

**An integrated geo-information system  
with emphasis on  
cadastre and land information systems  
for decision makers in Africa**

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[I would recommend a list of abbreviations and a short glossary defining specialist terms]

## Abbreviations and acronyms

ADOS African Doppler Survey

CBO [Community Based Organization](#)

AOCS African Organization for Cartography and Remote Sensing

FAO Food and Agriculture Organization of the United Nations

GDP gross domestic product

GIS geographical information system

GPS [global positioning system](#)

IGAD Inter-Governmental Authority on Development Countries

LIM land information management

LIS land information system

[ECE-MOLA: Meeting of Officials of Land Administration, Economic Commission for Europe](#)

NGO non-governmental organization

OSS Observatoire du Sahara et du Sahel

UGDA Unified Geodetic Datum for Africa

UNCHS (Habitat) : United Nations Centre for Human Settlement

UNDESA United Nations Department of Social and Economics Affairs

UNEP United Nations Environment Programme

UNESCO

UNITAR

WGS 84 (remove from the list of acronyms, and add to glossary)

**Glossary** [I would suggest to eliminate the glossary and put the definitions or explanations as foot notes in the text]

AFRICOVER project: [An on-going FAO project, aiming at establishing, for the whole of Africa, a digital geo-referenced database on land cover and a geographic reference.](#)

[Global Urban Observatory \(GUO\): a system of capacity building programmes and resources to help Governments, local authorities and their partner groups to monitor progress in implementing the Habitat Agenda and to expand the base of knowledge for better urban policy.](#)

[cadastre, cadastral](#)

[geocode](#)

[recordal](#)

[stakeholders' forum:](#)

[Unified African Datum: a common geodetic reference for Africa.](#)

[visual information settlement planning or VISP](#)

[WGS 84: World Geodetic System. An international geodetic system, based on satellite measurements. Currently the most precise geometric model of the Earth.](#)

## Introduction

This publication reviews the various types of cadastres and land information systems used in Africa. It assesses the overall status of these systems, the extent of their development, and their capacity to assist decision makers. Recommendations and guidelines are suggested to improve existing systems or develop new ones. The broad guidelines indicate how to adapt systems so that they can be used as analytical tools for land reform, physical planning, and the integrated administration of land resources, including environmental and socio-economic aspects. The major outcomes from this exercise should be, first, an increased understanding of the benefits of sound cadastral and information systems in national or municipal economies. Second, Member States should increase their awareness of the importance of modern cadastres and land information systems for decision-making, as well as for achieving the goals and political objectives of sustainable development.

An underlying theme is the socio-economic profile of Africa and the need for decision makers to gain information about the land so they can alleviate poverty without creating unaffordable costs to the State. It is useful, therefore, to bear in mind the actual income levels of people in Africa.

Some statistics—

- From 1985 to 1995 for the whole of Africa, the growth rate in GDP per capita was negative. In 1986, GDP per capita was USD 714 and in 1995 it was USD 665, with most years showing a negative growth rate
- Central Africa had the lowest GDP per capita and the largest negative growth rate. In 1985, GDP per capita was USD 493 and in 1995, USD 348, with a negative growth rate in all years. But in a generalized picture, not all countries in the region are equally poor
- North Africa has the highest GDP per capita with a small negative growth rate. In 1985, GDP per capita was USD 1290 and in 1995, USD 1273, with negative growth rates in half the years. Again, in a generalized picture, not all countries in the region are equally wealthy
- 48.8% of all urban households in sub-Saharan Africa are considered poor, and 45.8% of these are headed by women
- 48.6% of all urban houses in sub-Saharan Africa do not comply with building regulations
- For the African continent, the land-to-person ratio, which indicates pressure on land, has decreased from 0.62 hectares in 1965 to 0.26 hectares in 1995
- Some of the backlogs that have to be addressed in urban households in sub-Saharan Africa are that 31.6% have no potable water, 87.1% no sewerage connection, 57.5% no electricity connection

These figures are somewhat simplistic concerning the assessment of disposable income, of either governments or individuals, in relation to spatial information and surveys. They do not take into account tax rates of countries or their debt repayment obligations. Potential bilateral and multilateral funding and the effect of the future global economy have not been considered. Rather, these figures have been presented only as background information.

This information is critically important, as highly technical approaches and costly solutions are often proposed in the field of cadastral and spatial information. This information should

enable decision makers to reach better decisions and to assess alternative and new solutions when they are proposed for developing land information management (LIM) and cadastral systems.

# 1 Background

## 1.1 History

The United Nations has been involved in cadastral and land information issues since its inception. In the early 1950s, FAO published a series of monographs including one on the registration of rights in land.

In 1972, the United Nations called together an ad hoc group of experts in response to a resolution of the Sixth United Nations Conference on Asia and the Far East. It requested the United Nations to “study in depth the problems of cadastral survey and to consider the setting up of a permanent committee to keep developments in this field under constant review”. The report produced a series of guidelines directed particularly at developing countries.

A further meeting of a group of experts was convened in 1983 and updated the 1972 report. It stressed the need for speed, economy, and efficiency and encouraged the use of computer technology in developing land information systems.

In 1970 (it's ok), ECA held a seminar in Addis Ababa, Ethiopia, on the cadastre in response to a recommendation made by the Second United Nations Regional Cartographic Conference for Africa. This was then followed in 1992 when ECA developed a Compendium in Cadastral Regulations and Land Tenure Policy in Africa. In 1996, ECA in collaboration with the Observatoire du Sahara et du Sahel (OSS) undertook a subregional workshop, also held in Addis Ababa, on Land Tenure Issues in Natural Resource Management in anglophone East Africa. Its focus was on the Inter-Governmental Authority on Development Countries (IGAD).

Under the auspices of the United Nations Department for Development Support and Management Services, an interregional meeting of experts on the cadastre was held in Bogor, Indonesia, in 1996. This came about as a response to a resolution from the United Nations Cartographic Conference in Asia and the Pacific held in Beijing in 1994, which recommended that a range of cadastral options be determined to serve the different needs of countries in the Asian and Pacific regions. An outcome of the interregional meeting was the Bogor Declaration.

In 1996, the United Nations Economic Commission for Europe produced a set of guidelines on land administration for countries in economic transition as its contribution to the Habitat II Conference.

In 1997, the United Nations Department for Development Support and Management Services in New York called an ad hoc expert group meeting on legislation for surveying and mapping. It was held in parallel with the Sixth United Nations Regional Cartographic Conference for the Americas. The meeting was convened in response to a request contained in Resolution 14 of the Thirteenth United Nations Regional Cartographic Conference for Asia and the Pacific held in Beijing in 1994. An outcome of the meeting was a report on legislation for surveying and mapping.

This study does not summarize the reports and guidelines produced by these previous meetings as it presumes that all this information has become part of the accepted body of cadastral knowledge. Rather, it builds on all this previous work as it introduces additional approaches tailored for an African environment.

## **1.2 A land information management system for decision makers**

The major purpose of an LIM (either way) system should be to assist decision makers. The system designers should not have as their major focus the technical issues and logic associated with such systems. Rather, they should work to create an LIM system that increases the country's capacity to collect, interpret, and apply information, to establish trends, and to enable better decision-making.

## **1.3 Information is data**

What is information for one person might be data for another. Therefore, in this report, "information" is used to mean both data and information.

## **1.4 Variation**

As there is an enormous variety of conditions among African countries, each of which has distinctive characteristics, no attempt is made to develop a blueprint. Rather, analyses are intended only to establish broad parameters and introduce a range of possible new approaches that fit better within the African environment, with characteristics that are often unique. While most of the parameters discussed apply to many countries, some of the technical frameworks might apply more in Member States that do not yet have a fully developed cadastre. The technical approaches can be used to a greater or lesser degree to improve the amount and type of information available to decision makers, but this varies across the Member States, as it depends on the level of their existing cadastral development.

## **1.5 Colonial history**

One of the major challenges confronting most countries is the laws and regulations the colonial administration introduced to serve the interests of the colonial power. These laws were not designed to serve the needs of the country or the population. Consequently, separate cadastres have often developed, operating as informal systems in parallel to the cadastral system based on the colonial legislation. Because the nature of cadastral and property rights is complex, these laws and regulations remain entrenched in many countries to this day.

## **1.6 Politics, the cadastre and land information**

Cadastral and land information systems do not exist in isolation from the general political events of the nation. They are integral to its politics, because information is power, as is the allocation of land. For this reason, an approach should be taken that is sensitive to the political side, rather than one that is purely technical.

## 2 Decision makers and the present cadastral systems

A review of the cadastral and LIM systems in Africa indicates that land management decision makers in general are not presently obtaining sufficient information from these systems to make informed decisions. This is largely because—

- there is no documentary evidence of title for up to 90% of the parcels in developing countries, with an estimate that less than 1% of sub-Saharan Africa is covered by any kind of cadastral survey
- most African countries do not have an LIM system using LIS and GIS as a management tool. These systems either do not exist, or have lapsed, or are seen as too expensive
- cadastral systems, generally in manual form and incomplete in coverage, are supplying most of the available land information. No alternative source of comprehensive information for land management has been developed

The approaches and difficulties associated with most of the cadastral systems have a direct effect on the quantity, timing, and type of information available to decision makers. Major problems with cadastral systems are many—

- There is a general lack of financial, technical, and human capacity throughout Africa. Because the systems have inadequate resources, many are out of date, expensive to maintain, and inefficient. This restricts the amount and type of information that can be acquired, stored, and disseminated for decision makers to use.
- A World Bank study on Africa showed that if no dispute occurs, the process of land registration takes an average of 15 to 18 months, and that a period of 2 to 7 years is common. This lengthy and costly procedure means that tens of thousands of land titles are pending. Thus information is not available to decision makers in a timely manner. This in turn means that decisions are made without any real knowledge about the situation, which undermines sound land management practices.
- Most of the systems are centralized, which means that district and local decision makers have virtually no access to information held on the cadastral system. This has an impact on the sustainability of land management decisions.
- Available information often relates only to the part of the city or rural area where formal legal procedures were used for planning. Yet most decisions need to be made about the non-formal, customary parts of the country, which are not covered by the cadastre.
- 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. Cadastral system development has not kept pace with the information requirements of developing country decision makers.
- Where information exists, it is often spread among several government departments and gaining access to it is difficult. Most developing countries, including African countries, need to reduce the excessively high number of institutions involved in information flows on land management. They are usually public, highly centralized, not well managed, and have overlapping responsibilities. Because of this situation, decisions that require integrated and timely information tend to be made without any real knowledge about the situation.

