Searching for an Affordable and Acceptable Cadastral Survey Method

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SUMMARY

A cadastral survey and mapping system that is simple, quick and affordable speeds up official access to secure land tenure by many citizens and thus propel motivation for equitable land allocation and purposeful urban land development. The cadastre being the heart of modern, secure land tenure provides information about spatial locations and identities of individual land units or parcels. Cadastral survey plans and maps are the documents for efficient land registration because they unambiguously identify on the ground a parcel described in the register or assist to resolve boundary disputes that arise from lost or damaged boundary marks.

For decades, however, the affordability of the cadastre has been queried (for example: Meek 1968:284, Barry et al 1995:3, Kironde 2000:1, Njuki 2001:2, Osterberg 2001:1 and Fourie 2002:7). Specifically, the Cadastral Survey System in Tanzania has been blamed for being too costly and therefore not affordable. Kironde (2000:12) argues, 'The cost of surveying is very high and the productivity of land surveyors, in terms of plots surveyed, especially in public services is low.' The regulatory framework, technical standards, and methods as well as the administrative procedures that go with operations of cadastral surveys have often been cited as culprits of high costs and delays in the delivery of land to the needy (URT, 1994:38-39). If these contentions are correct, something must be done to remedy the deficiency.

This paper reviews the current Cadastral Surveying and Mapping System with the view to identifying the areas that lead to high and unaffordable cadastral survey services, and proposes appropriate solutions for urban settlements in mainland Tanzania.

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1. INTRODUCTION

Cadastral Surveying and Mapping is the cornerstone of the Cadastral System. Land Use and Environmental Planning, and Land Administration (such as property valuation, land allocation, land registration, land rent collection, etc.) are integral components of the cadastral system. These components must be synchronized with one another and function as a whole transparently to ensure coherent urban land administration and development, particularly regarding access to land that has legal security of tenure. The institutional set up in Tanzania puts all these land components under one roof, namely the Ministry of Lands and Human Settlements Development.

Many urban dwellers of various levels of income and status need land parcels on which to build owner occupied residential houses. The demand for planned, surveyed and serviced land has therefore always been quite high. Quoting Kombe (1994), Kironde and Rugaiganisa (2002:5) state that between 1978/79 and 1991/92, the Dar es Salaam City Council in Tanzania received 261,668 applications for plots but was able to produce *(survey)* and allocate only 17,751 plots. This meant the rest had to look in the informal settlements for their land needs. Official records released by the Surveys and Mapping Division (SMD) in 1999, showed that the annual supply of surveyed parcels in urban areas was not enough to meet the rising demand. In 2001 the demand was 150,000 parcels while the average annual output over the previous 10 years was 8,021 (Silayo, 2001:354).

Technical and administrative procedures and standards as well as the professional issues that are relevant in the supply of surveyed land are provided in various regulations and legislation, which regulate surveying profession in the country. The cadastral survey system gives preference to survey records (coordinates and plans) of parcel boundary positions over physical locations of beacons on the ground. Hence, in case of lost or disputed boundary of a land parcel, it is the record in the register that takes precedence over marks on the ground. This is why courts of law accept as conclusive, disputed or lost boundaries restored by qualified surveyors.

2. CADASTRAL SURVEYS

A cadastral survey is a land measurement activity whose purpose is to describe new or changed boundaries of land parcels and includes recovery and restoration of lost boundaries. The description may be textual, numerical, graphical or a combination of these. The surveys provide basic information about geometric description (including spatial location, size and shape) of land parcels. Such information is prerequisite to successful land registration in Tanzania.

A land parcel is the basic unit in the cadastral system. Each parcel is given a unique parcel number and address, which together with parcel dimensions are shown on a cadastral survey

plan. A set of beacons or Iron Pins in Concrete (IPC) defines a boundary line that separates adjoining parcels. Coordinated (fixed) boundary lines are invariably used. General boundaries comprising physical features such as hedges, walls, streams etc. on the ground may be used subject to written permission of the Director of Surveys and Mapping.

Accuracy, the degree of conformity with set standards, is observed in boundary surveys. Accuracy in the surveys is important because, among other things, it helps surveyors to determine equipments and methods to use. Furthermore, accurate land parcel information is a fundamental tenet of cadastral systems. High accuracy implies high cost. The question of low cost has been addressed by FIG (1995:3) when it states that a successful cadastre should provide security of tenure, be simple and clear, be easily accessible and provide current and reliable information at low cost.

