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CADASTRAL DATA MODEL FOR AN INFORMAL SETTLEMENT: CASE STUDY OF HURUMA, NAIROBI – KENYA

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ABSTRACT

The complexity of tenure claims in the informal settlements has been difficult to incorporate into the formal systems owing to their dynamic and continuously changing nature. Innovative tools are therefore required to capture these claims. This requires the development of a cadastral data model specifically for informal settlements that would document such claims to make it easier to manage the current situation as well as prepare for future formalization processes such as regularization or relocation. The main aim of this study was developing a typology of informal settlements in Kenya as a basis for developing a cadastral data model. A data model was developed based on the Social Tenure Domain Model (STDM) using open source geo-solution (SOLA). The model was found to be generally suitable for all the different informal settlement typologies.

Keywords: Informal Settlement, GIS, STDM, LA, Certificate of Residency

1. INTRODUCTION

With over one billion slum dwellers globally and in many countries, 60 percent of cities are informal (UN-HABITAT: 2008). The majority of countries in the world have both formal and informal land tenure systems covering 30% and 70% respectively with the former mainly in Africa since the colonial masters left while the latter do not have even frameworks for land registration (Okoth-Ogendo, 1999) and during transfers such as sale, this is often informal and the land records for those parcels lose currency. Additionally, the beneficiary group which remains often transfers their rights informally when moving or inheriting, as they do not follow the formal steps of the recordation or registration system, especially when it is not affordable, simple or locally operated (Payne et al, 2008). This issue is emerging in many places in the world (Barnes and Griffith-Charles, 2007).

Informal tenure arrangements have filled the gap to enable the poor to house themselves and earn livelihood. A major reason so many people are forced to stay in informal settlements is the state's failure to put in place an appropriate regulatory framework for providing low-cost housing or access to secure and serviced land. With nowhere to go, people encroach on unoccupied land, including areas that have been set aside for roads, railways and other public uses. For example, in Nairobi, about 2 million people, or 55% of the city's total population, live in the 200 informal settlements on only 5% of the city's total land (Habitat, 2010). Most informal settlements in Kenya are located in the neighbourhood of affluent estates (figure 1), and a proper database of the inhabitants is crucial for planning purposes. The data model would therefore be used to capture claims of the inhabitants and support government regularization programs.

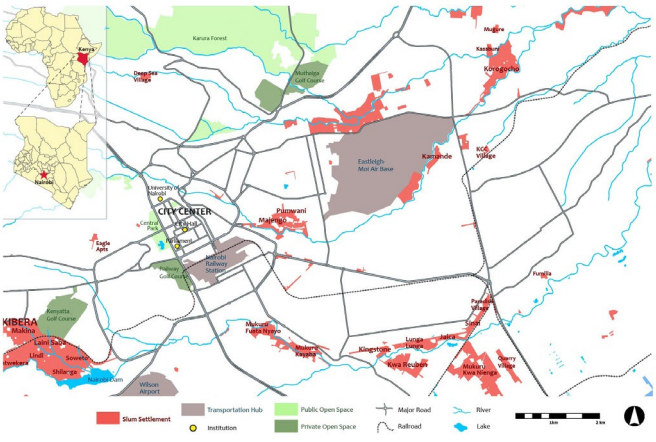

Figure 1: Distribution of informal settlements in Nairobi (Nairobi Zonal Plan, 2012)

To control and manage the informal settlements, the government established the Kenya Informal Settlement Improvement Program (KISIP) with a mandate of improving the living conditions in informal settlements in 14 selected Counties in Kenya. It is on this premise that serious attention has been put towards addressing pertinent issues affecting informal settlements ranging from security of tenure, infrastructure improvement, capacity development and planning for their future.

The Government of Kenya initiated land regularization program so as to bring some of the informal settlements into the formal systems. Land regularization refers to the process of planning and surveying of an informal settlement which had initially been occupied without adhering to the standards and regulations of planning and development control (National Land Policy, 2009). Informal settlements in Kenya are in dire need of such regularization since previously the response of the government has been evictions at one point and exclusion

from planning at another. With the promulgation of the Kenyan new constitution in 2010, paradigm shift was made towards addressing informal settlements where participation and inclusion was paramount.

