

The Kenyan Cadastre and Modern Land Administration

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Summary

Despite a history of more than 100 years and the introduction of provisional maps to support land registration, the Kenyan cadastre is largely incomplete. It consists of a patchwork of maps of different positional qualities, which would not be readily integrated to create a nation-wide coverage. This paper outlines the structure of the Kenyan cadastre and analyses the quality of the cadastral maps with regard to the requirements of modern land administration. From the assessment of the cadastre, it is suggested that the special characteristics of the maps be considered when integrating them. Towards this end, there is an on-going research to establish whether and how topographic datasets of higher positional quality could be used to improve the positional quality of such maps.

Zusammenfassung

Trotz einer über 100-jährigen Geschichte und der Einführung von »vorläufigen Karten« liegt der Eigentumsdokumentation in Kenia bei weitem noch kein vollständiges Kataster zugrunde. Das Kataster in Kenia besteht aus Karten sehr unterschiedlicher Punktgenauigkeiten, die nicht ohne weiteres zu einem flächendeckenden Kartenwerk zusammengeführt werden können. Dieser Beitrag beschäftigt sich mit der Struktur des Katasters und der Analyse der Kartenwerke in Kenia vor dem Hintergrund eines modernen Liegenschaftskatasters als Teil der Geodateninfrastruktur. In diesem Sinne ist zu empfehlen, insbesondere die jeweiligen Besonderheiten der verschiedenen Karten bei ihrer Zusammenführung zugrunde zu legen. Die weitere Forschung sollte darauf gerichtet sein, ob und wie topografische Datensätze höherer Punktgenauigkeit genutzt werden können, um die Qualität der Katasterkarten zu verbessern.

Keywords: Cadastre, land policy, land tenure patterns, provisional cadastral maps, data integration, Kenya

1 Introduction

The absence of a single and clearly defined national land policy in Kenya since independence in 1963 is the main reason for the existence of many land laws, some of which are incompatible. This has resulted in a complex land management and administration system, which is manifested through fragmentation, breakdown in land administration, disparities in land ownership and poverty. The consequences of these are environmental, social, economic and political problems, which among others include the deterioration in land quality, squatting and landlessness, disinheritance of some groups and individuals, urban squalor, under-utilization and abandonment of agricultural land, tenure insecurity and conflict.

To address these problems, the government initiated a process to formulate a national land policy, through a consultative process. The National Land Policy (GoK 2009) was finally approved in August 2009 by the cabinet marking a critical step in addressing the land question. Contemporaneously, a new Constitution of Kenya (GoK 2010) was promulgated in August 2010 replacing the older one that had been in place since independence. Apart from establishing a new structure of government and defining the relationship between the government and the citizens of Kenya, the new constitution also addresses the land question by stating a number of principles intended to guide the exploitation of the land and its resources and the establishment of a new land administration structure. The new administration structure is intended to facilitate the delivery of efficient, cost effective and equitable services to ensure devolution of land administration and management.

The National Land Policy in particular contains a number of objectives on various themes which are intended to ensure efficient, sustainable and equitable use of land for prosperity and posterity. With regard to cadastral surveying and mapping, the policy recommends the streamlining and strengthening of surveying and mapping systems. As to the cadastre and land information management, the policy recommends the establishment of computerized land information infrastructure at both national and local levels which should be efficient, user-friendly, accessible and affordable. In addition, the cadastre and other land information should be computerized and made available in a form and language that can be understood by most citizens. The policy also requires a National Spatial Data Infrastructure (NSDI) to be established to ensure the integration of and access to spatial datasets held and maintained by different national and sectoral agencies.

To realize these objectives in practice, the existing cadastral and other land information have to be converted to digital form and restructured based on adopted NSDI standards. However, until now cadastral coverage is incomplete. In addition, the existing cadastral maps have been produced using different coordinate systems, scales, and surveying methods as a result of different laws, regulations and requirements. The cadastre in its current status may not be readily suitable in a computerized environment. This is because the different cadastral maps cannot be readily integrated to create a homogeneous and seamless digital cadastre.

The goal of this paper is to outline the historical development of the cadastre and its current state in Kenya, and to assess it with regard to the requirements of modern land administration practice. The paper begins with an overview of the cadastre and related concepts.

2 Cadastre and Related Concepts

A hierarchy of concepts related to the cadastre and other land related issues is presented in Williamson and others (2010), with the land policy at the top and the land parcel at the bottom of the hierarchy respectively. Land policy is considered to be an abstraction of reality and consists of a group of coherent decisions taken by authorities to achieve the objectives related to land. Land policies do not render themselves to effective implementation; instead they are implemented through a set of laws and administration regulations. As such, land policy forms the foundation for land law and land management.

Land management involves the establishment of goals and mechanisms that influence land use in order to achieve desired policy objectives. In modern literature (ibid.), the modern paradigm in land management is characterized by a holistic approach by land administration systems to force their land administration processes to contribute to sustainable development. This is contrary to the traditional practice in which land management focused singly on either social or environmental or economic objectives.