Cost refers to the amount of money paid/payable in return for goods or services rendered. The official cost of a parcel therefore includes the expenses incurred by the government through the functions of the three component divisions, namely; the acquisition of the land to be surveyed, compensation paid on the acquired land, technical services rendered including: initial topographic mapping, land use zoning, surveying, valuation, sale/allocation, tax payable, provision of infrastructure and administrative overheads. Often many people do not disaggregate the cost of a parcel into its components. Instead the cost is wrongly lumped into the survey process as once implied by a Member of Parliament (MP) who urged the government to reduce fees for plot surveys because the majority of Tanzanians could not afford to pay the fees demanded for such surveys. The government responded by saying that the fees were necessary to meet the costs of surveying and preparing the plots (Daily News of 10th April, 2003:2)[1].

Affordability to pay a cost of a land parcel refers to 'ability and willingness' of parcel allottees to pay for the parcel and the services rendered. Based on this, it is contended that survey methods and standards, procedures and accuracy may be the contributing factors that make survey services unduly expensive and therefore not affordable by the majority of urban dwellers. Can simple, low-cost, fast and acceptable methods of surveying contribute to the lowering of parcel costs and thus making planned, surveyed and serviced parcels affordable to the majority of urban dwellers?

3. THE LEGAL BASIS

Because land ownership has historical connection with law of property, surveys that describe land units (i.e. cadastral surveys) have been carried out under legal frameworks. Hence, cadastral surveys are also known as legal surveys. The basic law on land matters in Tanzania, namely the Land Act No. 4 of 1999 states that a granted Right of Occupancy shall be issued on land that has been surveyed [section 22(1)]. Village lands are not a subject of a granted Right of Occupancy and are therefore not a subject of a survey as presented herein.

[1] The MP was reacting to the then ongoing government sponsored 20,000 Plots Project in the City of Dar es Salaam.

The principal legislation that regulates the technical operations of cadastral surveys in Tanzania is the Land Survey Ordinance, Cap 390 of 1956. This Ordinance is in consonance with the Land Registration Ordinance, Cap 334 of 1953, of which Section 88(1) states: 'No estate shall be registered except in accordance with an approved cadastral survey plan'.

In addition to Cap 390, the Professional Surveyors (Registration) Act No. 2 of 1977 establishes the National Council of Professional Surveyors (NCPS) whose main tasks include the certification of the competence of practising surveyors and enforcement of professional code of conduct and ethics.

4. OBJECTIVES OF CADASTRAL SURVEYS

The principal purpose of cadastral surveys in Tanzania is to give unambiguous spatial locations, sizes and shapes of land parcels (Silayo, 1997:16-20) specifically for land registration. Cadastral information is important in the assignment, processing and transfer of interests in land, levying land tax, supporting land markets, land development planning and so on. Efficient acquisition of such information is a critical issue for the achievement of timely urban land development.

Farvecque and McAuslan (1991:61 & 102) apparently impressed by the simple cadastre in Zanzibar where property boundaries used to be defined with reference to the names of adjoining owners without a survey plan attached to the deeds, advocated the use of a '*social cadastre*'.

Wallace (1999:3), supporting this view suggests that identification of land parcels, particularly in the Third World countries, can be without survey and also without locating the parcel on a map. He further notes that the earliest recording of land information depended on the reputation of ownership and local/community knowledge attributed to a parcel. Osterberg (2001:1) somewhat supports the same view but focuses on African countries thus, "… cadastre and land registration is not appropriate for African countries." He, however, takes a calculated position by recommending a parallel but more elaborate cadastral system that provides security of tenure for foreign investors in Africa. Anderson and Mikhail (1998:997), however, caution that the record on original land grants in the United States was once based on a social cadastre. But as the country developed and land became more valuable, land litigations became numerous. This form of land recording was therefore abandoned in favour of the mathematically based descriptions using metes and bounds and co-ordinate systems.

UNCHS (1990:28), referring to the description of land already settled, suggests that in the short term, some land-registration problems can be solved without land survey. Where there is good monumentation of parcels, an effective land-parcel referencing system and a static environment, simple adjudication to determine who owns each parcel may be sufficient to guarantee title and provide security for the landowners.