- Survey and mapping departments tend to be isolated within the government. This diminishes their influence on decision makers and makes it even more difficult for decision makers to use the information they hold effectively.
- Surveyors are often reluctant to change existing legal frameworks or relax current registration systems. Yet high standards of accuracy linked to legal accountability issues often make cadastral systems cumbersome and inflexible. This in turn slows down the processes of creating information, makes it difficult to form institutional alliances within government in the information field, and increases costs. All this directly affects the amount of information available to decision makers, as well as its timing.
- There are often no clear land or information policies in a country or the policies are outdated. Such policies generally relate to economic development, social justice and equity, and political stability. Land policies may, for instance, include or promote security of tenure, improved access to credit, land reform, land titling, the resolution of issues related to customary or informal settlement tenure; they may facilitate access to land for the poor and especially for women, and give guidance on land use and measures to prevent speculation. In the absence of such policies, it is very difficult to set priorities on the work of the land office or to obtain an adequate budget by linking the work to government objectives. It makes it difficult for surveyors to distribute information to a range of decision makers outside of government. Without a clear policy on land and information related to it, it is unlikely that the information in a structured format can be made available in a timely and transparent manner to decision makers.
- Many of the parcels in the cadastral systems are cloudy and information on them is ambiguous despite attempts to create cadastral systems with highly accurate information. This sends a mixed message to decision makers. On the one hand, they cannot obtain information in a timely manner because of the time taken to produce unambiguous title deeds, but on the other hand the information they receive often needs to be treated with caution, because it is not certain or may not be complete.
- There is a great shortage of urban mapping. Although cities are often the engine rooms of a country's economy, making sound decisions in urban management is made almost impossible because of the lack of information.

Linking cadastral systems to other land information systems has proved problematic because of—

- a lack of technical, human, financial, and management capacity
- the low quality of data and non-standard information collection
- institutional fragmentation
- power struggles over information at a number of levels
- poor horizontal and vertical links—communication, institutional, technical
- lack of unique identifiers within the data sets
- lack of parcel-based information
- ignorance of user requirements among technical people involved with the cadastral and information systems
- general lack of awareness of the applications and implications of LIS
- governments and departments within governments that do not treat information as a resource

### **3 Integrating surveying into a multidisciplinary land information management system approach**

#### **3.1 Land information management—more than a geographical information system**

An LIM system consists of a number of broad dimensions such as, first, a technological dimension (for example, hardware and software). Second, it consists of a set of organizing procedures, which structure the relationship among the functional components, and third, an institutional element, which includes a corporate structure. Fourth, it includes a platform or a resource base, on which data are stored and from which meaningful land information can be produced, analysed and disseminated. Finally, it includes an explicit, or implicit, policy towards users with transparency, information dissemination, and so on, often reflective of the state of the country's land policy, or lack of policy.

#### **3.2 A shared spatial framework**

The spread of, first, GIS and second, the multidisciplinary and participatory approach to development, challenges surveyors to develop inclusive rather than exclusive approaches to solve development problems. Surveyors have for years shared and used a spatially referenced framework, namely the geodetic network, to do this. More recently, the concept of a spatial data infrastructure (SDI) has been developed to allow efficient access to appropriately structured and spatially referenced data from many sources. However, both a geodetic framework and an SDI can generally be used only by specialists.

A spatially referenced framework should be developed that can be understood and used by a wider range of stakeholders and decision makers, with visualization being a core component of such a framework. At the same time, the framework should not ignore the needs of measurement experts. Such an inclusive reference framework should be developed for use by decision makers—nationally, regionally and locally.

#### **3.3 The land information management system and the cadastral system—separate but linked**

As less than 1% of sub-Saharan Africa is presently covered by cadastral records, and 90% of land parcels are undocumented in developing countries, it can be presumed that the cadastral layer in any existing or future LIM system in a country will in all likelihood either not be present at all or it will exist in an extremely incomplete form.

If the cadastral layer is completely left out of the initial design of an LIM system, it is possible to take a fresh approach in designing the system, as the design is not constrained by the limitations created by the cadastral layer. African conditions therefore allow new approaches, whereby the cadastre becomes a subsystem of the LIM system, rather than as is more conventional, the LIM system is subordinate to the characteristics of the cadastral system. If the LIM system is the dominant system, it is possible to avoid some of the design characteristics associated with a cadastral system, such as high accuracy, the requirement of legal evidence, and reliance on measurement-based approaches and professionals skills, and instead introduce other approaches that facilitate the development of an LIM system. (other approaches which do not rely on traditional cadastre systems, it's ok)

This does not mean that the cadastral layer should be eliminated entirely from the total LIM system. Nor does it mean that the LIM system should be used to replace the national cadastral

system by including in its design some of the characteristics conventionally found in cadastral systems in a lesser form, for example weaker forms of legal evidence or reduced spatial accuracies. Rather, the design of the LIM system should not allow these cadastral characteristics to limit the scope of the LIM system. Rather, in a phased design, linking mechanisms should be set up so that the existing national cadastral subsystem can be coordinated with the LIM system, but not dominate it, as is discussed below.

### 3.4 Conveyancing and mortgages not the primary design criteria

The primary purpose of an LIM system in the African environment should be to supply information for sustainable national and regional development, not for conveyance and mortgage. As indicated, there are few cadastral parcels in most countries, which implies that conveyance has only a small role. Mortgage should not be a critical issue for design. First, banks need to be able to foreclose on properties, and this can be problematic where there are extensive group or customary rights. Second, banks prefer to lend to individuals who are employed or who are already generating an income from the land, and who therefore have a disposable income with which to repay the loan. Income figures indicate that only a small percentage of people have such a disposable income. Therefore, these factors indicate that while mortgages are a useful legal instrument in a country, they should not dominate the design of an LIM system.

### 3.5 Various degrees of accuracy (accepted)

Approaches should be put in place that make it possible to use information of various degrees of accuracy within the same LIM system. Various degrees of accuracy should be accepted because—

- the cost of generating accurate and comprehensive standardized information is high
- the approach that precise surveys are needed to prevent possible problems in the future is adding to present-day problems, because there is insufficient information for decision-making
- it is difficult to harmonize standards when high accuracy sets the standard against which all other information is assessed
- human and financial capacity are lacking
- there is a possibility of using information produced for other purposes and by non-surveyors or non-professionals to populate the LIS and GIS. (it's ok, to populate the database, create the content of the database)
- a range of new, cheap technologies available makes it possible to generate information with less accuracy quickly and in quantity

### 3.6 Sustainable development

Sustainable development is defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. Although the term can be deemed too broad, it provides a framework that can be applied at different scales—global, national, regional, or local—and in different contexts and different places.

Sustainable development requires integrating a range of systems. In designing land management systems, it is critical that processes be put in place that integrate the principles of economic, social, and ecological sustainability. Economic sustainability requires economic growth through the reorientation of technology and the development of an economic system that is able to generate surpluses in a sustainable way. Sustainable patterns of global trade and finance require restructuring the current global economy, as it is presently increasing the vulnerability of many communities and countries. This principle should be taken into account by LIM system designers, specifically in relation to the choice of technology and the funding approach adopted.

Social sustainability reflects the principles of democracy, social equity, and empowerment by ensuring that the needs of the poor are met. This implies that social and environmental justice is given priority and that development programmes build on social capital, empowering people to participate in finding long-term solutions to problems. This principle as it touches an LIM system, means user access to information and linking due process to the technical processes of titling and land-use allocations.

Ecological sustainability stresses the importance of living within local and global carrying capacities and protecting the functioning ecosystems. This principle should be taken into account in LIM system design in regard to such things as the development of appropriate databases and data sets that supply information to decision makers, so that they can manage the environment better.

### **3.7 Participatory land-use planning decisions**

There has been a move away from the “package of plans” approach. In this situation the land parcel had to accord with the land use designated on a plan or be changed by the authorities to reflect a new use before the parcel was resurveyed. Surveyors often found themselves unable to finalize a survey (first titling, subdivision, or consolidation) because the land-use decision about the parcel had not been made by all the requisite authorities. This rural land-use planning or urban planning approach has fallen into discredit largely because—

- it is seen as a top-down exercise imposed by centralized authorities and not locally demand driven
- central government institutions have not had the human capacity to implement the plans locally
- land-use or planning decisions take an enormously long time
- the costs associated with the collection of comprehensive and accurate information are vast
- the focus is on the accuracy and comprehensiveness of information rather than producing critical information in a timely manner
- it does not take into account the de facto situation on the ground, often because there is no information available at the central level
- it does not take into account the wishes or needs of those already settled on the land
- sometimes different government departments have different plans for the same area, leading to overlapping allocations of land use and ambiguity on the ground

- it is not sustainable as the people on the ground are unlikely to adhere to the plans if the plans do not facilitate their own survival, or they do not have the financial capacity to follow the plans, or they do not understand the logic behind the plans
- if a plan is not followed, the government structure trying to put it in place is discredited, and this undermines good governance in general
- identifying user needs is not a static intellectual exercise but involves a dynamic process of resolving conflict among actual and potential stakeholders

Planners are becoming aware that they need to move away from a prescriptive approach to one of participation that facilitates the integration of the social and institutional dimensions of land management with the technical. Urban management plans and technical natural resource surveys should be integrated with participatory approaches. This integration needs to take place at the lowest possible level and involve all stakeholders in the decision-making process.

