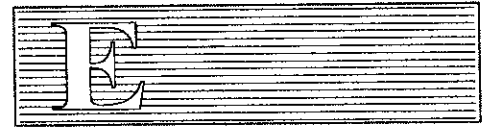




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**EXECUTIVE SUMMARY:
AN INTEGRATED GEO-INFORMATION (GIS) WITH EMPHASIS
ON CADASTRE AND LAND INFORMATION SYSTEMS (LIS)
FOR DECISION-MAKERS IN AFRICA**

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WITH EMPHASIS ON CADASTRE AND LAND INFORMATION SYSTEMS
(LIS) FOR DECISION-MAKERS IN AFRICA**

**Summary of working document revised by meeting of group of experts at
United Nations Economic Commission for Africa, Addis Ababa, 23-26
November, 1998.**

1. Introduction

The status of cadastral and land information systems in Africa is assessed, with specific reference to their capacity to assist decision-makers. Recommendations and guidelines are provided for the adaptation of existing systems and/or the development of new systems, so that they can be used for land reform, physical planning and integrated land administration. The guidelines take into account the need to create land information for decision-makers without creating unaffordable costs to the state, given that the average per capita income for Africa in 1995 was USD665.

2. Background

- The United Nations has been involved in cadastral and land information issues since the early 1950s and the UNECA held its first seminar on the issue in 1970;
- A variety of conditions exist among African countries, and no attempt is made to develop a blue print. While most of the parameters discussed apply to many countries, some of the technical aspects might apply more in Member States that do not yet have a fully developed cadastre. The technical approaches could be utilized to improve the land information available to decision-makers, but this would vary across the Member States, as it would depend on the level of their existing cadastral development.

3. Decision-makers and the present cadastral (information) systems

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

- No documentary evidence exists for up to 90 percent of the parcels in developing countries, with about 1 per cent of sub-Saharan Africa being covered by any kind of cadastral survey;
- LIS/GIS systems do not exist, have lapsed, or are seen as too expensive;
- Manual cadastral systems, with incomplete coverage, supply most of the land information.

4. Integrating surveying into a multi-disciplinary LIM systems' approach (see Diagram 1 below).

- An LIM system is **more than a GIS** as, besides the technology, it also involves organizing procedures, a corporate structure and a policy towards users;
- A **new spatially referenced framework** should be developed for a wider range of users and stakeholders, with visualization being its core component;

- Usually an LIM system is a sub system of a cadastral system and is limited by the cadastre's requirements (high accuracy, legal evidence etc.). As the cadastre covers less than one percent of sub-Saharan Africa, the **cadastral layer should be left out of the LIM system's initial design**, making it easier to develop an LIM system. The cadastre can be a linked sub-system of the LIM system;
- The primary purpose of an LIM system should be to supply information for sustainable development, **not for conveyancing and mortgages**;
- **Varying accuracies should be accommodated**, because of cost and lack of capacity in regard to the generation of accurate, comprehensive, standardized information. Information produced for other purposes, by non-surveyors, could be used to populate the LIS/GIS, by using new cheap technologies;
- **Sustainable development** meets the needs of present generations without compromising the ability of future generations to meet their own needs. LIM system' processes should integrate the principles of economic, social and ecological sustainability;
- **Participatory land use planning** has replaced the 'Package of Plans' top down approach, because of a lack of government capacity, and because the identification of user needs involves a conflict resolution process among stakeholders. Instead the social, institutional and technical dimensions of land use planning/management are being integrated at the lowest level. This approach is more cost effective and is based on the understanding that the *de facto* users are critical to land use allocation processes, rather than this being only a professional exercise. The LIM system should manage the information flows to facilitate such an environment. Also, participatory land use planning decisions generated locally have implications for cadastral surveys in regard to:- timing, coordination, institutional linkages and legal evidence;
- LIM systems should serve decision- makers at all levels, especially for **decentralized decision making**. Land registration, allocation of public land, permits for land development, conflict resolution, land use planning and management and land taxation should all be decentralized. Decentralized land information collection should be interconnected with vertical, horizontal and local network(s). Technical and institutional interconnectedness is integral to an LIM system. Also, national legal frameworks are required for local land management. Local institutions, acting alone, cannot legally define the rules by which they interact with outsiders. The decentralization of land information and/or land registration should be assessed in regard to the existing legal frameworks, and legal regimes adapted to facilitate local land management;
- Large scale government programs of compulsory systematic titling is not a viable strategy. Instead, **titling should be application driven, sporadic** and funded by the developer/investor. It should be done only after negotiation with local communities, to ensure that the resource base of the poor is not forfeited during titling. Government should quality assure this process;
- An LIM system should supply information to the users of **due process mechanisms**. Such mechanisms include, local land management forums, planning appeal boards, adjudication/ negotiation procedures for changes in land use/land rights;
- Land registration/recordal systems should be more accessible, in terms of location and cost. **The land office should be at the local level** and be user-friendly to poor, often uneducated people. This challenges existing land registration systems that are centralized, expensive and designed for the middle class, leading to an abuse of third