A common denominator in all these is a call to do away with surveys and maps. Can we then conclude that cadastral surveys are a cost bottleneck in security of tenure and land

development? The rest of this paper examines further possible applications of the social cadastre concept and the cadastral survey approaches in terms of cost and affordability.

5. OPTIONS FOR CADASTRAL SURVEY METHODS

The options available to the surveyor for carrying out a cadastral survey are either Ground Survey methods or Photogrammetric methods. These methods differ in terms of equipment needed, techniques used, accuracy requirements, personnel, time and cost necessary to accomplish the surveys. Graphical and compass methods have been useful in the past. Scientific and technological developments, which are faster, more accurate and much cheaper, have rendered them (the plane table and compass surveys) obsolete.

Numerical methods employ precise equipment and techniques to obtain accurate and reliable mathematical data from which numeric; textual and graphic records can be compiled. These methods use the traditional optical equipment; including theodolites, tacheometers, Electro-optical Distance Measurement Equipment (EDM), calculators; and the modern Global Positioning Systems (GPS), Total Station and Computers. These methods meet the requirements of fixed boundary surveys.

Photogrammetric methods are a form of graphical surveys. They are used to obtain accurate information about land from interpretation and measurements made from aerial photographs. These methods are cost efficient if the area surveyed is extensive with air visible parcel boundaries. The methods are ideal for the description of general boundaries. Use of either ground or photogrammetric method, requires control frameworks.

6. CONTROL FRAMEWORK AND SURVEY COSTS

Normally countrywide cadastral survey systems should begin with establishment of a survey control framework consisting of permanent reference marks, accurately fixed in three dimensions, (x, y, z). Such a framework is progressively broken down to establish dense network of points in areas where they are most needed. The key attributes of such a framework are to provide countrywide uniformity of ground survey and photogrammetric tasks and therefore facilitate unambiguous descriptions, locations and identifications of land parcels as well. It also:

- Provides a basic spatial framework for a unified Land Information System.
- Facilitates quality control, i.e. helps detection of mistakes and checks against accumulation of errors in survey measurements, hence maintaining consistency, improving accuracy and therefore giving greater degree of reliability of survey data.
- Helps to speed up fieldwork and thus decrease survey costs when it is readily available.
    - Provides scale and correct orientation of plans and maps, and
    - Reduces uncertainties in boundary surveys, i.e. checks against encroachments or overlapping surveys, thus avoiding confusions of boundaries, which may cause (costly) conflicts among parcels owners.

To underscore the need for control framework, Mapping contracts in Tanzania have had always to be preceded by separate contracts to provide survey control points first (Lugoe and Msemakweli, 1998:19).

In the past, establishment of control systems was costly; notably in terms of precision and resources needed. GPS technology has today improved accuracy and reduced time and therefore cost of surveys quite considerably. Time spent on survey operations can drop by as much as 80%. UCLAS has undertaken a boundary survey of 23 villages (covering about 91,410 hectares), in Maswa District in Tanzania, and spent a total of 30 workdays using GPS survey methods. By conventional survey techniques using tools such as the tapes/EDMs and theodolites, the duration would have been 150 days (Silayo, 2002:314) and about five times as expensive. Lugoe (1999:11) cautioned that the paucity of existing control points in Tanzania would continue to keep costs of survey projects very high. He estimated that this could raise survey costs by two to five times. He concluded, 'One of the consequences is that the provision of surveyed land in urban centres has fallen to all time low although demand is ever rising'.

Although modern survey equipment and technologies have provided cheaper and reliable techniques of land description and identification, many authors have often observed that cadastral survey processes are still expensive (for example: Barry et al 1995:3, Daily News 2003:2, Fourie 2002:7, Wayumba and Ogalo 2001, and Wallace 1999:3). Barry et al (1995:3) have raised concern about high accuracy as being the cause of delays and source of high survey costs. They argue that survey establishments should instead adopt low-tech, simplified cadastral survey methods and procedures.

In Tanzania, various authorities have, from colonial days to date, raised similar concern. Meek (1968:284) notes as follows:

> "The Tanganyika, (present Mainland Tanzania), Central Committee in their 1940 Report referred to the complaint that the high cost of surveys of land in Tanganyika was a deterrent to development."