The operational component of the land management paradigm includes the range of land administration functions carried out to ensure proper management of rights, restrictions and responsibilities in relation to property, land and natural resources. Land administration is considered to include processes of determining, recording and disseminating information about tenure, value, use and development when implementing land management policies (FIG 1999).

Within the land management paradigm, each country delivers its land policy goals by using a variety of land administration techniques and tools. Land administration in each country is unique. For example, although the four functions (land tenure, value, use and development) are identifiable in the German land management framework (Kötter 2001), not all of them are served by the cadastre. According to Hawerk (2003) there are no problems like informal and illegal settlements that would require formalization (adjudication) of the land rights. This is because in Germany, cadastral mapping and registration are carried out before land registration (»Grundbuch«). Furthermore, land registration is based on the title system, which encourages substantial mobility without threat to loss of property, thereby leading to complete territorial cadastral coverage with all kinds of landowners (private and state) and all kinds of land use (urban, rural, forests etc.).

Comparatively, a great deal of land tenure processes in Kenya concern land adjudication, because not all the land in the country has been registered. This is because of the dual application of the deeds and title systems of land registration. In addition, the Torrens and English approaches used in Kenya during land registration allow the use of both the fixed and general-boundaries in property

identification. This has greatly affected the consistency and coverage of the cadastre.

Differences are also evident in the character and content of the cadastre which is the core engine of land administration. In most countries, the land parcel is considered as the basic unit in the cadastre; however in some countries both land parcel and buildings are included while in others only the land parcels are included. For example, in Germany, the cadastral map contains all parcels and buildings in a state, in which all parcels are described with graphical and textual data. In contrast, the Kenyan cadastral maps do not include buildings. In both cases, however, the cadastre is parcel-based, i.e. information is geographically referenced to unique, well-defined units of land parcels. Further differences include for example, whether land parcels in state ownership like roads and streets are included in the cadastre.

The few examples aforementioned give credence to the fact that the concept of cadastre takes on different meanings in every country (Dale 2006) as a consequence of each country's historical development, its laws and customs, and to a large extent its form of conveyance and methods by which land registration was introduced. Therefore before making any effort to restructure the existing cadastre for modern land administration, it is necessary to understand the historical development and the present condition of the cadastre.

3 Historical Outline of the Kenyan Cadastre

In Kenya, cadastral surveying and mapping is integrated in the land registration process; as such, its development follows that of land registration. Chronologically, the development of the cadastre can be categorized into four periods: before 1902, between 1902 and 1945, between 1945 and 1963, and since 1963.

3.1 Before 1902

Prior to 1902 when the Crown Lands Ordinance was enacted vesting all land in what is Kenya today to the British Crown, land was held under customary tenure. Under the customary tenure then, land was neither considered as a commodity for sale nor could it be alienated or transferred. In this period the cadastre was simply non-existent.

3.2 Between 1902 and 1945

After 1902 the concept of individual ownership was introduced by the British in the crown land (all land in the colony including the land occupied by the indigenous people). Individual ownership of land had to be registered

according to a cadastral plan. Cadastral activities were effectively introduced in 1903 when a survey section was established and a chief surveyor appointed to superintend the demarcation and survey of parcels of land that had been alienated in Nairobi (Njuki 2001). This was realised through the enactment of four ordinances namely: the Land Titles Ordinance of 1908; the Crown Lands Ordinance of 1915, the Registration of Titles Ordinance of 1918, and the Land Surveyors Ordinance of 1923. These Ordinances guided the land tenure policies for almost fifty years.

Before the Second World War, cadastral survey activities were mainly confined to the land alienation programme at the Kenya Coast and the British settlements in Kenya's temperate highlands by farmers of European origin (these regions subsequently became known as the »White Highlands«). The objective of the programme was to alienate crown land to the British community according to the provisions of the Land Surveyors Ordinance of 1923 and registered under the provisions of the Registration of Titles Ordinance. The two ordinances required only fixed-boundaries whereby land was demarcated by permanent survey marks and the position of the survey marks accurately determined by mathematical computations. All Crown grants were to be compulsorily surveyed before they could be registered.

3.3 Between 1945 and 1963

After the Second World War, cadastral activities were mainly carried out to support the land tenure reform policy of transforming land in trust land areas from the customary land tenure to the statutory freehold individual ownership. The Trust Lands Act of 1959 was enacted to provide for the registration of land in the trust lands. Land registration in the trust lands was mainly carried out under the land consolidation programme.

The Land consolidation programme involved the adjudication (formalization of land ownership), exchange and gathering of fragments of small plot sizes of common ownership, in order to create more viable economic units for each owner. The process of land consolidation as was carried out in Kenya is equivalent to the accelerated land consolidation procedure used in Germany (Thomas 2004). In both cases, the objective is to consolidated scattered and/or uneconomically shaped parcels without necessarily creating new road systems or water resources projects. Usually, the procedure is initiated by a state authority.

