

DEVELOPMENT OF A CADASTRAL LAND DISPUTE CLASSIFICATION MODEL USING GEOGRAPHICAL DATA MODELLING

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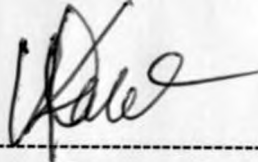
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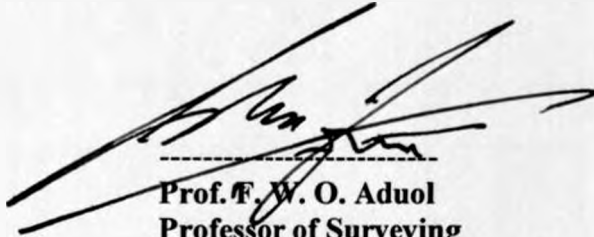
Declaration

This is my original work and has not been presented for a degree in any other University.

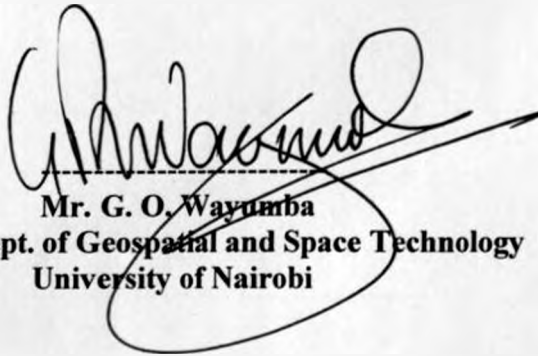


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Dedication

I dedicate this thesis to the late Sellah Christine Lumbasi Kalande. Though illiterate, she valued education, did not just give it to her own, she sacrificed her meagre resources to ensure other people's children have education.

Mama, rest in peace!

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Abstract

Land disputes undermine human dignity globally through their direct contribution to; food insecurity, environmental degradation, informal settlements, and the swelling numbers of displaced persons and the homeless. In spite of the numerous effects of land disputes, curative resolution mechanisms are preferred to preventive resolution mechanisms. This is because Land disputes have not been comprehensively studied and understood. Scientific classification of land disputes is lacking and knowledge on land disputes is still at its infancy. Land disputes therefore remain a universal problem without a universal classification.

The principal objective of this research is to use of geographical data modelling and cadastral knowledge to classify land disputes into distinct cadastral typologies. The objective is realised through dispute identification, geographical data modelling and prototyping. The study takes place in Bungoma Municipality, in Bungoma County.

Land dispute identification is carried out to reveal land disputes from various land dispute resolution agencies operating in Bungoma Municipality. Identified land disputes are tested for authenticity through evaluation of availability of cadastral details, disputant information, physical location on the ground and interpretation of PID and land registres versus real situation on ground captured by mapping.

Geographical data modelling involved two aspects. First it helped synthesis the continuous and infinitely complex land dispute real world into single factor maps presented as variables capable of being manipulated using map algebra. Secondly, it allowed the design of a spatial database by abstracting the land dispute real world through conceptual, logical and finally the physical model.

Prototyping illustrates the implementation of the physical model and demonstrates how the physical model classifies land disputes into distinct cadastral clusters. The prototype built in ArcGIS Model Builder carries out three tasks. First, it validates each dispute by matching each dispute claim to a cadastral parcel. Secondly, the

prototype classifies each validated land dispute. Thirdly, the prototype posts each land dispute classified to a thematic map and provides a hyperlink to all relevant dispute information and documents.

The developed system demonstrates land disputes can be identified, geographically modeled and classified in specific cadastral classes. The study concludes Cadastral Classification System developed can be used to improve Dispute Resolution Agencies' operations and management land disputes.

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List of Abbreviations

ADR	Alternative Disputes Resolution
CLB	Community Land Boards
COM	Component Object Model
DLB	District Land Boards
DLO	District Land Office
DMC	District Magistrates Court
GIS	Geographical Information Systems
GLA	Government Land Act
GNSS	Global Navigation Satellite System
LDCM	Land Dispute Classification Model
LDT	Land Dispute Tribunal
LTA	Land Title Act
OLE	Object Linking and Embedding
PA	Provincial Administration
PID	Preliminary Index Diagrams
RIM	Registry Index Maps
RLA	Registered Land Act
RTA	Registration of Titles Act

1. Introduction

1.1 Study Background

Land has always been recognised as a primary source of power and wealth. This fact stems from its capacity to draw and attract investment and to be an asset from which different natural resources are harvested. Amounts of power wielded or quantities of wealth derived from land are dictated by a collection of rights held over it. Often, individual or a bundle rights held over land get contested. Affirmation of multiple and conflicting claims with respect to the length, number and quantum of individual or a bundle of rights held over land and whether such rights are exclusively or collectively held constitute land disputes.

Common causes of land disputes around the world have been noted to include; multiple legal systems, mismatch of land registers and reality on the ground, multiple titles, sectarianism, ethnicity, corruption, overlap of boundaries and property rights (Centre of Advanced Study 2006: 16, Mahaphohn et al 2007: 24-25, Terlinden et al 2008 and Wehrmann 2008: 28). Irrespective of the cause, land disputes have extensive negative effects on economic, social, spatial and ecological development (Wehrmann 2008: iii). Land disputes lead to uncertainty in the land market, tenure insecurity (FAO 2004), sabotaged economic production and increased poverty. Often the land disputes culminate into land based conflicts that lead to civil strife, loss of lives, destruction of property and massive population displacement (GoK, 2002).

Though land disputes undermine human dignity globally, land disputes have no universal classification; they have not been universally defined in detail. In total, deep understanding of land disputes is lacking (Centre of Advanced Study 2006). This is because land classification criteria are many but informal (Wehrmann 2005). A first step in understanding of land disputes is therefore development of a formal and universal classification criterion.

A formal land dispute classification will be of great importance in a number of ways. First it will enable the drawing of a clear and deep understanding of the special characteristics of the particular land dispute, the causes of the dispute and the actors involved (including their positions, attitudes, behaviour, interests, needs and motivations), as well as their relations with each other (Wehrmann 2008). Secondly classification will eliminate heterogeneity in definition of land disputes and thus ease the crafting of global management and intervention approaches. This will greatly eliminate the often experienced duplication of efforts in formulation of resolution mechanisms.

1.2 Land Dispute Classification

A broadly acknowledged fact amongst all the informal land dispute classifications is that land disputes are a *social* fact in which at least two parties are involved; the roots of which are different interests over the property rights to *land* (Wehrmann 2008). This has resulted into two widely accepted and commonly used land dispute classification models:

- i. Land disputes classifications modelled on social aspects of land (Nyadimo 2005), (Foster 2010) and (Wallis 2010) and
- ii. Land dispute classifications modelled on properties of land in dispute (Ashley 1999), (So Sovannarith et al. 2002: 33–6), (Mahaphohn 2007: 20) and (Wehrmann 2008: 32).

Current social classification models include classification by Ashley (1999), So Sovannarith et al. (2002: 33–6), Mahaphohn (2007: 20) and (Wehrmann 2008: 32).

Ashley (1999), classified land disputes into three typologies:

- i. *Disputes between the state and ordinary citizens,*
- ii. *Disputes between citizens and representatives of the state and*
- iii. *Disputes involving private parties.*

So Sovannarith et al (2001) classified them into six land dispute typologies that included:

- i. *Conflict between neighbours,*
- ii. *Conflicts within families,*
- iii. *Conflict involving local authorities,*
- iv. *Conflicts involving state institutions and*

v. *Conflicts between villagers and private parties and companies.*

Wehrmann (2008: 32), preferred the method of land dispute classification based on the social dimension of disputes (Table 1-1). Classification offered by this model is the distinction according to the social level at which a conflict takes place. They include;

- i. *Intrapersonal,*
- ii. *Interpersonal,*
- iii. *Intrasocietal or*
- iv. *Intersocietal/international levels.*

Table 1-1; Classification of land conflicts (Wehrmann, 2005)

Interpersonal Level	Micro-social dimension	<ul style="list-style-type: none"> • Boundary disputes between neighbours • Ownership conflicts due to inheritance conflicts • Occasional multiple sales of private property by individuals without administrative assistance and without harming third parties • Individual occupation of private land • Building extensions on the private land of another • Illegal lease/sale of somebody else's private land
Intrasocietal Level	Meso-social dimension	<ul style="list-style-type: none"> • Boundary conflicts between tribes or villages • Illegal sale/lease of communal land/tribal land • Illegal allocation of state land by private individual • Group invasion of private land • Land use conflicts between farmers and pastoralists • Occasional building extension on state land • Occasional illegal use of state land • Illegal use of one's own land • Violent attacks on property
	Macro-social dimension	<ul style="list-style-type: none"> • Ownership conflicts due to legal pluralism • Land grabbing, Illegal sale/lease of state land • Evictions (by force) by governmental authorities • Land use conflicts between private and public utilisation due to a general disregard of land use regulations by a majority of people • Expropriation without compensation • Illegal acquisition and sale of somebody else's private property by individuals, supported by corrupt public agencies or courts • Multiple allocation of particular plots by officers working at the land registry

The reviewed classification models commendably attempt to simplify understanding of land disputes. The results of the models are widely descriptive and as varied as the general humanity which gets affected by land disputes. On the other hand, the classification models are weak as far as use of the results of classification for formulation of resolution mechanisms is concerned. Though all the reviewed social classification methods classified disputes based on parties to a dispute the end results of their classification models are not similar; they give forth heterogeneous typologies of land disputes.

Heterogeneity in definition of land disputes typologies poses a great challenge in the crafting of common management and intervention approaches. It is often a cause of duplication of efforts in the formulation of resolution mechanisms. Further it greatly limits boundaries of practice of land professionals interested in resolution of land disputes in a world where practice boundaries for professionals are largely diminished. In total, it restricts the ability of the land professional to alleviate human suffering.

The reason for heterogeneity of results is that, the social classifications do not take into consideration the fact that each disputed parcel is not only subject to parties involved but also a function of one or a combination of a number of a parcel's cadastral properties administered in (a) legal system(s). These models thus not only leave out an important parameter of land dispute- 'a parcel's cadastral properties' but also the meeting point of the parties and the parcel-'the legal system used to administer interests and rights in land'.

Land dispute classification modelled on properties of land in dispute include classification by Nyadimo (2005), Powell (2005), Jiri and Libor (2007), Foster (2010), Wallis (2010), made the initial attempt to model land dispute classification based on properties of land involved. Nyadimo (2005) classified land disputes based on contestations on access to, ownership of land and the power to alienate land in specific places in Kenya. Little is discussed about the methodology used in this classification. The resultant

land dispute typologies included; land administration disputes, land use disputes, inheritance disputes, boundary disputes, settlement disputes and political disputes.

Powell (2005), Jiri and Libor (2007), Foster (2010), Wallis (2010), discuss boundary disputes, which is a dispute modelled on land properties without making reference to how they classified it as a boundary dispute and what other types of land disputes exist.

1.3 Problem Statement

Land disputes affect different groups in different ways and are ubiquitous (Wehrmann 2008: 2 and Foster 2010); yet land disputes are likely to persist, increase in the near-term and medium-term future (Wehrmann 2008: 103) and become even compounded. This is because in many countries, formal land dispute resolution mechanisms are weak or effectively non-existent (FAO 2004: 29).

Lack of proper classification of land disputes is a major setback in the formulation of formal land dispute resolution mechanisms. Though studies on land disputes are many and theoretical, scientific analysis and clarifications are lacking (Wehrmann 2005). Current classification models give forth heterogeneous land dispute typologies despite the fact that they use a similar classification criterion. The models are also not all rounded. They consider one factor in land disputes to the exclusion of other factors. The resultant land dispute typologies to these classification models are thus schematic presentations of the situation with regard to land disputation and are not analytical (Zitelmann, 2005).

To resolve this, Wehrmann (2006) recommended an integrated system-oriented approach that would take into consideration the complexity of causes leading to these land disputes as well as their diversity and huge number of actors involved. Such an approach requires Land administrators to create Geographical Information Systems (GIS)-related databases. These databases should not only describe the type of land dispute but also indicate the location and size of the properties involved (Wehrmann, 2008: 50). This has not been done in Kenya. The *GoK (2002)* noted that since Kenya's inception, no deliberate efforts have been made towards the understanding of land disputes. Land disputes have not been

identified, recorded, analysed and classified. The problem statement of this study therefore is that;

“There has been no classification of land disputes in Kenya”

1.4 Objective of the study

The objective of this study is therefore to develop a cadastral classification of land disputes using geographical data modelling. Bungoma Municipality, a cash crop district in western Kenya has been selected as a case study.

Specific objectives of this study are;

1. To choose a suitable study area,
2. To identify and verify the validity of land disputes in the study area,
3. Design and implement Cadastral Land Dispute Classification Model Database using Geographical Data Modeling

Given the above research objectives, the study has the following research questions;

1. Research Questions for Objective 1

- How many registrations unit are in the study area?
- How many Dispute Resolution Agencies operate in the study area?
- What is the location of the study area with respect to known land clashes belt and the 2008 postelection violence locations?
- How many boundary systems operate within the study area?

2. Research Questions for Objective 2

- What are the land disputes identified by each land dispute resolution agency within the study area?
- Can each land dispute reported by dispute resolution agencies be spatially mapped to a physical parcel, PID and the land register?

3. Research Questions for Objective 3

- Who are the users and what is their user view of the Cadastral Land Dispute database?

- What are the entities of a cadastral land dispute classification model?
- What is the relationship between the entities?
- How can the entities be extracted from the land dispute 'real world' and loaded into geodatabases?
- Can a cadastral land dispute classification criterion be implemented in a prototype?
- What are the resultant cadastral land dispute typologies output by the cadastral land dispute classification prototype?
- How are the cadastral land disputes output by the prototype spatially distributed?

1.5 Justification and Relevance

Land disputes are a long standing issue in Kenya. They are not only the platform on which the Kenyan independence was fought and won but also the strain that has in the recent past threatened Kenya's cultural and ethnic harmony. Kenya's land disputes usually tend to be explosive and bloody and often characterised by massive population displacements and extensive destruction of property to levels that usually culminate into international humanitarian crises.

Though widespread in Kenya, explosive land disputes are mostly restricted to particular geographical belts and have a well known temporal pattern of reoccurrence. In Western region of Kenya, Kakamega-Kisumu-Kericho-Uasin-Gishu has been the traditional Land Dispute Belt (GoK 1992). However, the recently witnessed land based disputes that came after the 2007 disputed presidential elections extended beyond the traditional belt and sucked in the cash crop belt of Bungoma Municipality.

The broadening of the Western region land dispute belt into Bungoma Municipality raises a lot of concerns. First, there are great concerns about the economic relations between Kenya and her neighbours given that Bungoma Municipality lies on the transnational highway linking Kenya to her land locked neighbours. Secondly, there are social concerns that resulted from disruption of peaceful coexistence amongst the various communities attracted by the cash crop and job opportunities in the sugar cane milling

factory. Lastly, there are fears this could extend to other neighbouring districts and completely destabilize the region.

Studying and classifying of land disputes in this district is important in many ways. First, it will reveal land dispute typologies and their trends and inform why a traditionally land dispute free district could experience such unprecedented explosive and bloody land based disputes. Secondly an opportunity to classify land disputes and pave way for formulation of both preventive and curative mechanisms presents itself.

1.6 Scope and Limitation of study

Land disputes are rampant in Kenya. However, this study focuses on Bungoma Municipality in the Western Province of Kenya. The study Models a land dispute classification criterion using cadastral properties of the parcels involved. Social aspects of land disputes like human behaviour, alcoholism and culture are out of the scope of this study.

Though the study draws on land disputes from Land Dispute Resolution Agencies, it is not about land dispute resolution per se but is instead about developing a cadastral classification using geographical modelling to support understanding of land disputes. The functioning of Land Dispute Resolution Agencies and why they may have attracted particular disputes or disputants is not considered.

As a model development oriented research, the study does not perfectly conform to common research methods of evaluation, hypothesis testing or prediction. Development of models is not about hypothesis testing or establishing of patterns to lay ground for prediction. It is about understanding processes, checking for process improprieties and introducing mechanisms in the system to detect, cluster the improprieties and propose solutions.

The study came shortly after the postelection violence, probing for land disputes had to be done in a strictly moderated manner to avoid evoking ethnic animosity. Little land

records were found, there was serious dependence on individuals, village elders, government officials and the land dispute tribunal members who in some instances could have had vested interests in certain land disputes and disputants.

The study is designed and carried out at a constitutional transition time. Land disputes considered in this study are a making of the old constitutional order. The research is complete after ratification of a new National Land Policy and the promulgation of a new constitution which propose major amendment to the existing legislation.

1.7 Thesis Structure

This report is organised into chapters 1 to 6. Chapter 1 sets the parameters and frame work of the study. It gives a brief introduction of land disputes and recent attempts to classify disputes. The research problem defines the issues that necessitate this study. Objectives and research questions are extracted from the research problem. The significance of the study states the contribution of the study to the body of knowledge and use in policy formulation. The scope and limitation of the study discusses the extent of the study and the constraints encountered.

Chapter 2 introduces the cadastral context in which the research is carried out. It gives a historical evolution of the cadastral system in which the study is based. The weaknesses of the cadastral system and how the weaknesses have to the new and long standing land disputes are discussed. Existing land disputes and resolution mechanisms developed are discussed broadly.

Chapter 3 gives an overview of the process of choosing the study area. Feasibility analysis that dwelt on cadastral details, availability of dispute resolution agencies, satellite imagery and registration units is discussed. Features of Bungoma Municipality that made it considered as a study are also highlighted. The chapter further examines field observation during dispute identification and verification in Bungoma Municipality.

Chapter 4 takes a critical look at the model design. The conceptual framework of geographically modelling a cadastral land dispute classification is presented. Based on the conceptual framework, the chapter later dwells on the development of a land dispute database.

Chapter 5 presents the outcome of the study. Results of land dispute identification, land dispute verification in Bungoma Municipality are presented. Also presented in this chapter is a cadastral land dispute classification prototype which is the actual implementation of the designed land dispute database. The cadastral classes of disputes output by this prototype and their distribution in Bungoma are presented.

Chapter 6 is a discussion of the results in Chapter 5. Further, Chapter 7 gives the general and specific conclusion and recommendations based on the previous chapters.

2. Kenya's Cadastral System and Land Disputes

2.1 Kenya's Cadastral System

Kenya's cadastral system evolved alongside the land tenure system. As land ownership and land use rights transited from the customary to the colonial to the post colonial era, cadastral procedures and institutions to safeguard particular policies and interests were put in place. This was implemented to not only to give it legitimacy but also to entrench it and condense it into a cadastral system (Ogendo, 2007).

In the pre-colonial era, Kenya practised customary land tenure. Tenure relations under this customary system were controlled by socially distinct authority usually comprising of a functionary e.g. chief, an elder, council of elders or spiritual leader. Such an authority solved the problem of allocation by overseeing the access, management and use of land. Control was for the purpose only of guaranteeing access to land and the resources found on it. Decision about the persons to include and who not to include also rested in the controlling authority (Ojienda 2008: 13).

With the introduction of colonialism, these customary conceptions about use and ownership of land began to change. Colonialists instead settled on a cadastral system constituted and administered by three land ownership systems, three statutory tenure regimes each constituted with a bundle of land rights, two boundary systems enshrined in multiple mapping systems and a land rights delivery system overseen by multiple legal systems run as part of the political administration. Long after independence, this cadastral system is still in use.

2.1.1 Land Ownership Systems

Section 61 of Kenya's constitution classifies land into public, community (formerly trust land) and private land. The Kenyan land ownership systems cannot be explained without some historical analysis. According to the GoK (2002:21), at colonisation, to ensure state, political and economic power, one of the earliest imperial acts was the assertion of sovereignty over land occupied by indigenous Kenyans. This came in three phases; first

the expropriation of the Ten-Mile Coastal Strip by promulgation of an ordinance in 1908 requiring;

'All persons being or claiming to have interests in whatever immovable property..... before the expiration of six month..... (to) make a claim in respect thereof...'

The Land Titles Ordinance Act, currently CAP 282 of the Laws of Kenya declared that;

'All land... concerning which no claim or claims for a certificate of ownership shall have been made... shall be deemed crown land'

The second British assertion of sovereignty over land occupied by the indigenous people was later to be extended to the rest of Kenya. This was founded on the advice of the law officers of the crown on December 13, 1899 that under Britain's own foreign jurisdiction, the imperial power had control over and could therefore freely dispose of

'Waste and unoccupied land in the protectorate where there was no settled form of government and where land had not been appropriated to the local sovereign or to individuals'

Arguing that Kenya was such a protectorate, the law officers advised that the imperial powers was in this case at liberty to declare any land therein to be crown land or 'to make grants to them to individuals in fee or for any term'. That advice was duly incorporated into legislation; the East African Order in Council, 1901 which conferred the Commissioner of Protectorate power to dispose of all public lands on such terms and conditions as he may think fit, subject only to any directions which the colonial secretary of state may give. The Order in Council was later expanded and re-enacted in the form of Crown Ordinance 1902 and 1915 under which crown land meant:

'All public land within the East African Protectorate which for the time being are subject to the control of His Majesty's Protectorate and all lands which have been or may

hereafter be acquired by his Majesty Under Land Acquisition Act 1894, or otherwise howsoever'.

In 1915, an opinion delivered by the Chief Justice to the effect, *inter alia* that whatever rights indigenous inhabitants may have had to the land had been extinguished by colonial legislation leaving them

*'mere tenants at will of the crown, of land actually occupied which would presumably include land on which huts were built with their appurtenances and land cultivated by the occupier-such land including the fallow'*¹

By these legislations all land including the Northern Frontier District comprising the northern parts of the current Rift Valley, Eastern and the North- Eastern provinces were summarily appropriated by the government. These series of legislation introduced state ownership system to land in Kenya.

To ensure absolute administrative and ideological control over indigenous majority, the colonial government gazetted the first 14 land units reserved for African occupation under the Crown Lands Ordinance in 1915. In 1926, native reserves were gazetted. The purpose of the native reserves was to facilitate simpler and more efficient control and administration of 'natives' by the colonial government. These would now be administered in ethnically defined and exclusive boundaries under their own native authorities. This intensified competing claims for land resources among ethnicities, clans and lineages leading inevitably to disputes and social fracture. As a result, a lot of pressure was piled on the colonial government to institute land reforms.

The Government consequently set up three commissions between 1924 and 1935; the Ormsby-Gore Commission (1924-1925), the Hilton Young Commission (1927-1929), and the Morris Carter Commission (1930-1934). The Ormsby Gore Commission first

¹ In the case of *Isaka Wainaina, wa Gathomo and Kamau Wagothomo vs. Murito wa Indaraga* (2) wa Murito, (3) Attorney General of the Protectorate (1922-1923) 9(2), KLR, 102

mooted the idea of creating trust land from the native reserves to check the insecurity and restlessness within the African reserves. The Hilton Young Commission ratified the “dual” policy; to provide separately reserved areas for Europeans (White highlands) and Africans (Native reserves).

The Carter Commission recommended the creation of ‘Trust Lands’ exclusively for the use by Africans with respect to ownership but with the authority of use vested in the local authorities or county councils. As a result of these land Commissions, the land policy was reviewed and effected through the enactment of Trust Lands Act (Cap 288; 1939) to accommodate African interests and thus attain settler political security (Wayumba 2004). This introduced the second land ownership system; Trust Lands. Trust Lands are Communal land held in trust by the county council.

In 1954, the colonial government published a White Paper on the ‘Intensification of Agriculture’. This was known as the ‘Swynnerton Plan’ and was based on the assumption that African land tenure systems were, by virtue of their community orientation, inherently incapable of facilitating the development of modern agriculture. The solution, it was argued, lay in the conversion of those systems to individualised tenure arrangements, (Swynnerton, 1955).

Predicated on these arguments, the Native Land Tenure Rules were promulgated in 1956 establishing the system of adjudication, consolidation and registration. Subsequently, the Native Land Registration Ordinance was enacted to provide for individual ownership of land upon registration. These laws are in no doubt the forerunners of the present system obtaining under the Land Adjudication Act; Cap 284 of 1968, the Consolidation Act Cap 283 of 1962 and the Registered Land Act (RLA) Cap 300 of 1963. The RLA currently embodies the individual land ownership system with the effect that the registration of an individual proprietor of land vests in that person an absolute title (Ojienda, 2008).

Today, land ownership is divided into three categories; Public Land, Community (formerly Trust) Land and Private Land. *Public Land* is defined under section 62 of the

Kenyan constitution. *Community Land* is the land declared to be community Land and defined in Section 63 of the constitution of Kenya. It is land held in trust by County Councils on behalf of the local inhabitants. For as long as community land is not adjudicated and registered, it remains the property of local communities, groups, families and individuals in the area in accordance with the applicable customary law. Private Land is the title to which is registered in accordance with any of the laws that provide for registration of title. Land may be registered in the name of individual or company. Private land is defined in section 65 of the constitution.

2.1.2 Boundary Systems

The conditions at the time the Colonial Government was alienating land in Kenya were much the same as they had been in Australia. Thus, Torrens; a title registration system then in use in British Australia was borrowed and wholly adopted. Torrens system was a system based on monumentation of boundary corners. Properties dealt with under this system were usually either large farms or urban plots and fencing followed after surveys, thus slowly building up a pattern of enclosure. These accurate surveys; fixed boundaries at the white highlands were done under the provisions of the Survey Ordinance of 1923 and registered under the Registration of Titles Act (RTA) (Njuki, 2001). Most of the resources of survey of Kenya were directed to these cadastral surveys until immediate post World War II years when a small part was left as other resources were diverted to topographical mapping (Ratzeburg 1970: 10).

According to Njuki (2001), The Land Titles Ordinance of 1908 mandated less accurate surveys on adjudicated and unclaimed land at the Coast. The ordinance provided for a surveyor to demarcate and define boundaries of both adjudicated and unclaimed land as directed by the Recorder of Titles. Surveys were done by compass and chain, partially putting the Torrens system in use. Both survey and monumentation were not usually up to standard (Ratzeburg 1970: 11). This was later to be extended to the rest of the country but in a different form.

When land consolidation and registration started, Survey of Kenya pointed out that it would not be able to carry out the surveys by ground methods and to standards required if the scheme was to progress as fast as it was planned to do. They advised, to put it as simply as possible, that the system should be based on physical demarcation of boundaries and on air survey. It drafted what has since become the Registered Land Act- the Act which governs the general boundary system (Ratzeburg 1970: 11). According to Wayumba (2004), under this arrangement, the boundaries of parcels were walked and determined by the elders or committee members and the demarcation officer planted the hedges.

Once the boundaries were established, the boundary owners marked them with hedges. In order to produce the maps of the parcel boundaries, air photography of the entire adjudication area was carried out. This would show the parcel boundaries as marked by hedges, and through the direct tracings of such boundaries from the photographs the respective plot boundaries could be shown in map form. It was originally intended that once the boundaries were air visible, new aerial photographs would be acquired at a scale of 1:12 500 to generate more accurate maps; the Registry Index Maps (RIM). This process for the new acquisition was known as the “re-fly”, as proposed by Adams (1969). The process was however later abandoned due to lack of funds.

The photographs were simply used thereafter without any further corrections for errors being applied on them. The photographs were thus simply enlarged five times to a scale of 1:2500 to facilitate the production of representative diagrams of the parcels on transparent paper. The resultant intermediate maps were viewed simply as preliminary diagrams and were consequently referred to as Preliminary Index Diagrams (PID). They were referred to as diagrams because the photographs used to produce them were unrectified. PIDs have in fact remained as the official map for registration under RLA since the second phase of the program to produce Registry Index Maps (RIM) was not been executed in most parts of the country.

From these historical happenings, Kenya has two boundary systems, the Torrens Fixed boundary and the general boundary. The Fixed boundary is precisely defined by terminal marks and is accordingly backed by survey data in the form of angles and lengths (Kamau 1979). It is possible to precisely re-establish such a boundary by use through survey methods. The general boundary means that the exact line of the boundary had been left undetermined - 'as for instance, whether it includes a hedge or wall and how far it runs within or beyond it; or whether or not the land registered includes the whole or any portion of adjoining stream' (Simpson 1976: 135). Reestablishment of general boundaries is highly dependent on the environment and therefore not very accurate.

