them. While some of the customary rights and transactions have Western equivalents, many do not. Care should be taken not to omit this latter group of rights and transactions. They should all be identified and formalised.

Registration and Information

Various jurisdictions maintain various registers such as firearms, medical practitioners, surveyors and others. These registers are administrative records concerned with particular aspects of the community. Because of the importance of land in any society and certain characteristics it possesses, the registration of rights in land has required special treatment, different from other administrative records. In any records system, the attributes of interests are determined and recorded against discrete entities. With land, the entities are units of land, which are continuous and contiguous with other units or parcels of interest. Special techniques are therefore required to define and identify the land objects or entities about which data are recorded. These techniques are the domain of land surveying.

The immovability of land gives it certain advantages over other objects of property, resulting in, for instance its use as savings and investment, and as collateral for securing loans. The same immovability presents certain disadvantages. Since a purchaser cannot remove their purchase to a safe place, a fraudulent seller could, for example, try to sell the land parcel again to another unsuspecting buyer. Different land registration systems have therefore been developed mainly to prevent this possibility of fraud in land transactions, with an equally important objective to facilitate them and reduce associated costs.

It has been suggested that the land market is small in rural Africa. The cost of establishing and maintaining a registration system dedicated to land transactions may not be justified. However, with property rights being formalised, and administrative structures established to manage them, including enforcing rules, there is need for an information system to support the administrative tasks.

The information system needed is in the form of a land inventory system that identifies owners of different rights in land, together with other land characteristics needed for planning and administration. Such an inventory does not require expensive cadastral surveying to set up, especially with modern measurement systems, like the global positioning system (GPS). With proper design of the information system, land under different types of tenure can be provided for. Also, the system should make provision a variety of attribute data. And should be capable of being kept in paper medium, if computer resources are not available.

Conclusion

Africa has had a long history of land reforms. And the reforms are continuing for various reasons, in some places, to redress injustices of the past. Examples are South Africa, Zimbabwe and Namibia. In others, from a realisation that no state of affairs is perfect and there is always room for improvement. For example, the Botswana land tenure system, which is referred to as a successful example, is about to be reformed again. Tenders have just closed (July 30, 1999) for proposals to undertake an extensive review of the land policy with a view to recommending a new policy. As part of the global community, we are being affected and influenced by events happening elsewhere. The most important influences are the global market and information technology. There are few communities that are not affected. Even once remote villages now have access to regular information on world events in some form. With such regular contacts, direct or indirect, customs are continuously being modified, including land management and use practices.

Products manufactured in distance places are now available locally. These products are purchased with the earnings from products of the land. These lands are therefore being gradually, but definitely, being drawn into the global market. Global investors may therefore wish to invest "upstream" in the ultimate source of the products they buy and trade, the remote land somewhere in an African village.

Our land policies should therefore be prepared for such outcomes. However it does not mean that we should provide for these investors at the detriment of our people by copying completely their land management practices. Just like with languages and other customs, people who have to interact for mutual benefit, such as trade, may learn each other's language to facilitate the transactions, and may spend time to find out about dos and don'ts of the other. We accept differences in language and other aspects of culture. Land tenure is no different. As with most things, we should adopt what is good for us, and at a pace that will not cause social upheavals. Also as in other matters, we should make it easy for the "foreigners" in our midst to fit in by being consistent and providing them with relevant information.

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