The Presidential Commission on Land Matters (URT, 1994:38-39) received overwhelming evidence relating to problems encountered in the survey process. The evidence revealed that the survey methods, which ensured accuracy, were very expensive and not easily affordable either by the country or individual land users.

7. COUNTRY EXPERIENCES

The concern on high survey costs is not confined to the poor countries of sub-Saharan Africa only. It is also the concern of the Western affluent countries. A few countries are sampled.

SUB-SAHARAN AFRICA

Ghana

In Ghana, Kuntu-Mensah (p.4-5, citing Agbosu 1990) stressed the importance of surveying for title registration by saying that from the colonial times to 1986, title registration was not effective partly because it did not make reference to surveys or plans. He adds that after survey plans were introduced, (in 1986); field survey methods were not cost effective because the accuracies imposed were overly burdensome. He advocated use of less expensive, fast and simple technologies like GPS for cadastral surveying.

Kenya

Kenya presents a scenario that is fairly flexible, using both graphical and numerical survey methods. Osterberg 2001:1 notes that Kenya is perhaps the best example of a country, which has invested enormously and established European like cadastral systems for land registration through adjudication of existing traditional rights in very systematic and comprehensive way using simple methods that keep the costs for the registration as low and affordable as possible.

The process of carrying out fixed boundary surveys for the alienation of Crown lands to Europeans on the white highlands prior to the Second World War was expensive in terms of time and procedure (Wayumba and Ogalo, 2001). After the Second World War, the areas that were under Land Consolidation and Adjudication programmes were surveyed by identifying existing boundaries of individual fragments on unrectified photographs (adjudication). Replanning plots to produce demarcation maps (consolidation) then followed this (Wayumba and Ogalo (2002:2-3). The general boundary surveys were however inaccurate.

Namibia

Juma and Christensen (2001:1,5) report that in Namibia, the methodology to plan, survey and register land rights and ease access to credit for investment and development in the newly created towns was slow and therefore frustrating. In 1997, the government approved the Flexible Land Tenure System proposal under which the periphery of a block of land would be surveyed and registered, thus providing the holders with a perpetual occupation of a site within the block. The various land units within the block would neither be surveyed nor registered. A new system of title, called Starter Title would be issued for the block. The title relied on simple survey description and registration, thus enabling poor landholders in informal settlements to get security of tenure over the land they had settled on.

Zambia

Loenen (1996:6) citing Roth and Smith (1995:21), note that the cadastral standards in Zambia were too rigorous, the biggest bottleneck being the required surveying of land using fixed boundary survey methods. Loenen (ibid.), citing Mponda (1987:6) further noted that in the eighties, selected cadastral projects used photogrammetric methods in rural areas but were in fact more expensive than traversing.

EUROPEAN COUNTRIES

England

Description of boundaries of parcels in England uses the graphical system by which physical features constituting general boundaries of parcels are identified and annotated on existing topographical large scale (1:2500) Ordnance maps (Simpson, 1984:136, 370-372). Dimensions of land parcel boundaries are not shown on the maps. This approach is advantageous because topographical maps, which are required for many other purposes are also successfully used for land registration without requiring much additional survey costs.

Greece

The cadastre in Greece, called the Hellenic Cadastre (HEMCO, also uses large-scale topographical maps (1:1000 and 1:2000) as a base on which the geometric description of land parcels is made. The identification of the land parcel boundaries is achieved by:

- Neighbouring landowners showing the positions of boundaries, and
- A land surveyor recognizing and delineating the boundaries on a topographic map.

The resulting cadastral maps describe sufficiently the location of each land parcel boundary in conjunction with the topographic details (HEMCO, 1995).

Georgia

Georgia's cadastre is based on large-scale topographical maps (at 1:5000, 1:10000 and 1:25000 scales) and aerial photographs. Parcel boundaries were identified on the maps. Low-cost basic survey techniques were used to complement boundary information of the parcels as held. To minimize the cost of surveys, the use of boundary markers was limited (Campbell, 2000:5). Closed traverses tied to the national survey network were then executed near the perimeter of each survey block and through the interior of the block.