Gok, (2009) notes that; processes of land surveying and mapping are integral to an efficient land administration and management system. In addition to preparing maps and plans to support land registration, they map the earth for land use planning. In an attempt to ensure this and address problems inherent in the current mapping and boundary systems, the National Land Policy recommends;

- a. Amendment of the Survey Act (Cap 299) to allow; (i) use of modern technology such as Global Navigation Satellite System (GNSS) and Geographical Information Systems (GIS) (ii) regulation of non-title surveys
- b. Establishment of unitary and homogeneous network of control points of adequate density, preferably using GNSS
- c. Improve mapping standard in general boundary areas so that they fit a computerized system.

Whereas the recommendations are expected to resolve the current challenges within the mapping and boundary systems, new challenges may be encountered during implementation of these recommendations. There is bound to be high levels of anxiety in the public domain on the effect of the recommendations on past land injustices, new and long standing dispute. Support from the public is bound to be little and may spark land based conflict in some regions.

2.1.3 Tenure Regimes

In Kenya, rights held by a land owner are dictated by three statutory tenure regimes. These are freehold estates, absolute proprietorships and leasehold estates. According to the GoK, (2002: 49), as a relic of feudalism, the *freehold* connotes the largest quantum of land rights which the sovereign can grant an individual. Being held of the sovereign, however, the freehold is technically a tenancy hence subject to resumption by the State. The introduction of directives under the Agriculture Act, Planning Legislation all affirm the freeholders have no freedom of choice when it comes to the exercise rights over their land.

The *Absolute Proprietorship* was introduced by enactment of the Registered Land Act (Cap 300). Under Section 27 (a) of the Act; the registration of a person as the proprietor of land has the effect of vesting in that person absolute ownership of that land together with all rights and privileges belonging or appurtenant thereto. This was intended to extinguish customary tenure and replace it with rights that would be individually and exclusively held.

The *Leasehold* involves the derivation of rights from a superior title for a period of time certain or capable of being ascertained and the enjoyment of such rights in exchange of specific developments planned by the prospective leaseholder. Section 27(a) of the RLA states that registration of a person as the proprietor of a lease has the effect of vesting in that person the leasehold interest described in the lease, together with all implied and expressed agreements, liabilities and incidences of the lease. Statutory leasehold in Kenya are created either by the state in respect of land it holds directly under the Government Lands Act, by county councils in respect to land they hold in trust or proprietors who hold freehold or absolute proprietorship. The new constitution now rests the statutory power on the yet to be formed National Land Commission.

Proprietors are bound by rights shown in the registers and leases, charges and other encumbrances over the land as indicated in the register by overriding interests stipulated under section 30 of the RLA. The essence of the overriding interests is that certain kinds

of interests in land are made to bind third party automatically, even though they relate to matters which would not normally be shown on title deeds or disclosed abstracts of title (Ojienda 2008:112).

2.1.4 Land Rights Delivery System

Kenya's Land rights delivery system is a process which entails, among others the mobilisation of institutional mechanisms and personnel for granting of land rights, ascertainment of land rights, transfer of ascertained land rights and registration of such land rights. The land rights delivery system applies across all land ownership systems and statutory tenure regimes. Before the promulgation of the Constitution of Kenya 2010, the land rights delivery system was run as part and parcel of public administration. The Constitution of Kenya 2010 radically changed this and the entire land rights delivery process. The new constitution has mandated Parliament to enact and repeal relevant legislation. This would ensure the relevant legislation conforms to the new constitution. This is yet to be done. In the context of the study, reference has to be made to the old constitution and the relevant yet to be repealed Acts of Parliament.

At territorial level, Government land is administered by the Commissioner of Lands directly on behalf of the President under the Government Land Act. The Act provides for alienation and disposal primarily through three methods; by grants to various recipients for a variety of purposes, by leases of town plots and agricultural land for specified reasons of time; and by sale of agricultural land, thereby conferring freehold (absolute) title thereto (Ojienda 2008: 58). Either way, only the president has power to make grants or disposition of any Estates, Interests or Rights in or over un-alienated Government Lands. This has been extinguished by the new constitution and the powers to grant and dispose now lies with the National Land Commission.

Under the old constitution that stop being in effect in August 2010, the President would have to notify the Commissioner of Lands in writing that he intended to make a grant of un-alienated government land to whoever had been selected as a grantee. Only then could the commissioner legally proceed to formalise and sign the grant of title (GoK 2004: 8).

The only statutory criterion that was to be met prior to disposal of Government Land was that the land must be available, meaning that the land must not at the time of proposed sale or grant, be needed or required for Government purposes.

On the other hand, Government could also acquire both trust land and private land under any tenure regime. Disposition of trust to the Government was by setting apart in the manner specified in section 117 of the Kenyan old constitution. The setting apart extinguished any rights, interest and benefits of local community to the land. Government could also acquire private land for its use or on behalf of local authorities through compulsory acquisition as provided for by section 75 of the Kenyan old constitution. Either way, the yet to be repealed Land Acquisition Act empowers the commissioner of lands upon due notice in the Kenya Gazette and upon payment of full compensation to all persons having an interest in the land, to acquire the piece of land which the minister is satisfied is required for public use.

At a personal level, land may be disposed of by transfer or transmission. Transfers are done by the individuals in person under the regulation of the Land Control Act (Chapter 302 of the Laws of Kenya). The Land Control Act was enacted in 1967 with the aim of regulating, by means of public control, the manner in which the land owner or the owner of an interest in land is supposed to deal with it. On the other hand, transmission principally means the passing of land, lease or charge from one person to the other by operation of the law. Mostly the proprietor is usually unable to do the transfer by himself. This often results upon the proprietor's death, insolvency or bankruptcy (Ojienda 2008). Transmission upon death is provided under the Land Title Act (LTA), Registered Titles Act (RTA) and the Government Land Act (GLA). Transmission upon insolvency is administered under the Section 53 of the Bankruptcy Act.

2.2 Weaknesses of the Kenya's Cadastral System

As detailed in section 2.1 Kenya's cadastral system is highly vulnerable to disputation because of inherent defects in its design and subsequent inadequacies in both its management and organisational control.

2.2.1 Design Weakness

The land question in Kenya is a colonial legacy (Ogendo 2007, and Dale 2007). The Kenyan Cadastral system was designed and put in place at colonisation. At the time of design it was purposed to ensure that property rights granted or created under imposed foreign law were clearly defined and their boundaries maintained. It had little to do with the African land rights and ensuring systematic evolution of the African land order. Primarily, it was designed to ensure (Ogendo 2007);

1. The dislocation of land resources from the social, cultural and spiritual life of indigenous inhabitants by expropriation and development of white high lands
2. The suppression and subversion of indigenous land governance structures, institutions and laws by Systematic discrediting of customary laws and ensure judicial enactment of statutory laws and rights,
3. The ethnicisation and regionalisation of land by creation of native reserves
4. Emergence of the state and its agents as the dominant factor in land relations and
5. The virtual disappearance of common property resources by adjudication, consolidation and registration.

2.2.2 Management and Organisational Control Weakness

At independence colonial authorities proceeded to negotiate power transfer based on the principle that the settler economy would not be dismantled or otherwise destabilised. The final outcome of that negotiation was an independence settlement plan that provided limited scope for land redistribution by removing racial powers to land ownership in the settler areas. It only confirmed and safeguarded property rights acquired during colonial period. Explanation for this lies in the opportunity that the decolonisation accorded the new power elites (Wasserman, 1973). According to GoK, (2009), decolonisation process presented an adaptive, co-optive and pre-emptive process which gave the new power elites access to the European Economy. Therefore this process;

- i. Had to be moulded in a way that allowed the settlers to adapt to the changed economic and political situation by identifying new centres of influence that were not overtly political

- ii. Had to achieve the aim of socialising the new elite into the colonial political, economic, social patterns to ensure that the elite was able to rule functionally on an inherited political structure and co-operate with the outgoing ruler; and
- iii. Was geared towards preventing the mobilisation of a nationalist base that would be opposed to continuation of colonial policies after independence

To facilitate superintendence over that land, independent governments perpetuated a cadastral system. The cadastral system entailed the mobilisation of institutional mechanisms and personnel for ascertainment of rights, registration, demarcation and or survey, the preparation of PIDs, land registers and land market regulation among others. To date these processes are run as part and parcel of political administration and are overtly political (GoK 2002: 70) and thus often abused (GoK 2004 and Human Rights Watch 1997). The Land rights delivery system has been bedevilled by the following challenges;

- i. *Patronage*: Successive governments since independence have used land to consolidate political power. This is perpetuated through illegal gifts of land to buy political support (Human Rights Watch, 1997). Such gifts are done outside the provision of the law and cadastral system. Authorities create new procedures which are inappropriate or inconsistent with existing laws. In both cases, the results are confusion and creation of title that are disputable and often wholly void.
- ii. *Failed policy*: Land consolidation, adjudication and registration policies failed to recognize a variety of secondary rights under indigenous tenure, so depriving so many people including women (GoK 2009)
- iii. *Faulty mapping systems*: Most of Kenya is under the general boundary system administered under the RLA and supported by PIDs. Despite the errors inherent in the PIDS as highlighted in Section 2.1.2, the PID is rampantly and actively in use. According to Mulaku and McLaughlin (1996: 212), PIDs are expected to be reliable to 80% in respect of area and are expected to serve the functions of a cadastral map including;

1. Identifying registered land parcels on the ground
2. indexing registered land
3. enabling boundary relocation and dispute resolution
4. supporting subdivision and planning
5. enabling the determination of parcel areas
6. Serving as LIS base map or GIS thematic maps

Mulaku (1995) and Mwenda (2001) noted PIDs adequately fulfil the first two purposes but suffer from gross positional inaccuracies due to various geometric and radial metric errors induced during the flight acquisition and data transfer from photos to the tracings. The boundary information provided cannot therefore be very reliable. Discrepancies in areas up to and exceeding 50%, minimal financial benefits against the titles are some of the concerns that have been noted by Mulaku and McLaughlin (1996). This introduces quite enormous uncertainties in not only delineation but also restitution of lost boundaries. This has been and still is a recipe for land disputes.

- iv. *Inconsistency of the land registry*: The information gathered as a result of the adjudication, demarcation, survey and registration services was rarely organized in a form that could easily be retrieved or utilized for other purposes such as planning or land use management. Because of that limited focus, cadastral information attached to land parcels in registries were rarely disaggregated in terms of nature, quality or production characteristics, nor updated in response to changes in resource characteristics as a result of use, population pressure and technological change. Consequently that information is often inaccurate and of little use even for the purposes of land registry management (Ogendo 2007). Asymmetry between official records and what is on the ground persist and there is wide divergence between the land register and actual patterns of access (Haugerud, 1989). The divergence between the land register and actual patterns of access has led to uncertainty and dispute regarding claims to titled and or untitled land, fuelled corruption in land related institutions and further discouraged a number of Kenyans from seeking registration of land.

- v. *Multiplicity of legal systems*: Currently, both multiple customary and formal methods are in use as curative land dispute resolution mechanisms in Kenya. The two systems interact in unpredictable manner. Formal systems have grounded customary systems; even though customary systems, *de facto*, govern land dispute resolution. Customary systems on the other hand are not informal; rather they represent an alternative formality. Apart from being in conflict with each other, these systems are invariably in conflict within themselves. A disputant thus insists on the system that advantages him or her while disadvantaging the opposing disputant.

- vi. *Inadequacy of the tenure regimes*; the conversion of customary land tenure into a regime equivalent to freehold have led to a number of consequences. The first is the potential of extinction of trans-generational rights upon registration whenever present registered proprietors desire to exercise their power of disposition. The second is the emergence of serious incongruities between law and social reality on the ground due to the fact that registration alone has not triggered any changes in the perception of community in the land.

These weaknesses are part and parcel of the institutions and concepts of the Kenya's Cadastral System and are undeniably the major causes of land disputes in Kenya. They have not only increased land disputes but complicated the nature of Kenya's land disputes. The National Land Policy and the Constitution of Kenya promulgated in 2010 provides a platform to deal with these weaknesses. The success of these two pieces of legislation in dealing with the weaknesses is however not guaranteed unless the proposals made and legislation developed in the near future establish how to deal with the disputes born by the old constitutional order.

2.3 Types of Land Disputes in Kenya

Kenya's land disputes manifest themselves in different ways ranging from contestations on access to and ownership of land to the power to alienate land in specific places (Nyadimo,

2005). They vary from quite straightforward arguments to complex series of differences of opinion involving the interpretation of legal documents, formal and informal agreements (GoK, 2002) plus questions of ethnic and or lineage intent and motive.

Though complex and varied, Gok (2002) noted that since Kenya's inception, no deliberate efforts had been made towards understanding of land disputes. Thus Kenya's Land disputes have not been identified, recorded, analysed and methodologically classified. Thus, general classifications derived from different causes and effects of Kenya's land disputes have emerged and are widely in use. Common general classifications currently in use include;

i. Land administration disputes;

Land administration disputes are as a result of the inherent defects in the design and subsequent inadequacies in the management and organisational control of the land administration system. Such disputes stem from insufficient implementation of regulations, lack of transparency, corruption and limited or insufficient public participation, especially in land use planning among others (Wehrmann, 2005 and Nyadimo, 2005).

ii. Ethnic Land Disputes;

Ethnic land disputes are as a result of competing claims for land as a resource amongst ethnicities (GoK 1992 and GoK 2002). Though historical, more often than not they are usually politically instigated and have a well established temporal pattern of occurrence.

iii. Family disputes

Family disputes are intra family disputes (GoK 2002). Being the fourth decade after independence, there is generational change and land is supposedly passing from the second to the third Kenyan generation after independence. Subdivision disputes pitching brother against brother or son against father are relatively common. Deaths in both the second and third generation occasioned by the HIV scourge have in particular made this generational transition of land ownership quite complex. There are therefore also innumerable family disputes, most of them inheritance related.

iv. *Settlement Disputes*

This refers to land disputes in which the rights to land by an individual or a group of people are in doubt. Two types of land disputes are identified and these include: Squatter settlement disputes and Informal settlement disputes (Nyadimo 2005). Squatter disputes results in cases where absentee landlords' rights are seized by informal agents. Absentee landlords refers to persons who, seldom if ever use land of which they are the registered owners and such land, if it is managed at all, is managed by "agents" who may or may not have been validly appointed by the registered owner (GoK, 2001, p. 7). Many such agents are thought to be self appointed with no legal authority over the land. This has created a situation where the so called squatters are now demanding the right of ownership. On the other hand, informal settlement disputes are constituted by illegal occupation of government land and in some cases private land due to strong population growth and rural – urban migration.

v. *Land Grabbing Disputes*

Land grabbing disputes involve the seizure of private or public land. There are three common ways in which seizure is carried out. First, dispossession is carried out by powerful individuals who circumvent the law and thus fail to enforce and to comply with the land delivery law as it exists (GoK, 1999). Secondly, dispossession is achieved through creation of new procedures which are inappropriate or inconsistent with existing laws. Lastly, dispossession occurs when one takes over more land than one actually bought.

vi. *Land Use Disputes*

These are disputes which arise as a result of differing opinions on the use of land and extent to development projects. Land use disputes can further be divided into; Disputes between Pastoralists and Agriculturalists, Human-Wildlife Disputes, Natural Resource Disputes, Environmental Disputes (Nyadimo 2005)

vii. *Boundary Dispute*

Boundary disputes are caused either by inadequate or erroneous legal descriptions or by obscure or ambiguous conditions on the ground. While the actual title to land may be securely delivered in a deed, uncertainty of location of boundary lines can result from poor descriptions of a parcel giving rise to a dispute between neighbouring owners (Foster 2010).

As have been noted by Mulaku and McLaughlin (1996), the general boundary system in use in most parts of Kenya may have discrepancies to the level of $\pm 2\text{m}$ in boundary and $\pm 10\%$ or more in area. This introduces quite enormous uncertainties in not only delineation but also restitution of lost boundaries in Kenya.

2.4 Management of Land Disputes in Kenya

Tools and approaches to avoid and resettle land disputes can be distinguished into preventive and curative mechanisms (Wehrmann 2005 and Wehrmann 2008: 32). Management of Kenya's land dispute is highly reliant on formal and informal curative resolution mechanisms.

Informal curative mechanisms are closely guided by socially and culturally known and accepted arrangements and rules. Rationale and reverence for a set of rules and authorities are banked on to solve the problem of allocation by overseeing the access, management and use of land through community gatherings that give audience to both the complainant and the accused. According to Leach, (1968: 41-69) *customary methods* are closely guided by socially and culturally known and accepted arrangements and rules that include:

1. Tenure was family based and the head of the family held rights on behalf of other family members.
2. Acceptance that members could exercise certain rights over land in varying degrees of equality based on membership into a community's unit course which required varying performance of certain obligations.

3. Rights of control were vested in political authority of the unit or community. These distinct authorities usually comprised of a functionary e.g chief, an elder or a council of elders or spiritual leader.
4. Private property rights accrued to individuals because of the investment of their labour.
5. Resources which did not require extensive investment were shared as common pasturage and managed by relevant political authority or people appointed by the jurisdiction.
6. Violation of certain rules led to definite penalties that included charges of adjudication and charges towards maintenance of the hybrid insurance systems normally managed by the unit's authorities
7. Resolution of all land disputes were subject to customary law. This is law that was constituted of spontaneously evolved rules emerging through past dispute adjudication.

Formal resolution mechanisms though in use are limited and largely deal with boundary disputes. Formal boundary dispute is set out in section 21 of the Registered Land Act. Formal disputes on agricultural land (which may still involve boundary disputes) are set out in the Land Disputes Tribunals Act number 18 of 1990 which Act repealed the Magistrates Jurisdiction (Amendment) Act of 1981. Under this Act, members of the tribunal are elders appointed by the Minister through a gazette notice. These elders are persons in the community who by virtue of their experience are deemed to be competent to resolve land disputes between parties. The decision of the tribunal is filed in a Magistrate's Court who enters judgement in accordance with that decision. Any party aggrieved by the decision of the tribunal may appeal to the Provincial Appeals Committee within 30 days of the decision. Parties not satisfied with the decision of the Appeals Committee can appeal to the high Court only on points of law.

Section 60 and 67 The Constitution of the Constitution of Kenya 2010, requires the National Land Policy and the National Land Commission to encourage settlement of land disputes through local community initiatives consistent with the Constitution. The

legislation to put in place the National Land Commission is yet to be enacted and the National Land Commission has not come into force. The Sessional Paper No.3 of 2009 on National Land Policy which extensively considered views from; the general public, reports documenting past initiatives on land reforms, written submissions from individuals, groups and organisations is expected to seal gaps in the current land dispute management mechanisms. In this regard, the National Land Policy notes there is need to ensure access to timely and efficient dispute resolution mechanisms. To ensure this, it proposes that;

1. The Land Dispute Tribunal Act (N0. 18 OF 1990) be repealed and replaced by a more appropriate legislation of dispute resolution at the District and the Community levels
2. A division of be created in the High Court of Kenya to exclusively deal with land disputes
3. The government should;
 - i. Establish independent, accountable and democratic systems backed by law to adjudicate land disputes
 - ii. Establish appropriate and inclusive institutions for dispute resolution and access to justice with clear operational procedures and clear record keeping for making specific decisions on specific matters and encourage and
 - iii. Facilitate the use of Alternative Disputes Resolution (ADR) mechanisms to facilitate speedy and cost effective access to justice. The District Land Boards (DLB) and Community Land Boards (CLB) shall majorly adopt ADR.

2.5 Summary

Kenya's land administration transited from native land tenure largely communal to colonial tenure that established the system of adjudication, consolidation and registration. In between the native land tenure and the colonial land tenure, mistakes were made. A cadastral system with inherent design weaknesses was put in place institutionalising land disputes. At independence, the cadastral system was perpetuated; its design weaknesses

notwithstanding, successive post colonial governments introduced management and organisational control weaknesses. As a result, land dispute arose and became common but the resolution process was not made easier.

Since Kenya's inception, no deliberate efforts have been made towards understanding of land disputes. Land disputes have not been identified, recorded, analysed and classified.

This has greatly hampered the land dispute resolution process. Because of lack of understanding of land disputes, a lot of emphasis has been on curative land dispute resolution mechanisms and not preventive resolution mechanisms. The land administration as it is now, ignores land disputes until they cannot be overlooked any longer even as tension and violence rise to a level which threatens major parts of society (Wehrmann 2008: 50). Later, they resort to curative measures.

Curative measures come much later when the land disputes' effects cannot be reversed (Kariuki 2005: 99 and Wehrmann 2008: 91). Often, there is a big asymmetry between these curative mechanisms and the cadastral and tenure reality on the ground (Dale, 2007). The situation is further worsened by the protracted and inconclusive arguments occasioned by the multiplicity and complexity of the curative mechanisms.

Universally, resolution of land disputes is a key component of the land administration (Dale and Mclaughlin, 1999) and (FIG, 2008). Failure of Kenya's land administration to put in place a proper dispute resolution makes it incompetent. This incompetency is however circumstantial and is facilitated by lack of efforts towards understanding and classifying of land disputes. Identification, recording, analysis and classification of land disputes is a major step towards improving Kenya's land administration system.

3. The Study Area and Data Collection

This chapter details the process and reasons of selection of the study area, the field observations and acquisition of cadastral data.

3.1 Selection of study area

Selection of the study area was one of the first critical decisions. It directly had an influence on the methods and strategies to be put in place for the study. Availability of cadastral data, heterogeneity of land dispute claims and the probability of fanning land disputes were the main determinant in the selection of the study area. These three components led to the use of the following criteria for selection of the study area;

- i. Registration Unit:** Registration unit is a jurisdiction whose parcels constitute a manual land register and PID or RIM. In Kenya, it is usually an administrative unit known as a sub-location. It was imperative that a study area not only should be constituted by a complete registration but also be composed of more than one registration unit for diversity.
- ii. Land Dispute Resolution Agencies:** Land Dispute Resolution Agencies operating in the area were key in identification of both ongoing and long standing land disputes for use in this study. To ensure high confidence levels, the study area had to source for information from more than one land dispute tribunal. The study area therefore had to be chosen within an area with more than one land dispute resolution agency.
- iii. Past land disputes:** The study took place shortly after post election violence. The study area had therefore to include an area in which post election violence had been witnessed but on the other hand ensure that such the study would not reopen violence.
- iv. Population Status:** Land is intimately related to kinship and economic identity. Kinship and economic factors are thus major contributors to land disputes. To ensure a variety of land disputes, the research had to be carried in a cosmopolitan area.

- v. **Boundary System:** Kenya uses fixed boundary systems mostly in urban areas and general boundary in the rural area. Each of these boundaries attracts different types of disputes. The study aimed to have a study area in which both the two boundary systems were in use.
- vi. **Cadastral:** A substantial amount of information had to be extracted from the cadastre to be appended to the land dispute claims for geographical data modelling. A Cadastre is normally a parcel based, and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, the ownership or control of those interests, and often the value of the parcel and its improvements (FIG 1995). In the Kenyan context, the geometric description is contained in the PID or RIM. The rest of the components are contained in a land register. The study area therefore had to be an adjudication area with cadastral in place.
- vii. **Satellite Imagery:** High resolution satellite imagery was needed for extraction of land use of the disputed parcels. Availability of a clear spot image covering the area of study was a major consideration for the choice of the study area.

The study area was searched for in different parts of the country. Two areas were seriously considered; Mumias and Bungoma Municipality. However, as the study went on, main focus got directed towards, familiarity of the researcher, diversity of cadastral properties, registration units, land dispute tribunals and representation of various communities within the possible smallest study area. The possibility of carrying out the study without reawakening post election violence emotions as well as the security of the researcher were seriously considered. Bungoma Municipality area was chosen for the study (Figure 3-1 below) after it was found to fulfil most of the requirements that included;

- a. **Registration Units:** Within an area of 18 square Kilometer, the area was found to consist of 5 registration units, namely; Kanduyi, West Mateka, Sang'alo and Namasanda.

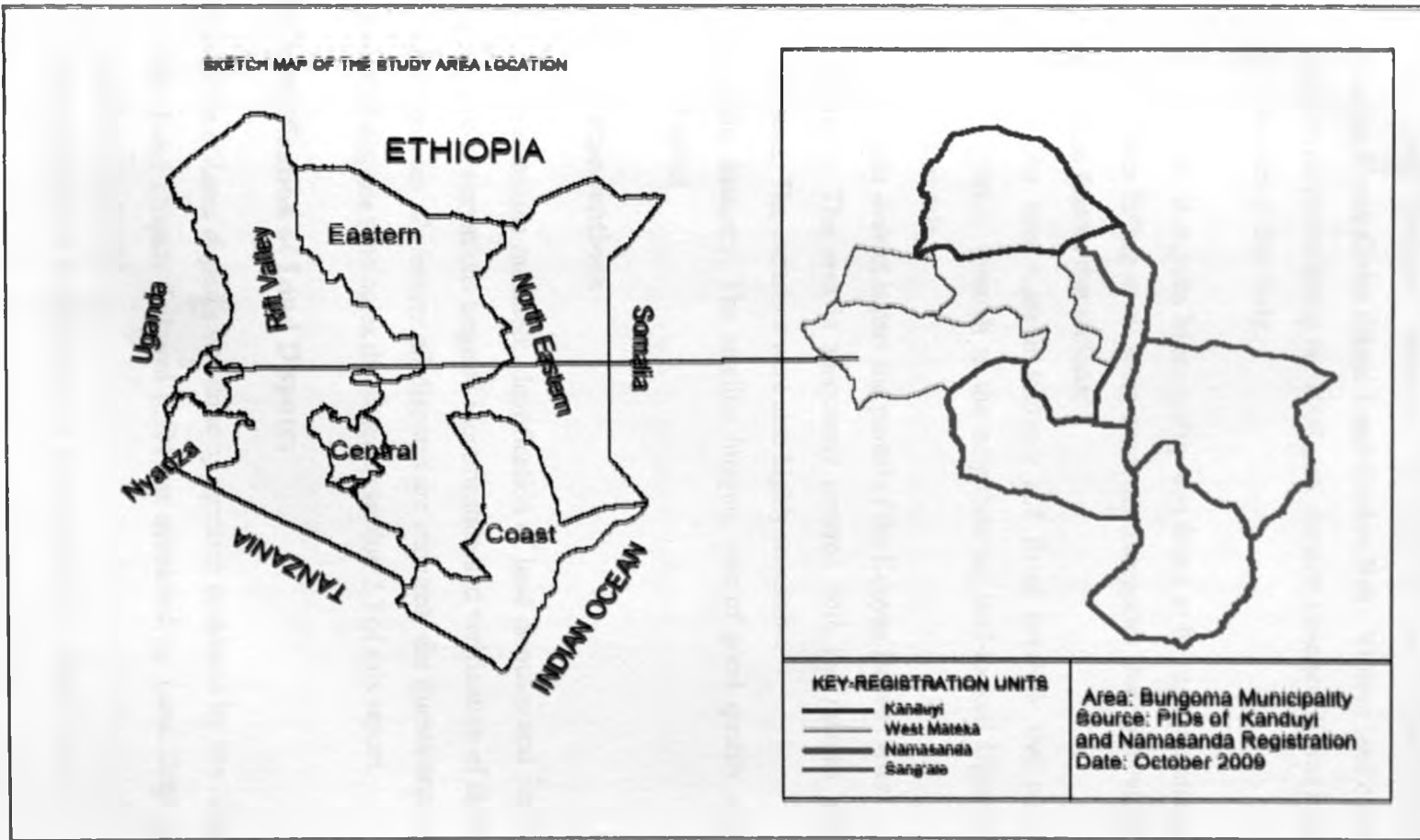


Figure 3-1; Study Area Location Sketch Map

- b. Land Dispute tribunals: The area was found to have two district land dispute tribunals operating independently. These tribunals provided sufficient diverse land disputes to be sampled from.
- c. Past Land Disputes: Bungoma Municipality lies within Kakamega-Kisumu-Kericho-Uasin-Gishu Ethnic Land Clashes Belt. Violent land clashes recur quite often most recent being the 2008 post election violence. It was important that the area be part of the study.
- d. Population: Bungoma Municipality was found to be highly cosmopolitan with the inhabitants falling in all socio-economic categories due to inevitable historic and economic factors that include;
 - a. The vast Kenyan Railway and Road network that converge into the districts through to the neighbouring land-locked Uganda, Burundi and Rwanda
 - b. The district is part and parcel of the Kenyan Bread Basket
- e. Cadastres: The area is adequately covered with the manual map and register cadastres. The cadastres were also highly accessible
- f. Satellite Imagery: The satellite imagery was of good quality and had the least cloud cover

3.2 Field Observations

The field observations included; identification of land disputes and verification of land disputes. Field observations targeted identification and verification of disputes known by resolution agencies. To ensure all disputes are captured, the questionnaire was designed to include all dispute typologies discussed in section 2.3 of this report.