- party rights and lengthy approval processes. Local registration offices make land use planning more sustainable, protect the land rights of the poor and shorten procedures;
- **Informal and formal tenure systems should be combined**, otherwise the informal systems will continue to defeat the goals of governments and others, trying to supply security of tenure, poverty alleviation, food security and sound land management. The LIM system should include formal, informal and customary tenures;
 - The LIM system should **remove all barriers to women's access to resources** including land and information, and ensure their full participation in all the decision making associated with the system, whether as users, decision- makers, generators of information or property owners;
 - Most land information in rural and urban Africa is not parcel based. Databases should accommodate **a range of identifiers**, including, un-referenced parcels, lines and points;
 - **Cost effectiveness and cost avoidance** approaches should be integral to system design;
 - **The vision for an LIM system** should be a focus on the user (decision-maker). Prior to the acquisition of technology, a User's Requirement Analysis should be undertaken, institutional co-ordination done by a Stakeholders' Forum, and a Technology Business plan created.

5. What type of decision- makers need spatial information

The public and private sectors, local and traditional authorities, informal settlements, utility companies, NGOs , including women's groups, among others.

6. What type of decisions need to be made

Often, because of a lack of available information, there is a divide between the reality of the situation and the ability of decision- makers to always comprehend that reality. Information is needed for a range of decisions such as, the resolution of land conflicts, natural resource management, the management of cities, land administration, and prior to investment.

7. Create a Stakeholders' Forum and undertake a User's Requirement Analysis

A Stakeholders' Forum should be created to build capacity among the country's decision-makers, to make more sustainable decisions. At national level there should be a Steering Committee heading the Stakeholders' Forum, assisted by a technical secretariat.

The Stakeholders' Forum should:-

- **Bring stakeholders together**, including technical people, so that land information acquisition and dissemination is not solely a technical process but is interactive;
- Assess the **existing cadastre** and LIM system, including a gender sensitive analysis;
- Identify **over-lapping responsibilities** in government. This will reduce public expenditure and increase the LIM system's capacity. A common base map should be promoted;
- Promote **public-private partnerships** where applicable, to increase capacity;
- Address both **centralization and institutional fragmentation** problems. Partnerships should be created between different institutions to set up the LIM systems' linkages, first institutional then technical links. This will improve the effectiveness of computerization;
- Include **all stakeholders**, even those who have been previously excluded from such forums;

- Create a **decentralized LIM** system which is **transparent** and serves all stakeholders;
- Develop an **integrated land information** and mapping system;
- Advise on an **appropriate regulatory environment** for the LIM system;
- Undertake a **User's Requirement Analysis**.

The Stakeholders' Forum approach accords with **Habitat and FAO proposals**. Habitat's recommendations, outlined in its Global Urban Observatory, relate to information at local authority level. The FAO suggests the establishment of a National Task Force to facilitate information exchange for integrated land management.

The **steering committee** attached to the Stakeholders' forum should catalogue information, analyze institutional mandates, undertake awareness campaigns and produce a handbook to inform users about existing information. The **technical secretariat** should produce and disseminate technical information and assess to what extent visualization should be used.