The direct cost to register a parcel and issue a registration certificate to a landowner was approximately $1.25[2]. This included the survey of the parcel, preparation of the registration documents and all the necessary supplies to produce these documents (Campbell, 2000:3).

8. THE CADASTRAL SURVEYING PROCESS IN TANZANIA

Cadastral surveys in Tanzania are carried out by both government and licensed private surveyors. There are at present 26 private surveying firms in the country. Most surveying jobs are sporadic as opposed to being systematic. Many requests are of surveys of single or a handful number of parcels. In part, this accounts for survey tasks being unduly 'costly'.

[2] Although no information is available about parcel size, this figure is unbelievably low. The Mid America Survey Company (http://matc.com/survey/ec.thml) noting that cost of a survey can vary widely, states that 'your (parcel) survey can be as low as USD 215.' In Tanzania, the survey of an urban land parcel (measuring say 15 m x 30 m) costs about USD 70.

The Presidential Commission on Land Matters noted that pressure on survey offices have led to ad hoc surveys for those who can 'afford' them (URT, 1994:39).

Surveys are based on monumented, coordinated, concrete boundary marks that delimit the corners of land parcels. The marks are coordinated by traverse systems, which are tied to control frameworks. A separate plan is prepared for every survey. Each plan is needed for preparation of Certificate of Titles of the individual parcels shown on it. The total number of such plans is quite large, thus contributing to overhead costs related to storage. There were over 39,680 plans countrywide at the end of December 2004.

The Steps of cadastral surveys

A cadastral surveyor working in Tanzania will encounter two different scenarios:

- In planned urban areas, the surveyor will set out land parcels (plots) from information provided on Town Planning (TP) drawings.
- A surveyor working in settled areas (rural or informal urban settlements) will work from sketch plans that show approximate locations and sizes of the land earmarked for survey. In such cases boundaries already exist on the ground. The survey process mainly involves boundary description and not setting out.

In planned areas, there are 20 steps that have to be followed till a deed plan for preparation of title for a parcel is ready. Table 1 summarizes the situation and highlights the relative costs.

Table 1: Steps and relative cost indication in the cadastral survey procedure using setting out approach in Tanzania. The cost ratings are estimated on a NIL-Low-Medium-High-Very High scale.

S/N	STEP	ACTIVITY/EXPLANATION	COST
1	Determining need for survey and land to be surveyed	Land identification, adjudication of existing rights, compensation, acquisition, preparation of topographic maps, and detailed layout plans.	Very High
2	Request for a survey	District/Municipal/Ministerial Office makes a formal request for carrying out a survey (s.9, Government Notice No. 72 of 2001).	Medium
3.	Issue of Survey Instructions	A District/Urban Council Surveyor or the Director of Surveys and Mapping issues Survey Instructions. This constitutes official authorization for the surveyor to enter the land and carry out the survey. Undefined delays are possible.	Medium
4	Assignment of a Surveyor	Survey Instructions issued by the Director of Surveys and Mapping are delivered to the respective district or urban survey offices for tendering/implementation. Data access and retrieval is a major bottleneck.	Medium

5	Reconnaissance, planning and costing	The field surveyor visits the site of survey to familiarize him/herself with the type of terrain, identifies requirements and logistics, plans and costs the survey. Unsettled claims are also identified for further action.	Medium
6	Establishment of a control framework	A framework of control points is established. The new survey is subsequently connected to the framework. Funds for establishment of separate control may be unavailable forcing surveyors to commence new work on ordinary survey marks or execute an isolated survey based on a local datum.	High
7	Demarcation	In areas where land has been acquired and compensation effected, demarcation involves block setting out from TP drawings.	High
8	Survey Coordination	Traverses are executed to tie the block corner points of the surveyed area to the control framework. According to the current regulations, minimum accuracy required is 1: 6,000 in urban areas. If a Total Station is available, coordination work may be executed in tandem with demarcation work, thus saving on time and cost.	High
9	Block subdivision for parcels	Individual parcels whose sizes are less than $400m^2$ are set out using tapes and iron pins. Positional accuracy of the boundaries set out in this way may be as low as 1:1,000, thus speeding up time to produce individual parcels within a block that is already rigorously fixed. Boundary dimensions of parcels larger than $400m^2$ are measured to the accuracy of 1:6000.	High
10	Detail Survey	All significant developments and natural features, (such as buildings graves, shrines and gullies), that may affect the value and therefore allocation of the parcels are surveyed and subsequently plotted on the plan. Accuracy required is of the order 1:1,000	Medium
11	Signing of boundary Certificates	The field surveyor signs a Certificate of Erection of Beacons (BC2) and a District Land Officer signs the Certificate of Acceptance of Boundary Beacons (BC1). This verifies and confirms completion of filed work.	Low
12	Data processing and compilation	Survey data abstraction, computation and compilation of the documents in a set file format. Both manual and computer assisted techniques are used.	Medium