3.2.1 Identification of Land Disputes

Identification of Land disputes was done by agencies mandated by law .They included;

- g. The Land Dispute Tribunal (LDT) as mandated by Land Dispute Tribunal Act number 18 of 1990
- h. The Provincial Administration as mandated by the Chief's Act.

- i. The Magistrate's Courts as mandated by the Civil Procedure Act (chapter 21)
- j. The Land Registrar as mandated by The Registered Land Act section 21(4).

Structured questionnaires (see appendix 1), aerial photographs and PIDs were used to collect dispute information from the LDT and Provincial Administration. Structured interviews give rise to very short and simple sequences; correctly worded question, admissible answer, acknowledgement of precept of that answer (Maynard & Schaeffer 2002).

Structured queries were used to extract a brief but detailed description of individual land disputes. These structured interviews were recorded on tape without the knowledge of the interviewee. After extraction of verbal description of individual disputes, aerial photographs and PIDs were used to physically pin point the affected parcels.

Four *LDT* were visited. They included the; West Mateka *LDT*, Kanduyi *LDT*, Sang'alo *LDT* and the Namasanda *LDT*. These tribunals had neither a designate office nor a functional registry. All were *LDTs* operated in the Office of the respective District Officer. Records of land disputes were found to be kept on triplicate loose pad. All copies of these records were left with the secretary of the tribunal for safe keeping. The secretary kept such records at his or her residence.

The second source of land disputes in the study area was the Provincial Administration. All the village elders in the study area were mobilised through their District Commissioners. The village elders were interviewed in groups. Most village elders had committed land disputes to memory and had no official records of the disputes. As a result, official descriptions of plots like parcel numbers could not be availed. Disputes were thus recorded and identified by the disputants.

The third source of land disputes was the District Magistrates Court. There is only one District Magistrates' court in the study area; the Bungoma Districts Magistrate Court. Land dispute records were found filed alongside other cases in the main registry. This plus the fact that the district magistrate served more than three administrative divisions

made the retrieval of the land disputes' records quite time consuming. Particulars in individual disputes files were used to identify parcels on the PID. After Identification on the PID, parcels were eventually identified on the aerial photo.



Figure 3-2; The Bungoma District Courts Registry

In the district land office, land disputes were identified through interviewing of the officials in the district land offices and the review of the land disputes' register. The land disputes' register detailed among other things the disputants and the parcel numbers. The parcel numbers were consequently used to identify the parcel on the PID. Once identified on the PID, parcels were in turn identified on the aerial photo.

3.2.2 Verification of Land Disputes

For each dispute identified, office and field verification of the dispute had to be done. Dispute verification involved confirming of the following for each dispute enlisted:

- i. Availability of dispute records,
- iii. Availability of cadastral information,
- iv. Positive Identification of disputants and
- v. Confirmation of the existence of the physical parcel Identification

Office verification preceded field verification. Office dispute verification involved review of available dispute records. Items considered as dispute records included dispute proceedings, letters of reference by an administrator to a dispute resolution agency and or statement by one of the disputants to a dispute resolution agency. For each dispute confirmed to have dispute records, a confirmation as to if its cadastral details were

available was made. Cadastral details sort for included; registration details if parcel registered, boundary information, transfer documents and land rights held.

Field verification of land disputes was conducted through field visits. Each dispute successfully verified to have adequate dispute information and cadastral records was tracked. Disputants were tracked using their family names and physical addresses. This was done with the assistance of the village elders and the aerial photographs. Tracking of the disputants was time consuming. Not all disputes recorded by the study were successfully tracked. Falsification of information and unwillingness to cooperate were the major challenges during verification of land disputes. The level of cooperation by disputants varied depending on the stage of dispute resolution. Resolved disputes had a higher level of disputant cooperation as compared to ongoing. Little information was given on ongoing disputes for fear of letting out crucial evidence to an opposing disputant.

3.2.3 Acquisition of Cadastral data

For each dispute verified, cadastral data had to be acquired from the Ministry of Lands and Settlement. Cadastral data acquired included; the PIDs and copies of land register (figure 3-3). In cases where the plot did not appear on the PID copies of mutation forms were acquired. If for any reason the parcel's register was not available, transfer papers had to be acquired.

Acquisition of cadastral data was quite costly. The disputes verified were found to be covered by 6 PIDs. Each PID cost Kshs. 400. 17 parcels were found not to have been updated on the PIDs. A copy of mutation forms had to be acquired for the respective parcels at a cost of Kshs. 350. 19 land registers were found missing from the registry. Respective transfer forms were acquired at a cost of Kshs.350. 55 land registers were acquired at a cost of Kshs. 250.

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PART A - PROPRIETY SECTION			
DATE: 21-4-67	SUBJECTS ETC		CHARACTER OF TITLE
S/WANDA/OKORO	Musha Ekombe		ABSOLUTE
472	L 2-16-4444 4-0-1-23 (4-1-67)		
2-1-74	7/11/67		
PART B - PROPRIORSHIP SECTION			
DATE	NAME OF REGISTERED PROPRIETOR	REMARKS AND DESCRIPTION	REMARKS AND REMARKS
1-31-67	OKOMBE OKORO	BY/RO/WANDA	ISSUED 300
2-11-67		RESTRICTION NO DEALING UNTIL THE MATTER OF COMPULSORY REQUISITION IS SORTED OUT BY THE CHIEF VALUERS	
3-7-67	MUSA OKOMBE	AMISI NAMUKUNDA	7-6 MIN OF ESTATE EXAMINATION
4-9-10-67	MUSA NAMUKUNDA OKOMBE		SUCCESSION
5-13-67		TITLE DEED	ISSUED A SURE
6-27-68		TITLE DEED	RE-ISSUED
7-5-6-96		TITLE DEED	RE-ISSUED
8-27-3-97		TITLE CLOSED	RE-ISSUED

Figure 3-3; A copy of the land register

4. Geographical Modelling and Cadastral Classification of Land Disputes

4.1 Introduction

The overall research objective is to develop a cadastral classification of land disputes by use of geographical data modelling. Geographical data modelling takes place through three stages of abstraction in a three level architecture. The levels of abstraction consist of an external, a conceptual and internal level. According to Collony and Begg (2005), the way users perceive the data is called an external level. The way the Data Management System and the operating system perceive the data is called the internal level. The conceptual level provides both the mapping and the described independence between the external and the internal levels. The key objective of the three-level architecture is to separate each user's view of the database from the way the database is physically presented.

The external level presents the users view of the database. The level describes that part of the database that is relevant to each user. The external level consists of a number of different external views of the database. Each user has a view of the 'real world' represented in a form that is familiar to the user. The external view includes entities, attributes and relationships of entities in the 'real word' that the user is interested in.

The conceptual model represents the communal view of the database. This level describes what data is stored in the database and the relationships among the data. The conceptual model is a complete view of the data requirement that is independent of any storage considerations. It represents the entities, their attribute, their relationship and the constraints.

The internal level is the physical representation of the database on the computer. This level describes how the data is stored in the database. The internal level covers the physical implementation of the database to achieve optimal routine performance and storage and space utilisation.

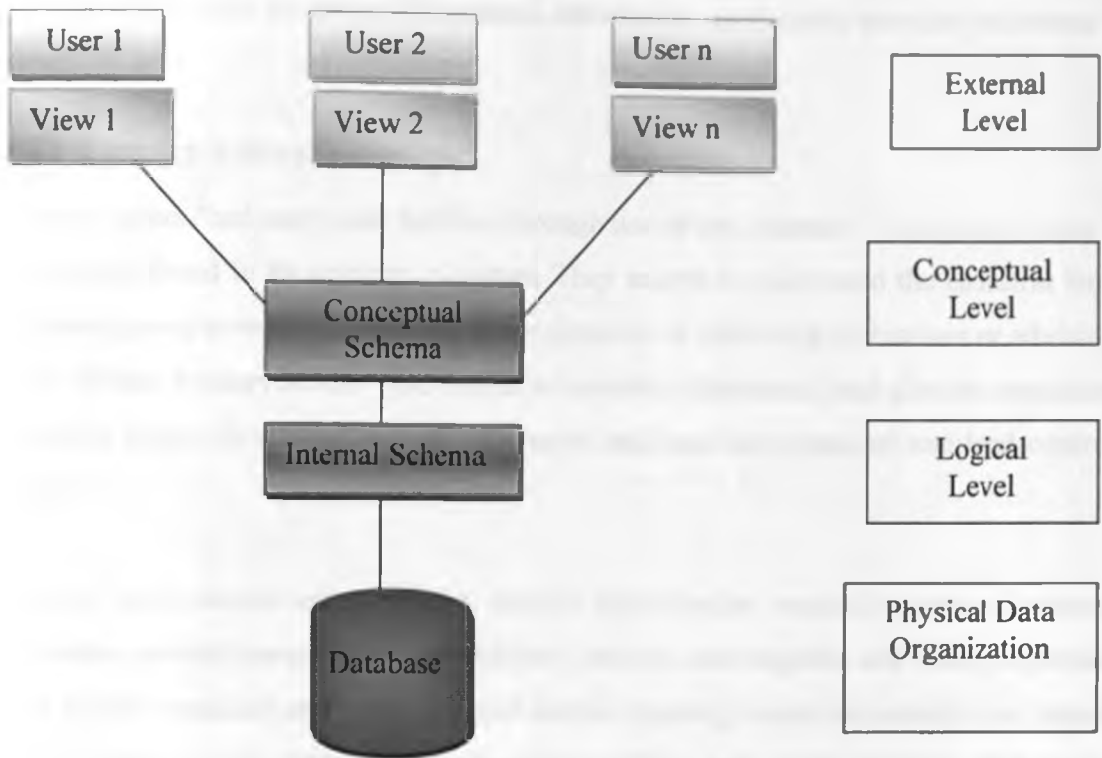


Figure 4-1; Three level architecture of geographical data modelling.

Source; (Collony and Begg, 2005)

4.2 External Level-User Needs Requirements

The objective of this level was twofold; to identify categories of users of the cadastral land dispute classification model and examine their 'cadastral land dispute classification model' requirements. To achieve these two objectives, users and their model requirements were identified using a questionnaire (Appendix B). 70 potential users of the cadastral land dispute classification model were interviewed, 10 people were randomly picked from each presumed group of users i.e. banks (10), the general public (10), land dispute resolution agencies (10), land control board (10), legal officers (10) and disputants (10) and prospective land buyers.

From the interviews, the presumed groups were refined into two categories of users and hence user views. The categories identified were; the primary actors and the offstage actors. Primary actors 'had user goals fulfilled through use of the database' whereas

offstage actors 'had an interest for general information on disputes but were not primary actor'

4.2.1 Primary Actors' View

Primary actors 'had user goals fulfilled through use of the database'. The primary user's goals were found to be advisory in nature. They sought to understand the cadastral land dispute typologies output by the model for purposes of informing themselves or advising their clients. Primary actors were found to include; disputants, land dispute resolution agencies, legal officers, land agents (surveyors and land sales persons) and land control boards.

Primary users viewed cadastral land dispute classification model in terms of; parcel, proprietor, encumbrance, land rights delivery process, land register, and RIM properties. That is, they required each cadastral land dispute typology output by model to be linked and be explicit with respect to; land registry (RIM and land register), land rights delivery process, encumbrances, proprietor, registered parcel and dispute evidence (figure 4-2).

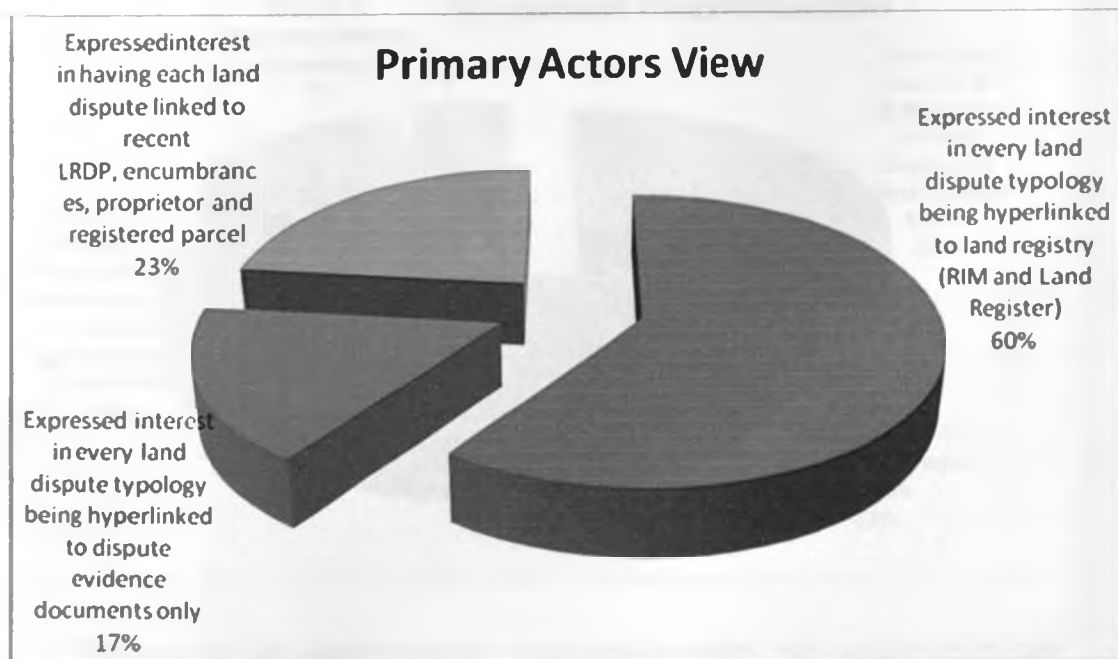


Figure 4-2; Primary Actors View

These results reaffirmed the need to develop a cadastral land dispute classification model that interfaces with the registry and continually and automatically updates the land register and RIM. Also affirmed is the need for a land dispute database that is a repository of authentic cadastral details and dispute evidence documents.

4.2.2 Offstage Actors' View

Offstage actor 'had an interest for general information on disputes but was not primary actor'. Offstage actors were identified to include the general public and prospective land buyers. Offstage users viewed cadastral land dispute classification model in terms of land dispute information and disputant information. That is they required the cadastral land dispute classification model to be explicit with respect to;

- Disputant Identification – offstage users were interested in a cadastral land dispute classification model that has the ability to publish and distribute disputant details and disputant proprietor status for each dispute classified. A review of the offstage disputant identification requirement re-affirmed the need to make disputant information widely available (figure 4-3)

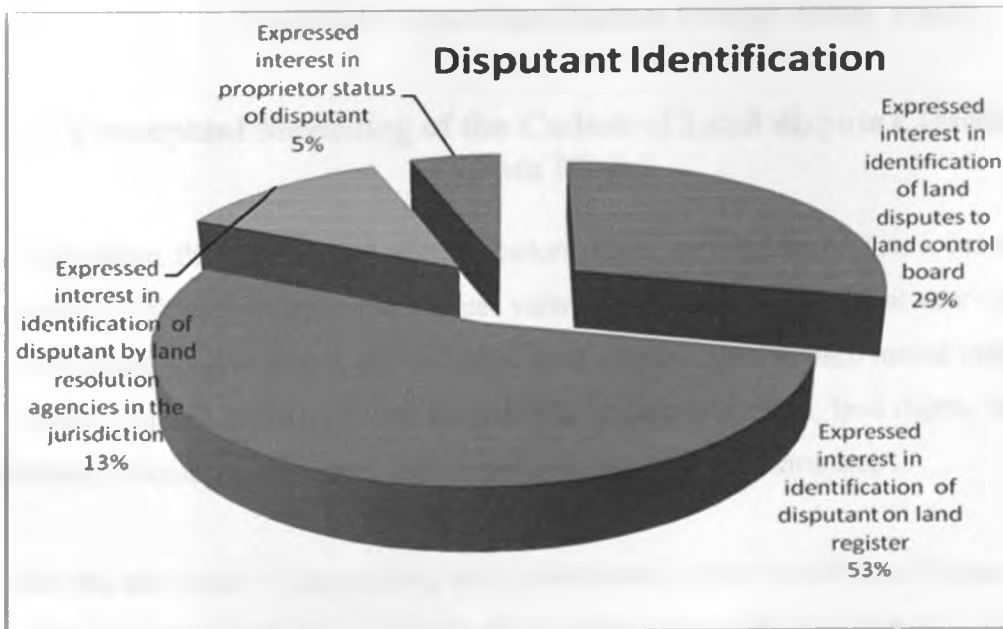


Figure 4-3; Cadastral land dispute classification model user needs on disputant identification

- Dispute location and distribution- Users were interested in a cadastral land dispute classification model that would publish location and distribution of disputed parcels. Analysis of dispute identification results revealed offstage were more concerned on identification of land disputes' location and distribution but were not interested in cadastral classes of land disputes as much (figure 4-4).

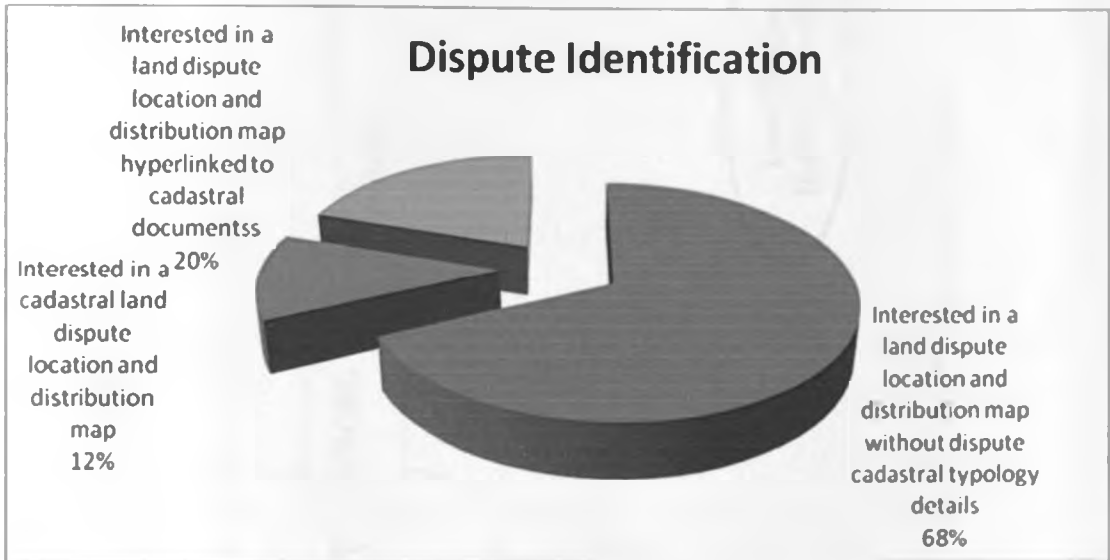


Figure 4-4; Dispute Identification- Offstage Actors' Views

4.3 Conceptual Modelling of the Cadastral Land dispute Classification Data Model

At this stage, the primary and offstage actors views were collapsed into a cadastral land dispute classification model 'communal view'. That is, the two different user views were consolidated to give fourth the cadastral land dispute classification model entities. The entities included; Registry Index Map (RIM), parcel, proprietor, land rights, land rights delivery process, land register, land dispute claims, and encumbrances.

After the derivation of the entities, entity relationships were established (figure 4-5) and cardinality constraints defined. Cardinality Constraints are the rules that try to capture the meaning of the data in system. A cardinality constraint defines the relation and specifies

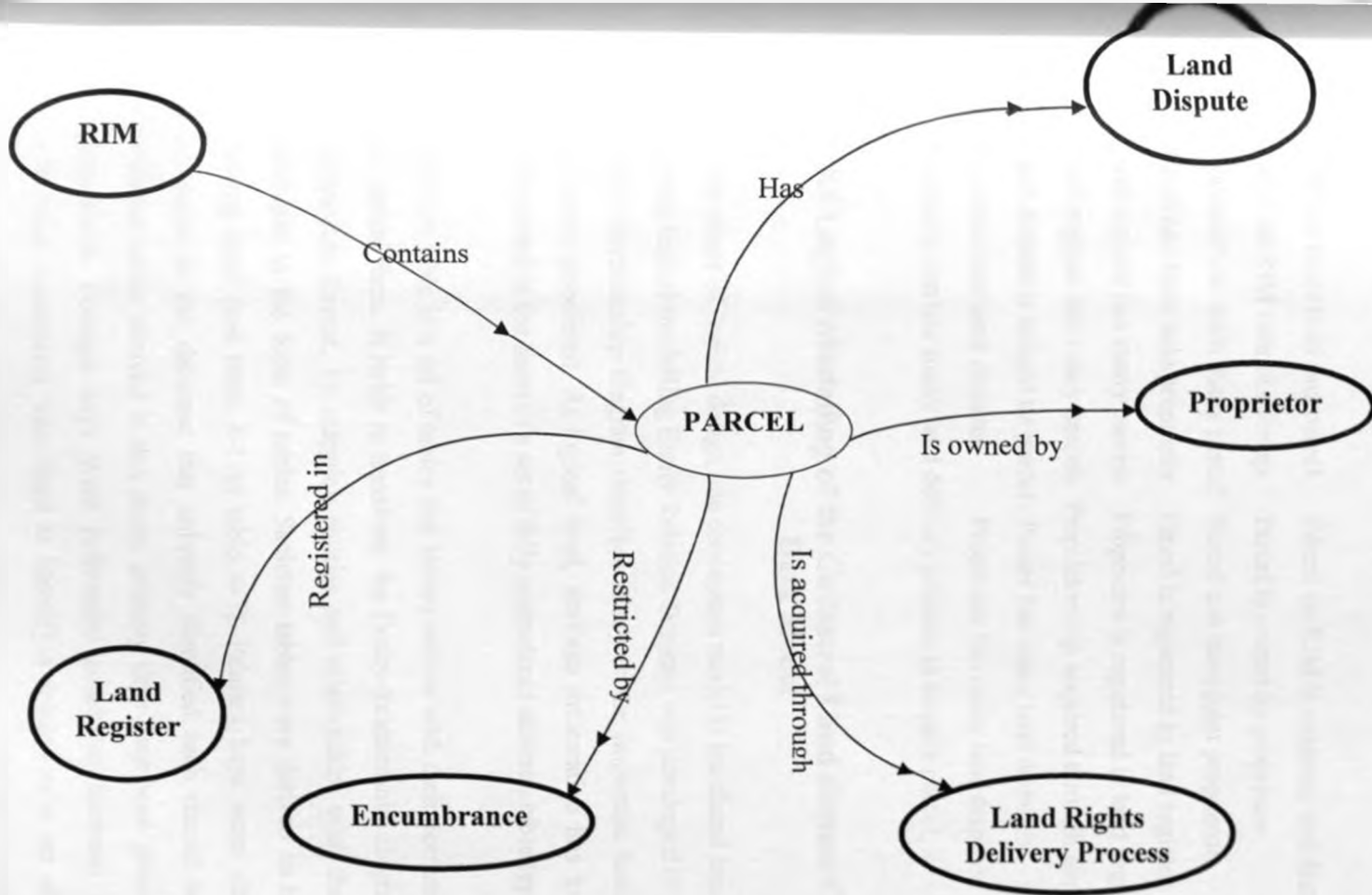


Figure 4-5 ; Land Dispute Conceptual Schema

the number of relationships in which an entry can appear or participate (Assefa, 1994). Cardinality constraints of the conceptual modelling are elaborated as follows;

RIM has more than one parcel	Parcel on RIM is uniquely and distinctly identified
Parcel on RIM cannot overlap	Parcel is owned by proprietor
Proprietor can own many parcel	Parcel can have joint proprietor
Parcel can have sole proprietor	Parcel is registered in land register
Land register has many parcels	Proprietor is registered in land register
Land register has many parcels	Proprietorship acquired through land delivery process
Land dispute is lodged on parcel	Parcel has many land disputes
Proprietor has land disputes	Proprietor has many land disputes
Proprietor can use many land delivery process to acquire parcel	

4.4 Logical Modelling of the Cadastral Land dispute Classification Data Model

In the phase of logical design, the conceptual model is translated into a logical model. During logical modelling Entity Relation Diagram was developed (Figure 4-6). The Entity-Relationship diagram describes many of the important features showing the attributes associated. At logical level, attribute information has to be conveniently represented in the form of a set of fully normalized skeleton table types.

Skeleton table is a set of tables that shows entities with their corresponding attributes in normal form. It helps to transform the Entity-Relationship diagram into computer compatible format, by mapping entities and relationships with their corresponding attributes in the form of tables. Skeleton tables were derived to have primary and foreign keys (see table 4-1 to table 4-7). Primary keys were attributes or set of attributes in the database that uniquely identified each record in a table. In the skeleton tables derived in this study, primary keys have been presented in bold and underlined. Foreign keys were referential constraint between two tables. The referential constraints were used to identify a column or a set of columns in one (referencing) table that referred to a column or set of columns in another (referenced) table. In the skeleton tables derived in this study, foreign keys have been presented in bold and italicised.

(a) RIM- a Registry Index Map is created by section 18(1) of the Registered Land Act (RLA) and its production is vested in the Director of Surveys. The Director of Surveys maintains a series of RIM for every REGISTRATION UNIT (REG_UNIT). Individual RIMs are identified from the respective series using a SHEET NUMBER (SHEET_NO) and is referenced to the adjoining RIM sheets by an INDEX NUMBER (INDEX_NO). Any revisions to the RIM are kept track off in the REVISION INDEX (REV_INDEX).

Table 4-1; RIM table

RIM	REG_UNIT	<u>SHEET_NO</u>	INDEX_NO	REV_INDEX

(b) LAND REGISTER- under RLA, a land register comprises in respect of each PARCEL (PARCELREG-NO) of land contained in the RIM (SHEET-NO) in each Registration Section. The register is kept in form of a ledger and therefore sheets can be easily taken out and returned. Each sheet has a REF-NO as its unique identifier. Dates when the register was opened (DATE_OPEN) and closed (DATE_CLOSE) are usually specified.