A centralized approach tends to require extensive collection of data, both quantitative and comprehensive. A participatory approach, on the other hand, tends to avoid cost. As it is oriented towards building consensus and resolving conflict, it requires a more selective set of information that is qualitative and semi-quantitative—in particular, socio-economic data and environmental indicators, both rural and urban. The people using the land are seen as the providers of critical information. This latter approach is therefore not only more cost effective but also generates land information in a timely manner.

Each group of stakeholders needs to be able to assess its needs based on its perceptions and understanding of the land issue and the availability of information. Consequently, it is essential to identify what information is critical, to establish a hierarchy of user needs and to negotiate successfully among the major stakeholders. An LIM system should supply this information, and in a way that encourages sharing knowledge and makes it possible for all stakeholders to use it, both by making it user friendly and by building capacity in stakeholders. Local or “insider” knowledge should receive priority, rather than professional or outsider knowledge automatically being considered first.

The LIM system should include the data sets being created at the centre by the macro, broad-brush or initial planning exercises and surveys. It should also include the information created on the ground as an outcome of stakeholder negotiations. It should manage the information flow between the centre and the locale, as this flow is critical to the success of participatory land-use decisions and knowledge sharing.

Finally, land-use or planning decisions generated locally after a participatory exercise has critical implications for the technical processes associated with cadastral surveying—coordinating institutional links, keeping records, creating legal evidence, and timing the survey. It should be possible for the titling and adjudication of land rights to be associated with the exercise of negotiating land use. If these two processes are associated on the ground, it should be possible to introduce other local forms of legal evidence into the technical processes associated with cadastral surveying and land registration and thus start to limit the colonial forms of legal evidence.

### **3.8 Decentralization**

An LIM system should serve decision makers regionally, nationally, and locally, with the emphasis on decentralized decision-making. Nearly all countries are in the process of decentralizing and redefining the role of the State, partly because so many centralized policies of land management have not met expectations. Decentralization means the

devolution of powers, functions, resources, and administrative programmes from central government to regional or local authorities and even to lower tiers at the community level. Activities that should be decentralized include land registration, allocation of public or publicly controlled land, all permits and approvals needed to undertake development of land via a “one-stop shop”, land-conflict resolution, land-use planning and management, and local strategic plans (about concerns such as the environment, disaster prevention, land taxation).

Such decentralization should create better vertical coordination between bottom-up information and local interest and top-down information and policy guidance that can harmonize overall national development policy with local programmes. Also, when decentralized systems of data collection are put in place, the fragmentation of information that takes place when different central agencies collect and disseminate it should be limited. However, the decentralized collections need to be systematically interconnected through common networks to improve opportunities for using the information. That is, network interconnectedness, both technical and institutional, vertical and horizontal, is integral to the design of an LIM system.

For vertical coordination to take place, a coherent national legal framework needs to be developed for land management in urban and rural areas that allows communities to express themselves according to local rules, including forms of organization and leadership. Creating such a national framework is critical, as local institutions acting alone cannot define the rules by which they interact with outsiders. Local groups and community-based systems are instead nested within a State legal regime. Equally, local rules cannot define the limits of State power, and State law provides the basic protection for individuals, such as third-party rights. State law also provides the basic guidelines for protecting important wider societal interests, such as watersheds.

Given the common link between land information and the technical processes associated with the cadastral system, any efforts to decentralize and disseminate information on land acquisition and land records and registration should carefully study the legal framework already in place. The efforts made should try to change the legal regime to make local land management easier.

### **3.9 Application driven rather than government programmes**

Conventional wisdom has it that large-scale, compulsory, systematic titling of smallholders is more cost effective than sporadic titling. Now doubt has been cast on this approach, especially for rainfed agricultural areas under customary tenure in sub-Saharan Africa and for highly mobile, poor urban populations. Rather, it is suggested that titling activities should be focused on localities of particular need—that is, they should be application driven and sporadic—and compulsory titling should be confined to circumstances where land is subject to intense competition.

In addition, governments, given their lack of human and financial capacity, should avoid undertaking and paying for cadastral surveys. Rather, surveys should be undertaken by the private sector and paid for by the applicant. In this way, investors and developers applying for high-value land should fund the survey and registration of such land. However, titling should not take place until, and unless, local communities have been consulted through an adjudication and negotiation process, to ensure that the resource base and space of the poor is not taken away during the titling process. Government should instead assure the quality of the process, laying the ground rules, setting the technical standards and legal evidence

requirements, monitoring that the rights of the poor are not infringed, and storing the information on the cadastral records and in the LIM system.

Small commercial undertakings and local developers, as users, should pay for adjudicating, negotiating, and titling, unless the government considers that the programme warrants subsidy.

### 3.10 Due process

A range of due process mechanisms should be developed to facilitate equitable economic development associated with land. Such mechanisms include local community land management forums or courts, planning appeal boards, education of citizens about their options and rights, adjudication and negotiation procedures that accompany the change of land use or land rights, and memorandums of agreement between departments responsible for land-use decisions. An LIM system should be set up to supply information to all stakeholders using mechanisms of due process.

### 3.11 Local record systems

For land registration to work in Africa, the system itself needs to become more accessible, in location, cost, and user friendliness. The land office should be local, and it should be user friendly to poor, often uneducated people. Such an approach challenges many existing land registration systems, which are generally—

- centralized
- expensive to the user; thus, the cost of complying with official laws and procedures increases the likelihood of non-compliance
- designed for use by the educated middle class or the previous settler population
- serviced exclusively by professionals, who are generally expensive and have a different corporate culture from the urban and rural poor
- capable only of recording legal land parcels and not the 30–80% of illegal land parcels (urban) and customary areas that exist in most developing countries
- serviced by technical personnel, who often have little experience in the urban informal aspects of land delivery; also, they likely have little experience with the legal and social processes associated with the range of customary tenure practices in a country
- based on colonial laws in regard to family law, inheritance, forms of evidence, administrative procedures, and so on
- based on individual rights and do not accommodate group rights or family rights
- based on a patrilineal system, whereas many countries in Africa have matrilineal inheritance systems
- not designed to resolve conflict over land use or facilitate decision-making
- not transparent or user friendly
- not designed to give legal advice to poor people who cannot afford to pay for legal services
- accountable only to professionals (public and private sector) and the courts, both expensive, rather than to the communities affected by their dealings

Such centralized land registration systems lead to land management problems such as—

- lack of up-to-date records, which hinders land readjustment, consolidation, and provision of service
- the abuse of third-party rights of those occupying the land

- lengthy approval processes and bureaucratic delays
- lack of knowledge about property rights and responsibilities by those who have been excluded from the system
- sustainability (agreed, lack of ..) of titling measures and land-use controls
- cumbersome, lengthy, time-consuming legal and administrative procedures

The failure at all levels to adopt appropriate rural and urban land management practices remains a primary cause of inequity and poverty. Where local registries exist and make information accessible to the public, it is possible to—

- build local knowledge about property rights and responsibilities, thereby improving the legitimacy and sustainability of the system
- protect the rights of those occupying the land, thereby increasing their security of tenure
- make land-use planning more sustainable
- help keep registry records up to date
- build local land management capacity to the point where people are not entirely dependent on professional outsiders, which increases the total capacity of a country
- get people to feel that the registry office is a local resource
- get poor people to reregister their land and undertake transfers
- ensure transparent and more comprehensive systems
- locally and cheaply solve most boundary and inheritance disputes and disputes of the group versus the individual
- provide a framework for negotiations between the different actors involved in land rights and land-use allocation
- guarantee public access to land records and registers
- avoid some of the lengthy legal and administrative delays that are linked to land delivery procedures driven from the centre

Such local registration systems should be put in place. The cadastral technical processes should then be linked to participatory land-use decision-making, so that land rights and land-use rights are adjudicated and negotiated at the same time. This should facilitate information flows within the LIM and the cadastral systems. Information collected and made available locally should be passed on to the national institutions and vice versa, in an appropriate way.

### **3.12 Merging the formal and informal land-tenure systems**

Unless informal and non-formal systems, such as informal urban settlements and customary areas, are combined with formal systems they will continue to defeat the goals of governments, investors, developers, and development agencies, who are trying to supply security of tenure, economic development, poverty alleviation, food security, and sound land management practices. The informal systems of land tenure, delivery, and use should be absorbed into the formal system. This merger means moving away from inappropriate policies, laws, standards, financing mechanisms, allocation mechanisms, and the inability of central governments to deal with conflicting claims. An LIM system should include information that covers the whole spectrum of systems—formal, informal, and customary.

### **3.13 Gender equality**

An LIM system should ensure that men and women have full and equal access to the economic resources of the country. Security of tenure is a condition for providing adequate shelter for all, in both urban and rural areas, and for developing sustainable human

settlements in an urbanizing world. Security of tenure is also a condition for food security, especially for the rural poor. Market interventions in rural and urban areas tend to impoverish women more by decreasing their rights to land. Therefore, there should be female and local participation in any decision-making process concerning the land and its use, especially during any adjudication and titling exercise.

The LIM system should be created only after a gender-sensitive analysis has been undertaken. This is important not only for the security of tenure of women in rural and urban areas but also for keeping the system current. If women are excluded from the system, they will not use it, and this could result in records not being kept up to date because of informal transfers and land-use decisions.

The LIM system should aim at removing all barriers to women's access to resources and ensure their full participation in all the decision-making processes associated with the system, whether as users, decision makers, generators of information or property owners. There should be special regard for women in poverty, especially women heading households, women farmers, and women who are the sole providers for their families.