13	Drafting of the cadastral plan	A cadastral plan is prepared for every new survey. The plan depicts for each parcel, its number, spatial location, size, shape and contiguous land. A copy of the plan is made; on it the methods used to fix the various block/parcel boundary corners are depicted. This copy, called a Working Diagram, is a guide for subsequent checking of the survey file.	Medium
14	Preparation of Cadastral Survey Report	The report on a cadastral survey is prepared in a standard form and format, outlining the method of survey used, problems encountered and how they were overcome.	Low
15	Independent checking of plan and job file	A surveyor who was not involved in the execution of the work checks the file (i.e. field notes, computations, and report) and plans to ensure completeness and compliance with both legal and technical requirements. Mistakes/errors discovered in the field data are corrected by a field re-measurement while computational ones are simply corrected on the file or plan.	Medium
16	Submission of Survey to the Director of Surveys and Mapping	The plan and the file containing the original data are submitted to the office of the Director of Surveys and Mapping for further scrutiny and approval.	Low
17	Approval of survey	The office of the Director of Surveys and Mapping causes a thorough quality re-examination of the file and plan. If these are flawless the survey is approved, otherwise the file and plan are returned to the field office of origin for extra fieldwork. Backlog of incoming jobs may be a great cause for delays of approval or rejection of received jobs.	Medium
18	Filing of approved work, or Return of rejected work.	The approved survey documents are filed as property of government [section 13(1) and 17(3), Cap 390]. The plan and the other records may henceforth be used for parcel registration and most importantly for the preparation of Certificate of Titles of the individual parcels.	NIL
19	Submission of copy of survey plan to allocation committee	Each district has a Land Allocation Committee, which allocates land to successful applicants. A copy of the approved plan is availed to the Committee.	Low
20	Request for Deed Plans	A deed plan is prepared for every parcel on the plan for purposes of title registration. Delays can be caused by backlog of such plans to be prepared.	Low

These steps are many and each may allow room for bureaucracy that adds to the total cost and/or causes delays in implementation/accomplishment of a survey.

9. DISCUSSION

The spatial description of land parcels can be made using either a social cadastre, or plans/maps based on cadastral surveys, aerial photographs, topographic maps or high-resolution satellite imagery.

The social cadastre descriptions of a land parcel come from historical past and they are used to-date, particularly in informal urban settlements. Ownership of most land in informal urban settlements in Tanzania uses this cadastre to provide fairly acceptable security of tenure. No wonder even some middle and high-income urbanites have built in informal settlements.

The social cadastre descriptions rely on local community knowledge. If such local knowledge ceases to exist, the descriptions become obsolete. They may cause serious problems if the parcels were mortgaged. Such descriptions can thus work well only for limited times in areas of low economic activities or as a transition to future lasting descriptions. But, if the whole world is working on globalization at all levels, is globalization of the cadastre sacrosanct?

The methods deployed in England, Greece, Georgia and Kenya using large-scale topographic maps, or simple and low-cost survey techniques may offer rewarding experiences for Tanzania and probably for the rest of Africa. The efficacy of these systems, however, requires stable boundaries with visible physical features on the ground and large-scale maps. Both such requirements are not yet practicable in Tanzania. Surprisingly, how were the English stable boundaries established in the first place?

Adoption of a graphic cadastre based on general boundaries such as hedges should be considered in the background of boundary maintenance and restoration. Despite the successful story told about the Kenyan experience, Osterberg (2001:1) adds that the system was falling apart for lack of maintenance. In many parts of Africa, most trees/shrubs used as hedges for boundaries, dry up during the long dry seasons and are often completely destroyed by fire outbreaks. Some of the resistive plants/shrubs may overgrow laterally into neighbour's land, making boundary location more uncertain and thus be a source of conflicts. Moreover, skepticism about general boundary surveys has also come from Kenya. Wayumba and Ogalo (2001:1) argue that the surveys are inaccurate and lead to misleading information to property owners and financial institutions accepting such properties as collateral in loan agreements. Can Africa rely on such boundaries?