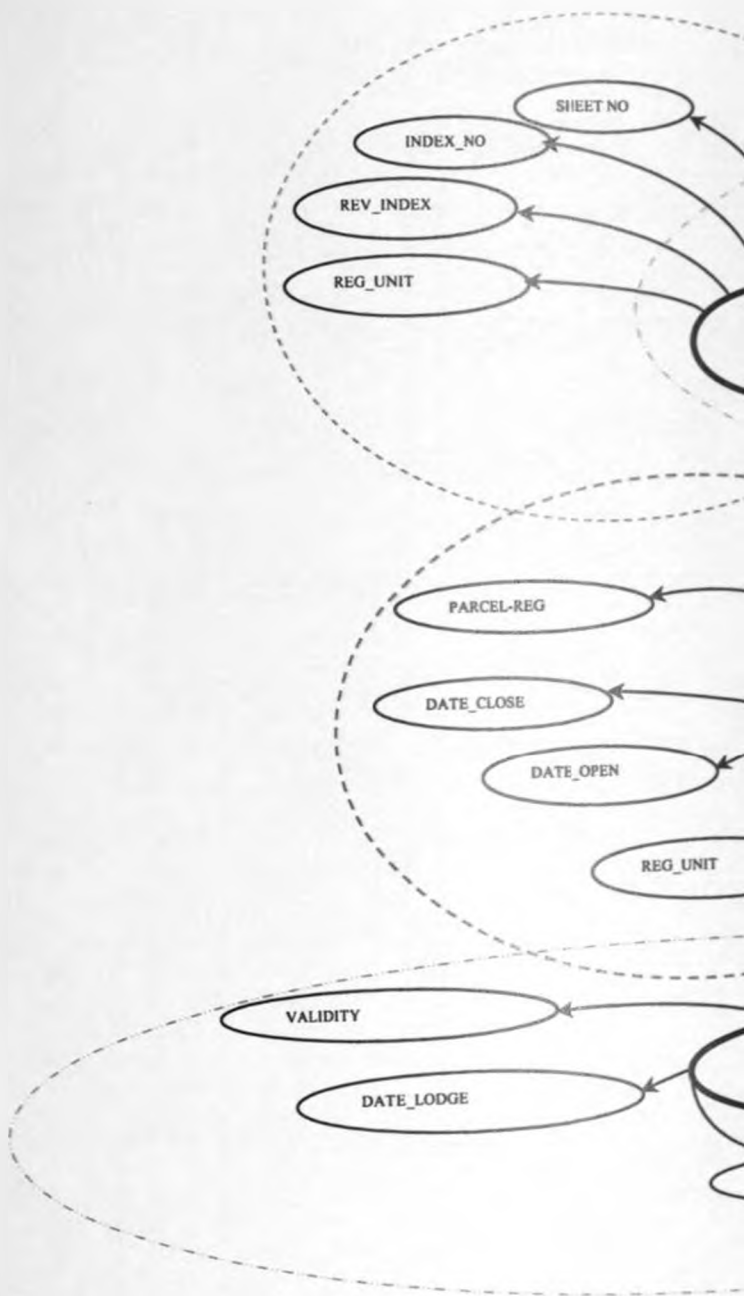
Table 4-2; Land Register table

LAND REGISTER	<u>REF_NO</u>	DATE_OPEN	DATE_CLOSE	REG_UNIT	<i>SHEET-NO</i>	PARCEL_REG

(c) PARCEL- is a registered spatial unit of ownership with a unique specific AREA (AREA). Parcel is uniquely identified by a REGISTRATION NUMBER (REG_NO) on the land register; a (SHEET_NO) uniquely identifies which RIM a parcel is registered on.

Table 4-3; Parcel table

PARCEL	<u>REG_NO</u>	AREA	<i>SHEET_NO</i>



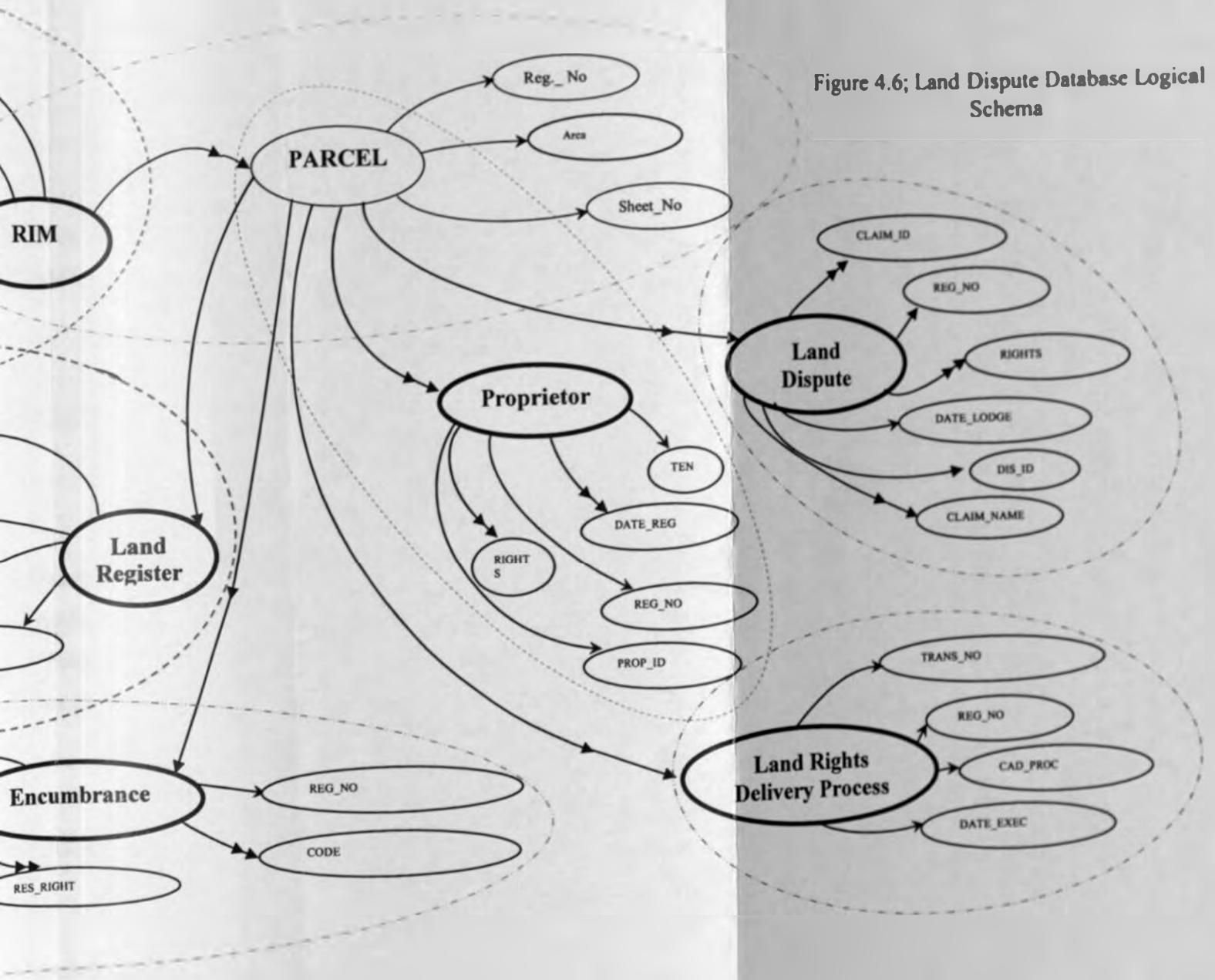


Figure 4.6; Land Dispute Database Logical Schema

(d) PROPRIETOR- is a registered owner of PARCEL (REG_NO) and is uniquely identified by PROPRIETOR IDENTIFICATION NUMBER [PROP_ID]. A proprietor has a bundle of LAND RIGHTS (RIGHTS) in a specific TENURE (TEN) acquired on a DATE OF REGISTRATION (DATE_REG).

Table 4-4; Proprietor table

PROPRIETOR	<u>PROP_ID</u>	DATE_REG	RIGHTS	TEN	REG_NO

(e) LAND DISPUTE- is a conflicting claim laid on LAND RIGHTS (RIGHTS) of or/and over a PARCEL (REG_NO) Land disputes are uniquely identified by DISPUTE LODGEMENT ID (DIS_ID) by a CLAIMANT (CLAIM_ID) and NAME (CLAIM-NAME) on a specific DATE OF LODGEMENT (DATE_LODGE)

Table 4-5; Land Dispute Table

LAND DISPUTE	<u>DIS_ID</u>	DATE_LODGE	RIGHTS	REG_NO	CLAIM_ID	CLAIM_NAME

(f) ENCUMBRANCE is any right or interest that exists in someone other than the owner of an estate and that RESTRICT RIGHTS (RES_RIGHTS) of proprietor on a specific PARCEL (REG_NO). Encumbrance is uniquely identified by CODE (CODE), have LODGEMENT DATE (DATE_LODGE) and LEGAL DURATION within which they are valid (VALIDITY).

Table 4-6; Encumbrance table

ENCUMBRANCE	<u>CODE</u>	DATE_LODGE	VALIDITY	REG_NO	RES_RIGHT

(g) LAND RIGHTS DELIVERY PROCESS uniquely identified by transaction number (TRANS_NO) is a link of CADASTRAL PROCESSES (CAD_PROC) that ensures the transfer of land rights of a PARCEL (REG_NO). Land rights delivery processes are of different types and have particular DATE of EXECUTION (DATE-EXEC).

Table 4-7; Land rights delivery process table

[LAND_RIGHTS DELIVERY PROCESS	<u>TRANS_NO</u>	DATE_EXEC	CAD- PROC	<i>REG_NO</i>

4.5 Physical Modelling of the Cadastral Land dispute Classification Data Model

The physical Model focussed on the implementation of the designed logical land dispute classification data model. Physical modelling achieved generation of the physical land dispute database and development of cadastral classification of land dispute prototype.

At this stage, software in which to implement the logical data model was taken into account. The logical data model was implemented in ArcGIS geodatabase. Geodatabase is a common data storage and management framework for ArcGIS. It combines “geo” (spatial data) with “database” (data repository) to create a central data repository for spatial data storage and management.

Two types of geodatabases exist; personal and file geodatabase. Personal geodatabases is a Microsoft Access database with a set of tables defined by ESRI for holding geodatabase metadata and with geometry of features (essentially shapefile geometry fragment). A file geodatabase is a collection of various types of GIS database held in file system folder. Each dataset is a separate file on disk. The datasets are the typical GIS data models.

4.5.1 Generation of the physical land dispute database

Generation of the physical database involved extraction of entities from the real world, definition of how entities get stored in the database and population of the geodatabases.

Cartographic modelling techniques namely; digitisation and mapping were used to extract spatial and non spatial entities and their attributes from the real world to enable the population of geodatabases (see figure 4-7 below).

Land Dispute claims and parcels were extracted by *mapping* identified and verified land disputes. A GPS receiver loaded with Farm Works Software was used in mapping the identified and verified land disputes. The Farm Works Software was used alongside a PDA running Pocket PC operating system. The HP iPAQ was the Pocket PC chosen for use in this study for field record-keeping and mapping.

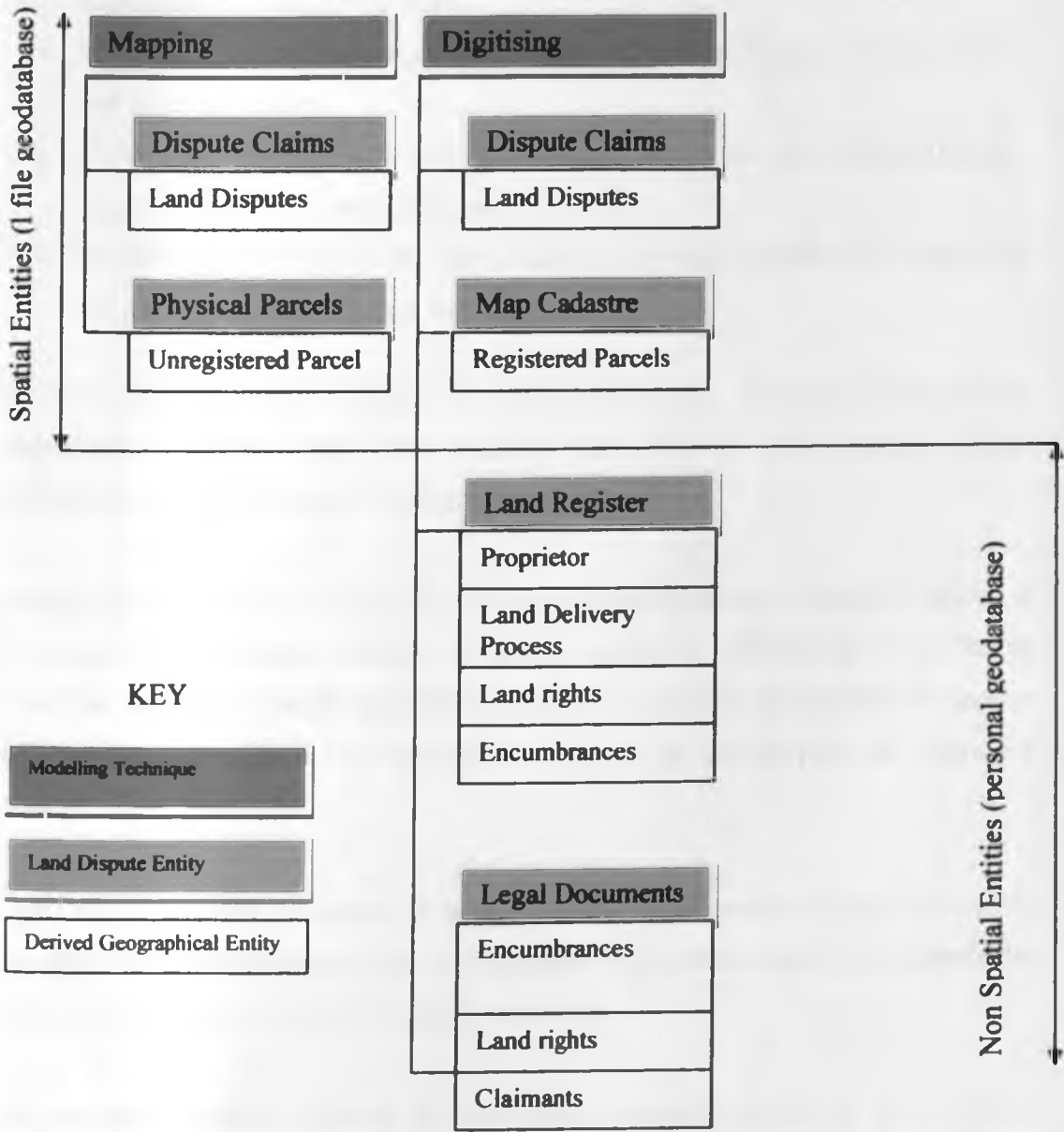


Figure 4-7; Results of Cartographical Modelling of Land Dispute Entities

Farm Works Software was chosen on because it had the following features and capabilities:

- Mapping tools for drawing parcels, structures and landmarks.
- Unlimited mapping and layering capabilities. This allowed loading of the vector and raster PIDs to act as background map.
- It allowed use of Google Maps for drawing field boundaries and displaying of the same maps as background maps.
- Was able to Calculate acreage automatically allowing validation of field records and disputant claims.
- It's simple to use "Transparency Tool" made it easy to see how PID and Google map layers related to each other and
- Its buffering tool allowed the identification of overlapping rights and mapping of the same even when hostility was exhibited.

The HP iPAQ was chosen on because it offered; bright screen, good power management, compatibility with the major GPS receiver cards, 384MB total memory, 320MB ROM, 64MB SDRAM and up to 256MB persistent storage.

Mapping of these entities by the GPS receiver involved picking of; physical features at the centre of the dispute, portions of parcels subject to affirmation of conflicting ownership, land rights and the land delivery process. Land disputes and Parcels mapped were downloaded, exported into shape files and loaded onto a GIS platform (figure 4-8 below).

Digitization was adopted to extract both spatial and no spatial entities. Registered parcels were the only spatial entities derived by digitisation. Registered parcels were digitised by scanning and screen digitising PIDs of the study area.

The non spatial entities extracted by *digitisation* included; proprietor, land delivery process, land rights, and some land dispute claims. Proprietor, land delivery process and land rights were extracted from digitising the analogue land registers. Land Dispute

Claimants and some land rights were extracted from legal documents acquired during land dispute identification and verification.

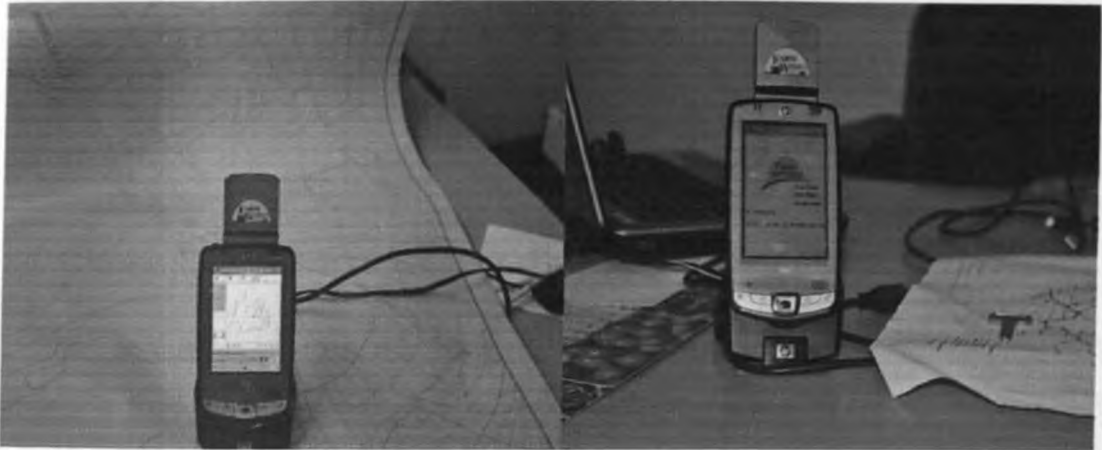


Figure 4-8; HP iPAQ Loaded with Farm Works Software and GPS Receiver

After extraction of entities from the real world, spatial entities were loaded into the file geodatabase in ArcGIS. Non spatial entities were loaded into personal geodatabase designed in Microsoft Access. Different data formats adopted while loading extracted entities' tables into the file and personal geodatabase are as follows;

RIM- [REG_UNIT (string) **SHEET_NO** (string) INDEX_NO (string) REV_INDEX (string)]

LAND REGISTER- [**REF_NO.** (string), DATE_OPEN (Date), DATE_CLOSE (Date), REG_UNIT (character), **SHEET-NO** (string), PARCEL_REG (string)]

PARCEL - [**REG_NO.** (string), AREA (float), **SHEET_NO** (string)]

PROPRIETOR- [**PROP_ID.** (string), DATE_REG (Date), RIGHTS (character) TEN(character)]
REG-NO(string),]

LAND DISPUTE- [DIS_ID, (string), DATE_LODGE (Date), RIGHTS (character), *REG_NO*(string), *CLAIM_ID*(string), *CLAIM_NAME* (character)]

ENCUMBRANCE- [CODE (character), DATE_LODGE (Date), VALIDITY (float) *REG_NO* (string), RES_RIGHT (character)]

LAND RIGHTS DELIVERY PROCESS- [TRANS_NO(string), DATE_EXEC (Date), CAD-PROC (character) *REG_NO* (string)]

4.5.2 Development of a Cadastral Land Dispute Classification Prototype

This stage aimed at demonstrating the cadastral land dispute classification model features through a prototype. A prototype is 'a working model of a system which may emphasize some specific aspects of it' (Reeve et al 1999:119). The prototype built here is a working model of the study design feature in the previous chapter and is geared towards meeting the study objective that is; 'cadastral classification of land disputes'. Figure 4-9 below shows the architecture of the prototype.

The prototype is subjected to three tasks to demonstrate the following functionalities;

- Validation of land disputes in the database
- Cadastral classification of land disputes
- Distribution of cadastral land disputes in the study area

Validation of land disputes involved linking non spatial cadastral properties archived in Microsoft Access (including land delivery processes, encumbrances, land rights, proprietor details and dispute information) to a physical parcel on the PID and the mapped disputes. This was achieved through linking of the personal and file geodatabase by Object Linking and Embedding (OLE). OLE is the specifications for object technology developed and used by Microsoft in all its operating systems, development tools and application software packages. Based on the underlying COM (Component Object Model), OLE is the foundation for component software. It makes easy to create compound documents consisting of multiple sources of information from different applications.

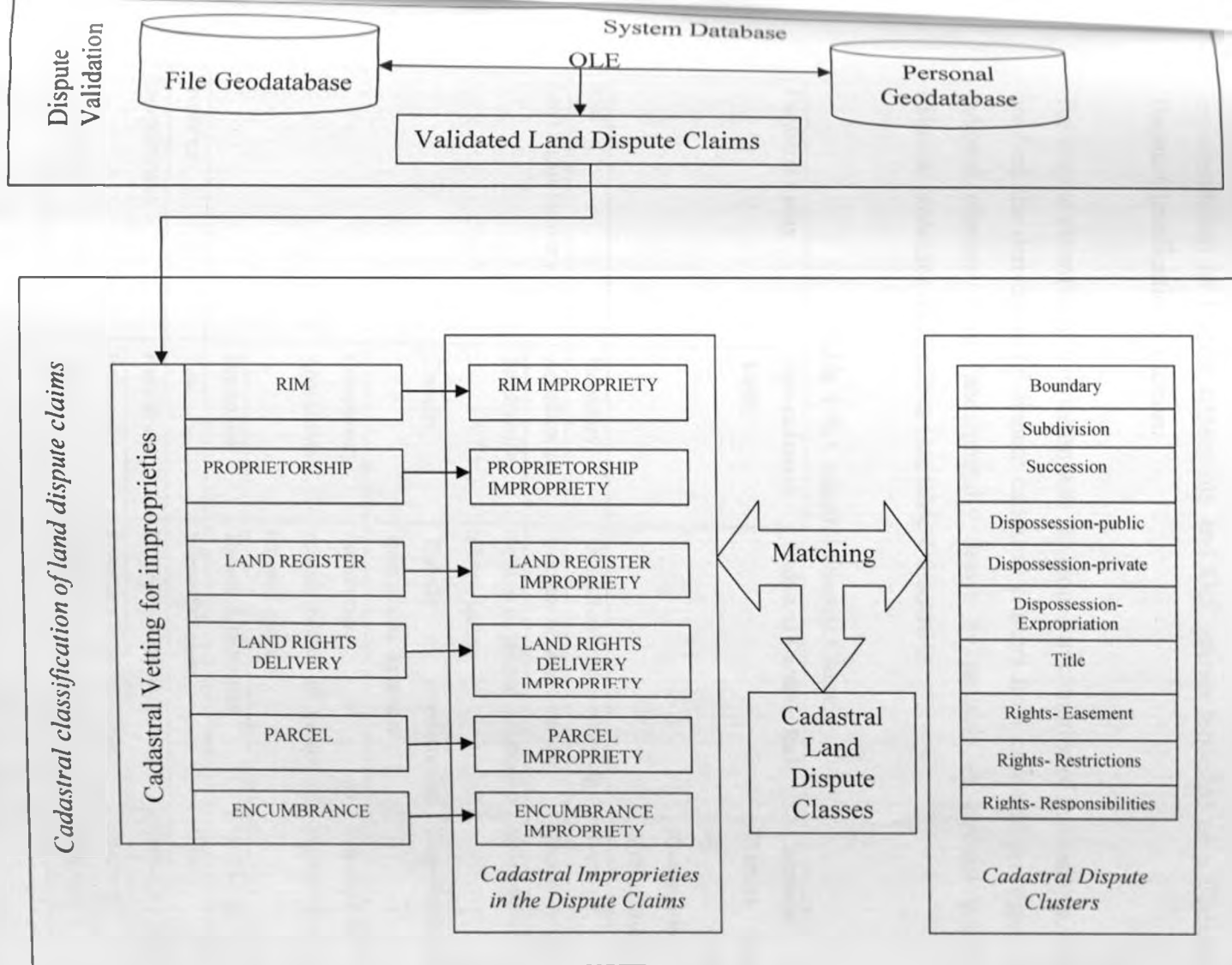


Figure 4-9; Cadastral Land Dispute Classification Prototype Architecture

Validated land dispute claims were subjected to a cadastral classification process. Cadastral classification was constituted by spatial and non spatial optimised GIS querying of the relational spatial database. The optimised GIS queries were an implementation of logical constraints and GIS queries modelled on a Cadastral Land Dispute Classification Criterion.

The dispute classification criterion was developed to comprise of three stages. First stage involved the derivation of dispute cadastral clusters from cadastral processes. Dispute cadastral clusters were fundamentally drawn by analysis of cardinal principals of cadastral processes and entities (see table 4-8 below).

Table 4-8; Cadastral Dispute Clusters

Cadastral Entity	Sub-cadastral Entity	Cadastral Cardinal Rule	Cadastral Disputes Clusters constituted by Omission /Commission of cardinal rules
RIM	Boundary	Distinct and not overlapping	Boundary
Land Rights Delivery	Adjudication	Doctrine of public interest	Dispossession- Public
	Subdivision	Split of parcel and registration of new splits	Subdivision
	Transfer	Transfer of proprietorship from private to private	Dispossession- Private
	Compulsory Acquisition	Satisfaction of all responsibilities of power of eminent domain	Dispossession- Expropriation
	Succession	Deceased proprietor	Succession
Proprietor	Title	Mirror Principle	Title
Encumbrances	Restrictions	Proprietor Liabilities	Restrictive Rights
	Easement	Proprietor Responsibilities	Easement
Land register	Cadastre	Statutory Completeness	Cadastral

Second is the derivation of cadastral improprieties from the dispute claim. Derivation of cadastral improprieties was drawn from validated claimant dispute claims. This criterion

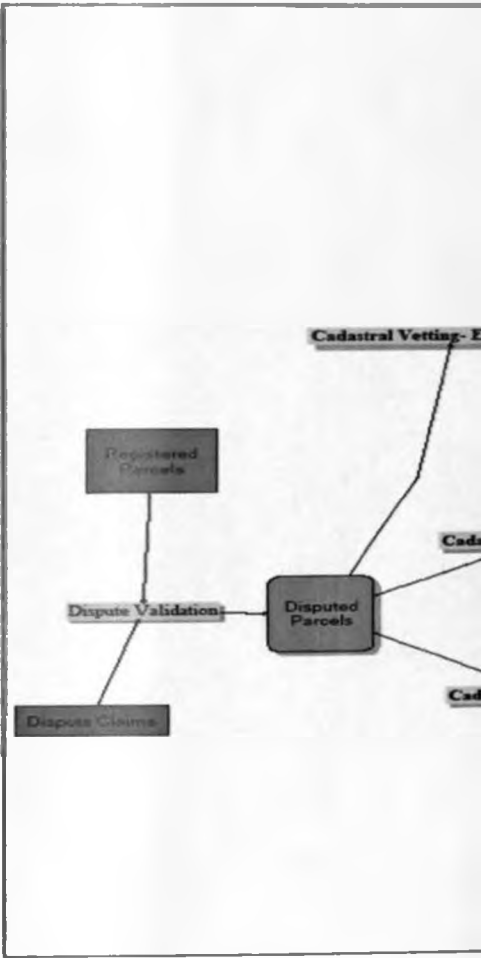
proposes vetting of land dispute claims for violation of selected key cadastral principles and processes within the land register, proprietorship and parcel, land registration process (title), land rights delivery process and land rights execution.

Land Dispute claims successfully vetted for one cadastral principle progressed for vetting at the next stage. On the other hand, any impropriety discovered was automatically coded and posted as a cadastral impropriety. The last process in land dispute classification criterion proposed by this study is the matching of cadastral dispute clusters to the cadastral improprieties to produce a cadastral land dispute typology. Through automated matching, the code is posted as a distinct dispute typology through automated matching with predefined cadastral clusters.

The prototype architecture was implemented in ArcGIS using the ArcGIS Model Builder. Figure 4-10 below illustrates a section of Land Dispute Classification Model flow chart. As illustrated in figure 4-9 above, in the ArcGIS Model Builder, multiple Geo-processes and GIS queries are strung together in a process flow chart to constitute an executable Land Dispute Classification Model (LDCM). At every run of the LDCM, model validation must take place. By validating the entire model, verification of the validity of all data elements and parameter take place. Validating returns 'has-been-run processes' to their 'ready-to-run state'. Validation of entire model fails most commonly if; the input dataset no longer exists or was renamed, or a field was deleted.

After model validation of the LDCM, the model can be run at any stage by ordering;

- Running of all processes regardless of their state of validation or
- Running of processes that are in the ready-to-run state or
- Running of a selected process. Earlier processes in the chain will also run if needed. Later processes in the chain of processes will not run; however, if they were in the has-been-run state, their state will change back to ready-to-run.