### **3.14 A range of identifiers**

Undocumented customary tenure is the most common form of landholding in rural sub-Saharan Africa. Undocumented tenure or tenure under cloudy title, sometimes linked to a parcel but often not, is the most common form of landholding in urban sub-Saharan Africa. Databases should accommodate a range of identifiers, georeferenced parcels, unreferenced parcels, lines, and points. Both parcels and non-parcels can then be used when information is collected, analysed, or disseminated (section 5).

### **3.15 Cost effectiveness**

An LIM system design needs to avoid costs and make cost-effective choices concerning standards and partners, whether they be other departments in government, the private sector, NGOs, or bilateral and multilateral funding agencies. Cost effectiveness should be assessed not only in regard to acquiring the GIS but also in regard to maintenance and running costs, local training costs, and after-sales service provision. The technology should be affordable after the completion of the project is completed.

### **3.16 Vision**

An LIM system should be created where the primary focus is the user—the decision maker. The first outputs from an LIM system project, before the technology is acquired, should be a user's requirement analysis and a stakeholders' forum (section 6) to improve institutional coordination.

Also before acquiring the technology, a technology business plan should be created. It should be a street map for the project and it should include objectives, business requirements, purpose and use, primary output or function, implementation strategy with stages and phasing, institutional matters, staffing, training, life-cycle costs, procurement strategy, maintenance, and replacement. The specifications for the information technology should be written independently of the technology approach. They should be written in terms of objectives, product, and function, and not in terms of the technology or method used to produce a product. In this way, emerging technologies can best be considered for the project or programme. System designers can then propose optimal solutions involving appropriate

technologies and methods. Finally, the technology chosen should be appropriate, cost effective, and within the capacity of the country or agencies involved to purchase, install, and maintain it efficiently.

#### 4 Decision makers and decisions to be made

Decision makers need spatial information. Examples are—

- government departments across many sectors—national, provincial, and local
- planners—rural, urban, regional, and financial
- decentralized community and district structures
- private and commercial investors—including those wishing to exploit natural resources
- developers and real estate agents—formal and informal
- people from a range of disciplines
- politicians—national, provincial, and local
- natural resource and urban managers
- smallholders, farmers, and farmer groups
- householders—with formal and informal tenure, with formal and informal buildings
- traditional chiefs
- informal settlement leaders
- local and international NGOs and CBOs (community based organizations)
- national and international agricultural research institutions, both public and private
- individuals involved in land reform, land redistribution, land readjustment, and consolidation
- planners of health services and education
- developers and managers of sewerage and water articulation and transport engineers

Perhaps as many as 80% of decisions are based on spatial information either directly or indirectly, with some decisions more clearly having a spatial component than others.

In many countries, because decision makers lack information, there is a divide between the reality of the urban or rural situation and the ability of the decision makers to comprehend that reality. They need information to make decisions in a range of situations, some of which include—

- resolving conflicts, where information is needed to facilitate adjudication and the negotiation of land rights and land use
- planning for urban development, where information is needed to facilitate land delivery, readjustment, and consolidation
- managing natural resources, where information is required for efficiently exploiting them, for undertaking environmental impact assessments, for monitoring the use of the natural resources of the country, and for enforcing laws against exploiters who are degrading the environment
- managing a country's political relations, where information is required on international boundaries, and for internal political relations, on provincial and local administrative boundaries
- managing potential disasters, where information is required on human settlements in rapid transition such as refugees and other populations suffering from famine, drought, or war
- managing buildings and housing stock to ensure that they are sufficient for the population, where information is required on the amount and quality of buildings in the country

- managing cities, where information is required on human settlement patterns, tenure patterns, buildings, and existing services and infrastructure
- handling land administration, where information is required on where concessions have been allocated, what customary areas exist, what roads are in place, and so on
- developing policy (national, provincial, local), where information is required on the existing situation and what are the problems and opportunities

Decision makers have to deal with conflicting desires for land use when making decisions, such as for urban land, which is needed for housing, industry, commerce, infrastructure, transport, green spaces; and between water, sanitation and health, (it 's ok, conflict between water which to the greatest extent is used for agriculture, and the use of water for human consumption and sanitation) between the economy and the environment, between cities and the hinterland. Decision makers also need compiled information; they must know the needs of all stakeholders, including needs for cultivated and grazing land, water supply, firewood, building material. They need to know the economic, social, legal, and institutional framework within which negotiations are taking place and what actions are being delivered. Finally, they require information over time, so that they can compare such things as rate of change and rate of degradation to decide among the different options.

## 5 Stakeholders' forum and user's requirements analysis

To manage land effectively at least three elements should be present—information about the land, clear policies on how it should be managed, and the participation of everyone with an interest or stake in the land. Stakeholders are interest groups or dependent groups—that is, the categories of people or institutions that share a common interest in a piece of land, be it an individual plot, the territory of a community, a natural conservation area, a region, or a country.

A stakeholders' forum, calling together those with an interest in or who are dependent on land information should be created, with the primary objective of building the capacity of decision makers in the country to make more sustainable decisions. The stakeholders' forum, and any LIM system associated with it, should be inclusive and not exclude particular stakeholders, or it will not be possible for all the decision makers involved in a conflict to reach consensus. Stakeholders who should be involved include—

- public sector—central ministries and departments of Agriculture, Central Statistics, Community Affairs, Education, Environmental Affairs, Finance, Forestry, Health, Housing, International Cooperation, Justice, Lands, Local Governance, Mines, Planning, Public Works, Transport, Urban Planning; representatives of regional government, representatives of local authorities, both urban and rural, registry or record office of deeds and titles, valuation office, surveys, mapping, national land information system, government utilities
- local authorities
- government research institutes
- representatives of traditional authorities, formal or non-formal
- representatives of informal settlements
- representatives of religious institutions, where they have a land management role
- private sector—utility companies, developers both formal and informal—professional association of surveyors, professional association of planners, professional association of lawyers, financial institutions, private sector research institutions
- representatives of NGOs and CBOs, including women's groups
- representatives of cooperatives and trusts

- donors and development partners, bilateral and multilateral cooperation organizations

The exact mix will vary from country to country; not only will the functions of departments differ, but also there will be a difference as to which functions are carried out by the public sector and which by the private (formal and informal)

Nationally, a steering committee should head the stakeholders' forum. The committee should comprise representatives from government and key stakeholders' groups. It should be assisted by a technical secretariat.

The stakeholders' forum should—

- bring technical people, such as surveyors, GIS specialists, computer specialists, to meet with other stakeholders. A major objective should be to transfer knowledge from measurement experts to other professionals and decision makers, and between technical experts and decision makers at the centre and those at provincial and local levels. Part of this process should include increasing the capacity of decision makers to use the LIM system. This should be done to build up a knowledge base on land management among the stakeholders, so that acquiring and disseminating information is not solely a technical process but is interactive. This is a critical component of such a forum, given that power relations are often the greatest institutional problem in LIM systems, which fail to get off the ground more often because of institutional problems than because of technical problems.
- create a vision for an LIM system that will build its ownership across sectors and facilitate sharing and exchanging experiences.
- assess the existing LIM and cadastral systems, including a gender-sensitive analysis.
- identify and advise government on reducing overlapping responsibilities across government departments in relation to information flow and the technical processes associated with land. This should assist in reducing public expenditure by improving institutional arrangements and administrative procedures and limiting duplication. Also by sharing existing data sets, the capacity of the LIM system should be increased at little extra cost. An important aspect is promoting a common base map available to many users.
- advise government on the necessity of recognizing the role of the private sector, the need to promote private sector participation where applicable, and the promotion of public and private partnerships, to increase the capacity of the country to reach its objectives, particularly concerning the regularization of existing informal land management practices.
- address both centralization problems and the problem of institutional fragmentation. This should be done by, among other things, creating good partnerships between different institutions both vertically and horizontally, thereby setting up vertical and horizontal links of the LIM system—first institutional links and then technical links. By addressing institutional issues first, the costs associated with computerization can be avoided in the short to medium term. But at the same time, the ground is being prepared for efficient and effective computerization once the institutional links are in place.
- address the need to build capacity by devoting time and energy to mapping the institutional geography of the stakeholders involved in land management and understanding the strengths and weaknesses of each institution in the information

game—their manner of financing, and so on. This map can then be used to work out a strategy to design an ongoing process of stakeholder involvement in the LIM system, to ensure that it has broad and ongoing support from the community of users.

- address the problem of land management conflicts and advise on solutions. This approach should mean that a range of stakeholders previously excluded from such forums could now be included.
- create sustainable systems by building capacity among local staff through training, and by putting in place the requisite work incentive programmes, to combat the syndrome of low pay and low motivation.
- create an LIM system that is decentralized and that uses local knowledge. A people-centred process of making local decisions requires that community-based knowledge and actions be given priority when new knowledge and technology enter from outside. At the same time, outside sources are needed for solving specific problems or for understanding basic processes. This approach requires a high level of social infrastructure and networking, which should be integral to the LIM system design.
- create a system in which both process and information are transparent and serve all stakeholders and the market.
- advise on policy and funding arrangements for the development of the LIM system.
- design any future changes in an LIM system in a gender-sensitive way.
- develop an integrated information and mapping system. In most countries, there are usually no policies for providing mapping or for supplying land information and its maintenance. Often there is no nominated agency for urban information.
- Run public awareness campaigns that inform the public about the LIM system and its uses.
- advise on how to develop, evaluate, and where necessary promote the regulatory environment necessary for the LIM system to function. If the cadastral system is a subsystem of the LIM system and does not dominate it, it is possible that many of the regulatory features of a developed-world LIM system should not be necessary and a more cost-effective, flexible, and user friendly policy could be developed.
- formulate guidelines for undertaking a user's requirements survey. Too often the surveyor or legal expert has produced information that satisfies the needs of the experts only and has not met the needs of other users, especially decision makers. An assessment of user's requirements should be undertaken or commissioned at a very early stage by the stakeholders' forum, to establish the user's requirements before technology is discussed. It should be an ongoing exercise that continually monitors user needs. In this way, the LIM system should receive the necessary user support.