The areas where land consolidation programme has been carried out in Kenya are referred to as consolidation areas. The core of the land consolidation programme was in the Central Province of Kenya carried out under the provisions of the Land Consolidation Act of 1959. Neighbouring farmers were compulsorily displaced in an effort to create room for larger units. The compulsory relocation of people caused discomfort, thereby making

the programme unpopular. At the moment, the land consolidation programme is restricted to the former Meru district. Interestingly, this programme, which began in 1966 in this area, is yet to be completed.

3.4 1963 to present

After independence, the main land reform programmes were: land adjudication, land redistribution and land allocation.

3.4.1 Land adjudication

Since the land consolidation programme proved to be unpopular and slow because the desired targets could not be achieved, the government appointed a mission on Land Consolidation and Registration in Kenya (1965–66) to find ways and means of accelerating land consolidation. The mission recommended that the ascertainment of land rights be carried out by the process of land adjudication (Lawrence et al. 1966) mainly in agriculturally high potential trust lands. In addition, the requirement to compulsorily survey land before the land is registered was changed after the government realized that a lot of development was being hampered by the slow pace of settlements caused by backlog in land surveys.

Land adjudication programme was the main land tenure reform carried out after independence. The programme was meant to make individual land titles available to the indigenous people by formalizing their customary rights where they were living. The areas where land adjudication has been carried out without consolidation are called enclosure areas, named after the enclosure movement of the 1700s. The movement, according to Williamson and others (2010) was a controversial process of taking common lands for traditional purposes such as communal farming, grazing, hunting and access to timber and other resources, and fencing the lands to be placed in private ownership.

Apart from the agriculturally high potential areas, land adjudication is also carried out in the rangeland areas (also called group ranches) for nomadic pastoral communities, where group ownership is preferred to individual ownership. The parcels of land in these areas are registered in the name of the group representatives in trust on behalf of the rest of the group members under the provisions of the Land (Group Representatives) Act of 1968. A group in this context refers to a tribe, a clan, a family or any other group of persons whose land, recognized under customary law, belongs communally (undivided) to more than five persons who are members of that group. Each group selects about ten of its members to be registered as trustees of the land by the Government. These trustees can allocate portions to the group (Wayumba 2004). This model of land tenure was introduced in Kenya as part of the African Land Development (ALDEV) to improve

on the carrying capacity of the land, the productivity of cattle, and to control the ecological imbalance usually associated with such fragile ecosystems.

By far, land adjudication has been the largest programme for individualization of tenure ever undertaken in Kenya and in a systematic manner. So far over 25% of the total land area in Kenya has been adjudicated and mapped in one form or another and is yet to be started in some parts of the country.

3.4.2 Land redistribution

Individualization of tenure has also been realised through land redistribution and through allocation of government land. Land redistribution is carried out thorough government and private initiatives. After independence, through a government initiative, the government would buy land from the British settlers and redistribute it to the indigenous people through the Land Settlement programme. Through private initiatives, companies and cooperative societies would buy large farms previously owned by settlers, subdivide and allocate them to a large number of farmers. The areas where this programme has been carried out are called settlement schemes.

3.4.3 Land allocation

Although the allocation or alienation was the first tenure process introduced through which the government could lease land to individual owners, the process was reinvigorated after independence. Land allocation was and still is carried on a need basis, but especially for residential, commercial and industrial development in urban areas. This programme has been going on for over 100 years and land parcels of varying sizes are involved.

4 The Kenyan Cadastre

4.1 Land tenure patterns

All land in Kenya is classified into three categories, namely: government, private and trust land, and are respectively 10%, 20% and 70% (Mwenda 2001). The proportions are not as a result of any policy requirement but as a result of the natural registration and land transfer processes. These categories have been renamed as public, private and community lands respectively in the national land policy and in the new constitution.

According to the new constitution (GoK 2010), public land is land vested in and held by the government in trust for the people of Kenya. The Constitution and the National Land Policy contain clauses that specify what is considered public land, for example, land held, used or occupied by a state organ, national parks, government game reserves, water catchment areas, all rivers, lakes

and other water bodies, and specially protected areas. Recognizing the non-existence of a system for registering public land, the policy requires mechanisms to be established for registering public institutional land and to establish mechanisms for repossessioning any public land acquired illegally or irregularly.

Private land is land held by individual persons or legal persons like private companies and co-operative societies after alienation from government land or adjudication from trust lands. The land is held either under freehold tenure or leasehold tenure. The policy requires the land to be held on terms that are clearly sub-ordinate to the doctrines of compulsory acquisition and development control.

Community land is the land vested in and held by communities identified on the basis of ethnicity, culture or similar interest. Community land include among others land lawfully registered in the name of group representatives under provisions of any law, ancestral lands and lands traditionally occupied by hunter-gatherer communities, and land held lawfully as trust land by county governments, for example, rural markets, rural public schools etc. Any unregistered community land shall be held in trust by county governments on behalf of the communities for which it is held. With regard to community land, the policy requires the documentation and mapping of existing forms of communal tenure, whether customary or contemporary, rural or urban, in consultation with the affected groups, and incorporate them into broad principles that facilitate the orderly evolution of community land laws.