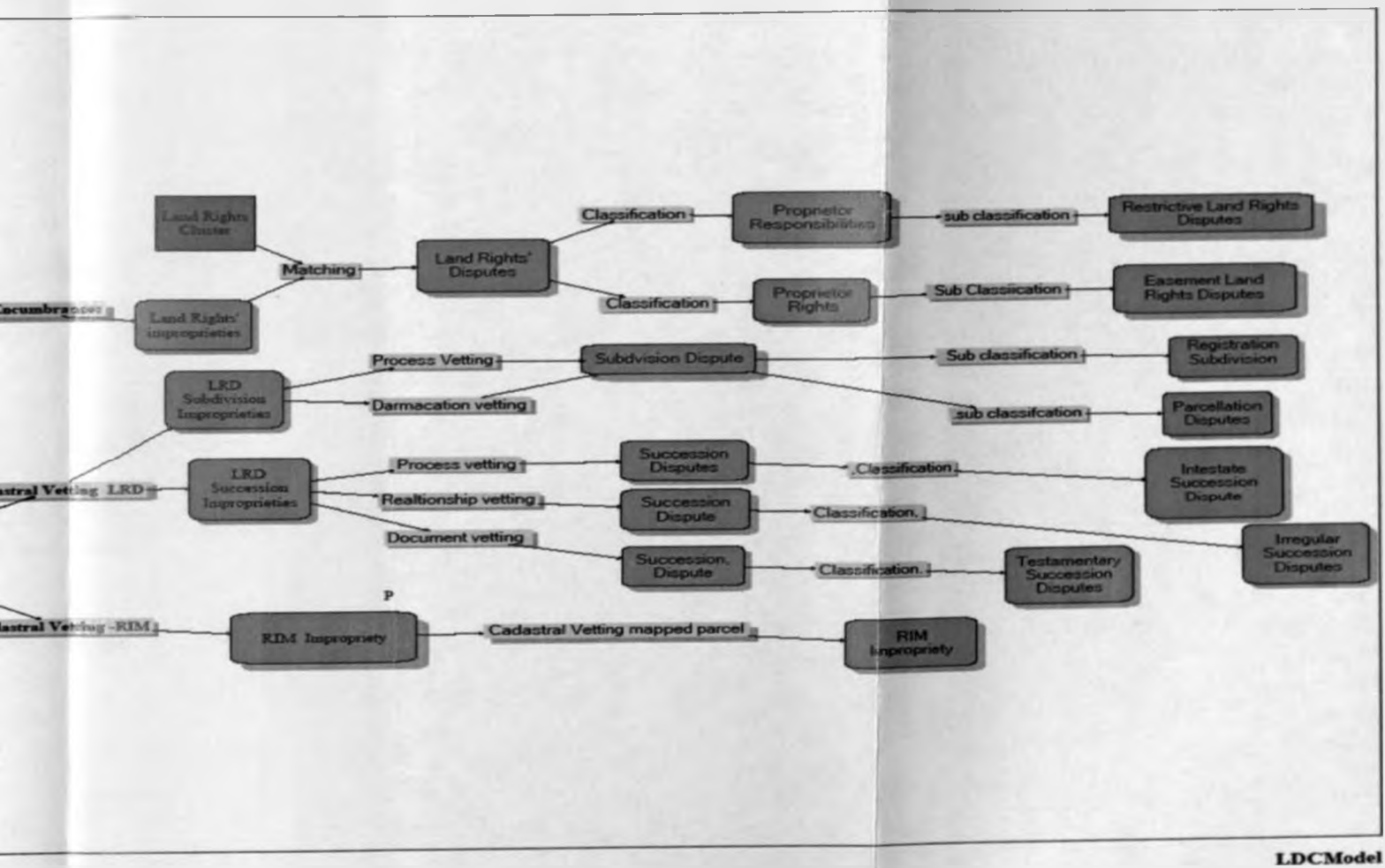


Figure 4-10; A section of Land Dispute Classification Model Flow Chart

5. Results

This chapter presents the results of the study. The outcome of Dispute identification, dispute verification in Bungoma Municipality and the eventual implementation of the designed cadastral land dispute classification model in the prototype are presented.

5.1 Dispute Information Collection

Table 5-1 shows the total number of disputes identified and recorded by each land dispute source used by the study. These were disputes as identified and recorded without considering if the same dispute had been multiply identified by different sources.

Table 5-1; Disputes Identified by each Source

Tribunal	Total Land Disputes Identified
Land Dispute Tribunal	272
Total Land Disputes -District Magistrate Court	76
Total Land Disputes- District Land Office	103
Total Land Dispute- Provincial Administration	441
Total Land Disputes Recorded	892

Figure 5-1 to 5-3 below, shows the distribution of the 892 disputes identified by all the Dispute Resolution in Bungoma Municipality.

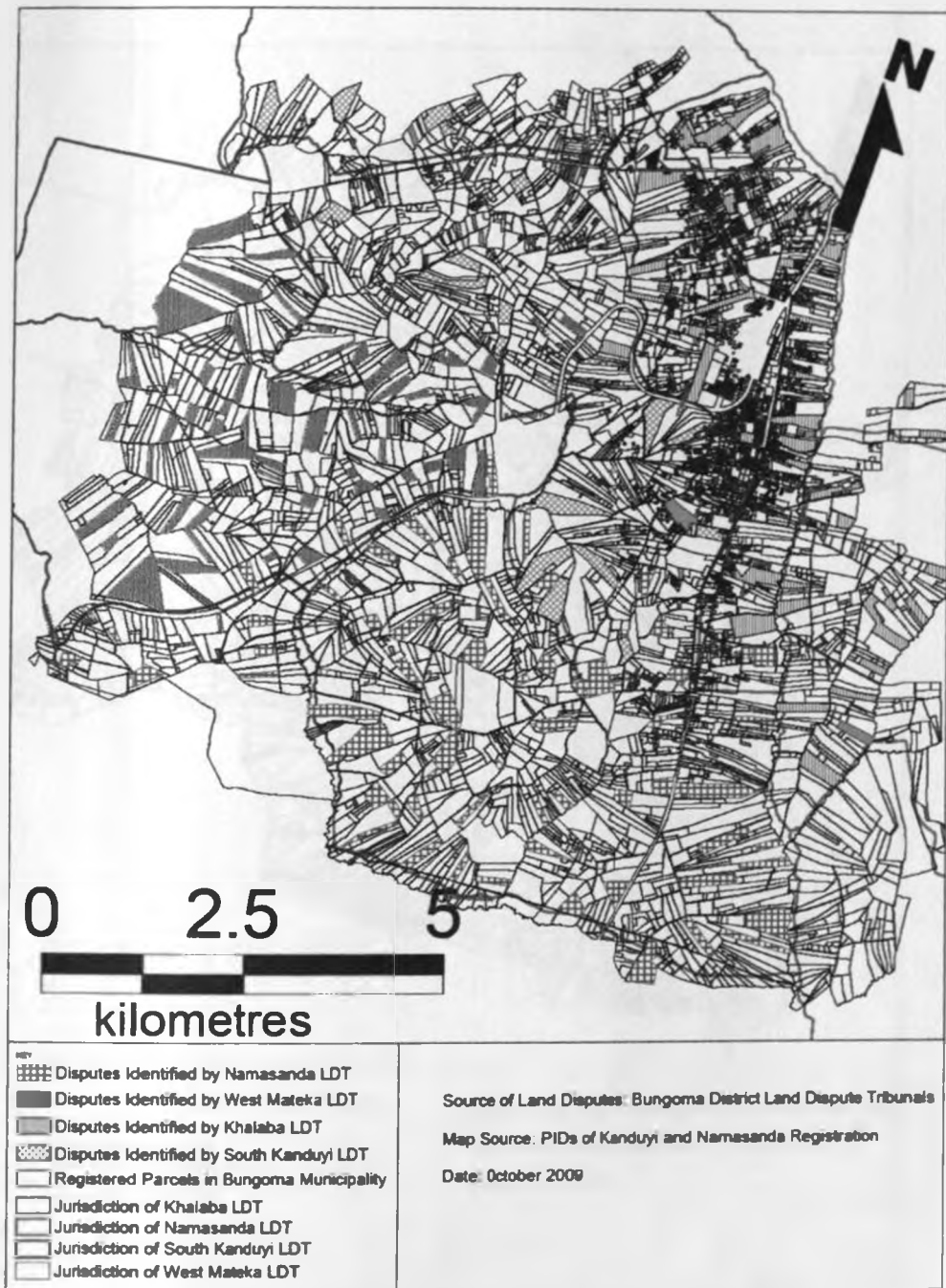


Figure 5-1; Land Dispute Identified by the land dispute tribunals in Bungoma Municipality

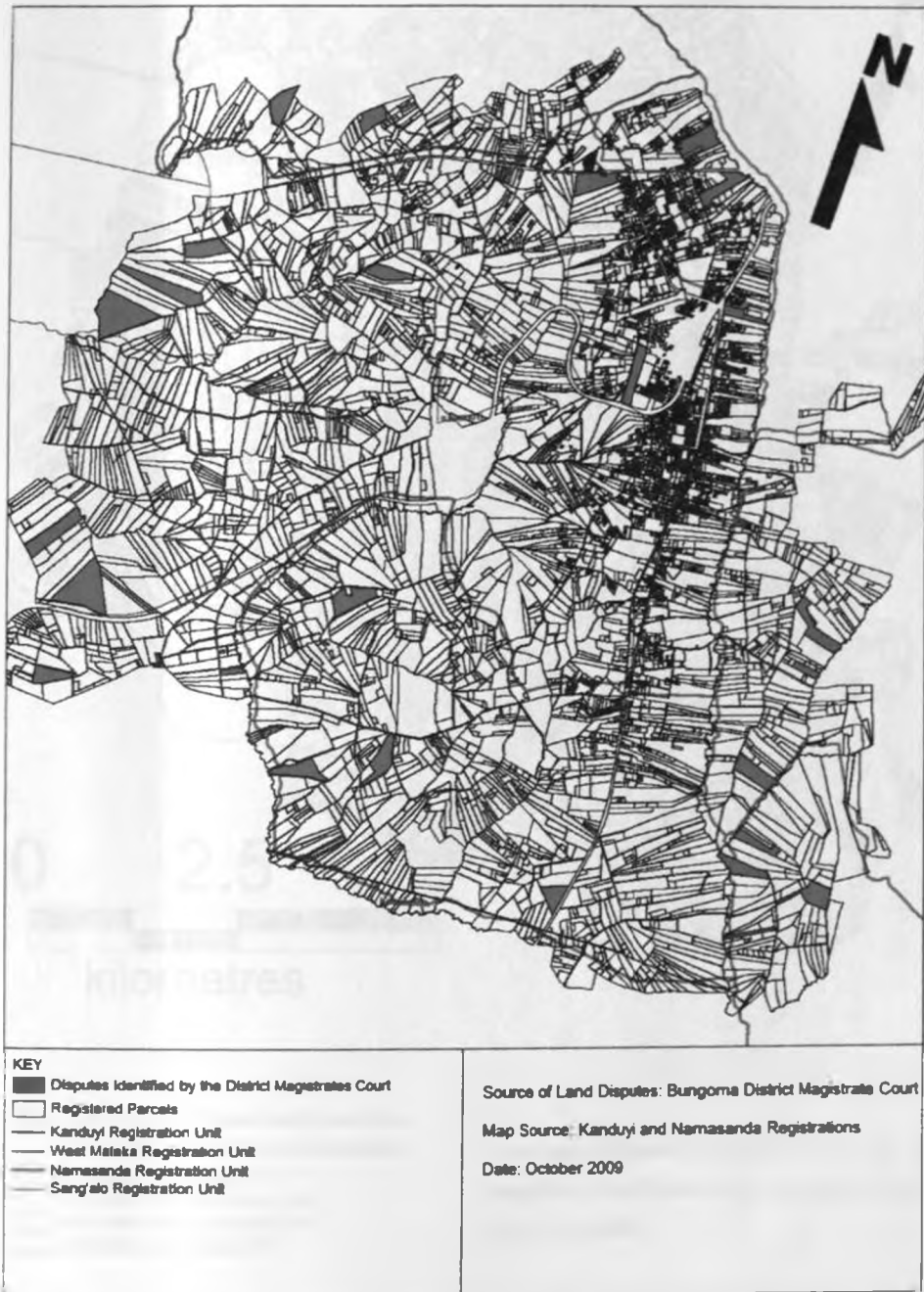


Figure 5-2; Land Disputes Identified by the District Magistrates Court in Bungoma Municipality

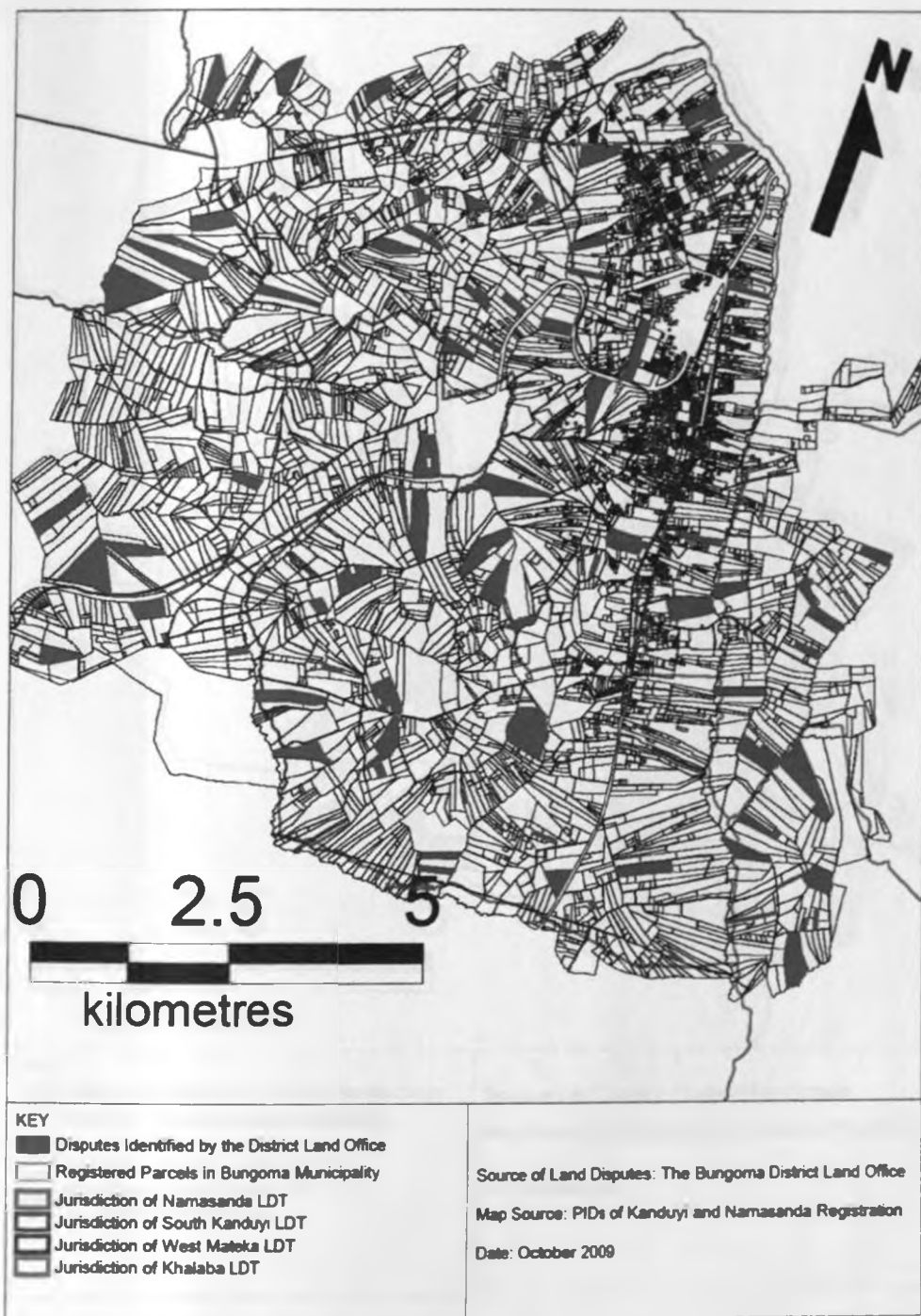


Figure 5-3; Land Dispute Identified by the District Land Office in Bungoma Municipality

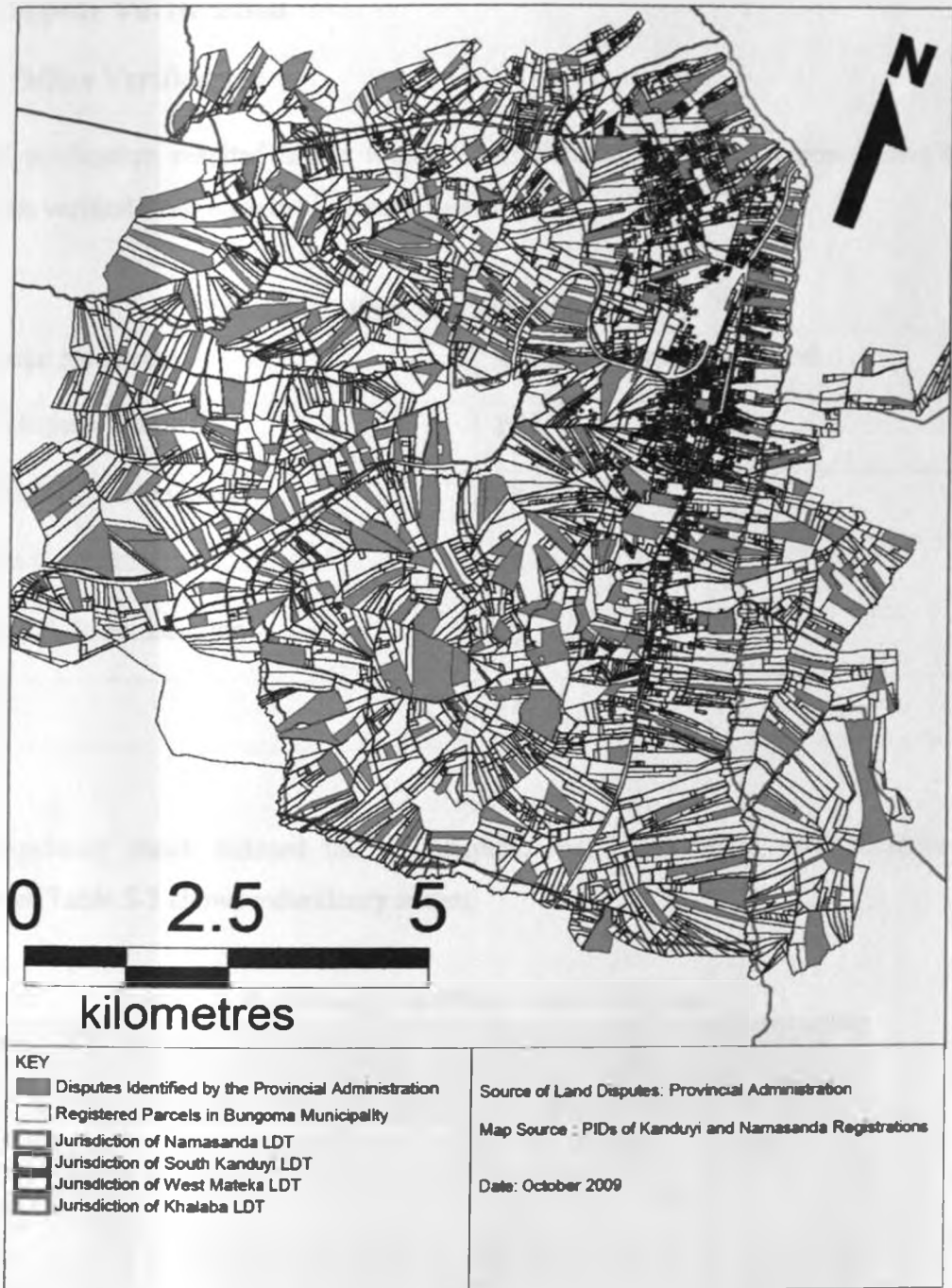


Figure 5-4; Land Dispute Identified by the District Land Office in Bungoma Municipality

5.2 Dispute Verification

5.2.1 Office Verification

Initial verification resulted into a total of 175 disputes. Table 5-2 below shows total disputes verified from each land dispute source.

Table 5-2; Office verified disputes

Dispute Source	Total Disputes verified
Land Dispute Tribunal	104
District Magistrate Courts	16
District Land Office	15
Provincial Administration	40
Total	175

A redundancy check reduced the 175 disputes realised at initial verification to 87 disputes. Table 5-3 shows redundancy statics

Table 5-3; Redundancy of Office verified disputes

Land Dispute Source	LDT	DMC	DLO	PA	Total
LDT	-	15	14	55	81
DMC	-	-	5	1	6
DLO	-	-	-	4	1
Total					88

5.2.2 Field Verification

The 87 disputes that successfully underwent office verification were later subjected to field verification. A total, 53 hours and 43 minutes was spent in the physical verification of disputes (table 5-4). Figure 5.2 shows distribution of the verified land disputes

5.3 Cadastral Land Dispute Classification Model-Prototype

The cadastral land dispute classification prototype performs four tasks. First it validates dispute claims, secondly it classifies the disputes into distinct cadastral classes, thirdly it publishes a list of cadastrally classified land disputes and lastly it posts the disputes to a hyperlinked dispute location and distribution maps.

5.3.1 Land Dispute Validation

At validation the entity 'parcel' is joined with entities- 'RIM, proprietor, encumbrance, land rights delivery process and land register' to output 'registered parcels'. Registered parcels are then joined with the land dispute claims. Parcel registration number is the primary key for registered parcels and is defined as the foreign key in dispute claims. It is the parcel registration number that is used to join these two entities. The output of the validation process is the disputed parcels which are immediately posted onto the map window (figure 5-6). Land dispute validation process report is also output (Appendix C).



Figure 5-5; Dispute Validation in the land dispute cadastral classification prototype

Table 5-4; Time Spent in field verification of land disputes

PNO	MIN	SOURCE	PNO	TIME (MIN)	SOURCE	PNO	TIME (MIN)	SOURCE	PNO	TIME (MIN)	SOURCE
100000285	hostile	LDT	200001087	Not found	PA	20000313	Not found	PA	300003930	58	LDT
100000302	23	DLO, DMC, LDT, PA	200002616	hostile	LDT	200001857	52	PA	300003998	45	LDT
100000428	32	PA, LDT, DLO	200000146	64	LDT, DMC	200000657	30	PA	300000332	34	LDT
100000054	19	LDT	200000202	28	DLO, DMC, LDT, DMC	200001204	Wrong info	DMC	300000202	34	LDT
100000000	47	DLO, PA, DMC, LDT	200000210	29	PA	200000674	69	PA, DLO, LDT	300000000	12	LDT
100001202	Not found	PA	200000455	45	LDT	200000011	hostile	DMC	300000000	59	LDT
100000000	Not found	PA	2000008531	78	LDT	200010578	Not found	PA	300001678	37	PA, DLO, DMC, LDT
200001922	24	DLO, LDT	100000143		LDT, PA	200000595	34	DLO, LDT	300001335	39	DMC
200000880	123	PA, DMC	200000345	hostile	PA, LDT	200000514	Wrong info	PA	300002360	44	PA, LDT
100000054	24	LDT	200000407	76	PA	200005466	Not found	PA	300000015	74	LDT, DMC
400000815	65	PA	200000257	124	LDT, DMC	200008478	58	DLO	300001071	39	LDT, DMC
400000810	Not found	LDT	200000502	hostile	PA	200000902	59	LDT	300000254	18	DLO, DMC, LDT
400012042	67	PA	200000786	Wrong info	PA	200012199	hostile	LDT	200000279	Not found	DLO
400000255	hostile	PA	200000814	38	LDT	200001314	50	LDT	200001301	28	DLO, PA, DMC
400003031	hostile	LDT	200000794	98	PA	200001743	Not found	PA	200000708	73	DLO, PA, DMC
400007721	56	LDT	200007038	Wrong info	PA	200001207	48	LDT, DLO	400000811	Wrong info	PA
400001951	61	PA	200012316	68	LDT	200003855	55	LDT, DLO	100000147	45	PA
400001065	54	LDT	200008822	48	PA	200000876	68	LDT, DLO	100000258	hostile	PA, DLO
400001022	48	PA, LDT	200000640	Wrong info	PA	200000744	37	LDT	200000788	Wrong info	PA
400000993	39	LDT	200002932	Not found	PA	300003563	hostile	LDT, DLO, DMC	200000641	31	PA
400001855	Not found	PA	200000000	41	LDT	300002095	16	LDT, DLO	400001009	23	PA
400000000	156	PA	200000711	hostile	LDT	300001525	55	LDT	200000000	1023	

Table 5.4: Time spent in field verification of land disputes

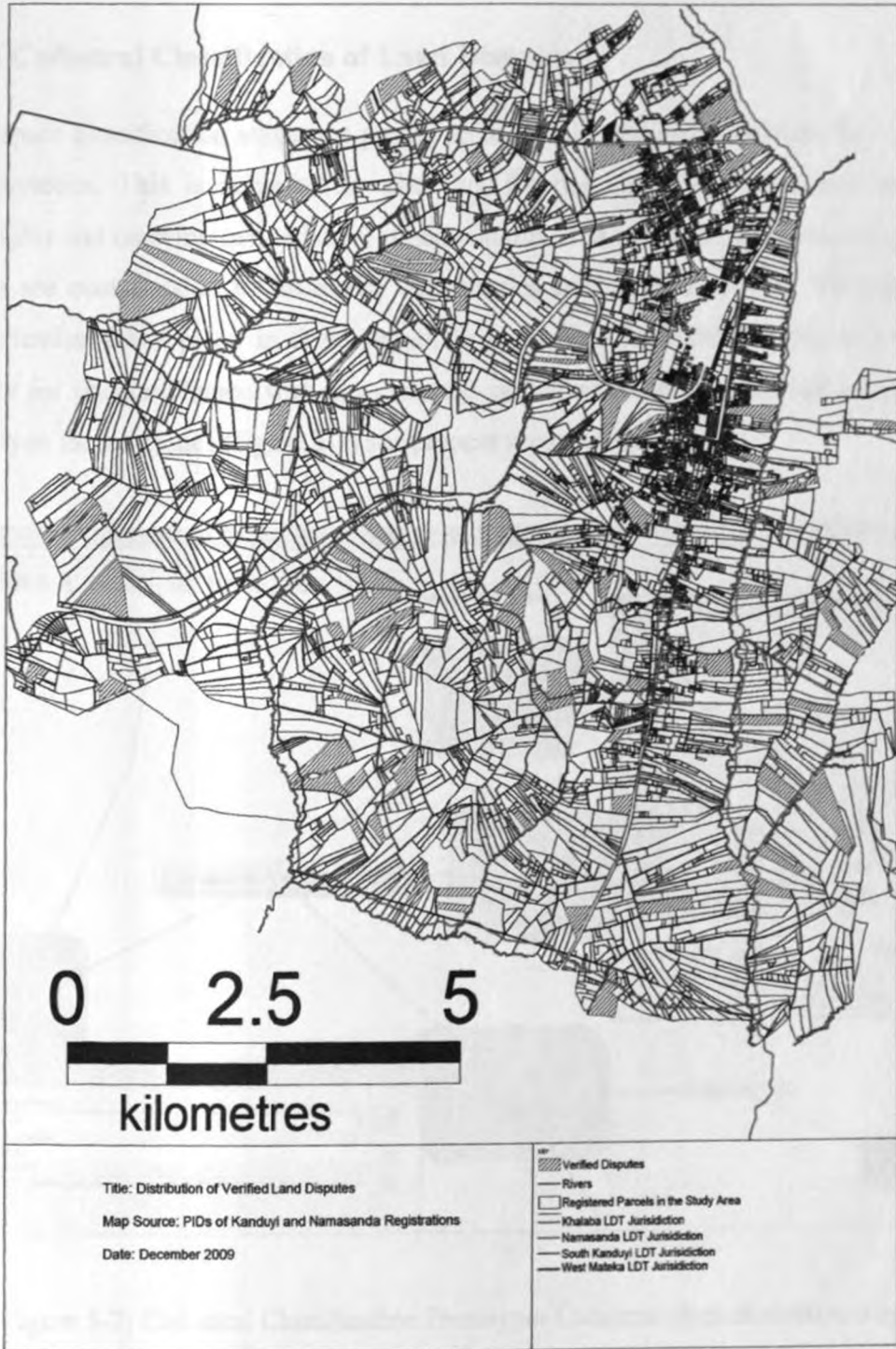


Figure 5-6; Distribution of Verified Disputes in Bungoma Municipality

5.3.2 Cadastral Classification of Land Disputes

At dispute classification stage, the prototype tests validated dispute claims for cadastral improprieties. This is achieved by checking for non compliance with key cadastral principles and carrying out cadastral process audits. The compliance checks and process audits are compounded in structured GIS queries and geoprocesses. In this prototype, classification takes place in three stages. First stage of classification purely relies on checks for noncompliance with key cadastral principles to derive cadastral land dispute class type improprieties (figure 5-7) see process report in Appendix C.