## 5.1 Habitat, FAO, and the stakeholders' forum

The approach outlined above is in line with suggestions made by both Habitat and FAO. Habitat has suggested, in its Global Urban Observatory approach,<sup>1</sup> that institutional partners should help local authorities and others create, manage, and maintain local databases and information systems. Habitat states that the major benefit of such an activity is effective

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<sup>1</sup> [I suggest a footnote here to tell what the Global Urban Observatory approach is, or to refer to a specific reference in the bibliography.] The explanation is added to the glossary

policy development. They put forward the approach that to effect this, the information collected should be relevant to local decision-making processes and that the policy analysts and policy makers should have the requisite skills to interpret the information. Habitat also suggests that an information technical working group be linked to the working group associated with their indicators programmes.

FAO suggests that countries establish natural resource information systems as a tool for decision-making. An information working group should be established to negotiate and obtain agreements on information standards and the maintenance of networks. FAO also indicates that this approach should involve channelling information to decentralized structures in the district and the community. They suggest that to undertake this, a national task force be established with one of its major functions being to investigate and facilitate the exchange of information and to support and enable a holistic and integrated approach to land management. Approaches of the different United Nations agencies in regard to an LIM system should be dovetailed.

## 5.2 Information and the stakeholders' forum

The steering committee that forms part of the stakeholders' forum should develop information and communication functions such as—

- issuing a catalogue of the existing information
- analysing the mandate and responsibilities of the various institutions involved
- carrying out an awareness campaign that makes full use of the media in general
- organizing “best practices” competitions, exhibitions, and official awards
- publishing newsletters and magazines
- producing a handbook to inform users and stakeholders about existing information and how to obtain access to it, the flow of information, how to obtain access to land, the condition of the land, and its availability

As in general land management, decision makers are not presently obtaining sufficient information from cadastral and LIM systems in Africa to make informed decisions, Technical agencies should create links between the cadastral system and other land information systems, so that a central office can provide comprehensive information, thus minimizing overlaps, duplication, and inconsistencies. The general public should also be able to get easy access to any land information—about its availability, any requirements and conditions of access, and so on. Such functions should also be entrusted to the steering committee of the stakeholders' forum.

The technical secretariat associated with the stakeholders' forum should be in charge of producing and disseminating technical information such as—

- norms, standards, specifications
- scales of information at different level
- assistance to users to identify their needs

It should also be responsible for developing a strategic plan to develop or integrate any new approaches in the development of an LIM system, which uses visualization (see section 7.2) to a greater or lesser extent. Institutions should work out when, how, and how far they should go in responding to such new approaches.

## 6 Technical implications: supplying decision makers with the “big picture”

### 6.1 Design criteria for a land information management system

The major design criterion for an LIM system should be to create it for decision makers. It should supply an overarching national framework, known to surveyors as a reference framework, for a range of spatial information products and users—degrees of accuracy, scales, geographical locations, national, local, attributes. A shared reference framework, or “big picture”, needs to be developed for an LIM system that is inclusive rather than exclusive, to be used by both non-experts such as most decision makers, and measurement experts.

Such a national overarching framework should accommodate—

- high- and low-value land
- people in the capital city and rural areas
- skilled professionals and technicians with basic training
- raster and vector spatial data from a range of techniques and technologies
- GPS (explanation in glossary)—centimeter, submeter, uncorrected hand held
- conventional terrestrial approaches—plane table to theodolite
- remotely sensed images—satellite and photographic
- graphical data (I am not sure about the proposed elimination of the term pictorial, pictorial and graphical are not the same.)
- geometric (measurement-based) data
- topological (connectivity, not absolute position) data

Design criteria for the overarching or reference framework should include—

- the ability to link existing and future paper maps and GIS data sets of various degrees of accuracy and scales to the LIM system
- the ability to link existing and future cadastral information to the LIM system, both locally surveyed, low accuracy, and professionally surveyed information, georeferenced or not
- the possibility that the work be done in phases, with phases done in parallel or sequentially, each having a separate visible outcome
- the ability to service cross-sectoral users
- the 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, with respect to both the framework and the information outputs, rather than geometric data being the core component of the system

Innovative and cost-effective approaches can be developed if the design is not constrained by cadastral system characteristics and makes use of the new technologies coming on line.

### 6.2 Visualization: a shared-reference framework

The reference frameworks for cadastral and LIM systems have generally been measurement based. A graphical or pictorial reference framework and information output should make it possible for decision makers to visualize the spatial information and make informed decisions. Decision makers should be able to see (visualize) what exists on the ground, so that they can make better and more appropriate decisions. It should also be possible to link the

decision maker's graphical framework to a geodetic framework, so that the tasks presently being done by the measurement experts can continue to be undertaken.

The graphical framework consisting of small-scale base maps, created through cartographic generalization, should be based on features that aid visualization of decision makers and should include among other things—

- *Information about major features in the country, such as coastlines, rivers, lakes, roads, mountains.* Although many of these features occur on a topographical map, it is not useful to include all topographical features and contour lines as this could make the map too “noisy” and technical for non-experts, many of whom cannot interpret contour lines easily.
- *Geographic names* serve as a common reference for most non-experts and are crucial for decision makers to orient themselves. For this reason, geographic names are one of the most common data sets found in LIM systems. It is an accepted international convention to use more than one name for the same area if there is no agreement on its name.
- *Major administrative boundaries.* International boundaries and other major boundaries should be included. However, not all administrative boundaries should be included in the base map; otherwise it could be too noisy for decision makers, and other features that decision makers use to locate themselves might have to be left out. Experts, by working with users, should use their discretion to identify what can be left out and what is essential information.
- *Human settlement patterns.* To date, official maps have shown only human settlement that conforms to cadastral parcels or that is considered as legal. As much of human settlement is not considered legal (30–80% of all cities in developing countries) or is not on the cadastral records (customary tenure), maps of human settlement have been largely incomplete.

An additional factor in mapping human settlement has been that the unit of study has generally been the parcel, or the building, and scale factors related to measurement issues, together with cost, have prevented mass mapping of the individual parcels in human settlement. If human settlement patterns are generalized as classes, and mapped thematically and graphically rather than as individual units, it is possible to create cartographic generalizations relatively cheaply that help decision makers visualize them. Other more expensive approaches exist that can create a picture for the decision maker, where large-scale photography and specialized software is used, but this might be considered too expensive for the mass mapping of parcels.

- *Land-use and tenure patterns.* The land-use patterns depicted should not be the conventional land-use classifications such as soil types, land suitability, or land cover, as they do not give decision makers sufficient generalized information, especially as they generally exclude the link to existing human settlement and patterns of exploitation. Also, the land-use classifications should not hold any legal status. They should depict the existing *de facto* (no comment) land use, irrespective of its legal status rather than what the *de jure* land use should be according to zoning.

The land-use patterns depicted should be based on broad classes of land use linked to human settlement and exploitation. The patterns should be based on the broad socio-legal land tenure classifications relevant to that country. The

classification of land tenure should not be in the exclusive and legal sense, often used in cadastral surveying, but be used in an inclusive way to cover all forms of land tenure—legal, illegal, social, and informal.

### 6.3 Graphical base maps

A data-rich source, such as aerial photography or satellite imagery, should be used to create a graphical base map. Aerial photography might be too expensive for this exercise, and satellite imagery could well be the cheapest way of creating such a base map and populating the associated GIS. Using imagery should be much more cost effective than carrying out individual and expensive ground surveys. However, any existing information in the countries should be fully used. Data should also be obtained from topographic maps where they exist, and if they do not or their quality is poor, from the satellite imagery.

Imagery as a data source is expensive. Therefore, the approach should be to use the baseline imagery only as a backdrop for the base map, as a one-off cost for which funding could be sought. Cartographic generalization should be used to depict land use and land tenure by interpreting the remotely sensed images. Getting new imagery to update the base map should therefore be necessary only on an ad hoc basis.

Such a national base map should give small-scale, topologically correct land use linked to human settlement patterns. To keep costs minimal, it should supply only a generalized big picture of a country or region. It should not be used to supply any detailed boundary information or measured population densities. It should not attempt to ascertain the boundaries of individual properties, distinguish all the individual fields under use, or do demographic calculations.

This accords with the AFRICOVER approach,<sup>2</sup> which uses—

- visualization as a key component
- a simplified topographic layer upon which the thematic layers can be referenced
- high-resolution satellite imagery both to create the maps and to populate the GIS
- cartography as the output
- a homogeneous and hierarchical classification system

However, to help decision makers, both national and local, to visualize, it is suggested that an additional category be included in the classification system, that of land tenure patterns (social, legal, formal, non-formal). Base maps at sufficient scale should also be created for urban areas.

This type of base map should use a fairly small scale to make the approach cost effective. However, the most appropriate scale for such an exercise would need to be carefully assessed to obtain the optimum relationship between avoided costs on the one hand and the amount and accuracy of generalized information on the other. It should also depend on other factors such as whether areas are urban or rural, forest or non-forest. Scales of 1:250,000 to 1:100,000 will be used for the AFRICOVER land cover map series; 1:50,000 may also be used for selected areas in some countries.

A range of base maps of different scales should be created, using remotely sensed images giving different resolutions, starting with a very small scale for national coverage. Where greater spatial resolution is required, for example, along settled coast lines with tourist potential, slightly larger-scale base maps should be created. Urban base maps should be

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<sup>2</sup> Recommend another footnote here to tell briefly what AFRICOVER is.

created at the largest scale. The result would be a series of layers, all linked graphically or geodetically. When more detail is required for an area, it should be possible to zoom in.