8. Some technical implications: Supplying decision-makers with the 'Big Picture'

The **major design criteria** is to create an LIM system with a national reference framework which can be used by a range of decision-makers, both non expert and (measurement) expert. A shared framework, or 'big picture,' needs to be developed (see Diagram 1.), which accommodates: -high/low value land, urban/rural, professionals and technicians with basic training, raster/vector, high/low accuracy data, from a range of techniques and technologies. It should also accommodate graphical (pictorial), geometric (measurement based) and topological (connectivity not absolute position) data. The LIM system's reference framework should: -Link paper maps and cadastral and/or GIS data sets of varying accuracies, service all levels of decision-makers cross sectorially, and enable decision-makers to visualize spatial information, both the framework and the information outputs, instead of geometric data being the core component.

Decision-makers should be able to visualize (see) what exists on the ground, so they can make better decisions. The graphical (pictorial) framework, of small scale base maps created through cartographic generalization, should include:-

- Information, about **major features** in the country, such as coastlines, roads etc., **geographic names**, and **major administrative boundaries**;
- **Human settlement patterns** generalized as classes, mapped thematically and graphically. Data acquisition is cheaper if individual houses/fields are not mapped;
- **Land use/tenure patterns**, but not using the conventional land use classifications. Patterns should depict existing *de facto* land use, irrespective of its legal status, not the *de jure* land use zoning. Land tenure should not be based on cadastral parcels but should include all forms of land tenure –legal, illegal, social and informal.

This largely follows the AFRICOVER approach, however to aid visualisation, land tenure patterns should also be included in AFRICOVER's classification system. Satellite imagery should be used to create the **graphical base maps** and populate the GIS. The maps should give small scale, topologically correct land use linked to human settlement patterns, and supply a generalised 'big picture' of a region cost effectively. A series of base maps of different scales should be created, with urban base maps at the largest scale. The result

should be a series of layers, all linked graphically and/or geodetically. Research and development should be undertaken in the establishment of a visualisation based LIM system, as well as the appropriate standards and specifications.

The graphical and geodetic frameworks should be linked (see diagram 1.) with the base maps being the common frame of reference for both decision-makers and/or experts. The base maps make it possible: -to use information of varying scales (by referring either to the major features depicted or to the measurements), to link spatial information of varying accuracies (either by cleaning up the data or through eye-ball generalizations related to graphical information), and to link graphical information to any existing cadastral surveys. Also, the maps should be created for a manual (paper) system, but be capable of being transformed into a GIS/LIS. The cadastral link should be a separate exercise to avoid the demanding characteristics of the cadastre at the outset. If finance is limited, the graphical reference framework should be produced first as the primary data set.

Linking the graphical and **geodetic** frameworks is crucial to the comprehensive economic development of Africa. There are presently a number of problems in regard to Africa's geodetic framework. The AFRICOVER project will not produce the geodetic accuracy specifications to address all these problems. It will start by harmonizing the geodetic datum, reference spheroids and map projections. All geodetic datums will be transformed into WGS 84. However, a Unified Datum for Africa is not planned as an outcome. Rather, the project will attempt to achieve mapping accuracies at a scale of 1:250,000. ECA, AOCRS and the International Geodetic Organizations should cooperate with the FAO so that in establishing the mapping datum for AFRICOVER, geodetic standards are also achieved.

Present approaches emphasize the need to **link the central and local levels and decentralize decision making** and information. This has implications for an LIM system: -

- A graphical base map should enable central level decision-makers to make holistic broad brush initial planning decisions. If final decisions are only made after local consultations are held, such exercises can be used to generate the large scale information required to change the land use and/or land rights. The symmetry and richness of local information makes up for its lower
- accuracy. This approach makes it unnecessary for the central level to hold high accuracy and/or large scale information giving complete coverage. Large scale, comprehensive information, is only required once an initial decision had been made about an area. This approach is application driven and facilitates cost avoidance and cost recovery;

Land tenure/land use could be mapped at any central point using remotely sensed images, for economies of scale, with the information being made available locally. As users drive cadastral systems, the land office should be local and not centralized. If cadastral information is kept locally, it will be unnecessary to transfer information from the local to central level, as long as the administrative processes ensure that the final decision is made locally, utilizing both central and local sources of information. Records of low value land surveyed to lower accuracies should be kept in the local land office.