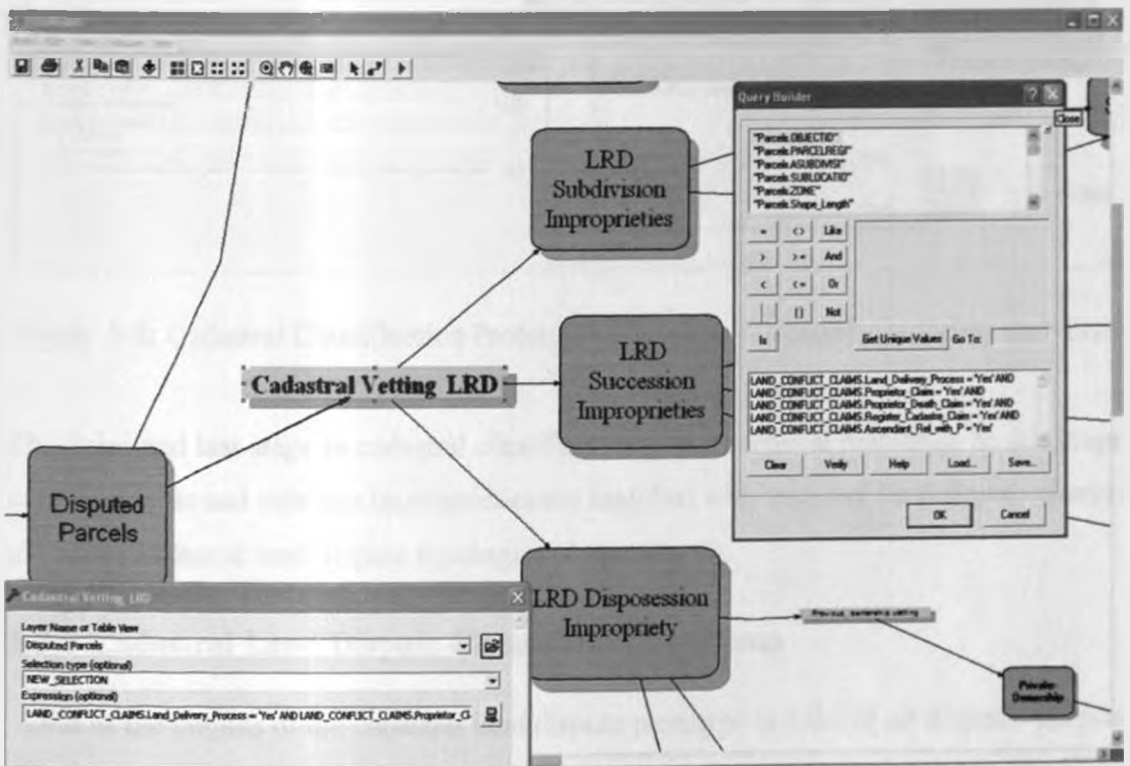


Figure 5-7; Cadastral Classification Prototype- Cadastral class derivation stage

Second stage of classification carries out process audits for noncompliance with key cadastral principle identified in the first stage of dispute classification. This stage is

iterative because one or more processes have to be checked in each noncompliance singled out in the first stage (figure 5-8) see process report in Appendix C.

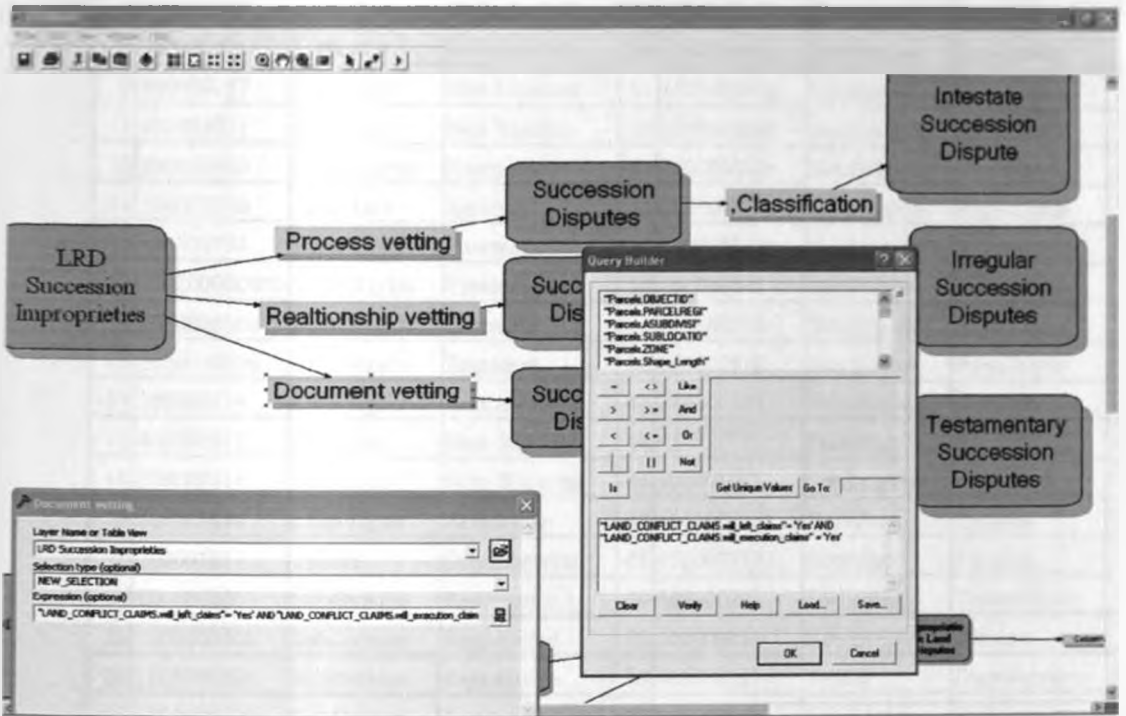


Figure 5-8; Cadastral Classification Prototype- Cadastral sub class impropriety derivation stage

The third and last stage in cadastral classification is the cadastral matching. In this stage, cadastral class and subclass improprieties are matched with cadastral land dispute clusters to output cadastral land dispute typologies (Appendix C).

5.3.3 Cadastral Land Dispute Classes and Sub-classes

One of the outputs of the cadastral land dispute prototype is a list of all disputed parcels, their cadastral dispute class and subclass (table 5-5). The prototype outputs a Microsoft Access files and automatically posts it into the personal database, thus allowing establishment of relations with the land register and printing or emailing to other interested parties.

Table 5-5: Cadastral Classification of Land Disputes in Bungoma Municipality

ID	PARCELNO	CLASS	SUBCLASS	ID	PARCELNO	CLASS	SUBCLASS
3	400001022	Succession	Testamentary	28	100000060i	Subdivision	Registration
4	300001071	Cadastral	Multiple Title	29	100000060h	Subdivision	Registration
6	300001071	Cadastral	Multiple Title	30	100000060	Subdivision	Registration
8	400000257	Boundary	Non Riparian	31	100000060g	Subdivision	Registration
7	400003031	Boundary	Non Riparian	32	100000060f	Subdivision	Registration
10	200005466	Land Rights	Easement	33	100000060e	Subdivision	Registration
14	300003930	Boundary	Riparian	34	100000060j	Subdivision	Registration
13	200000794	Land Rights	Easement	35	100000060k	Subdivision	Registration
15	200000000	Land Rights	Easement	36	100000828	Subdivision	Parcellation
12	200000880a	Land Rights	Easement	37	100000828	Subdivision	Parcellation
12	200000880b	Land Rights	Easement	38	100000828	Subdivision	Parcellation
17	200000674	Land rights	Restrictive	43	200000595	Succession	Intestate
16	400000815	Boundary	Non- Riparian	44	20002593	Boundary	Riparian
18	200000814	Boundary	Non- Riparian	46	400001951	Land rights	Restrictive
19	200000676	Land rights	Restrictive	47	4000002101	Boundary	Riparian
20	200001857	Tenure	Dispossession	48	4000002592	Boundary	Riparian
22	1000000601	Subdivision	Registration	69	300000202	Succession	Testamentary
23	100000060b	Subdivision	Registration	73	100000054	Succession	Intestate
24	100000060c	Subdivision	Registration	74	400008351	Tenure	Dispossession
25	100000060b	Subdivision	Registration	77	400000811	Land rights	Restrictive
26	100000060d	Subdivision	Registration	76	400000810	Land rights	Restrictive
27	100000060k	Subdivision	Registration	70	200012316	Tenure	Expropriation

To ensure unique identification, all parcels were modified to be 9 digits. Prefix added is Reg. Unit ID

5.3.4 Cadastral Land Dispute Maps

The prototype outputs two sets of cadastral dispute maps. First map has each classified dispute hyperlinked to sets of documents and information (figure 5-9). A click on any classified dispute leads to an automatic popup of relevant document presented as evidence to the dispute.

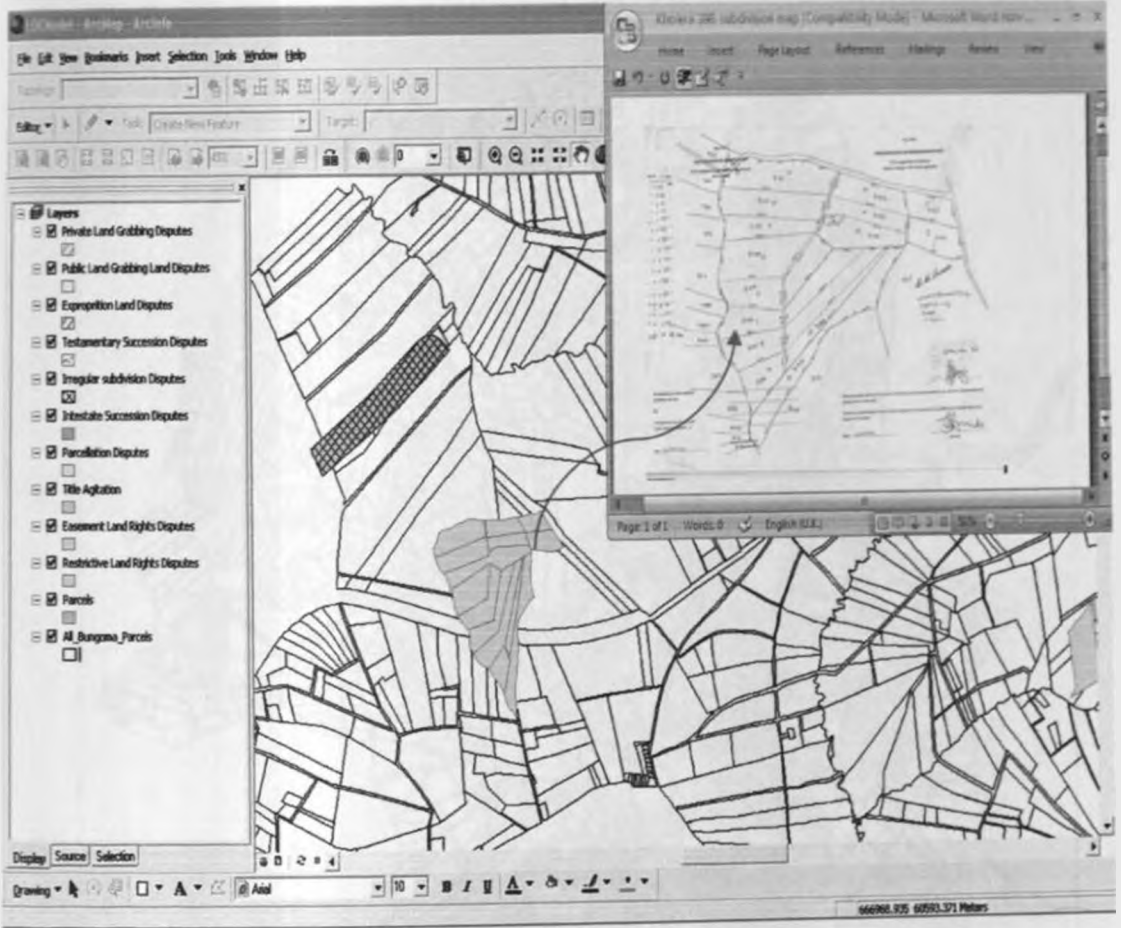


Figure 5-9; Hyperlinked cadastral land dispute map output by the prototype

The second map output by the prototype is a printable un-editable map of cadastral dispute location and distribution (figure 5-10 shows)

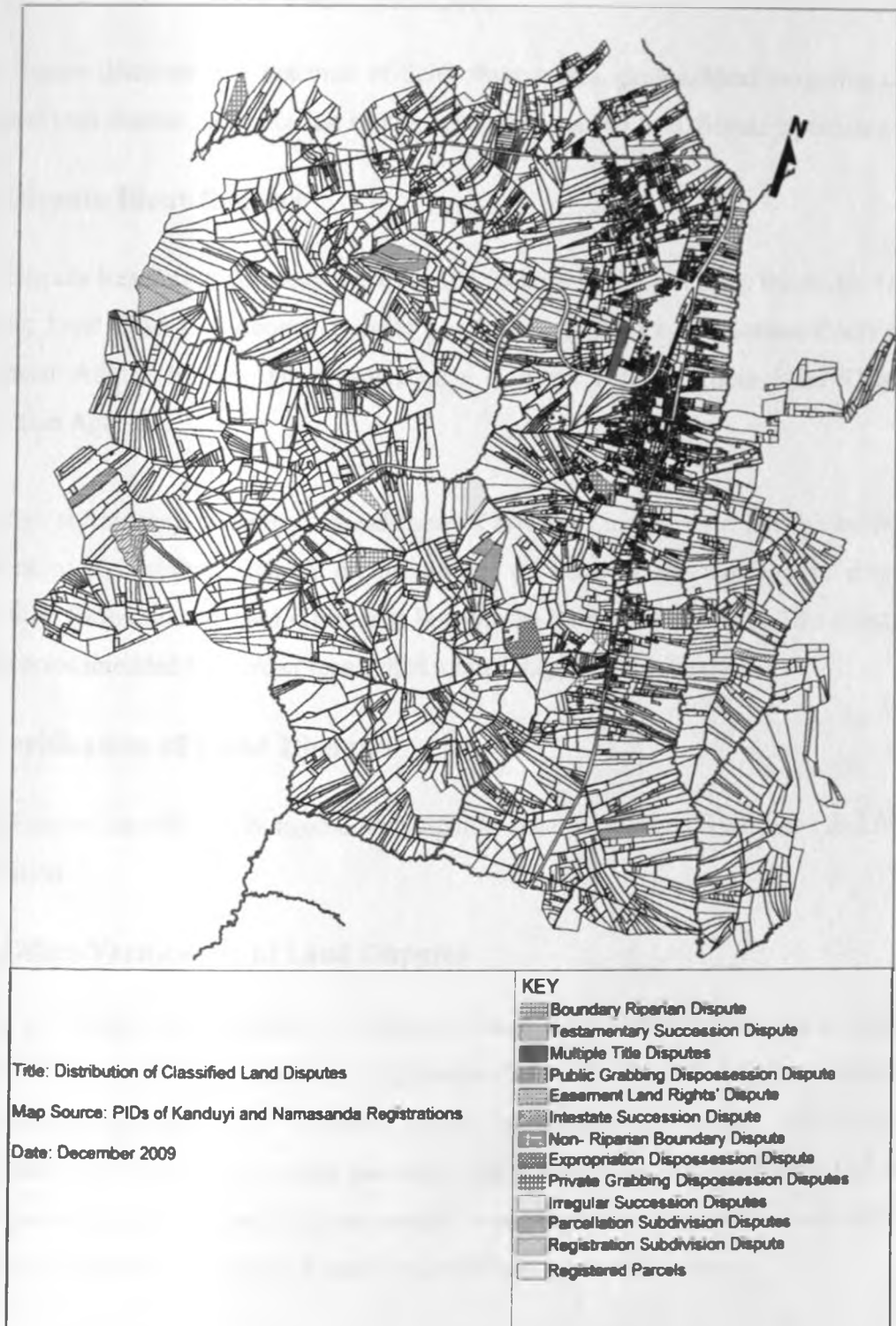


Figure 5-10; Distribution of Cadastral Land Disputes in Bungoma Municipality

6. Discussion

This chapter discusses the outcome of field observations, geographical modelling of a cadastral land dispute classification and the resultant cadastral land dispute typologies.

6.1 Dispute Identification

Four Dispute Resolution Agencies were used to identify land disputes by the study. They include; Land Dispute Tribunal, District Land Office, District Magistrates Court and Provincial Administration. High redundancy is noted between these Land Dispute Resolution Agencies.

This high redundancy is deemed an indicator of synergies in dispute resolution between agencies or a confidence check on the ability of some of the agencies in dispute resolution. Resolution of land disputes is beyond the scope of this study. This question will be recommended for further research in a later chapter of this study.

6.2 Verification of Land Disputes

Land disputes identified in Bungoma Municipality underwent office verification and field verification.

6.2.1 Office Verification of Land Disputes

Figure 6.1 shows the percentage of disputes successfully verified from each dispute source. Office verification involved confirmation of availability of dispute records by each source, availability of cadastral details of parcels in dispute and positive identification of disputants. At this particular stage, Provincial Administration had the lowest percentage of disputes being successfully verified, followed by district land office, the district magistrates' courts and lastly land tribunals in ascending order.

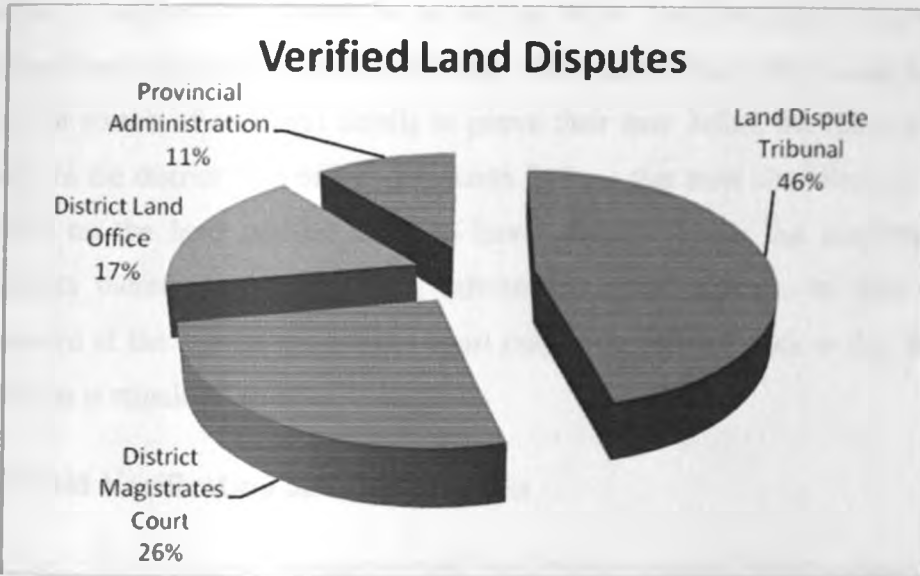


Figure 6-1; Percentages of disputes successfully verified from each dispute source

The ascending order denotes two things, the validity of evidence presented to the land dispute resolution agencies and the stages of litigation which a land dispute is likely to go through in an effort to have it resolved. The lower the percentage of verified disputes the less refined the evidence and consequently; the earlier the stage is, in terms of litigation attempts.

Five of the dispute types considered for classification was noted to have been reported to all the resolution agencies used by this study to identify disputes. A review of these land disputes revealed four of the disputes had been reported to the Provincial Administration first, followed by the district land office, followed by the district magistrate court and finally the land dispute tribunal. One of the five disputes had progressively been reported in a similar order except that after the land dispute tribunal, it was again taken back to the district magistrate's court.

The reason why a dispute is likely to be reported to the Provincial Administration first is because of ease of access and affordability. The Provincial Administration is highly decentralised and so it was found to be highly accessible to all disputants. No fee is

required to lodge a land dispute to the village elder. Post Provincial Administration, it was found out disputants would then revert to the district land office as an afterthought mostly in search of cadastral details to prove their case before the relevant resolution agency. In the district land office, disputants find out that most alterations or stay orders imposed on the land register seem to have originated from the magistrates courts. Disputants therefore after gathering information make attempts to have their case determined at the district magistrates court only to be referred back to the land dispute tribunal as is stipulated in law.

6.2.2 Field Verification of Land Disputes

There were four outcomes during the field verification process. Either a dispute was found, or not found completely, or found but with wrong information or found but not considered for further study because of hostility (Figure 6.2).

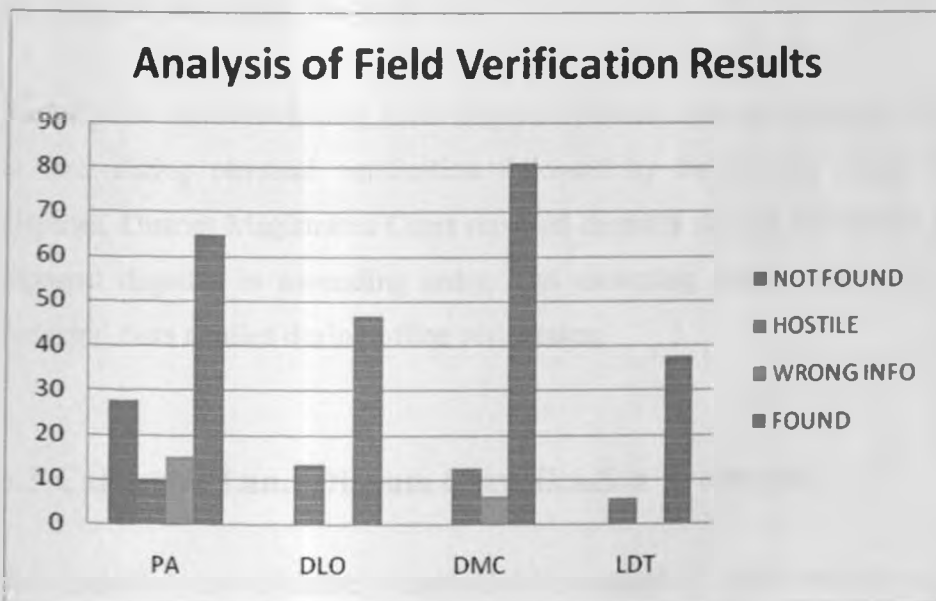


Figure 6-2; Outcome of field verification

Whereas the Provincial Administration is highly accessible and affordable in terms of reporting land disputes for resolution, it lacks the resources and knowledge to verify validity of documents presented to it by disputants. As a result, it is the only dispute

agency, which had some of its identified disputes successfully verified during the office verification only to get to the ground and find no such disputes and or parcels existed.

The study found out any dispute reported was likely to be hostile regardless of the source. Land Dispute tribunal had the lowest percentage of hostility. This is associated to the fact that most disputes studied seemed to have not gone beyond the Land Dispute Tribunal, meaning that disputes at this stage had already been resolved.

Wrong information outcome during field verification was restricted to the Provincial Administration and the District Magistrates Court. All the disputes found with the wrong information were disputes that fell outside the study area. For Provincial Administration, such disputes were found to have been reported from the neighbouring jurisdiction because the disputant had had an unfavourable ruling in his real jurisdiction. For the District Magistrates court, it had a wider jurisdiction than the study area and so some of the disputes fell outside the study area.

For disputes that were found, Land Dispute Tribunal reported disputes took the least time to find during physical verification followed by the District Land Office reported disputes, District Magistrates Court reported disputes and the Provincial Administration reported disputes in ascending order. The ascending order defines the indiscrecy of cadastral facts availed during office verification.

6.3 Cadastral Land Dispute Classification Prototype.

The cadastral classification prototype is purposed to carry out three tasks. First is validation of land disputes. Validation is based on matching of the reported land dispute claims with the parcels (registered and unregistered). This is fulfilled by use of a key identifier which in this case is the primary key to all the land dispute entities. This is the basic requirement in relational databases enabling one to relate and manipulate thematic data or tables. Only reported disputes will be validated. Dispute detection is out of the scope of this study.

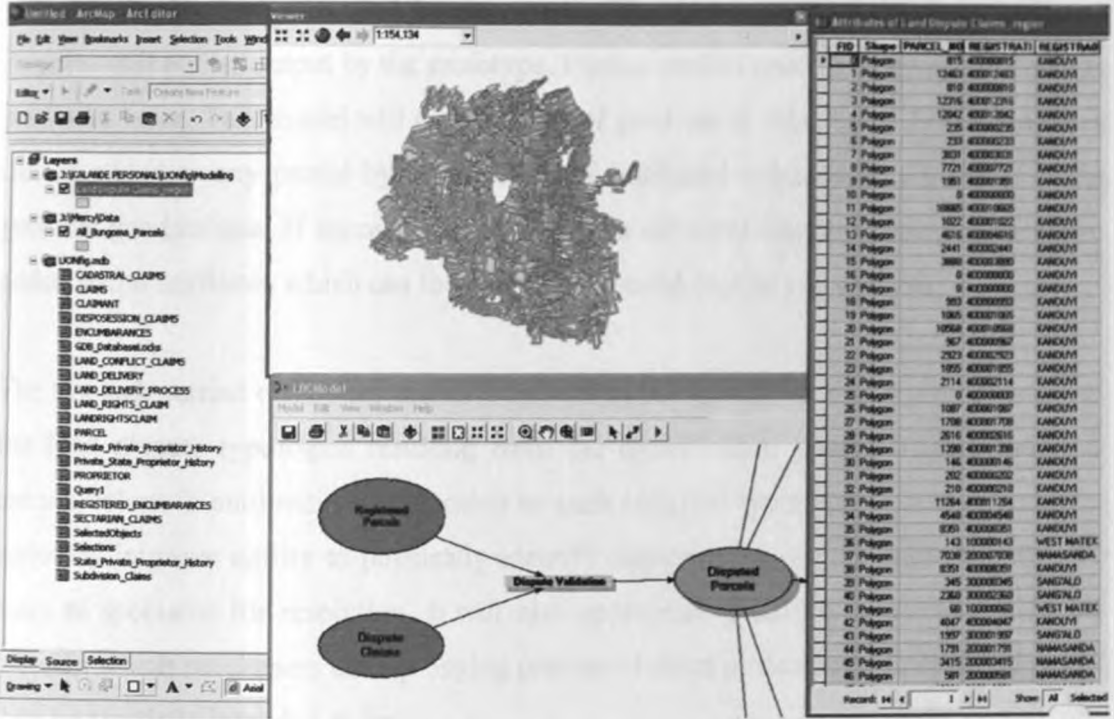


Figure 6-3; Validation of Land Disputes by the Prototype

Since parcel registration numbers are unique to each parcel in Kenya, they are recommended for use as the key identifier. Various land dispute resolution agencies can use the parcel registration number to uniquely identify land disputes. This has been demonstrated in the prototype. As noted in previous chapters, updating of PIDs and posting of informal land delivery processes takes long and at time does not get done at all. This will pose a great challenge to validation if the system is implemented. A lot of manual reconciliation and intervention will be required.

The second task carried out by the prototype is the classification of land disputes. Once the relevant information is captured in the prerequisite tables in Microsoft Access and spatial units are captured in the GIS, the prototype will uniquely output land dispute cadastral classes. Cadastral nature and details of specific cadastral land dispute typologies is discussed in later sections of the thesis.

Social factors in land disputes were beyond the scope of this study. Thus social factors in land dispute like behaviour, alcoholism, gender discrimination, effects of pandemics like

HIV-AIDS were not modelled by this study. The social factors behind the cadastral disputes will not be output by the prototype. Further studies need to be carried out on this particular issue. This model will definitely be of great use in this regard. Social attributes can be added to any parcel by introduction of additional columns on any tables in the personal geodatabase. If successfully done, output cadastral dispute typologies will have added social attributes which can then be used in social studies and analysis.