With such a database in place, formalization of such informal settlements becomes easier because a current register of the inhabitants are kept and a reliable base map capturing their structures of interest equally drawn. Pro-poor approaches involving participatory adjudication to accommodate social land tenures would require less accurate forms of data (Zevenbergen, 2011). They would also have to be closer to the ground to improve correctness of records and ease of access.

However, the complexity of social tenure claims in the informal settlements has been difficult to incorporate into the formal systems owing to their dynamic and continuously changing nature. The social tenures range from the structure owners, their relatives including children and the tenants whose records have been either unavailable or existed in piece-meal in different departments or organizations, moreover, informal transactions such as sale, inheritance, moving out, conflicts continue to operate without proper and up-to-date register. Therefore innovative tools are required to capture these claims. This necessitates the development of a cadastral database that would document and accommodate such informal claims therefore making it easier to manage the current situation as well as prepare for future formalization processes such as regularization or relocation. The model finally demonstrates its utility in the four informal settlement typologies but could further be customized to incorporate the fifth typology of informal settlements on ancestral land.

The challenge with informal settlements is that they are continuously changing, there exist a bundle of rights ranging from structure owners, tenants and their relatives. Difficult to capture claims based on conventional approaches because of congestions and hostility hence innovative tools such as Voluntary Geographic Information (VGI) and Participatory GIS (PGIS) was adopted.

2. INFORMAL SETTLEMENTS IN KENYA

The phenomenon of informal settlements in Kenya can be associated with reasons that are both historical as well as current. Historically, the colonial model of land tenure displaced many Africans which created landlessness alongside the colonial urban policy that excluded the Africans from urban settlements. There was no room for Africans in cities like Nairobi. Later on, the colonial administration allowed Africans access to urban areas through Kipande system (a pass). Those coming to the urban areas would either be accommodated in the shelter provided by their employer through the trusteeship policy that required employers to provide housing for their employees or in the "Native Settlements" where the municipal authority then built houses for the Africans. But when the number of Africans coming to the urban area grew beyond the capacity of the designed "Native Settlements", those who could not find housing moved to the fringes of Nairobi such as today's Mathare valley informal settlements.

After independence in 1963, the new administration deployed a mixed and varying policy which at one stage consisted of the call for the Africans to return to their rural "homes" while other times there were forced evictions of those who had resided in makeshift structures that were mainly built on public land. Between the 1970s and the late 1990s, the government attempted various initiatives which did not reverse the trend. The increased growth and expansion of informal settlements in almost all counties in Kenya can be associated to both continuity of some colonial modes of exclusion as well as the inattention of policy makers to policies, budget priorities and housing needs of the low income population.

Kenyan informal settlements are currently plagued by insecure tenure, increasing unemployment rates, residential overcrowding, and deterioration of already over stretched infrastructure and services, environmental

degradation and acute housing shortages. Lack of security of tenure is perhaps the greatest challenge since informal settlements emerge on public, community and private land. Due to tenure insecurity most informal settlement residents live under constant fear of evictions which in turn make development initiatives difficult. There are competing land rights in such areas. There are the tenants, the structure owners (both resident and absentee) and the land title holders in case of private lands. Materials and Methods

2.1 Study Area

Redeemed village, an informal settlement in Huruma, Nairobi, Kenya was the study area. It is one of the six villages in Huruma alongside Ghetto, Kambimoto, Mahira, Grogon. It is a home to approx. 300 people and neigbours the busy Kiamiako slaughter houses. The village was founded in 1978 after the residents were evicted to pave way for the construction of Kiamaiko market. Redeemed village formally known as Post, was burned down and the pastor from Redeemed Gospel Church assisted the residents with reconstruction and was since been renamed "Redeemed". The village measures approximately 0.8 acres and is enclosed between Kariobangi road and Mathare road adjacent to Kiamakaiono slaughter house. It is located in Kkiamaiko war, in Mathare constituency, in Nairobi and it is approximately 3 Km from Nairobi CBD. (Figure 2)

Figure 2: Study area - Redeemed Village, Huruma - Nairobi

The village is dominated by structures and as such the study will focus on structures as spatial units as opposed to the land parcels. The project was limited to the relationship between people and structures only and Redeemed village representative of the predominant characteristic of the others villages in Huruma.

3. METHODS

The main objective of the study was to characterize informal settlements in Kenya and to develop and test a generic cadastral model that can be used to document the tenure claims. Table 1 gives a summary of the methods adopted for each objective.