Clearly, the largest category of land in Kenya is the community land. This is because much of communally owned land which mainly lies in the rural areas has not been registered and mapped. Although a greater percentage of community lands are in the rural areas, still some secondary towns in Kenya are predominated by community land tenure. As a consequence, there is usually shortage of serviced land for all forms of urban development due to limited availability of public land. In addition, it is generally argued that customary land tenure is less responsive to general urban land demand (Olima and Obala 1998).

4.2 Cadastral maps

Different types of maps are used to support land registration in Kenya. The most famous maps are the survey plans for urban areas and the Registry Index Maps for rural areas, which are respectively numeric and graphical. Other maps used to support land registration are graphical and only used provisionally. As an integral component in the land registration process, these maps are created during a first registration of the land and amended afterwards in case of a sub-division of the land.

4.2.1 Survey and deed plans

A deed plan, usually produced for each parcel of land in urban areas, is traced from a survey plan based on fixed-boundaries. A fixed-boundary is an invisible line defined geometrically through an accurate survey. These boundary lines are generally more accurate and legal. A survey

mathematical data from which the numeric cadastre is created. These methods use the traditional optical survey equipment including theodolites, tacheometers, Electro-optical Distance Measurement Equipment (EDM), total stations, and also the Global Positioning Systems (GPS). The only problem with fixed-boundary surveys is that they are expensive to carry out.

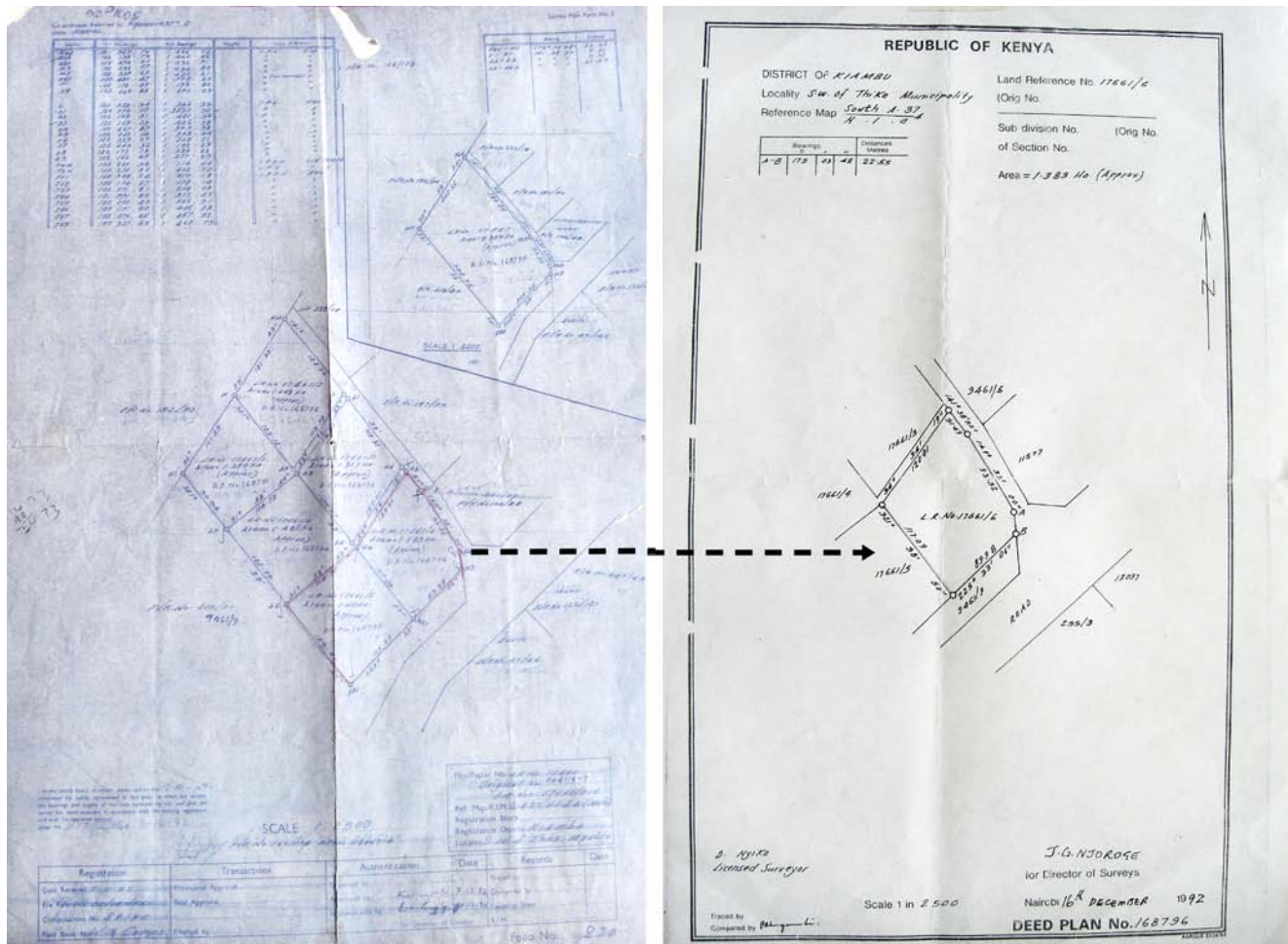


Fig. 1: A Survey Plan (left) from which a Deed Plan (right) is extracted (Courtesy, Survey of Kenya)

plan [Fig. 1 (left)] shows measurements (bearings, distances, areas and coordinates) of all the surveyed parcels and the adjoining parcels, while a deed plan [Fig. 1 (right)] which is abstracted from the survey plan typically shows the bearings, distances and area of an individual land parcel. The survey and the subsequent deed plan are named so because they are prepared from surveys that are based on a planned layout of land parcels. Usually, the preparation of the Part Development Plan (PDP) on which the surveys are based precedes the survey.