The last task carried out by the model is indicating the spatial location and distribution of the land dispute typologies resulting from the classification process (figure 6-4). A unique colour is automatically allocated to each cadastral typology. This is expected to seriously improve ability to physically identify dispute types and appropriately allocate them to specialist for resolution. It will also appropriately advice buyers and eliminate cases in which purchasers end up buying protracted court processes and not useful parcel they had initially intended to buy.

Land Dispute Agencies in the study area however, noted disputants often want disputes handled in secrecy. Display of disputes on maps will reduce to great degree disputants presenting disputes for resolution. The investigation of effects of openly displaying disputes on a map was beyond the scope of this study and is recommended for further study.

6.4 Cadastral Land Disputes

Through Geographical data modelling, a cadastral classification of land disputes is developed by this study. Four types of cadastral land dispute classes were identified (Figure 6-5). They included; Land Rights' Delivery Disputes, Land Rights' Disputes, Tenure Disputes and Cadastral Disputes. These disputes vary from quite straightforward arguments to complex series of differences of opinion involving intent, motive and interpretation of cadastral records.

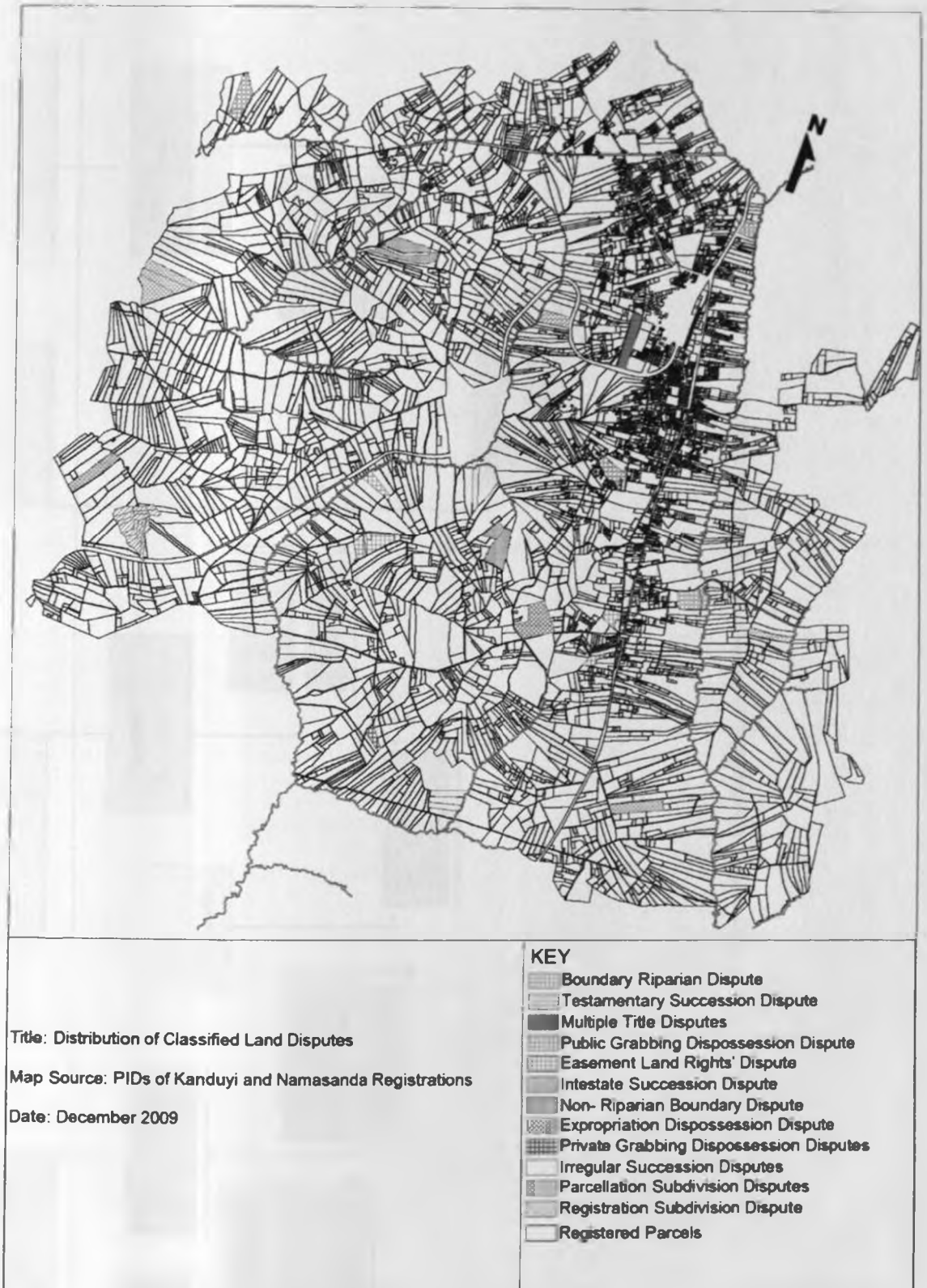


Figure 6-4; Distribution of Cadastral Disputes in Bungoma Municipality

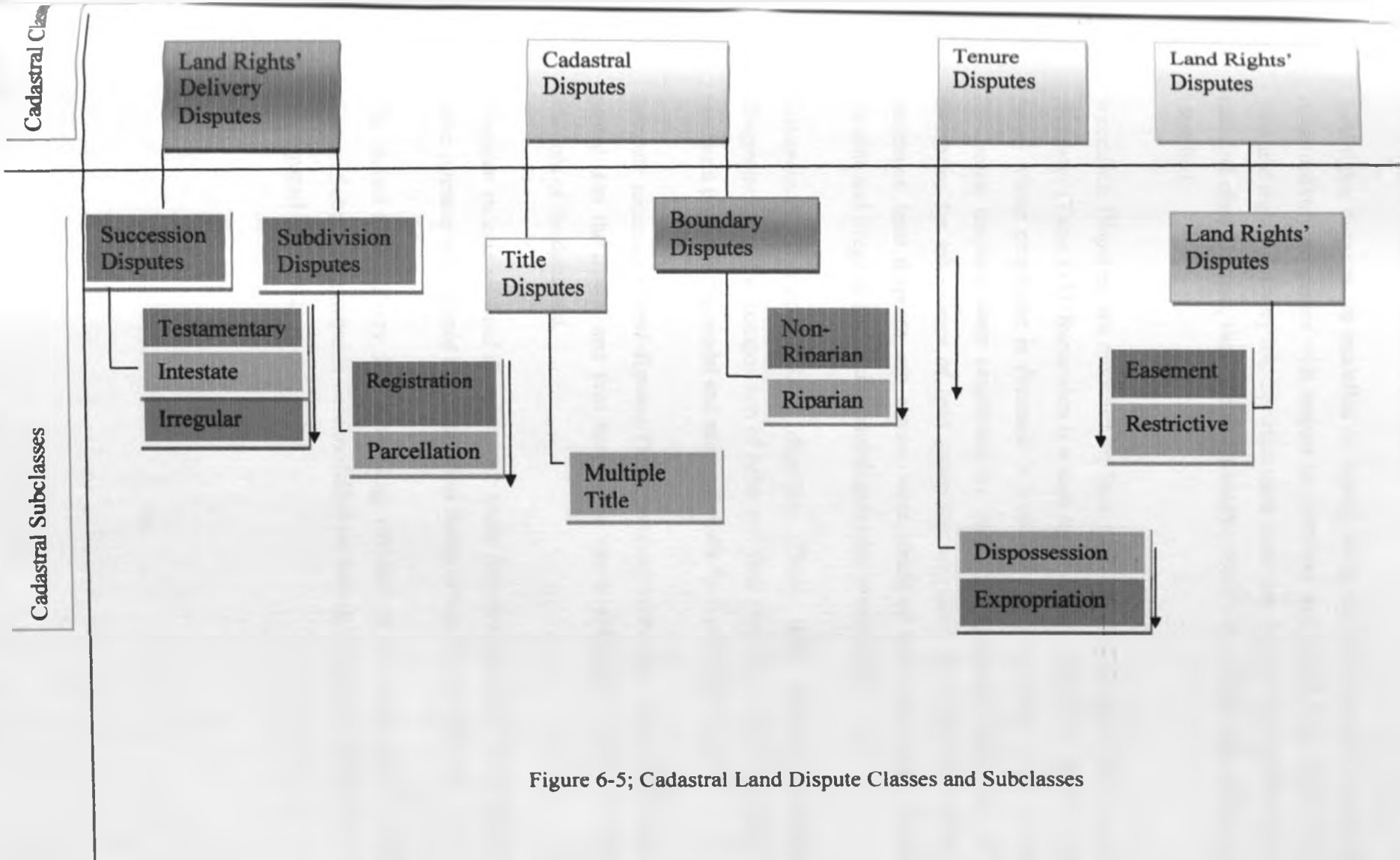


Figure 6-5; Cadastral Land Dispute Classes and Subclasses

6.4.1 Land Rights Delivery Disputes

Land rights disputes are modelled on lineage (temporal and generation aspects) of land rights delivery processes with respect to proprietor and parcel entities of the database. Two land rights' delivery improprieties were identified. Upon matching with land dispute cadastral class clusters, two dispute typologies namely succession and subdivision were identified.

Succession Disputes; are modelled on land rights delivery process with respect to the proprietor (Table 6-1). Succession is a land rights delivery process in which a registered parcel whose proprietor is deceased is passed on to heirs, next of kin or distributee. Succession disputes were constituted by competition amongst heirs, next of kin or distributee for inheritance of land ownership and land use rights of a decedent. Three succession land disputes sub classes were identified from this study; testamentary, intestate and irregular succession land disputes but was contested.

Testamentary succession land disputes- These were disputes resulting from disagreements of the composition of heirs and their respective shares as contained in a testament posted in the model and executed in the form prescribed by law.

*Intestate succession land disputes-*These involved incidences where there was no will posted into the model and thus succession was established in favour of the nearest relations of the deceased.

Irregular succession land disputes were those that resulted from nullification of heirs either intestate or instituted by testament in favour of non heirs or the state.

The second land delivery dispute typology revealed by this study was the Subdivision dispute. Subdivision disputes were modelled on land rights delivery process with respect to the parcel (table 6-2)

Table 6-1; Succession Dispute Modelling

Tool Name:Select Layer By Attribute

Tool Source:C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\Layers and Table Views\SelectLayerByAttribute

Parameters:

<i>Name</i>	<i>Direction</i>	<i>Type</i>	<i>Data Type</i>	<i>Value</i>
Layer Name or Table View	Input	Required	Table View or Raster Layer	Disputed parcels
Selection type	Input	Optional	String	NEW_SELECTION
Expression	Input	Optional	SQL Expression	"LAND_DISPUTE_CLAIMS.New_Number_Claims" = 'Yes' AND "LAND_DISPUTE_CLAIMS.Proprietor_Death_Claim" = 'No' AND "LAND_DISPUTE_CLAIMS.Proprietor_Claim" = 'Yes' AND "LAND_DISPUTE_CLAIMS.Ascendant_Rel_with_P" = 'Yes' AND "LAND_DISPUTE_CLAIMS.Map_Cadastre_Claim" = 'Yes'
Output Layer Name	Output	Derived	Table View or Raster Layer	Succession disputes

Messages:

Executing (Cadastral Vetting- LRD): SelectLayerByAttribute Parcels NEW_SELECTION
 ""LAND_DISPUTE_CLAIMS.New_Number_Claims" = 'Yes' AND "LAND DISPUTE CLAIMS.Proprietor_Death_Claim" = 'No' AND "LAND_DISPUTE_CLAIMS.Proprietor_Claim" = 'Yes' AND "LAND_DISPUTE_CLAIMS.Ascendant_Rel_with_P" = 'Yes' AND LAND_DISPUTE_CLAIMS.Map_Cadastre_Claim" = 'Yes' Parcels

Table 6-2; Subdivision Dispute Modelling

<i>Subdivision Dispute</i>				
Tool Name: Select Layer By Attribute				
Tool Source: C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\Layers and Table Views\SelectLayerByAttribute				
Parameters:				
<i>Name</i>	<i>Direction</i>	<i>Type</i>	<i>Data Type</i>	<i>Value</i>
Layer Name or Table View	Input	Required	Table View or Raster Layer	Disputed Parcel
Selection type	Input	Optional	String	NEW SELECTION
Expression	Input	Optional	SQL Expression	LAND_DISPUTE_CLAIMS.Proprietor_Claim = 'Yes' AND LAND_DISPUTE_CLAIMS.Occupation_Claim = 'Yes' AND LAND_DISPUTE_CLAIMS.Register_Cadastre_Claim = 'Yes' AND LAND_DISPUTE_CLAIMS.Land_Delivery_Process = 'Yes'
Output Layer Name	Output	Derived	Table View or Raster Layer	Parcels
Messages:				
Executing (Cadastral Vetting- Land Delivery Process): SelectLayerByAttribute Parcels NEW_SELECTION "LAND_DISPUTE_CLAIMS.Proprietor_Claim = 'Yes' AND LAND_DISPUTE_CLAIMS.Occupation_Claim = 'Yes' AND LAND_DISPUTE_CLAIMS.Register_Cadastre_Claim = 'Yes' AND LAND_DISPUTE_CLAIMS.Land_Delivery_Process = 'Yes'" Parcels				

Subdivision is a land rights delivery process in which a proprietor who is alive partitions a unit parcel registered in his name and transfers it to his descendants. This dispute typology was as a result of modelling of the land rights delivery process with respect to parcels' topology. Subdivision disputes were noted to have topological errors of overlap type. In addition, when these parcels were modelled for land rights delivery process (registration), each registered parcel was identified to be a parent of more than one unregistered parcels. Subdivision land disputes were two in nature; Parcellation and Subdivision registration

Parcellation land disputes were constituted by a disputed subdivision processes and or outcome. In the case of disputed subdivision process, an ascendant resisted partitioning his parcel to legally and or customarily qualified heirs. On the other hand, a disputed outcome of the subdivision process involved the refusal of the subdivision process either partially or in entirety. Commonly disputed aspects in a disputed outcome of the subdivision process included parcel contiguity, parcel size and legality of heirs.

Subdivision registration disputes were disputes that came up as a result of agitation for registration of parcels of a successful subdivision process (see figure 6-6 below). Disputes of this nature were found to have the subdivision plans ready just awaiting registration. *Subdivision registration disputes* were driven by insecurity of the heirs activated by domestic circumstances and times ill health of the ascendant.

6.4.2 Cadastral Land Disputes

Cadastral land disputes were modelled on the RIM with respect to the parcel and on the land register with respect to proprietor rights. Disputes modelled on the RIM gave forth to Boundary Disputes whereas those modelled on the land register resulted into title land disputes. In both cases, the topological fabric of parcels was put to test using topology rules in the geodatabase. 'Must not overlap (Area)' and 'Must not overlap (Area-Area)' topological rules are employed for modelling of boundary and titles respectively (table 6-3 and table 6-4).

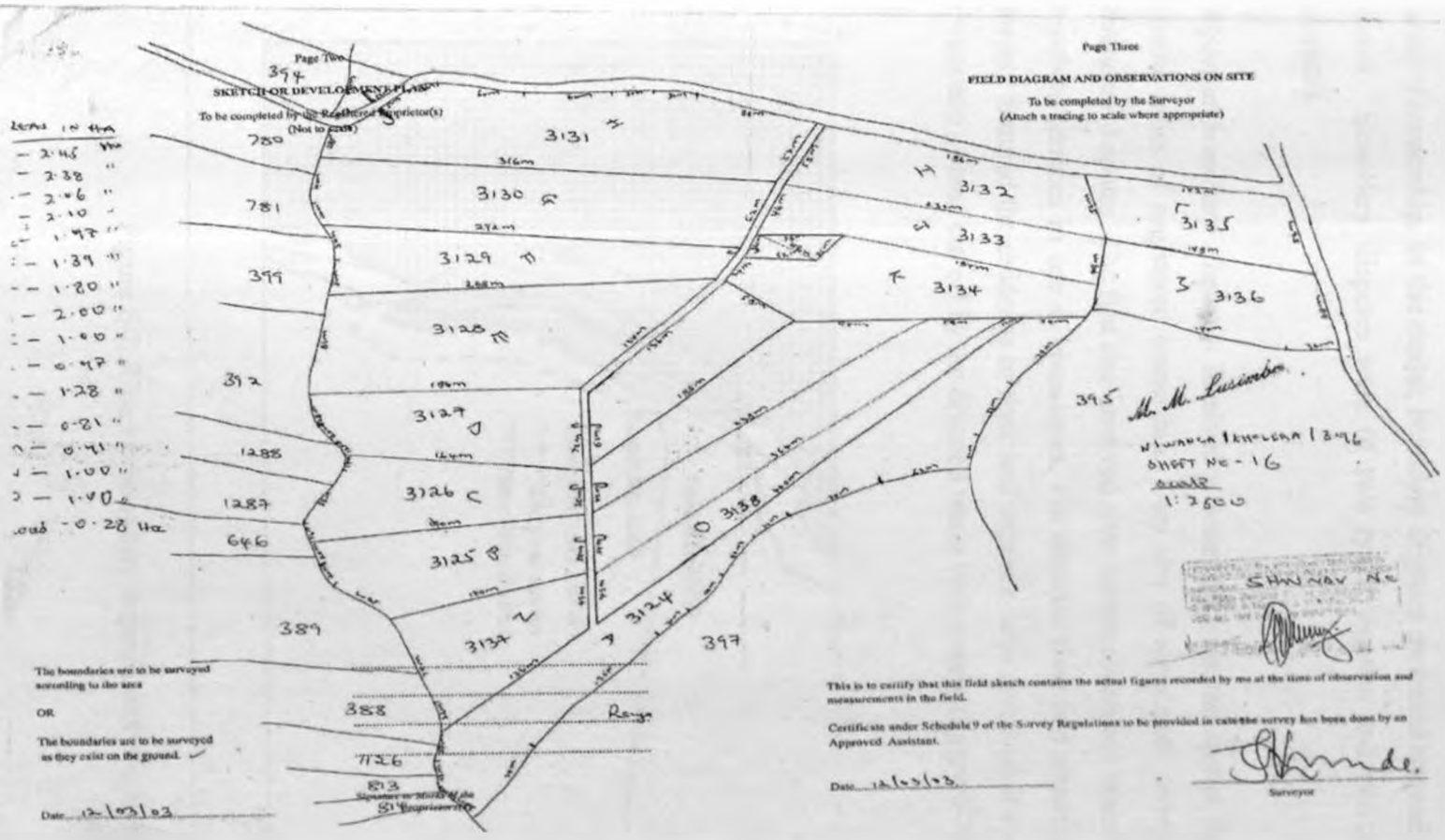


Figure 6-6; successfully subdivided parcel with a subdivision registration dispute

Boundary disputes were found out to be constituted by the indefinability of the spatial line separating two spatial units of registered ownership thus resulting into overlapping spatial units of ownership. In the model, boundary disputes presented themselves as topological errors. Boundary disputes were of two types; riparian and non riparian boundary disputes.

Riparian boundary disputes- involved a water body as the spatial line separating two spatial units of registered ownership. Two sets of arguments were noted in riparian boundary disputes. The first one involved river course diversions whereas the second one involved terraces in use as boundaries. For diverted river and stream course arguments mainly featured the evidence of river and stream course diversion if it ever occurred and ownership of land cut off by the diverted water body course (figure 6-7).

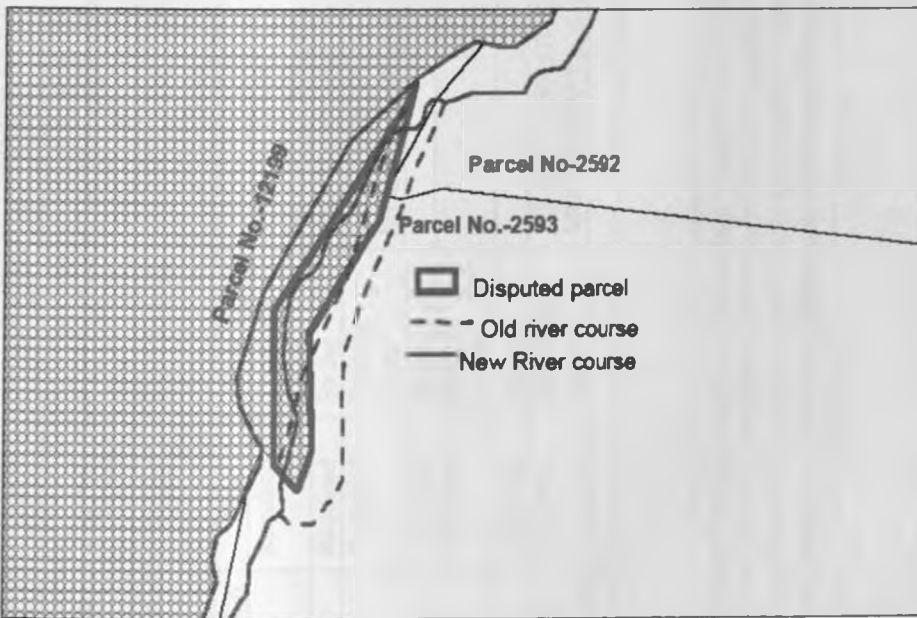


Figure 6-7; Riparian boundary dispute involving a river diversion

Table 6-3; Cadastral Dispute Modelling-Title

Cadastral Modelling- title				
<i>Tool Name:</i> Add Rule To Topology				
<i>Tool Source:</i> C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\Topology\AddRuleToTopology				
Parameters:				
<i>Name</i>	<i>Direction</i>	<i>Type</i>	<i>Data Type</i>	<i>Value</i>
Input Topology	Input	Required	Topology Layer	J:\LAND DISPUTE CLASS. MODEL\UONfig\Modelling\DATABASE\UoNFIG.gdb\Edits\Registered Parcels
Rule Type	Input	Required	String	Must Not Overlap (Area-Area)
Input Feature class	Input	Required	Feature Layer	J:\LAND DISPUTE CLASS. MODEL\UONfig\Modelling\DATABASE\UoNFIG.gdb\Edits\LAND DISPUTE CLAIMS
Input Subtype	Input	Optional	String	
Input Feature class	Input	Optional	Feature Layer	
Input Subtype	Input	Optional	String	
Output Topology	Output	Derived	Topology Layer	J:\LAND DISPUTE CLASS. MODEL\UONfig\Modelling\DATABASE\UoNFIG.gdb\Edits\Multipletitles.....
Messages:				
Executing (Title Validity Vetting): AddRuleToTopology "J:\LAND DISPUTE CLASS. MODEL\UONfig\Modelling\DATABASE\UoNFIG.gdb\Edits\Multipletitles" "Must Not Overlap (Area)" "J:\LAND DISPUTE CLASS. MODEL\UONfig\Modelling\DATABASE\UoNFIG.gdb\Edits\LAND_DISPUTE_CLAIMS" # # # "J:\LAND DISPUTE CLASS. MODEL\UONfig\Modelling\DATABASE\UoNFIG.gdb\Edits\Multipletitles"				

Disputants who allegedly changed river course always denied that a diversion ever occurred and if they did admit they felt the cut off portion was as an act of God or as result of their reclamation effort. On the other hand, disputants claiming river and or stream course diversion felt the cut off portion was just an extension of their parcel. In incidences where there were agreements as regarding the diverted river course, the question as to where the boundary lay in relation to the river and or stream course always came up. The most cited presumption was the *ad medium filum* (to the centreline) rule, whereby the line of the boundary was presumed to be centre line of an adjoining stream/river. Of course, with claims of a diverted river course determination of the centreline remained very contentious especially under the general boundary system.

For terrace/ditch boundaries, argument arose as to where the exact boundary lay and who really owned the ditch/terrace. As it infrequently happens, the ownership of the terrace/ditch is unknown and there is no conclusive evidence one way or the other. Some disputants presumed the boundary to lie at the edge of the ditch further from the bank because an owner ditching the border of his land is likely to throw the spoil back onto his own and not somebody else's property. Opposing disputant thought otherwise.

Non riparian boundary disputes involve disputes over lines separating spatial units of ownership. In this case, such lines do not involve water bodies. The major cause of non riparian dispute was noted to have been asymmetry between boundaries on the ground, those on maps and verbal descriptions which were used to define the units of property recorded in the register. The study noted Boundary disputes were a making of the inadequacy of the boundary and mapping systems in use.

Modelling of the land register with respect to proprietor rights resulted into title disputes. Title disputes were found out to mainly involve multiple titles. The study deduced multiple title disputes to be disputes constituted by the existence of two or more titles for a defined spatial unit (the same parcel of land). Multiple title disputes were found to be commonly propagated by myth of sanctity of title (GoK, 2002) acts of corruption and transposition of titles mostly amongst contiguous parcels.

6.4.3 Tenure Land Disputes

Modelling of proprietor (table 6-4) with respect to statutory tenure systems resulted into the fifth dispute typology; the Tenure Land Disputes. Three tenure types exist in the study area. They include; private, state and trust land tenures. Legal means to transfer parcel between these three tenure types exist. Disputes resulting from irregular transfer between the land tenure types were modelled as tenure disputes. Tenure dispute typologies were identified to include; dispossession and expropriation.



Figure 6-8; Caveat emptor on a dispossessed parcel

The irregular transfer of land under private or state or trust land to an individual or institution under private tenure constituted dispossession. In the study area, *dispossession disputes* resulted from:

- i. Irregular allocation of public land; In the study area, though most Trust and Public Lands were set aside for certain purposes because of their ecological integrity, cultural relevance or strategic location and could not be allocated to private use unless public interest dictates that they should (GoK 1999: 15), corrupt officials had allocated such land without reference to the foregoing imperatives. Because of this, public resentment set in leading to land dispossession related disputes.

Table 6-4; Tenure Dispute Modelling

Proprietor Modelling- Private State-Proprietor History				
Tool Name: Copy Rows				
Tool Source: C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\Table\CopyRows				
Parameters:				
<i>Name</i>	<i>Direction</i>	<i>Type</i>	<i>Data Type</i>	<i>Value</i>
Input Rows	Input	Required	Table View or Raster Layer	C:\Documents and Settings\wkalande\Application Data\ESRI\ArcCatalog\OLE DB Connection (6).odc\Private_State_Proprietor_History
Output Table	Output	Required	Table	J:\LAND DISPUTE CLASS. MODEL\UONfig\Modelling\DATABASE\UoNFIG.gdb\PuLG_OID
Configuration Keyword	Input	Optional	String	
Messages:				
Executing (Current ownership -vetting): CopyRows "C:\Documents and Settings\wkalande\Application Data\ESRI\ArcCatalog\OLE DB Connection (6).odc\Private_State_Proprietor_History" "J:\LAND DISPUTE CLASS. MODEL\UONfig\Modelling\DATABASE\UoNFIG.gdb\PuLG_OID" #				

ii. cultural relevance or strategic location and could not be allocated to private use unless public interest dictates that they should (GoK 1999: 15), corrupt officials had allocated such land without reference to the foregoing imperatives. Because of this, public resentment set in leading to land grabbing related disputes.

iii. Fraud; this was noted to have contributed to dispossession disputes for both public and private land. Disputes of this nature included;

- Incidences where a purchaser transferred more land to himself than he had bought.
- Ignorant land owners being tricked to sign land transfer documents or swear affidavits in court only to realise they had sworn to transfer their parcels.
- Multiple sales of parcels and
- Gazetting of titles as lost titles to land and acquisition of new titles to the same parcel.

iv. Trustee relationships- In the study area, it was identified that both in the intestate and testamentary succession an executor acts on behalf of the family until grants are issued to the beneficiaries. Often the trust relationship between the beneficiaries and the trustees is abused with the executor going all the way to have all the property registered in his name. Disinherited family members found it almost impossible to challenge a first registration where the registered trustee proprietor was an executor of the estate. Adversely affected family members were subjected to the rigours of having to establish that a trust relationship exists between them and the dishonest family member (GoK, 2002). Because of the high cost of litigation, lots of victims were found to suffer silently

The second tenure disputes was Expropriation Disputes; One of the residual powers that the state derives from the Constitution as the owner of radical title is *eminent*

domain which gives the state or its assigns (e.g county councils) the right to compulsory acquire private land for public purposes. In the study area, this was implemented through the Land Acquisition Act. The Act empowered the Commissioner of Lands upon demonstrable public interest, issuance of due notice in the government gazette and upon full payment of full compensation to all persons having interest in the property, to acquire any piece of land which the minister is satisfied that it is required for public use (Ojienda, 2008: 91) and ensure the parcel is not used for the purpose other than the one it was acquired for. The model revealed a number of cases where one or a number of these conditions had not been met. A case in which the government failed to meet these requirements stipulated in law and moved on to compulsory acquire private property or set apart trust land was considered expropriation. Assertion of conflicting ownership or land rights claims by government/agent of government like municipal council and individuals from whom such land has been acquired from constituted expropriation disputes.