3.2.1 Characterization of informal settlements in Kenya

Several documents were reviewed including the National Land Policy, National Slum Upgrading and Prevention Policy, KISIP Project Appraisal documents as well as other reports that have been conducted in informal settlements. In each document, special attention was dedicated to the sections addressing informal settlement regularization and options for upgrading of such settlements. Characterization of informal settlements was elaborated with emphasis on tenure status of the land occupied categorised into public land, private land and community land. Details are further discussed in Chapter 4.

Other methods used include literature review of previous research conducted and published in various journal articles, conference papers and Civil Society Organizations (CSO) unpublished reports. A Focused Group Discussion (FGD) was held with the leaders of the selected informal settlement where specific characterization was discussed and evaluated against the broad typologies already developed from the literature review. The FGD tool used is attached in the appendices

3.2.2 Development of cadastral model

The four stages of modelling were used in the process. The first phase entailed external modeling and it involved identification of the users/stakeholders involved in informal settlement regularization program. They were mapped based on the previous attempts that have been tested by both government interventions and Community self-driven initiatives.

The second phase was conceptual modeling and different classes were identified and their associations established in a Unified Modelling Language (UML) diagram. Some classes were found to be aggregates of others hence were classified as sub-classes. Relevant associated attributes, methods plus their multiplicities were well defined and designed using Dia drafting software. Each attribute data item was described to specify the data values that will go into the database and primary keys identified. Classes such as structures were given structure code as the primary key.

The third phase was the logical modeling, in which skeleton tables were generated from the conceptual model based on the attributes of the classes. The tables were normalized to conform the First, Second and Third Normal Forms. Other non spatial data items such as name was broken into first, and other names, likewise the associating class linking structures and the people was set to be either structure owner or a tenant. Multiple structure owners were also taken into consideration.

The final step was the implementation of the database management system that was customized from the generic Social Tenure Domain Model (STDM) developed by UN-Habitat. The customization involved the introduction of the classes modelled, their correlation and specification of the data values that would be instantiated. Each data field must have the same data type as the ones captured in the classes and the configuration completed so as to adapt to the new changes.

4. RESULTS

4.1 Typologies of informal settlements

The following typologies (Table 2) characterize the tenure arrangement for informal settlements in Kenya.

Table 2: Typologies of informal settlement in Kenya

Land Category	Typology	Informal settlement Category	Examples
Public land	1	Government land	Mathare, Huruma, Kibera, Maweni
	2	Reserves(Roads, Riparian, Pipeline)	Gitathuru, Mukuru, Deep Sea, Mitumba
Private land	3	Individual	Embakasi village, Likoni Misufini
	4	Company /Group	Kisii village
Community land	5	Ancestral	Manyatta, Nyalenda

Land tenure and administration in informal settlements are quite complex. Lack of security of tenure is perhaps the greatest challenge amongst all the typologies except the last typology where the greatest challenge the subsequent updating of the formal cadastre, making it difficult to manage up to almost four generations outside the register.

The first four typologies have a similar characteristic of tenure insecurity with most residents living under constant fear of evictions which in turn make development initiatives difficult. Under typology one which forms the lion's share, the national land policy had

recommended for regularization with no proper framework of how it should be done other than applying the conventional approaches which have been tried in some places such as Mombasa, Mkomani informal settlement and the end result was gentrification and currently the settlement is a home for both the middle and upper middle class while the genuine beneficiaries have been displaced to other neighbouring informal settlements of Mnazi Moja and Shauri Yako informal settlements (Mombasa County Inventory Report 2014, unpublished)

Where this typology appeared to be the easiest to formalize and government's interventions have been revolving around this typology, specifically among the criteria for selection under KISIP is that the informal settlement must fall under this typology, therefore infrastructure priorities have been implemented to this typology. Examples include Kayole Soweto, kcc village which again in spite of huge infrastructure investments by the World Bank, gentrification pushed the beneficiaries to the neighbouring Matopeni informal settlement since the land value had increased as a result if infrastructure improvements hence with the idea of willing buyer willing seller, the genuine beneficiaries sold their allocation letters even before their titles were out (Pamoja Trust inventory report, 2005).