Typically, survey plans and the subsequent deed plans are of the highest positional accuracy compared to the other cadastral maps. This is because survey plans are based on fixed-boundary (coordinated) surveys.

Survey plans are based on ground survey methods that ensure that the requirements of fixed-boundary surveys are met. The methods employ precise equipment and techniques to obtain accurate and reliable mathe-

4.2.2 The Registry Index Map (RIM)

According to the provisions of the Registered Land Act of 1963, a RIM is the main cadastral map prepared for the first registration of land (during the adjudication process) and amended during subsequent land subdivisions. It is used to identify on the ground a plot shown on the register; assist in the re-location of a boundary, should it be lost; enable sub-division to be effected; and for calculation of areas.

A RIM shows the outline of all individual land parcels within a given jurisdiction using general-boundaries, i. e., they are not coordinated. A general-boundary is demarcated by natural or manmade features: wall, fence, ditch or hedge, etc. The boundary lines are inaccurate; they are only indicative and not legally binding.

The RIM is usually prepared using ground survey methods for every registration district (equivalent to an

administrative district) or a part thereof and is divided into registration sections, which are identified by distinctive names. The registration section may be further divided into blocks, which are identified by either numbers or letters or a combination of both.

A RIM typically contains information about the location, sheet and index number, edition of the sheet, sheet history (amendments), plot numbers and scale. The scale is very important since no measurements are provided to show the dimensions of the boundaries, and the map user can only rely on the scale ruler to scale off the distances from the map.

The obvious limitation of the RIM is the lack of indication of measurements on both the length of the boundaries and of the areas of the individual parcel. Another limitation is that since all amendments are made on the original sheet whose scale is fixed, the map can get very congested due to continuous changes on consecutive resultant parcels which may lead to illegibility of the map.

4.2.3 Provisional cadastral maps

4.2.3.1 Demarcation maps

The Registered Land Act of 1963 allows the use of provisional cadastral maps for land registration prior to the preparation of more accurate RIMs. For example, during the land consolidation programme, cadastral surveying and mapping was based on aerial photography at a scale of 1/12500, from which base maps at a scale of 1/5000 are prepared. The base maps were subsequently enlarged to scale of 1/2500 for purposes of area computation and as the basis for the preparation of an »Allocation Plan«. The allocation plan is then used for demarcation of the boundaries on the ground as reflected on the allocation plan. The maps used to support registration are then prepared by tracing the allocation plans and are known as demarcation maps, which are provisional RIMs. Fig. 2 shows an example of a demarcation map.

In the earlier days of land consolidation programme, these provisional RIMs were upgraded through a process known as »Refly«. The owners of the consolidated lands were requested to

plant hedges on their boundaries and after these hedges grew and were air visible, aerial photography was carried out at the scale of 1/12500. From these photographs and after ground control was provided by means of triangulation or trilateration, maps at the scale of 1/2500 were produced photogrammetrically showing the boundaries. Ground survey methods were used to mark and plot the missing boundaries. The main limitation of the demarcation maps is the absence of measurements.

4.2.3.2 Preliminary Index Diagram (PID)

Cadastral survey and mapping for land adjudication in enclosure areas uses provisional maps called Preliminary Index Diagrams (PID). These maps are created by the land officers using enlarged aerial photographs or by ground methods or both. Only in a few cases in enclosure areas were boundary surveys done on base maps using plane table surveying. In the majority of cases, enlarged aerial photographs are used. The process entails undertaking aerial photography at a scale of 1/12500 or 1/25000. These photographs, which are usually un-rectified and mosaicked, are enlarged to scales of 1/2500 or 1/5000. After the identification and marking of parcel boundaries on them by photo interpreters, parcel boundaries are then traced out from the marked photographs, thereby producing an interim map for registration.