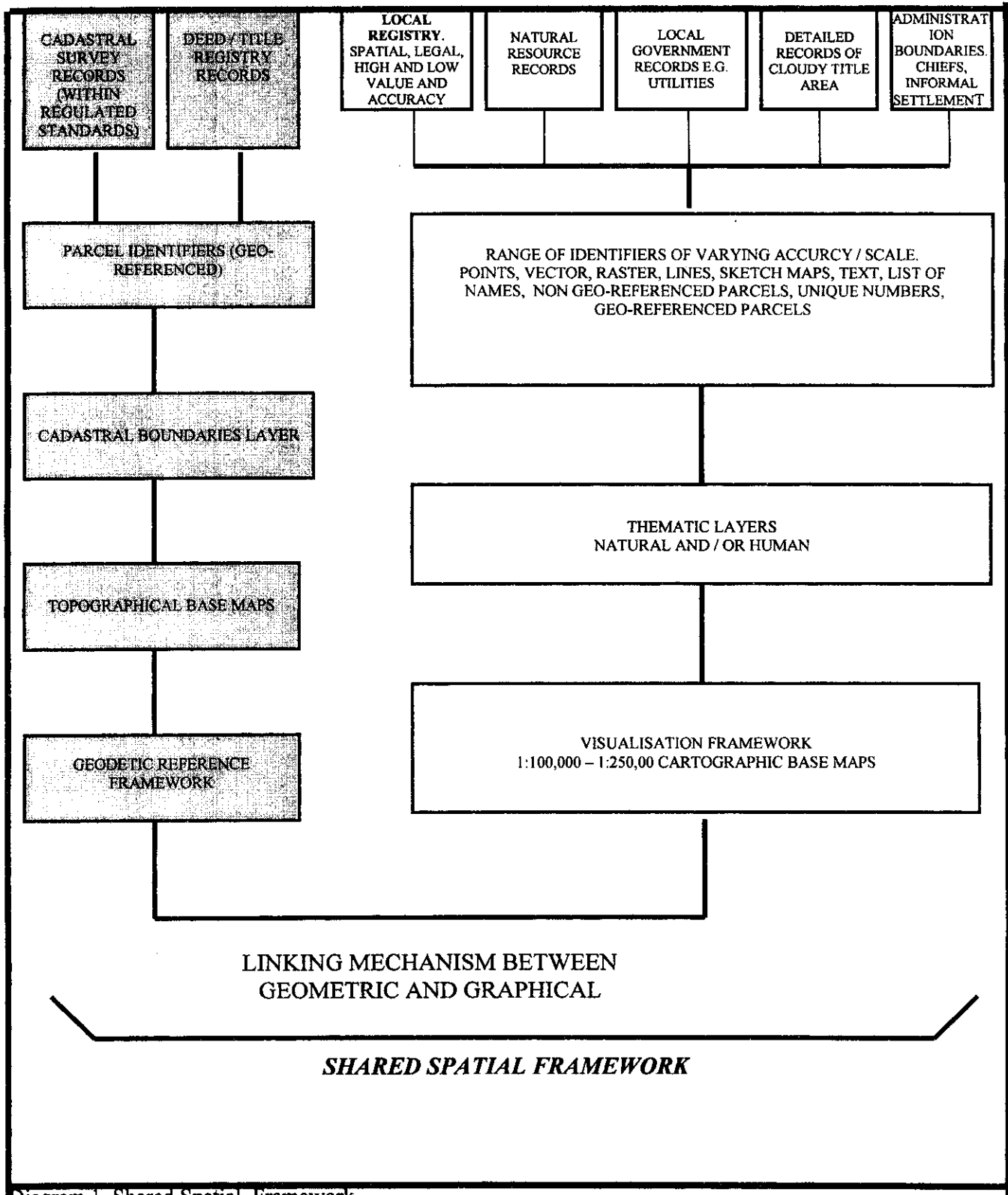


Diagram 1. Shared Spatial Framework

- To avoid costs, no record of the low value land should be maintained at national level. Lengthy technical processes will be short circuited for low value land leading to cost savings;

By decentralising the LIM node, information could be provided by people with fewer skills, using lower grade, cheaper technology. This is possible because: - the graphical base map allows local surveyors to produce a textual, data rich, topologically correct, description of features in the field, to accompany their lower accuracy surveys, supported by a public witness system. This should increase the amount of data and coverage in the LIM system and reduce costs. The survey data could be transformed by professional surveyors into stronger legal evidence when required, after an investigation of the local land office records and on site inspections, accompanied by adjudication/negotiation, to be able to create a clear title, defensible in the highest courts. Information about rights to high value land should be held both by the wider society and by the affected local group. The responsibility for, and funding of, the information flow, including updates, should rest with the investor/developer and the professionals.