The Namibian proposal, which is intended to support the Flexible Land Tenure System through a Starter Title, seems to offer a workable solution for the informal urban settlements. Silayo (2004) made a similar proposal that was discussed with the Director of Surveys and Mapping, Mr. Lazarus Mollel, and it is currently being implemented in informal settlements.

Establishment of control frameworks by conventional techniques used to be very expensive. Availability of modern GPS and Total Station equipment has expedited the process while improving accuracy and enabling the coordination of land parcels at low costs. In 2002/2003 the Ministry of Lands and Human Settlements Development initiated the so-called '20,000 Plots Project' in the City of Dar es Salaam. It acquired a total of 4,920 hectares in the sparsely settled informal settlements in the City, paid compensation and prepared drawings for setting out parcels. 27,640 parcels were surveyed using digital techniques. The total survey cost was Ths 1 billion (1 USD approx. = Tsh 1,000/=). The average cost of survey per parcel was about Tsh 36,000/=. This underlines the cost effectiveness of systematic surveys coupled with the application of modern technology. The main constraint however hangs on the cost to procure and maintain the needed hardware and software.

Cadastral surveys are a prerequisite for land registration and titling in Tanzania (Land Act No. 4 of 1999). Unfortunately land registration is optional and is therefore sporadic. The associated surveys are equally so. Sporadic surveys are very costly to execute. An isolated piece of land of about one hectare may cost as much as USD500 instead of the same amount for surveying say 5 similar adjoining units at a go (compare this with the contents of the previous paragraph).

Title registration system in Tanzania guarantees title. Hence, the Land Registration Ordinance [S.100 (3)] and the survey Regulation No.5 (2) respectively (a) provide for indemnification by government any person who suffers loss by reason of errors in the cadastral plan filed in the land registry, and (b) imposes stringent regulation to surveyors on accuracy, fidelity and completeness of their jobs. This explains the reason for checking and rechecking surveys despite the insistence on the use of self-checking and independent checking methods both in the field and computations. The checking and rechecking process adds survey costs. If licensed surveyors are persons whose expertise in the profession has been tested and certified, why should their work be scrutinized so meticulously? Introduction of a mandatory Professional Indemnity Insurance for all licensed surveyors can replace the meticulous re-examination, thus making approval of survey works a formality and so reduce survey, time and costs. A discussion with some private insurance firms on this matter, however, revealed that the premium and mode of payment could be problematic.

10. RECOMMENDATIONS AND CONCLUSIONS

Accuracy and cost of a cadastral survey are closely related. Both depend on the purpose, method of survey and the location of the land surveyed. A survey carried out in a heavily built up informal urban settlement, where most of the existing buildings are to be preserved, should adopt the flexible, low-accuracy, low-cost and **modified social cadastre** approach in which only the periphery of a block needs to be rigorously surveyed, while the interior holdings are described using aerial photographs or high resolution satellite imagery as explained by Silayo (2004). Interim Starter Titles (in Namibia) or Provisional Titles/Licences (in Tanzania) may then be issued to parcel owners based on such provisional descriptions. This will address security of tenure and thus be free from unpredictable

demolitions, which may be prevalent in informal settlements whenever government wants to come up with any plan that needs space.

Fixed boundary surveys give rise to permanent parcel descriptions, records and documentation. Therefore parcels created from Town Planning drawings, coordinated by fixed survey methods using digital technology, and applying independent and self-checking routines, should be appropriate for new urban areas being opened up.

The unit cost to survey a land parcel falls sharply as the number of parcels surveyed in a single task increases. The Georgian and the '20,000 Plots Project' in Tanzania are two supportive examples. It is therefore cost-wise beneficial to both governments and parcel owners if new areas opened up for development are put under compulsory systematic survey and registration.

A cadastral system that is affordable is a key factor to achieving planned urban development. The operators of the system should put in place flexible short, medium and long-term programmes that are cost friendly to implement. That way we shall motivate planned urban development.

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