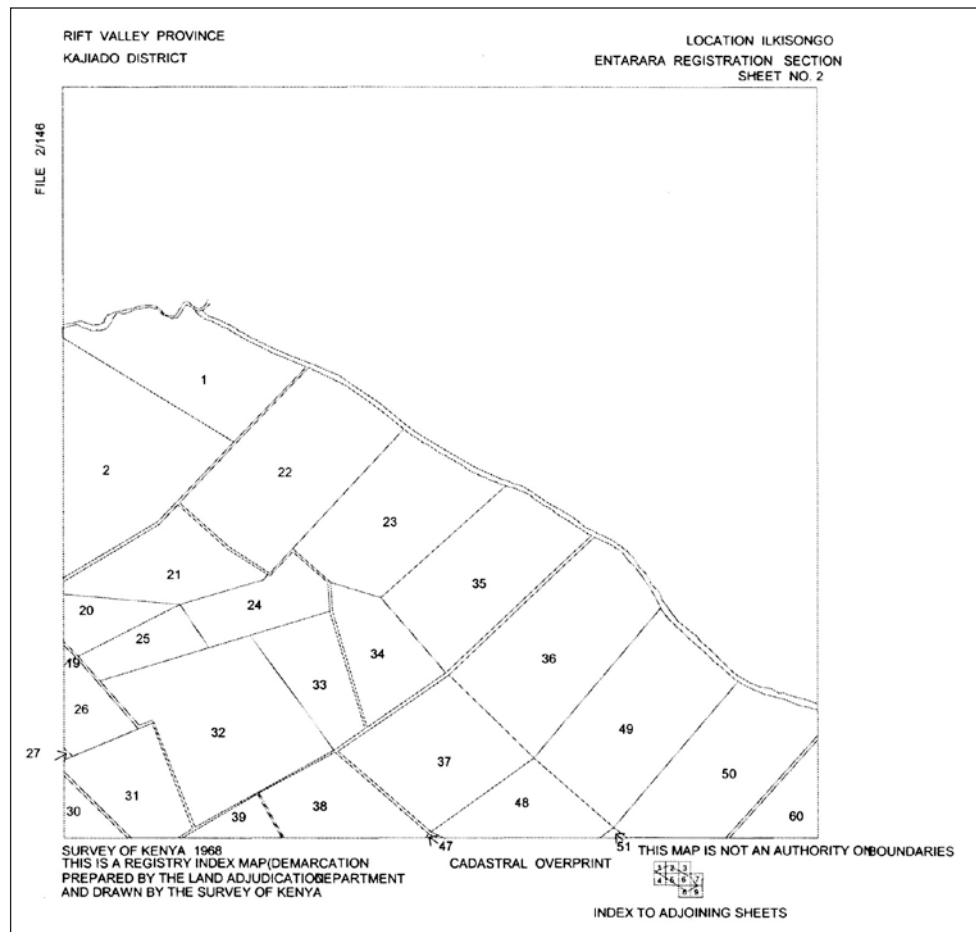


Fig. 2: A Demarcation Map for part of a Registration section (Courtesy, Survey of Kenya)