A **range of identifiers** is needed to address the problem of the integration of spatial information within an LIM system. The integration of different data from different sources, which was captured using different methods, at varying accuracies and resolutions, and stored in different formats, using diverse referencing mechanisms, is a critical issue. To solve the problem, a referencing mechanism common to every system is required, together with a range of identifiers (not just accurately surveyed parcels).

Conventionally LIS systems have used parcels as the basic unit of data collection and the linking mechanism to other information in the database. Most information about the land in developing countries could not be utilized in an LIM system, as the information is not often parcel/polygon based, let alone cadastral parcel based. A graphical reference framework makes it possible to use information from a range of sources which could not otherwise be used, through the use of non parcel based identifiers, both when acquiring the information, and as the linking mechanism. The type of identifiers, of varying accuracies and scales, which an LIM system should be able to accommodate are: - points, geo-codes, lines and polygons (with/without fuzzy boundaries), text (including lists of names), unique numbers, parcels (poorly surveyed/geo-referenced), sketch maps and photographs.

Urban and rural examples demonstrate that a range of identifiers is required for decision making.

Information is required to regularize **urban** informal settlement. The underlying properties are often not parceled (state and/or customary) and low accuracy thematic polygons should be used for the boundaries of the state, informal settlement and customary areas. Lists of leaders should be attached to the thematic polygons, to identify stakeholders for negotiation. A geo-code (and text) against a location, such as an informal site, or house, should also be used.

Most **rural** family holdings have not been mapped (un-parceled). A commonly used spatial reference is a country's administrative units. However, socio-territorial units, such as chiefships and/or extended families, take most decisions about land management. A range of

identifiers, besides a polygon for the administrative units, should be used. Again, a geo-code is appropriate, consisting of selected points representing an area or feature of interest. Lists of names of leaders should be attached to the socio-territorial areas to facilitate negotiation, for sustainable land use. Also, fuzzy boundaries might be more useful than definite boundaries.

9. Regulatory Frameworks and Quality Assurance

The frameworks that should be put in place by governments include a:-

- Spatial framework **shared by all stakeholders** –i.e. a graphical framework in the form of base maps, based where possible on the geodetic framework;
- Regulatory framework that also **caters for the poor** and protects their land rights;
- **Institutional and policy** framework for the LIM system.

10. New tools and approaches

LIS/GIS systems should be adapted specifically for the African environment using the new tools available. Full use can be made of the new technologies only if:-

- The **cadastre is a sub system** of the LIM system allowing varying accuracies/scales;
- **Non parcel identifiers** are used in the database;
- **Graphical references are generated routinely** when mapping, designing databases, choosing scales, technology etc. A LIS should display and output the results of data analysis in a format that is understood by all stakeholders, including local communities;
- Surveyors develop procedures for incorporating the data from non-surveyors into databases, and for **assisting non-surveyors** to use and acquire better spatial information.

11. Recommendations

- LIM systems should be designed to **assist decision-makers** and increase a country's capacity to acquire information. The primary focus should not be on technical issues;
- A **Stakeholders' Forum** should be set up in conjunction with the **Habitat GUO Program** and the **National Task Force under consideration by the FAO**;
- A **User's Requirement Analysis** should be undertaken;
- **Policy development** should take place within the Stakeholders' Forum;
- **Graphical base maps** should be considered by using the **AFRICOVER** project. AFRICOVER should also include a land tenure classification and be used to create a Unified African Datum;
- **Pilot project(s)** should be used to demonstrate the feasibility of a GIS/LIS system based on visualization, and include a cost benefit analysis. Regional organizations and/or countries should be invited to formulate such pilots;
- **Regional Forums**, which include existing regional LIS organizations, should work out a spatial data framework for cadastral and LIM systems at regional level, in liaison with similar LIS organizational structures at international level (Habitat's GUO and FAO's proposed Task Forces);
- The Regional and National Forums of Stakeholders should **identify sources of funding**.