Additionally with the establishment of the National Land Commission under the National Land Commission act, 2012, administration of public land was vested to the commission hence alienation of such lands to the informal settlements on leaseholds may jeopardize availability of land banks for future developments especially owing to the trend that in actual fact the genuine beneficiaries would still sell out their allocated land and again look for another government land which they will in turn request for allocation.

The second typology represents a very unique category, majority of which came as a result of a previous eviction from another land. Such cases were experienced in Mathare where the residents were pushed to occupy the Mathare valley which is a riparian reserve yet they were settled there as a temporary measure to take care of the immediate need. Also in the same category is the Kibera informal settlement where the better part falls along the railway reserve and they were issued with temporary occupation licences by the Kenya Railway though they settled on very dangerous positions with respect to the railway line (RAP report, 2010).

Under this typology, the national land policy recommended relocation because their area of settlement was found to be dangerous or environmentally sensitive thus they could not be settled where they are. Attempts by government to relocate them have been resisted and apart from a negotiated relocation by Kenya Railway in Kibera, majority still occupy these reserves and are prone to hazards such as floods, derailment of the railway among others.

The third typology is very interesting and has been a subject of debate in national TV stations. The recent case has been the famous Waitiki farm in Likoni Mombasa that was raided by informal settlements (Daily Nation) who then deliberately refused to leave even after a court order was issued. Similar cases were also found in Embakasi village, Nairobi where informal settlements invaded private properties and the owners have accessed their land to date while the occupiers have since been selling parts of that land to unsuspecting buyers (Embakasi village KISIP report, 2015)

This typology requires a lot of negotiations with the owners before any regularization could commence and in most cases, it might involve buy off by either the informal settlement residents or the government. Without such negotiations, very little could be done other than letting the status quo to remain.

The fourth typology occurs where a legal entity such as companies or cooperatives are the legal owners of the land occupied by informal settlements. In such cases, very little negotiations have been experienced but rather evictions which occurred in some two informal settlements of Kalahare and Mathare in Mombasa (Haki Yetu report, 2014) and Kisii

village in Nairobi which are still battling it out with a company that is the legal owner of the land they occupy and is even paying land rates on their behalf.

This typology is usually marked with accusations of who occupied the land first and contestation of the acquisition of such land by the purported companies. The informal settlements often accuse the companies of irregular acquisition of such lands hence they have been reluctant to concede the request by the companies to leave but have decided to stay put unless they are forcefully evicted by the companies.

4.2 The Cadastral Model

The cadastral conceptual model is illustrated in Figure 3. The classes, their attributes and behaviours/methods were drafted in a UML diagram as shown above. Classes that share common attributes were aggregated so as to reduce redundancies as well as explore inheritance characteristics of the super-class. The key beneficiaries of the informal settlement was agreed to be structure owners and tenants hence they constituted the class Party through aggregation of the Tenant and Structure owner sub-classes. They inherited all the attributes of the party class although the methods applied to each were slightly different, e.g. the structure owners subclass had some permanency while the tenant subclass was dynamic and easily changing.

An associating class linking the party and the structure was developed and called the social tenure relationship. It picked the attributes of the tenure status of both structure owners and tenants to differentiate their relationship with the class called structure. A structure was mandatory class without which no party can be linked. The degree of multiplicity was specified where at least a structure must exist first before a party could be attached to it while a party could be attached to at least one structure or more

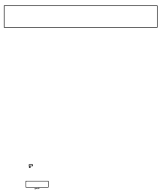

Figure 3: The cadastral model for informal settlements

4.3 Testing the model

Aerial Imagery of 15cm resolution covering the project area was acquired. All the structures were digitized into vector format using QGIS as open source GIS software (Figure 4). Under the crowd sourcing technique, the community leaders were able to identify the digitized structures overlaid on the imagery printed at enlarged scale. Therefore it was used to number all the digitized structures. The numbers were then written on the print out created by preparing overlapping sheets drawn at a much larger scale. These were edited in QGIS environment and a structure number created to be used as the unique identifier. This will constitute the structure class as captured in the conceptual model.

Figure 4: Numbered structures

The model constrained the data entry such that a structure must first exist before any tenant or structure owner could be linked to it under the social tenure relationship. This was important to

sieve the problem where beneficiaries were being added yet never attached to any existing structure, thus constituting ghost beneficiaries. Likewise one structure could have a structure owner and also occupied by a tenant, therefore different tenure status could exist for the same structure. This was a key factor that highlighted the bundle of rights that often exist in informal settlements that could be captured under one database.