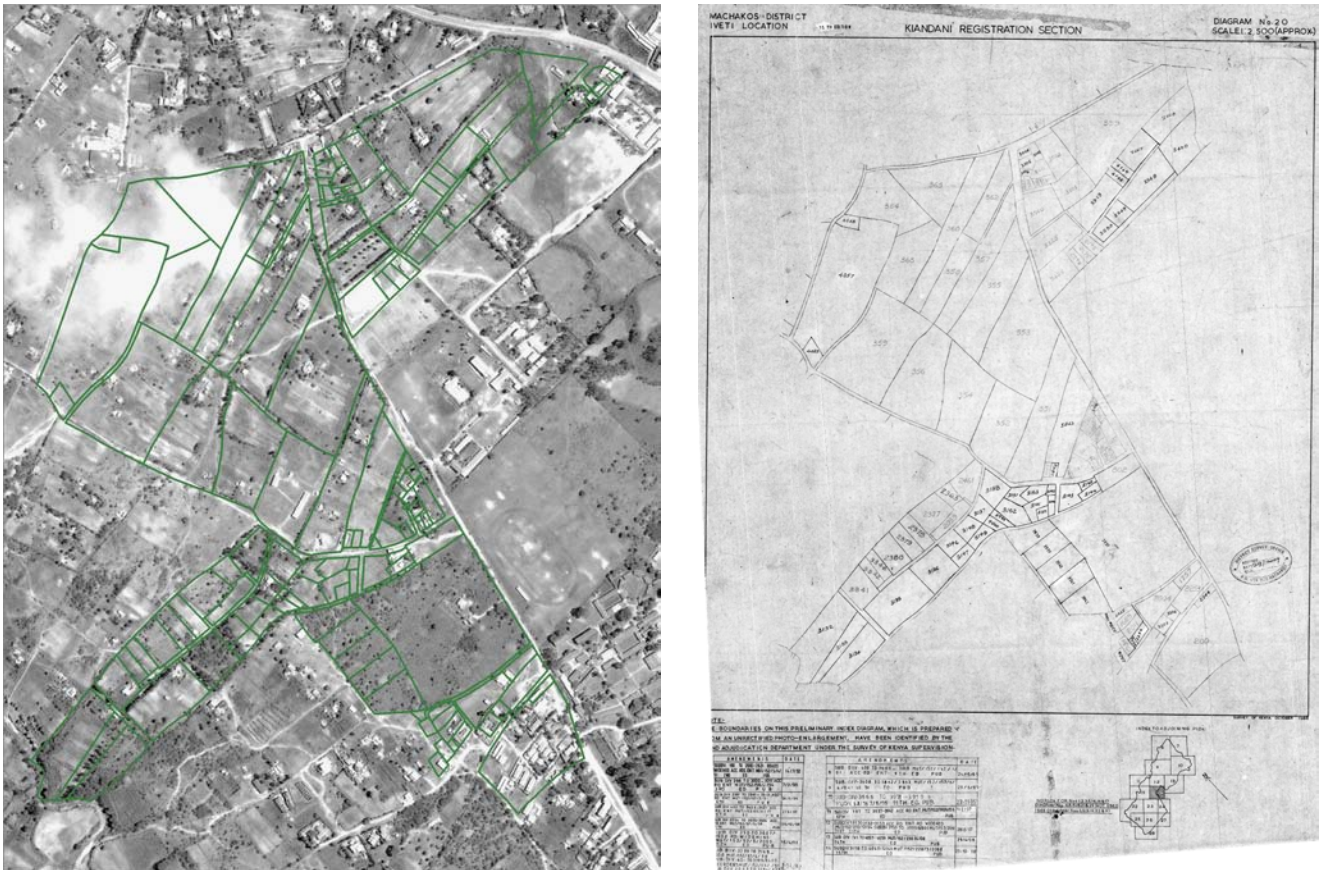


Fig. 3: Left – marking of parcel boundaries on un-rectified, uncontrolled and mosaicked aerial photographs; Right – resulting PID after tracing from the marked photographs (Courtesy of the Survey of Kenya)

Although PID (illustrated in Fig. 3) are prints of maps showing approximate parcel boundaries, their main weaknesses are the non-uniformity of scale within a particular index map sheet, unreliability of distances and areas calculated using these map sheets and sometimes distortion of the shapes of the land parcels. This is largely because the PID is not controlled in any way.

4.2.3.3 Registry Index Maps – range land (provisional)

In range lands where trust lands are converted to group ownership, natural features appearing on published 1/50000 topographical maps are accepted as boundaries. Boundary markers though coordinated to the nearest metre using approximate ground survey methods are marked on the 1:50000 maps but their coordinates are not often used to compute the areas.

4.3 Common map scales and typical positional accuracies

The different maps used to support land registration have different positional accuracies depending on the registration legislation and the method of survey used. For the preparation of survey plans and deed plans, the land parcels are mapped to the highest positional accuracy specification (0.03m). The RIMs for urban areas, although based on both fixed and general-boundaries,

have a nominal positional accuracy of about 0.30 m. The Demarcation map, the PID and the RIM Range land (provisional) have variable geometric accuracies and are considered as interim RIM subject to more accurate surveys. For PIDs, Mulaku and McLaughlin (1996), for example, showed that deficient inaccuracies of more than 20m in position and more than 50% in area are not unusual. Tab. 1 gives a summary of the cadastral maps used in Kenya on the basis of the common scales and typical positional accuracies.

Tab. 1: Cadastral map types and their common scales and positional accuracies

Type of Map	Common Scales	Positional accuracy
Survey Plans/Deed Plans	1/500 – 1/5000	±0.03 m
Registry Index Maps (RIM)	1/10000	±0.30 m
Demarcation maps	1/2500	variable
Preliminary Index Diagrams (PID)	1/2500 – 1/5000	variable
RIM Range (Provisional)	1/50000	± 10 m

4.4 Cadastral coverage

As a result of the voluntary nature of land registration and integration of cadastral surveying, mapping and registration, cadastral coverage is incomplete, in addition to being of inconsistent positional accuracy. To determine the extent of cadastral coverage the knowledge of the extent of land registration is important. Tab. 2 gives a summary of cadastral coverage in terms of the category of the land parcels, the type of map used and the total surface area covered. The values quoted in Tab. 2, were obtained from Departments of Survey and Land Adjudication and Settlement (MoL 2010) and in (Njuki 1999). The values do not necessarily reflect the current situation but are not significantly different. Latest statistics on government land in urban and rural areas in terms of coverage are not readily available. With a total land surface area of about 582,600 square kilometres, 14.6 million hectares of registered and mapped land represents coverage of about 25%.

Tab. 2: Cadastral coverage

Category of land	Map	Area (million ha)
<i>Trust land</i>		
Consolidation Areas	Demarcation maps / RIMs	8.0
Enclosure Areas	PID	
Group Ranches	RIMs (provisional)	3.3
<i>Private Land</i>		
Settlement Schemes	RIMs/PIDs	1.012
Company and Cooperative farms	Deed plans / RIMs and RIMs (provisional)	2.2*
<i>Government Land</i>		
Urban and rural Areas	Survey plans / cadastral index maps	0.101**
Total		14.6

* (Njuki, 1999); ** this is an approximate value for 250,000 plots of various sizes in urban areas (a plot size of 1 acre is assumed).