Research and development need to be undertaken to establish such a visualization-based LIM system, as well as the appropriate standards and specifications. Issues that should be addressed before it is established include creating awareness among users, conducting a feasibility study including a pilot project, learning from best practices and experience, determining the system's requirements and developing a project proposal, testing and evaluating the system, acquiring the system and starting it up, and finally, operating the system and reviewing it.

Standardization and specification are important in the setting up an LIM system so that data sets are integrated and information flows among stakeholders. Further research is required on exactly what form the core data sets for visualization should take in relation to this issue, to ensure that visualization can be used in the same way by different users. A strategic plan should also be formulated to develop or integrate any new approaches in developing an LIM system that uses visualization to some extent. Institutions should work out when, how, and how far they should go in responding to possible new approaches.

#### 6.4 Linking the graphical reference framework to the geometric framework

The graphical and geodetic framework should be linked (see figure 1) so that measurement experts can work from the geometric data to the graphical and back again. The base map should—

- supply a common frame of reference for both decision makers and experts
- supply a small-scale reference framework that could be visualized and used by decision makers
- supply a reference or geodetic framework for measurement experts
- make it possible to use information of various scales by referring either to the major features depicted or to the measurements, depending on the level of skills of the map or data user
- make it possible to link spatial information of various degrees of accuracy, either by cleaning up the data or through eyeball generalizations related to graphical information
- make it possible to link graphical information to any existing cadastral surveys; existing information from sporadic surveys could be linked to such a base map, as could any additional future surveys, either graphically or geometrically, depending on the resources available
- be created for a manual or paper system, but be capable of being transformed into a GIS/LIS
- not be created specifically by a systematic titling exercise (it's OK the way it is. It refers to produce documents giving evidence of titles to land), although the information from such surveys should be used if possible

Any linking of cadastral information should be a separate exercise from making the base map to avoid the demanding characteristics of the cadastre from the outset. For example, cadastral requirements should not determine the choice of image scale.

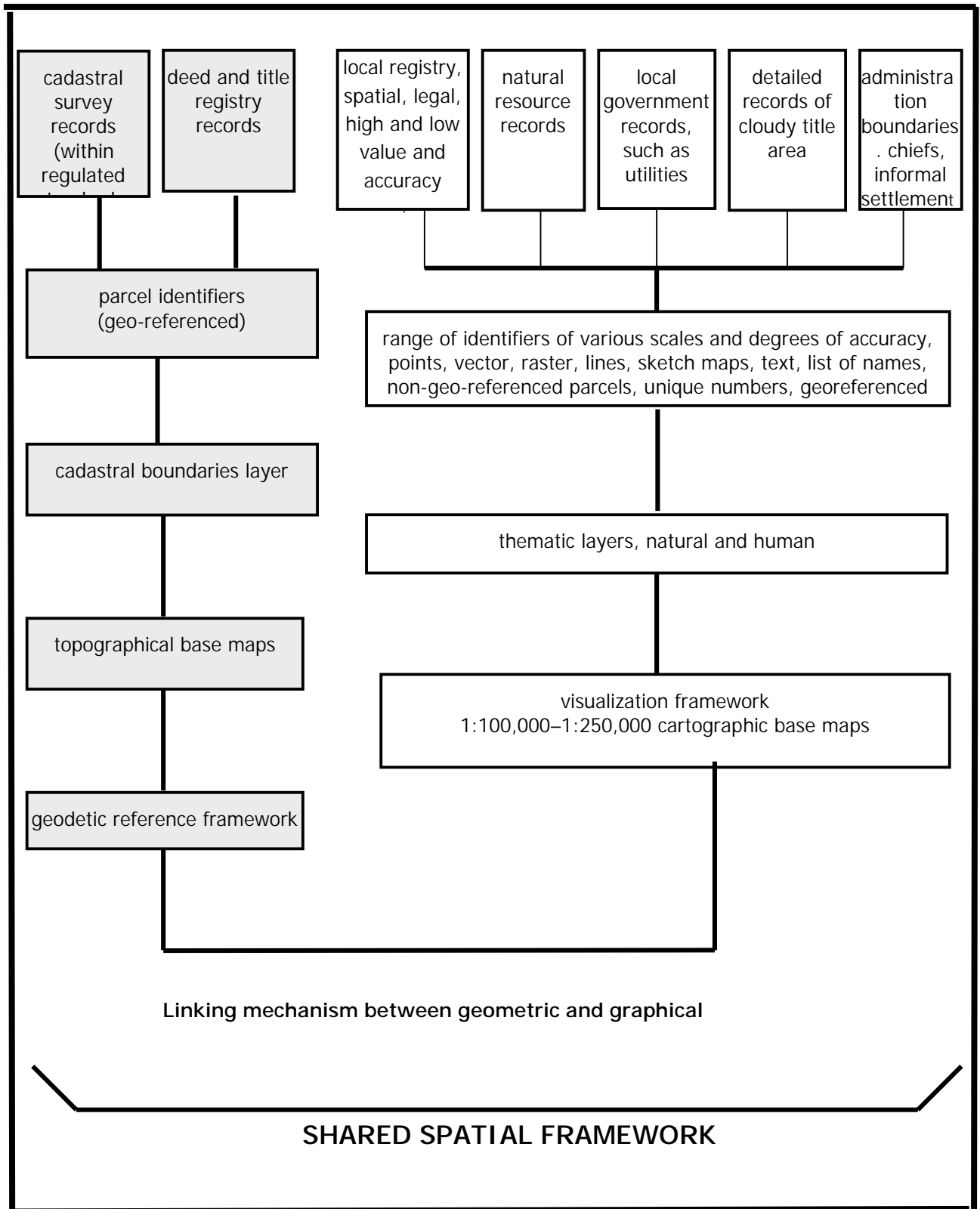


Figure 1. Shared spatial framework

A note of caution, however: if finance is limited, the graphical reference framework should be produced first as the primary data set either in a phased operation or on its own, as it has stand-alone properties such as—

- it is immediately useful to decision makers
- measurement experts can also use it, albeit in a limited way
- it is data rich
- it can be used across sectors
- larger-scale graphically based data sets can be linked to it

The satellite imagery should not only supply the land-use data for the cartographic generalizations depicted on the base map, it should also be used to create a geometric spatial framework. Depending on which type of imagery is used, additional fine detail could be obtained from the satellite image and used to create additional higher resolution data sets within a GIS/LIS. This step should be undertaken independently of the creation of the base map.

## 6.5 The geometric link

Such a graphical national spatial framework along the lines of the AFRICOVER project, which could be used by all decision makers and not just measurement experts, should be a priority. However, there should be a tie between the graphical and the geodetic spatial frameworks. Such a graphical–geodetic link is crucial for the comprehensive economic development of Africa, as among other things, complex multinational projects, mineral exploitation, and investor development associated with high-value land tends to be linked to sound cartography and surveying and is more effective when based on it.

A number of problems about the geodetic framework in Africa should be addressed. In many areas of Africa, like in other developing areas of the world, the basic geodetic networks are not good enough, resulting in varying degrees of accuracy or no data being available. This often causes problems for cartographic and survey-based projects. Establishing and using regional and subregional databases could be very difficult. This has important implications in the environmental field where, for example, watersheds and forests occur across international boundary lines.

While the AFRICOVER project should deal with a number of the issues, it will not necessarily produce the geodetic accuracy required to deal with all these issues. The AFRICOVER project will start by harmonizing the geodetic datum, reference spheroids, and map projections. All geodetic data will be transformed into WGS 84 (explained in the glossary). However, a unified datum **(We should stick to the original. Datum is a geodetic reference. Although it is a Latin word and the plural should be data, the word data has a total different meaning. This is why the adopted plural of Datum is Datums)** for Africa is not planned as an outcome of the AFRICOVER project. Rather, the project will attempt to achieve mapping accuracies at a scale of 1:250,000.

To create a graphical–geodetic spatial framework to serve the whole range of stakeholders involved in the economic development of Africa, ECA, AOCRS (in the glossary) and the international geodetic organizations, for example the IAG (International Association for Geodesy), should cooperate with FAO so establishing the mapping datum for AFRICOVER conforms to geodetic standards. This should enable the geodetic community to compute a Unified Geodetic Datum for Africa (UGDA), which should be linked to WGS 84, using GPS data collected during the AFRICOVER project campaign. To achieve such a unified and

homogeneous datum for Africa through the FAO AFRICOVER project, it is recommended that the following steps be implemented—

- The African Doppler Survey (ADOS) data be analysed and its relationship to WGS 84 established.
- The national–ADOS transformation parameters be computed for each country using the ADOS points on the existing national geodetic control.
- The national–ADOS shifts be analysed for the whole continent, to establish if there is any useful pattern that would make it possible to combine them.

If no pattern exists, the values obtained should be analysed and the shifts (WGS 84–national) computed to establish if there is any pattern for points scattered across Africa. If a pattern is found, 30 uniformly distributed points should be selected and an African GPS campaign undertaken.

This network and the new shift parameters should be computed for use in datum densification for each subregion. This should then become the new African datum.

## 6.6 Linking the central and local levels: data flows and technical processes

Conventionally, processes have been developed in which as much information as possible is compiled and stored in the capital city to enable efficient centralized decision-making about a wide range of issues. For a number of reasons, this approach has generally not worked. Present approaches emphasize the need to link the central and local levels more closely on the one hand, and to decentralize stored information and decision-making on the other. This has a wide range of implications for an LIM system.