Since it was also observed that it was a common trend for one structure owner to have multiple structures, the model allowed linkage of many structures to one structure owner enabling one to many relationships. This could very vital during negotiations for way leaves because give and take scenarios could be discussed with facts on the table. Previously structure owners introduced their family members including the under aged and allocated them some structure rooms so as to benefit in double portion.

Digital proof documents were then designed which could aid extraction of vital information from the database such as the structure and the personal details of the beneficiaries coupled with other static design features such as logos, signatures which ensured that counterfeits proofs were prevented and could easily be noticed because they will not be from the database. Other support documents such as photos of the beneficiaries could also be added.

Once the template have been designed, then any party information as well as the structure in which social relationship exist was generated and printed as a pdf document which could be manually signed off by the relevant authority and a copy left for the beneficiary. This was meant for dealing for the issue of perennial squatters who keep from moving from one informal settlement to another in anticipation of getting assistance in both cases.

5. CONCLUSIONS

Based on the study, informal settlements in Kenya are categorised in five broad typologies which emanates from both colonial and post-colonial times. Various attempts have been made by the Kenyan government to try and reverse this trend by improving the existing informal settlements and also preventing the occurrence of new ones though the methodology and strategy adopted have been laborious, time consuming, expensive and not suitable to the immediate needs of the informal settlements. A holistic approach to addressing the pertinent issue of tenure security which emerged to be the underlying issues across all the typologies except typology five, can be solved by this model while typology five, the model could be modified by introduction of super class of land parcels but structure maintained as the unit of social tenure and the children of the parcel owner as the party class.

The tenure document auto-generated from the database could be a digital proof of tenure security that could authenticate the genuine beneficiaries of the informal settlements in which government could plan for and their tenure status improved in a continuum framework under the existing laws and regulation. This would limit and put a cut-off date to the number of people currently occupying informal settlements and bar influx of new arrivals after establishing necessary mechanisms of stopping perennial squatters.

The bureaucratic formal land administration procedures make the system expensive and prone to corruption coupled with the lack of clear land administration systems for regularization of informal settlements. Space allocation in such areas has been done in a haphazard manner by various actors ranging from local administration to politicians with no regard to existing laws. There are competing land rights: There are the tenants, the structure owners (both resident and absentee) and the land title holders which could be a government body, private entities or ancestral, hence a continuum approach based on this model can suite enhancement of tenure security in informal settlements.

6. AKNOWLEDGEMENT

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8. KEY TERMS AND DEFINITIONS

Informal Settlement: Refers to the occupation of a parcel of land without adhering to the planning regulations and standards, often characterized by tenure insecurity and limited services of water and other basic amenities.

Social Tenure Domain Model (STDM): Refers to a specialization of Land Administration Domain Model (LADM) that addresses social relationships between people and land under informal/unrecognized and customary tenures.

Open Source Software: Is a free to use software that is not limited to licences for its use

Unified Modeling Language (UML): Refers to a data modelling language that is based on object-oriented databases which consist of object classes, behaviours and states.

Cadastre: Refers to a parcel-based land information system that shows relationships between people and land through rights, responsibilities and restrictions.

Global Land Tool Network (GLTN): A network of land professionals, academia, CSOs, Bilateral Institutions that develops land tools and its secretariat is UN-Habitat.

Certificate of Residency: Could a document that is given to a resident of a place to assert his/her occupancy. It could depict some form of recognition.

Continuum of land rights: A model of registering land rights incrementally i.e. from temporary leases all the way to freeholds.

Geographical Information System (GIS): A system of hardware, software, data, procedures and people that helps in storage, manipulation, analysis and dissemination of both spatially referenced and textual data.

9. APPENDIX

Table 1: summary of the methodology

Objective	Research Question	Methods	Output
Characterize informal settlements in Kenya	What is the tenure status of land occupied by informal settlements?	Desktop Review Interviews	Informal Settlements Typologies
Developing the model	What is the appropriate model for informal settlement?	External modeling/User Needs Assessment Conceptual Modelling Logical Modelling Physical modelling	User needs assessment report Unified Modelling Language (UML) diagram
Testing the model	Can the model accommodate all typologies?	Digitization of the structures Editing and numbering of the structures Creation of the dummy register Importation of the numbered structures and the dummy register into the customized STDM	Database