5 The Kenyan Cadastre and Modern Land Administration

In organized societies, land administration and management is characterized by the use of technology which offers improvements in collection, storage, management and administration of land information. At the same time, technology offers potential for spatial enablement by using location as the basis for integration of land in-

formation. In addition, efficient and effective land administration to support sustainable development requires a Spatial Data Infrastructure (SDI) to operate. In this section, the Kenyan cadastre is assessed to establish whether it is appropriate for modern and organized land administration as aimed by the National Land Policy. The assessment is based on the requirements of a modern land administration system (Enemark et al. 2005) and as envisioned by Cadastre 2014 (Kaufmann and Steudler 1998). The aspects used for assessment include: integration of the functions of land administration, accessibility of cadastral information, cooperation on common standards and data model, automation, and quality of information.

5.1 Integration of the functions of land administration

The core functions of land administration can only be integrated by building them on core and common cadastral knowledge. The first and second statement of cadastre 2014 envisages a cadastre that covers all land objects and not just land parcels. At present, however, the Kenyan cadastre is parcel-based and contains mainly privately owned land parcels. This is because there has been no systematic approach to register and map publicly owned lands. Besides, no buildings are included in the cadastre.

The second statement of cadastre 2014, which suggests that the separation between the land register and the cadastre shall be abolished, does not yet hold in Kenya. This is because the land register and the cadastre are physically separated, and as a consequence, there is sometimes inconsistency between the two.

5.2 Accessibility of cadastral information

To facilitate e-land administration and participatory democracy, accessibility of land information to all is required. The fifth statement of Cadastre 2014 suggests that the public and the private sectors will work closely together in establishing and in maintaining a cadastral system. At present, cadastral information, which includes the survey plans and the RIMs, can be obtained by private surveyors at a fee. The same applies to the information from the land register, in which individuals can obtain information through an official search. Currently, the mode of accessing land information seems to be sufficient and is likely to continue even in the era of modern land administration.

5.3 Cooperation on common standards and data model

The third statement of cadastre 2014 suggests that cadastral mapping as a stand-alone activity shall be replaced

by data modeling. Data modeling ensures a common understanding of concepts and processes within a given land administration system. Currently the Kenyan cadastre is not based on any common data model, let alone the existence of any formalized cadastral and land administration data model. The Land Administration Domain Model (ISO, 2008) and Cadastre 2014 are international efforts in data modeling, which could be starting points for the implementation of a national land administration data model.

5.4 Automation of the cadastre

The global trend in land administration systems is the reliance on Information and Communication Technologies (ICT). The fourth statement of cadastre 2014 suggests that the use of paper and pen in cadastral mapping shall be replaced by computer systems that permit automation. Although there is evidence of automation in some sections of the department responsible for the cadastre, the cadastre is still analogue. Moreover, the lodging of cadastral surveys for approval by the Director of Surveys is still required to be done in analogue form despite the use of digital land surveying equipment to capture data in the field. To be suitable for modern technology-based land administration, the cadastre together with the land register have to be automated, taking into account common standards and data models.

5.5 Quality of cadastral information

The quality of cadastral information is an important element in modern land administration. The quality of cadastral information can be described in terms of consistency in the land register and the cadastre, completeness of cadastral coverage and positional accuracy. So far, land adjudication has only been completed for about 25% of the total land surface area of Kenya. This means that cadastral coverage is far from complete. Under title registration both coordinated and un-coordinated boundary systems are used, which means that cadastral coverage is neither continuous nor of homogeneous quality. The completeness of cadastral coverage is further complicated by the use of more than one coordinate system (UTM and Cassini-Soldner) in cadastral surveying and mapping, not to mention the use of interim maps which have no coordinate grid.

From the foregoing, it is obvious that the positional accuracy of the cadastre is also not homogeneous because of the use of different surveying and mapping techniques, which have different accuracy capabilities. In general, the inconsistency of the positional quality in the cadastre is a result of the influence of the various laws, regulations and requirements.

6 Conclusion

The Kenyan cadastre has been presented in terms of the historical development and the survey and mapping involved in the creation of the cadastre. An assessment of the cadastre against the requirements of the modern land management paradigm was carried out. It has been established that cadastral coverage is largely incomplete mainly because land registration, which requires cadastral mapping, has equally not been completed. Coverage is further complicated by the use of both fixed- and general-boundaries and the application of more than one coordinate system in cadastral surveying and mapping, not to mention that the majority of maps are provisional most of which have no coordinate grid. The Kenyan cadastre in terms of coverage can be described as a patchwork of isolated and inhomogeneous cadastres.

The different types of maps that form the cadastre have to be integrated when creating a seamless national cadastre. This is by considering the special characteristics of these maps. For the survey plans based on fixed-boundaries, the main focus should be the harmonization of the different coordinate systems used for reference in the maps. For the RIM based on general-boundaries the focus should be to coordinate them by using a common coordinate reference system. For the provisional cadastral maps, like the demarcation maps and the PIDs, efforts should be directed at first improving their positional and geometric quality before integration with the more accurate cadastral maps. Following this last proposal, there is an ongoing research to establish whether and how topographic datasets can be used not only to improve the geometric qualities of such legacy graphic cadastral maps but also towards their integration. This will go a long way in supporting the principle in the National Land Policy that requires the improvement of mapping standards in general-boundary areas towards the realization of a computerized optimal cadastre.

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