A graphical and georeferenced base map should enable decision makers based in the capital city to make more reasonable and holistic decisions—but only for broad-brush planning. They probably would not have sufficient accurate, large-scale information to make a final land-use planning decision. However, this technical limitation is not a problem, if planners move away from top-down land-use planning decisions made in capital cities that do not consult the people on the ground. This type of approach does not make land-use decisions sustainable.

Decision makers should make initial broad-brush land-use planning decisions for specific areas based on the big picture supplied by the base maps, but the final decision should be made only after consulting with the people in the local area. The local consultations should then generate the additional large-scale information required for making changes in land use or land rights.

While local information is not always of the highest accuracy (spatial data), completeness, or correctness (textual), its symmetry and richness often largely makes up for deficiencies in spatial accuracy. For example, valuation, registry, and tax information about the same parcel in the capital city may be very difficult to obtain if the records are in different departments and do not have the same parcel numbers. However, to obtain the same information locally is relatively simple because many people know (can visualize) the parcel and its owner or occupant. Again, gathering such information is more cost effective because it forms part of the consultation and negotiation exercise. (it is OK)

It should no longer be necessary to generate and maintain spatial information of high accuracy and large scale that gives complete coverage for all possible circumstances for

decision makers in the capital city to use. It should not be necessary to create these data until an initial decision has been made about a specific area, such as when a government programme is under way or an investor has made an application for land-use rights. This approach makes it possible to both avoid costs and streamline resource allocation, making it much more cost effective to acquire the necessary information. It should also allow the costs of acquiring information to be better allocated within government and facilitate cost recovery from private sector applicants.

It should be possible to map general land tenure and land-use information, without legal ramifications on ownership or zoning, at any central point using remotely sensed images. This is important for economies of scale. At the same time, the information could be made available locally, either by transferring digital information or by distributing paper maps. While it is possible to create current general land tenure and land-use information remotely, it is not possible to do this with cadastral and titling information, as users drive the updating of this information parcel by parcel. Cadastral and land registration systems need to be decentralized to keep local land management and information current; otherwise, they become too expensive or fall into disuse.

By decentralizing the LIM node, information could be provided by people with fewer skills using lower-grade and cheaper technology. This is possible because—

- the graphical nature of the base map, distributed at local level either as paper maps or digitally, allows a textual description of features in the field. This makes it possible to use lower accuracy surveys produced by local surveyors using plane tables, hand-held GPS and other methods.
- surveys will generally be topologically correct relative to each other and to the graphical features.
- local information symmetry and knowledge (visualization) make it possible to check and improve less accurate information.
- the work of local surveyors often supplies sufficient security of tenure to local people because these people have local knowledge (visualization over time) and because it is linked into the public witness system.

By making it possible for less skilled surveyors, as well as other people, to produce usable information—

- the amount of data and coverage within an LIM system should be increased
- the cost of new data acquisition should be dramatically reduced
- other non-experts, such as NGO personnel, could produce information

Yet at the same time, if the base maps accommodate both graphical and geometric use, professional surveyors could clean up this survey information when necessary, to the point where it could support the capital city decision maker or investor. But by using lower forms of technology and local surveyors, it is possible to avoid costs until more accurate information is needed.

However, this more inclusive approach to data acquisition raises the issue of professional responsibility and the image of surveyors, as users expect them always to produce accurate information. Geographers, planners, and other professionals are already producing information of various degrees of accuracy. Surveyors too need to develop innovative ways of doing the same, and to develop approaches that indicate to the public the integrity of the information and the extent to which the surveyor is prepared to be legally accountable for it.

For example, registry maps in support of general boundary surveys and topographical maps showing international boundaries usually have a disclaimer indicating that the maps are not an authority on boundaries (see figure 1).

If the cadastral and land registration information records are decentralized, and land-use decisions made in the capital city are not finalized without consulting those occupying the land, it should not be necessary for the capital city to hold all the cadastral and land registration records. If most property information is kept locally, it should not be necessary to transfer information from the local level to the central level, as long as the administrative processes ensure that the final decision is made only at the local level, using both central and local sources of information. Records of low-value land surveyed to lower degrees of accuracy should be kept at the local land registry, along with the local high-value land surveyed to higher degrees of accuracy, as in figure 1. To avoid costs, no record of the low-value land needs to be maintained at national level. If the authorities wish to alter the rights of any land, local investigations by professionals should be undertaken first. This would mean that the lengthy technical processes, because of the number of steps, would be short-circuited for low-value land, which should cut down the costs of such surveys. Holding the records at the local level should also make land management more efficient and effective, and it should build local capacity to undertake land management, thereby increasing sustainable land use.

For high-value land, such as land with mineral rights, cash crops or high-rise buildings, professionals should use higher-order surveys linked to the geodetic to produce the requisite legal evidence for investors or developers. They should do this in conjunction with an investigation at the local land registry and on-site inspection, accompanied by adjudication and negotiation, to be able to create a clear title, defensible in the highest courts of the land.

The investor or developer requiring this certainty should fund the titling and adjudication exercise, as well as the recordal (let's leave it as it is, I like the word) of the cadastral survey information, either at the national level or locally. Legal evidence about rights to high-value land should be held both by the wider society and by the affected local group. The responsibility for the information flow, including updates, and funding of it, should rest with the investor or developer and the professionals (OK, professionals in land administration, which may include the surveyors).

From another perspective, the conventional systematic titling approach involves government in large and complex programmes. If the application-driven, user-pays approach is adopted, sporadic titling using the new technologies should be cheaper for governments to undertake, providing that systems and technical processes are set up to handle this sporadic titling of land that is mostly of high value.

## 6.7 A range of identifiers and information

One of the major problems in the information field has been integrating data from different sources, captured using different methods, at various degrees of accuracy and various resolutions, and stored in different formats, using diverse referencing mechanisms. To overcome this problem, and to be able to integrate information from diverse sources within an LIM system, there first needs to be a referencing mechanism that is common to every system. Second, a range of identifiers must be used, not just accurately surveyed parcels.

Some form of measurement has served as the conventional common reference system, but this has caused problems and a graphical reference should be considered as a viable alternative in the African environment. If a graphical reference framework is adopted, then it should be applied routinely when mapping, designing databases, choosing scales and

technology, and so on. The visual component should be the core component in linking, and it should routinely allow decision makers to be able to visually compare different sets of information.

Conventionally, LIS systems have used parcels as identifiers. Parcels have been the basic unit of data collection and the link to other information in the database. This has meant that most information about the land in developing countries could not be used in an LIM system, as the information is not always parcel or polygon based, let alone cadastral parcel based (see below).

A graphical reference framework should also make it possible to use information from a range of sources that could not otherwise be used, by using non-parcel-based identifiers, both when acquiring the information and as the linking mechanism. The types of identifiers, of various scales and degrees of accuracy, that an LIM system should be able to accommodate are—

- points, geocodes (sometimes known as dots on plots), lines and polygons, in vector or raster format
- polygons with fuzzy boundaries
- text, including lists of names and unique numbers
- parcels—poorly surveyed, non-georeferenced, and georeferenced
- sketch maps and photographs, in the absence of any better identifier

Examples from both urban and rural areas are given to show why a range of identifiers is required, as well as the type of information that would be needed to make decisions in these areas.

Before upgrading or regularizing an urban informal settlement, information is required about occupation patterns and what exists there legally. Large-scale informal settlement development often occurs contiguously over a range of legal land-tenure types such as—

- State land—often the State does not have an inventory of its land; also, often State land has not been parcelled, and generally the informal settlement boundaries do not coincide with the State land boundaries
- privately owned land—again, the location of the informal settlement does not always precisely match the cadastral parcels and is likely to cover many properties in one spatially contiguous unit
- customary land, which conventionally is not parcelled
- a mixture of these

Aside from the property parcels of privately owned registered land, information in the form of thematic polygons of low accuracy should be created showing the location and approximate boundaries of the informal settlement and the customary areas. Lists of leaders in the informal settlement or customary areas should be attached to such thematic polygons for the purpose of identifying which stakeholders and decision makers should be involved in negotiating changes in land use or land rights.

Houses or buildings cannot be used as parcel equivalent identifiers for a range of reasons—

- In urbanizing customary areas, if a layout plan based on existing houses is created by using aerial photography, the land actually under use by that household is arbitrarily removed from that house and allocated to someone else (this issue was debated at the meeting of experts and was left as it is). This is not a sustainable land-use strategy.

- Often in low-income formal settlements designed for one house per parcel, a second informal house is constructed on the same parcel, and it uses most of the services in the formal house. This doubles the water, sewerage, and transport requirements for the area. Decisions about servicing such an area could not be either parcel based or house based but would probably need to be based on both.
- One house generally includes more than one household.

It is not possible to use the cadastral parcel as the only identifier, even if cadastral surveys have been completed for a low-income development. It is possible that informal structures were erected instead of permanent structures erected in compliance with building standards. Often when land is invaded after a cadastral survey but before the land is actually registered as individual parcels, the authorities do not register them until, and unless, the informal settlement is regularized. If the surveyed parcels have not been registered, other unregistered titles might still exist in the area, with the “owner” holding a document bearing a description and sketch map.

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. The variation is minimized, though still of consequence, if the settlement of the residents was undertaken by a local authority in terms of the cadastral layout. The greatest variation is where people have invaded the land and nobody has pointed out the cadastral boundaries to them.

In these situations, a more useful identifier would be a geocode and text against a location, such as an informal site, or house, or part of a house. A geocode can also be used to identify existing but unmapped infrastructure, with the geocode being used as a crucible against which information can be tagged while the complete picture is being created. By using a geocode as an identifier, information on the informal settlement can be acquired in a logical way and organized within an LIM system. This approach should dramatically increase the amount of information that can be collected in such settlements, as well as its analysis, thereby facilitating decision-making. Finally, information collected with such a range of identifiers could be used to—

- make an inventory or land audit of the land tenures in the targeted area; this information could then be used to build specific administrative procedures to clean up the rights in the area, as part of the regularization programme
- determine existing layout, plot size, and levels of existing infrastructure and services
- evaluate compensation costs for land needed for the upgrade

In rural areas, given the lack of cadastral information, the mostly commonly used spatial reference is the administrative units of the country. Agricultural census data, legal regulations, policy, and centralized or provincial planning decisions are made in terms of the administrative unit. However, spatial relationships in rural areas are much more complex. A range of indicators besides a polygon for the administrative units should be used because—

- land management decisions are more often taken by socio-territorial units, such as chieftaincies, 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 frequently, there is no information on the boundaries of the socio-territorial areas, even at the level of chieftaincy, 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
- boundaries of socio-territorial areas are flexible and can change over time

At the level of extended families, parcels would also be insufficient identifiers. Most family landholdings have not been mapped. Less than 1% of Africa is covered by the cadastre and most of that is in the urban areas. Even if fields and homesteads can be identified, it is not always clear whether the family land is held by only one family member (usually male and older) in trust for the others, or if different parts of the land are held by different parts of the family. Some form of adjudication needs to take place before the parcels are created.

Matrilineal systems of inheritance exist in many parts of Africa. A man leaves his land to his sister's son and not his own son. This means that a widow and her sons have few, if any, rights to her husband's family land. External pressure is causing matrilineal land inheritance to convert to patrilineal in some areas, especially those close to towns. The adjudication and parceling of such land could be unwise, complex, and expensive. The land rights that women hold are generally nested within the family's land rights.

Instead, identifiers other than parcels should be used to gather information in rural areas parcels. Again, a geocode or point identifier should be used, which would consist of selected points representing an area or feature of interest, as specified by local people. It should also be used as the spatial referencing mechanism. Lists of names of leaders should be attached to the socio-territorial areas to facilitate efficient and more sustainable decision-making by local stakeholders. Also, fuzzy boundaries or boundaries that are purely illustrative and have no fixed accuracy might well be more useful than definite boundaries. Finally, information collected on a range of identifiers should make it possible to—

- link information about the relationship between land and population, thereby building land management and decision-making capacity, as it is this link that has direct impact on food production, competition for land, mismanagement of natural resources and environmental degradation, mass migration, and political conflicts
- integrate information for better decision-making. Conventionally information has been collected about the natural world using hierarchies and classifications. This system often has no direct counterpart in the socio-economic fabric of land users. Linking such scientific surveys to locally generated information should increase sustainable land-use practices

## **6.8 Visualization for decision makers**

Technical approaches that make use of the visualization aspects of spatial information should make it possible for a wide range of decision makers and people with fewer skills to use the base maps and the LIM system.

In many countries, there is no urban mapping. By using the base maps, urban planners could obtain a big picture of the existing city and its land use in a generalized form, then go on to integrate lower accuracy or larger-scale data sets. For example, information from the base map could be integrated with local information about the shape and structural features of the city, facilitating the design of urban development programmes. Conventionally, urban planning and development are undertaken through land development and subdivision—plot layout. A base map with visualization as a core concept facilitates a different approach, where the city is shaped and progressively developed according to its structural features. In the city, these are mainly the trunk infrastructure grid; in the settlement, the installation of the nearest facility, street network, schools, and markets.

The base map could serve to identify areas where there is little or no human settlement, which would be available for exploitation or conservation, making possible planning decisions

about allocating large concessions, such as for forestry or tourism. The base map information could also be used for adjudication of the concession, before it is titled, and then professionals could transform the information into a precise definition of the extent of the area for use by the investor as legal evidence. The base map could also be used as a baseline against which environmental degradation would be assessed over time. Specific areas of concern could be compared using updated remotely sensed images.

In emergency situations such as famine or war, governments should be able to assess the rapid migration of populations by using the base map as the baseline, mapping specific affected areas where necessary, using techniques such as visual information settlement planning, or VISIP.

## 7 Regulatory frameworks and quality assurance

Government's major responsibility in spatial information and survey should be to create the frameworks that facilitate decision-making. The frameworks that should be put in place include—

- a spatial framework that all stakeholders can share, such as a graphical framework in the form of base maps, based where possible on the geodetic framework
- a regulatory framework that caters for surveyed and unsurveyed land during the titling process—thus protecting the third party rights of those who are occupying the land through negotiation and adjudication before the land is titled
- a regulatory framework that caters for the poor, who are often in the majority, and not just the middle class
- a set of mechanisms and processes, both local and national, that facilitates appeals by aggrieved parties for land use and land rights
- a system of valuation and compensation that is considered to be fair by the market; otherwise people will sell informally rather than enter into negotiations with the State
- an appropriate system that will assure quality (it's OK, quality that is appropriated: variable accuracy and other elements), to protect third party rights and for technical standards
- a stakeholders' forum, or something similar, to create the institutional framework and climate for the LIM system
- a communications system between national, provincial, district, and local areas—transport networks, telephones, and other communication networks
- a programme to distribute base maps, either digitally or on paper, to all stakeholders, across sectors and locally
- a policy framework for land information, with transparency and user access to information being critical
- a structured business plan for a funding programme

## 8 New tools and approaches

Land information and geographic information systems have primarily been developed to improve efficiency, reduce reliance on an expensive labour force, and capitalize on the advances being achieved with computers and in communications. Also, land registration systems have generally recorded individual property rights and were designed to support a property market, with land being foremost a commodity. Many of these characteristics do not fit comfortably in African countries. Instead LIS and GIS should be adapted specifically for the African environment, using the range of new tools coming onto the market and the

innovative strategies being developed that are associated with them. Full use can be made of the new technologies only if—

- a framework is adopted in which the cadastral system is a subsystem of the LIM system. This allows various scales and degrees of accuracy to be used in the LIM system
- non-parcel identifiers can be used in the same database
- graphical references are generated routinely when mapping, designing databases, and choosing scales and technology, rather than relying only on geometric references. Decision makers should be able to routinely compare different sets of information
- most outputs of technological solutions can be visualized by decision makers. Technologies and strategies that facilitate visualization should be given priority. A LIS should be able to display and output the results of data analysis in a format that is understood by all stakeholders involved in a land management decision, including local communities
- surveyors routinely develop procedures for incorporating the data from non-surveyors into databases, and for assisting non-surveyors to understand, use and acquire better spatial information

Additional new tools need to be developed. Each Member State, depending on its abilities and special requirements, should use present approaches to land registration, namely deeds and titles. However, family and group registration approaches are an important issue for Africa. Further research should look for better ways to integrate these group systems with the formal registration systems.

Research in the field of LIS/GIS and LIM systems should be accorded priority in institutions of higher learning to improve the visualization process and the methodologies of collecting, maintaining, processing, and disseminating data within such a framework. Developments in the area of information technology need to be assessed and fully utilized, including links with the African Information Society Initiative, being promoted by ECA.

## 9 Recommendations

Key recommendations that should emerge from this exercise follow:

- LIM systems should be primarily designed to assist decision makers and increase a country's capacity to collect, interpret, and apply information, and to establish trends for improved decision-making. The major focus of the LIM system should *not* be on the technical issues and logic associated with LIM systems.
- A stakeholders' forum should be set up in conjunction with the Habitat Global Urban Observatory Programme and the national task forces under consideration by FAO, and begin by addressing the issues of institutional links that are associated with an LIM system.
- An analysis of user's requirements should be undertaken.
- Policy development should take place within the stakeholders' forum.
- The cadastral system should be separate from the LIM system, but linked to it, so that its characteristics do not dominate the LIM system.
- graphical base maps should be introduced by means of the AFRICOVER project. The project will supply most of the visual information required but should also include land tenure (social, legal, formal, non-formal) as one of its classes, to help decision makers visualize

- The AFRICOVER project should be linked to a geodetic project, which will create a Unified African Datum
- A comprehensive technology business plan should be developed before a country acquires any hardware or software
- An LIM system should make full use of the new technologies, especially with respect to outputs that allow decision makers to visualize and use spatial information

Using experiences from best-practices programmes, a pilot programme or projects should be developed in the region to demonstrate the feasibility, viability, or replicability of a GIS or an LIM system based on the visualization approach the present study has developed. A cost–benefit analysis of the pilot LIM system should be undertaken to assess the extent to which such an approach is self-sustainable, both economically and technically. These exercises should give guidelines about incorporating this approach in national and regional programmes. Regional organizations, together with selected interested countries, should be invited to formulate such a pilot project at country level

A regional forum should be established to harmonize and work out a spatial data framework for regional cadastral and LIM systems, in liaison with similar international LIS organizational structures. Examples are the Habitat global, regional, and local urban observatories; the FAO GIS and LIS global, regional, and national task forces and offices. The regional forum should define the type of data sets that could be exchanged between the Member States and should develop compatible formats for recording. It should also promote South–South technical cooperation and transfer of knowledge.

The regional forum should count on existing regional organizations such as—

- UNECA, in liaison with regional offices and programmes of specialized UN agencies such as FAO, UNCHS (Habitat), UNDESA, UNEP, UNESCO, UNITAR
- AOCRS, the African Organization for Cartography and Remote Sensing (it has been corrected)
- regional centres for surveying, mapping, and remote sensing
- regional professional organizations
- regional charters of users (if any)
- regional networks of cities and local authorities
- environmental information system programme for sub-Saharan Africa
- Observatoire du Sahara et du Sahel (OSS)

The regional and national forums of stakeholders should identify sources of funding, inform donors and development partners of their activities, and seek to involve them. Funding should come from governments, the private sector, and external donors. Local community resources should also be counted on. Participatory stakeholders should build partnerships on specific programmes and projects and apply the principle of cost sharing to implement the work. Pricing policy should also follow the cost-recovery principle.

[needs a brief wind-up paragraph—even a one-sentence paragraph.](I'll do it. give me three days)

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