6.4.3 Land Rights' Disputes

Modelling of disputes (table 6-5) with respect to claimed rights gave forth land rights' disputes. Land rights' disputes were found to include;

- i. *Restrictive Rights Disputes*; Restrictive rights are rights effectively limiting a proprietor for the benefit of another from building on his land to a certain extent or restricting its use in a particular manner. Restrictive rights' disputes involved cases where enforcement of such rights was contested. Restrictive rights' disputes identified in the study area were land use and transactional related. Restrictive land use disputes mainly involved restriction of building of houses of worship and planting of certain trees on boundaries (figure 6-9).

Table 6-5: Land rights modelling

LAND RIGHTS MODELLING

Tool Name: Add Join

Tool Source: C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\Joins\AddJoin

Parameters:

<i>Name</i>	<i>Direction</i>	<i>Type</i>	<i>Data Type</i>	<i>Value</i>
Layer Name or Table View	Input	Required	Table View or Raster Layer	Parcels
Input Join Field	Input	Required	Field	Parcels.PARCELREGI
Join Table	Input	Required	Table View or Raster Layer	J:\KALANDE PERSONAL\UONfig\Modelling\DATABASE\UONfig.mdb\LAND_RIGHTS_CLAIM
Output Join Field	Input	Required	Field	PARCEL_REGISTRATIO_NO
Keep All	Input	Optional	Boolean	true
Output Layer Name	Output	Derived	Table View or Raster Layer	Parcels

Messages:

Executing (Vetting Land Rights Claims): AddJoin Parcels Parcels.PARCELREGI "J:\KALANDE PERSONAL\UONfig\Modelling\DATABASE\UONfig.mdb\LAND_RIGHTS_CLAIM" PARCEL_REGISTRATIO_NO KEEP_ALL Parcels

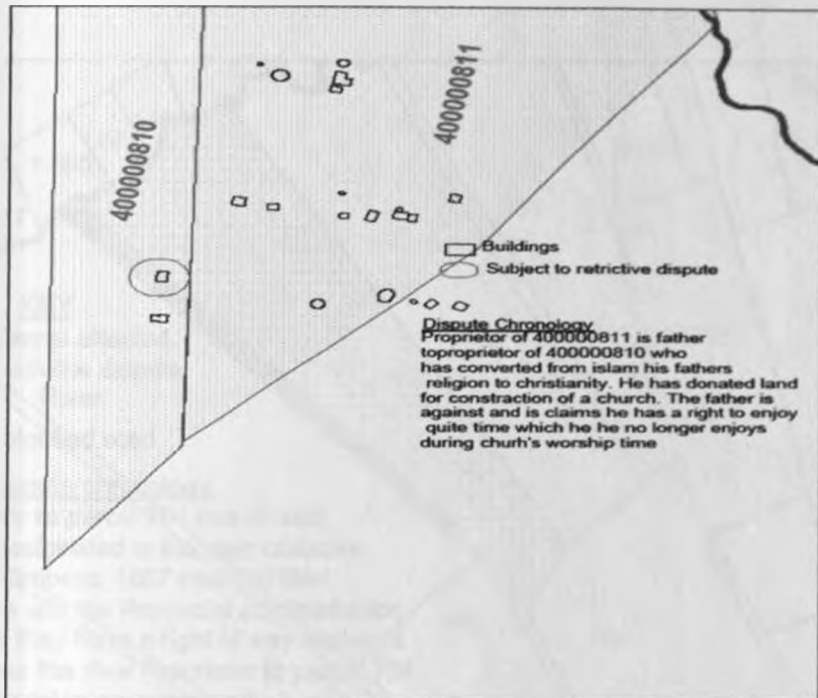


Figure 6-9; Restrictive Rights Land Dispute

Restrictive transactional rights disputes were mainly disposal land rights disputes. Mostly disputes of this nature restricted a proprietor from disposing or leasing his parcel. Such restrictions were often found to have been imposed by claimants who had interests in the parcel.

- ii. *Easement Disputes*; Easement is considered a right attached to a parcel of land which allowed its owner to use the land of another person in a particular manner or to restrict its use to a particular extent; but this right, by definition does not include profit, which is a right to go on the land of another and do something on it (Ojienda, 2008: 112). Easement disputes majorly included right of way (Figure 6-10) and right to water points.

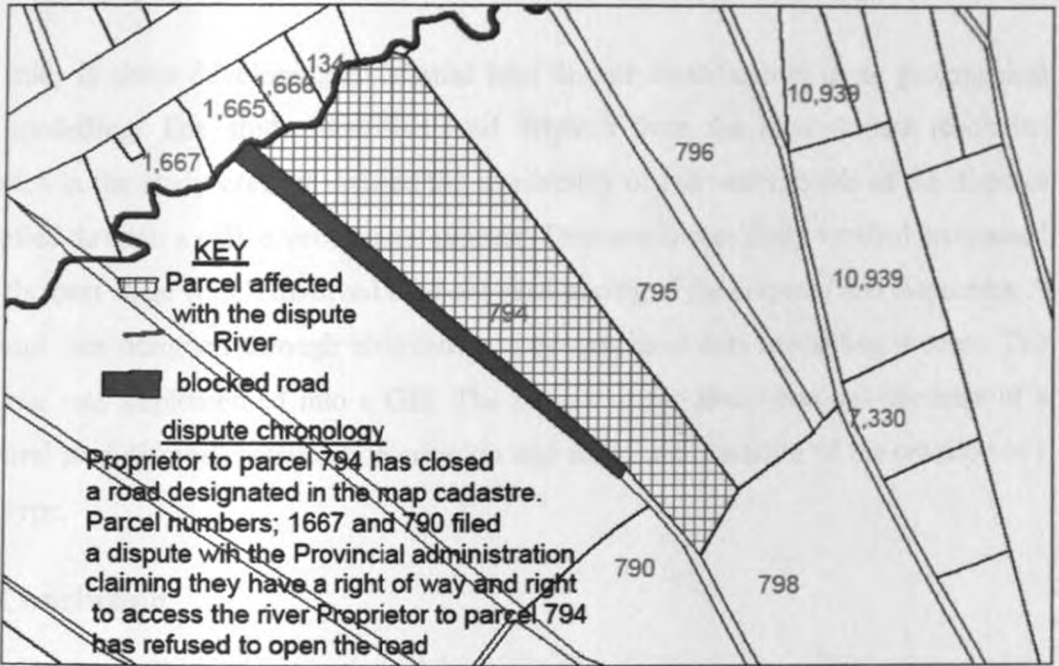


Figure 6-10; Easement Dispute- Right of way and right to access river

7. Conclusion and Recommendations

7.1 Summary

The study is about developing a cadastral land dispute classification using geographical data modelling. The study identified land disputes from the land dispute resolution agencies in the study area; it verified the availability of relevant records of the disputes identified through a office verification process. Disputes successfully verified progressed onto the next stage which involved field physical tracing of the disputes and disputants. A database was designed through abstraction; a geographical data modelling process. The database was implemented into a GIS. The climax of the study was development of a cadastral land dispute classification criterion and the implementation of the criterion in a prototype.

7.2 Conclusion

The following can be concluded from this study;

Land disputes can be identified

The study identified land disputes from the land dispute resolution agencies. Four land dispute resolution agencies operate in the study area. They include the Provincial Administration, The district Land Office, The District Magistrates Court and the Land Dispute Tribunal. One land dispute can be identified with more than one land dispute resolution agency. When and how a dispute is reported and hence can be identified by a certain dispute agency is determined by the affordability and access to the land dispute agency, evidence in possession of the disputant and time taken before resolution of dispute since its inception. It is most likely that a dispute is bound to be first identified by the Provincial Administration followed by the District Land Office followed by the District Magistrate Court and finally the Land Dispute Tribunal. The later the resolution agency in the resolution hierarchy the easier it is to trace a land dispute on ground, because more information about the dispute, disputants and parcel in question is availed

Cadastral Records and details are not a prerequisite at the time of reporting a dispute to the dispute resolution agencies

An attempt to verify the availability of dispute records and their validity confirmed resolution agencies do not pay attention to the land dispute cadastral records and their validity at the time a land dispute claim is reported. An office and field verification intended to check cadastral records and their validity ended up with only 20% of the identified disputes being successfully verified. This finding affirms that members of dispute resolution agencies have very little access to land registries. Reasons for limited access to the land registry by members of the resolution agency are threefold. First these members lack cadastral knowledge to prompt the need to request for cadastral records or demand access to the land registry. Secondly, in cases where by virtue of experience members realize the need for cadastral records, they lack adequate resources to access and purchase such records. Thirdly, the study noted whereas dispute resolution agencies were highly decentralized, land offices were only available in the proposed county de facto headquarters. This limits access to land records by disputants and agencies in far flank areas.

Geographical Data Modeling can be used to develop a Cadastral Land Dispute Classification System: Geographical Data Modeling was used by the study to develop a Cadastral Land Dispute Classification System. A conceptual Model was abstracted from the land dispute real world. Land dispute entities were identified. The logical data model was developed showing each entity, its attribute and how it relates to the other land dispute entities. The logical model was implemented in ArcGIS through physical modeling. Through digitizing and mapping, datasets were extracted from primary and secondary land dispute sources. The extracted datasets were populated in spatial Database and non spatial database. A Cadastral Land Dispute Classification Prototype was modeled in ArcGIS Model builder. A validation process was inbuilt in the model to ensure spatial and non spatial datasets are linked. It was noted the classification model only validates disputes whose cadastral details are captured. A cadastral classification is also inbuilt in the classification model. All cadastral dispute typologies are posted on a map to indicate their spatial distribution and location.

Cadastral Land Dispute Classification should be put in place.

User needs assessment revealed high demand for a ubiquitous cadastral land dispute classification model that would perform the following tasks;

- Classify land disputes and post them to the land register
- Classify land disputes and publish all relevant dispute evidence and records
- Classify land disputes and post lists and maps to land dispute resolution agencies and land control boards.

7.3 Recommendations

Based on the findings of the study, discussion and conclusion, this study recommends the following:

Development of a Land Dispute Information System: Only 20% of all land disputes identified by the dispute resolution agencies used by this study had records. Records available were in custody of secretaries to the land dispute resolution agencies. They were therefore more of personal than public records. Availability of records was at the whim and mercy of the agency's secretary. Such records cannot be effectively put to use by the land market and for purposes of dispute management. Sessional Paper No.3 of 2009 on National Land Policy proposes the formulation of an efficient Land Information Management System. The proposed Land Information Management Systems is silent on how it will deal with land dispute inventories. This study proposes development of a Land Dispute Information System to work hand in hand with the proposed Land Information Management System. The Land Dispute Information System should among others enable;

- i. Recording of land disputes at any point. Use of mobile telephony to report cadastral land disputes should be made possible.
- ii. Incorporation of the cadastral land dispute classification model. Upon validation of a reported dispute by the Community Land Boards (CLB), the Land Dispute Information System should automatically classify the respective land disputes. Classified disputes should be

transmitted on to the right resolution agency. The classified disputes should also immediately get appended to the land register with a detailed proper description of the exact type of dispute.

Creation of Land Advisory Commissions to advice proposed Land Dispute Resolution Agencies: In spite of the high redundancy of land disputes among land dispute resolution agencies, 80% of disputes identified by the agencies had no credible cadastral detail and dispute records. Certainly, the agencies resolution disputes operating in the study area do not give much attention to cadastral details of reported land disputes. This is because agencies' members lack proper cadastral knowledge. This study proposes establishment of a Land Dispute Advisory Commission to seal this loophole.

This recommendation will fit in well with the recent legislation. The Constitution of Kenya (2010) vests resolution of land disputes to the National Land Policy and the National Land Commission. National Land Commission is yet to be formed. The National Land Policy is in place (GoK 2009) and proposes the repealing of the Land Disputes Tribunal Act (No. 8 of 1990) to allow establishment of appropriate and inclusive institutions for dispute resolution with clear operational procedures and clear record keeping for making decisions at the Community level, District level and in a division of the High Court. The opportunity provided by the National Land Policy to establish all inclusive institutions should be exploited to constitute the Land Dispute Advisory Commissions.

The Land Dispute Advisory Commissions should be constituted by multidisciplinary commissioners who should include among others professionals with cadastral knowledge. Any dispute should first be reported to a Land Dispute Advisory Commission for review and vetting to ascertain the subject matter in contention before being forwarded to the appropriate resolution agency. This will not only hasten dispute resolution but also ensure fair and accurate resolution of disputes.

Free and unrestricted access to land records by the Land Dispute Advisory Commission and Land Dispute Resolution Agencies: Unconditional and all time access to cadastres by the Land Dispute Advisory Commission and Land Dispute Resolution Agencies will be beneficial in two ways. First, it will help in understanding of the dispute before them and thus enable them come up with the most appropriate solution. Secondly, they will be empowered to timely and accurately advice the land registrar on registration and lifting of encumbrances on the registers when need arises. This will help avoid eliminate malicious placement of encumbrances on the land register and also prevent transacting of parcels with both new and long standing disputes.

Publication of cadastral land dispute registers and maps; The Constitution of Kenya (2010) assures security of land rights and transparent and cost effective administration of land. This cannot be achieved by lack of proper mechanisms to publish and distribute land dispute information. Restriction of display or distribution of registers of proprietors of undisputed land is in order if there is need. Such need however should not include concealing of disputes for the purposes of 'selling off the dispute'. Generation of public land dispute registers and maps will help eliminate inheritance of disputes especially through purchase. Apart from being public, such registers and maps should be ubiquitous in land offices of the Community Land Control Board, the District Land Control Board, the Land Dispute Advisory Commission, the National Land Commission and the Land Dispute Resolution Agencies.

Further study of land disputes: The Cadastral Land Dispute Classification carried out by this study touched on many issues, aspects of land disputes and land dispute classification. Not much is known about most of these issues because information on land disputes is at best general and at its infancy. The following have a direct relationship with cadastral land disputes and components of the cadastral land dispute classification model but could not be covered in this study. They are recommended for further study.

1. *The social aspects behind each cadastral land dispute typologies-* In total, the individual cadastral disputes are a relationship of expressions of persons with respect

to a cadastral parcel. The study dwells on the cadastral aspects of this relationship. Human nature which is a fundamental entity in this relationship is neither considered in cadastral classification of these land disputes nor in the discussion of individual cadastral disputes. Studies need to be carried out to establish the social aspects of each cadastral land dispute.

2. *How each cadastral land dispute typology relates with HIV AIDS and Gender Inequality*; HIV and gender inequality featured prominently during dispute identification and verification. Women were found most disadvantaged; they were often disposed and badly humiliated during dispute resolution. 79.8% of the disputes which were identified and could not be verified because hostility had women as the complainants.

HIV related deaths were noted to have completely complicated the land delivery process. Premature deaths in both the second and third generation after Kenya's independence occasioned by the HIV scourge have in particular made generational transition of land ownership quite complex and highly contested. Studies need to be carried out to establish how each cadastral dispute contributes to cruel humiliations to families affected by HIV and gender inequality.

3. *Development of cadastral land dispute early warning models*; This study used cadastral knowledge and geographical data modelling to output distinct cadastral land dispute typologies. The two methods employed are by all standards exact sciences. A study should be carried out to investigate if the methods employed in this study can be used further to derive a correlation between individual cadastral land disputes and their principal causes. Principal causes of land disputes were noted during this study to include; intimate relationship between kinship and land, late transformation of land into a marketable commodity, evolution of tenure, design and organisational structure of cadastral systems. It should be established if correlations derived between these principal causes and individual land disputes can be used to develop cadastral dispute predictive models and early warning systems.

4. *Development of cadastral resolution models*; Sections 60 and 67 of the Constitution of Kenya 2010, requires the National Land Policy and the National Land Commission to encourage settlement of land disputes through local community initiatives consistent with the Constitution. According to the constitution, this is to be achieved by application of traditional dispute resolution mechanisms. The constitution is vague and not explicit as to what these traditional dispute resolution mechanisms exactly are. Traditional dispute resolution mechanisms can be interpreted to either mean customary land dispute resolution mechanisms or proven workable dispute resolution methods or established practice or routine mechanisms.

If interpreted to mean customary land dispute resolution mechanisms, two challenges arise. First customary resolution mechanisms have not been gazetted; at best they are agreed tenets within a certain community. If applied, they could be fiercely challenged both in the public opinion and judicial court. This would most likely only help exacerbate land disputes. Secondly, a lot of disputes are intra communal and thus customary land dispute resolution mechanisms cannot be applied.

If interpreted to mean proven workable dispute resolution methods or established practice or routine mechanisms then it is quite likely dispute resolution is going to be held hostage to the past institutional weaknesses as noted in *GoK 2002: 78*. First, the current formal and informal curative resolution mechanisms are too general and not specialised to face off the usually unique, distinct and technical land disputes. Usually, land disputes involve more complex and unique questions of law or fact or technical cadastral subject matter beyond the competence of the tribunal and legal instruments in use. Most decisions reached are therefore incompetent and cannot be certified as best established practice. Secondly, records of land dispute proceedings and decisions do not exist and there are therefore no references to be made to. A study should be conducted in various cadastral jurisdictions to detail successful resolution mechanisms to individual cadastral land disputes. This should be packaged

into land dispute resolution models which can be gazetted and adopted as traditional dispute resolution mechanisms.

Though the Sessional Paper No.3 of 2009 and the new Constitution of Kenya promulgated in August 2010 were formulated to correct these challenges, and have proposed amendment to several acts of parliament. If successfully amended, it is expected certain disputes will no longer come up. Two challenges are however expected. One certain disputes are bound to evolve and appear in new forms.

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Appendix A- Land Dispute Identification Questionnaire

To be conducted through a verbal interview. This is meant to be answered members of the four land dispute resolution agencies in Bungoma Municipality

Section 1- Particulars of Dispute Resolution Agency's Member

Name

Age

Sex

Contact Details (Mobile telephone Number)

Level of Education

Dispute Agency

Date of recruitment into dispute resolution agency

Section 2- Land Dispute Identification (Intention-Engage the village members in the land dispute identification process.)

2a- List land disputes recently reported to your agency (Recorded and Not recorded)

Dispute NO	Date Reported	Disputants	Cause	Parcel No	Village

2b- List land disputes recently resolved by your agency (Recorded and Not recorded)

Dispute NO	Date Reported	Disputants	Cause	Parcel No	Village

2a- List long standing land disputes you may no off within the jurisdiction of you dispute resolution agency (Recorded and Not recorded)

Dispute NO	Date Reported	Disputants	Cause	Parcel No	Village

Section 3- Experience with Land Disputes (Intention-Background Information to verify qualitative and quantitative accuracy of land disputes listed by the interviewees in the first questionnaire).

1. a. List some of the land disputes that you were unable to solve?
 - b. Why were you not able to solve?
 - c. What action did you take when you realized you could not solve some of the cases?
 - a. referred to higher authority
 - b. Just left
 - c. Told to come later after consultation
2. Are there some land disputes you solved exceptionally well?
3. Are there some land disputes you solved so poorly?
4. Do you have a special record of land disputes brought to your office for resolution?
5. What are the challenges you face while solving land disputes?

For each challenge try linking it to a particular dispute

Appendix B- Cadastral Land Dispute Classification Database User Needs Assessment Questionnaire

Was conducted through a written interview and was meant to be answered by potential users of the cadastral land dispute classification model. The questionnaire was sent to banks, dispute resolution agencies, disputants, land control boards and legal officers within Bungoma Municipality.

Section 1- Particulars of Potential Users of the Database

Name

Age

Sex

Who do you work for?

Banks/ dispute resolution agency/ disputant/, land control board/ legal officers

Section 2- User Needs Assessment

2 a) How frequently do you need land dispute information?

1. Rarely
2. Often
3. Very frequently

2 b) What do you need dispute information for?

1. To advice clients
2. To make organisational Decisions
3. Personal decision making
4. Land Administration

2 b) Would you use a cadastral land dispute classification database?

1. yes
2. No

If yes, what would you want to use it for?

1. Extraction of location and distribution of general land disputes
2. Extraction of disputed parcels 'list
3. Identification of disputants
4. Identification of dispute information with respect to;
 - a. Disputant information
 - b. Parcel Information
 - c. Relevant affected cadastral records
 - d. Dispute Evidence records
5. Cadastral dispute typologies details for each disputed parcel
6. Cadastral dispute location and distribution maps
7. Other (please specify)

Appendix C- LDCM Process Reports

Cadastral Vetting- LRD

Tool Name:Select Layer By Attribute

Tool Source:C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\Layers and Table Views\SelectLayerByAttribute

Parameters:

<i>Name</i>	<i>Direction</i>	<i>Type</i>	<i>Data Type</i>	<i>Value</i>
Layer Name or Table View	Input	Required	Table View or Raster Layer	Parcels
Selection type	Input	Optional	String	NEW_SELECTION
Expression	Input	Optional	SQL Expression	"LAND_DISPUTE_CLAIMS.New_Number_Claims" = 'Yes' AND "LAND_DISPUTE_CLAIMS.Proprietor_Death_Claim" = 'No' AND "LAND_DISPUTE_CLAIMS.Proprietor_Claim" = 'Yes' AND "LAND_DISPUTE_CLAIMS.Ascendant_Rel_with_P" = 'Yes' AND "LAND_DISPUTE_CLAIMS.Map_Cadastre_Claim" = 'Yes'
Output Layer Name	Output	Derived	Table View or Raster Layer	Parcels

Messages:

Executing (Cadastral Vetting- Parcels): SelectLayerByAttribute Parcels NEW_SELECTION
 ""LAND_DISPUTE_CLAIMS.New_Number_Claims" = 'Yes' AND
 "LAND_DISPUTE_CLAIMS.Proprietor_Death_Claim" = 'No' AND
 "LAND_DISPUTE_CLAIMS.Proprietor_Claim" = 'Yes' AND
 "LAND_DISPUTE_CLAIMS.Ascendant_Rel_with_P" = 'Yes' AND
 "LAND_DISPUTE_CLAIMS.Map_Cadastre_Claim" = 'Yes' Parcels

Start Time: Wed Nov 17 16:03:30 2010

Executed (Cadastral Vetting- Parcels) successfully.

End Time: Wed Nov 17 16:03:30 2010 (Elapsed Time: 0.00 seconds)

Process vetting

Tool Name:Select Layer By Attribute

Tool Source:C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\Layers and Table Views>SelectLayerByAttribute

Parameters:

<i>Name</i>	<i>Direction</i>	<i>Type</i>	<i>Data Type</i>	<i>Value</i>
Layer Name or Table View	Input	Required	Table View or Raster Layer	Parcels
Selection type	Input	Optional	String	NEW_SELECTION
Expression	Input	Optional	SQL Expression	"LAND_DISPUTE_CLAIMS.Proprietor_Death_Claim" = 'Yes' AND "LAND_DISPUTE_CLAIMS.will_left_claims" = 'No'
Output Layer Name	Output	Derived	Table View or Raster Layer	Parcels

Messages:

Executing (Process vetting-wills): SelectLayerByAttribute Parcels NEW_SELECTION
""LAND_DISPUTE_CLAIMS.Proprietor_Death_Claim" = 'Yes' AND
"LAND_DISPUTE_CLAIMS.will_left_claims" = 'No'" Parcels

Start Time: Wed Nov 17 16:03:31 2010

Executed (Process vetting-wills) successfully.

End Time: Wed Nov 17 16:03:31 2010 (Elapsed Time:56.00 seconds)

Cadastral Matching

Tool Name: Make Feature Layer

Tool Source: C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\Layers and Table Views\MakFeatureLayer

Parameters:

Name	Direction	Type	Data Type	Value
Input Features	Input	Required	Feature Layer	Cadastral class and sub class Improprieties
Output Layer	Output	Required	Feature Layer	Expropriation, subdivision, succession, land rights, boundary.....
Expression	Input	Optional	SQL Expression	
Workspace or Feature Dataset	Input	Optional	Workspace or Feature Dataset	
Field Info	Input	Optional	Field Info	Parcels.PARCELREGI Parcels.PARCELREGI VISIBLE NONE;Parcels.ASUBDIVISI Parcels.ASUBDIVISI VISIBLE NONE;Parcels.SUBLOCATIO Parcels.SUBLOCATIO VISIBLE NONE;Parcels.ZONE Parcels.ZONE VISIBLE NONE;Parcels.Acreage Parcels.Acreage VISIBLE NONE;Parcels.CLAIMDESC Parcels.CLAIMDESC VISIBLE NONE;Parcels.Dispute_Typology Parcels.Dispute_Typology VISIBLE NONE;LAND_DISPUTE_CLAIMS.Parcel_Registration_No LAND_DISPUTE_CLAIMS.Parcel_Registration_No VISIBLE NONE;LAND_DISPUTE_CLAIMS.Proprietor_Claim LAND_DISPUTE_CLAIMS.Proprietor_Claim VISIBLE NONE;LAND_DISPUTE_CLAIMS.Map_Cadastre_Claim LAND_DISPUTE_CLAIMS.Map_Cadastre_Claim VISIBLE NONE;LAND_DISPUTE_CLAIMS.Encumbrance_Claim LAND_DISPUTE_CLAIMS.Encumbrance_Claim VISIBLE NONE;LAND_DISPUTE_CLAIMS.Land_Right_Claim LAND_DISPUTE_CLAIMS.Land_Right_Claim VISIBLE NONE;LAND_DISPUTE_CLAIMS.Register_Cadastre_Claim LAND_DISPUTE_CLAIMS.Register_Cadastre_Claim VISIBLE NONE;LAND_DISPUTE_CLAIMS.Land_Delivery_Process LAND_DISPUTE_CLAIMS.Land_Delivery_Process VISIBLE NONE;LAND_DISPUTE_CLAIMS.Occupation_Claim LAND_DISPUTE_CLAIMS.Occupation_Claim VISIBLE NONE;LAND_DISPUTE_CLAIMS.Ascendant_Rel_with_P LAND_DISPUTE_CLAIMS.Ascendant_Rel_with_P VISIBLE NONE;LAND_DISPUTE_CLAIMS.Proprietor_Death_Claim LAND_DISPUTE_CLAIMS.Proprietor_Death_Claim VISIBLE NONE;LAND_DISPUTE_CLAIMS.Beacon_Claims LAND_DISPUTE_CLAIMS.Beacon_Claims VISIBLE NONE;LAND_DISPUTE_CLAIMS.New_Number_Claims LAND_DISPUTE_CLAIMS.New_Number_Claims VISIBLE NONE;LAND_DISPUTE_CLAIMS.Unregistered_No_Claims LAND_DISPUTE_CLAIMS.Unregistered_No_Claims VISIBLE NONE;LAND_DISPUTE_CLAIMS.will_left_claims LAND_DISPUTE_CLAIMS.will_left_claims VISIBLE NONE;LAND_DISPUTE_CLAIMS.will_execution_claims LAND DISPUTE CLAIMS will execution claims VISIBLE

				NONE;PuLG_OID.Expr1000 PuLG_OID.Expr1000 VISIBLE NONE;PuLG_OID.Prev_ID PuLG_OID.Prev_ID VISIBLE NONE;PuLG_OID.Process_of_Acquisition PuLG_OID.Process_of_Acquisition VISIBLE NONE;PuLG_OID.PARCEL_REG PuLG_OID.PARCEL_REG VISIBLE NONE;PuLG_OID.ID PuLG_OID.ID VISIBLE NONE
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Messages:

```

Executing (Cadastral Matching 10): MakeFeatureLayer Parcels_Layer1 "Expropriation Land
Disputes" # # "Parcels.PARCELREGI Parcels.PARCELREGI VISIBLE
NONE;Parcels.ASUBDIVISI Parcels.ASUBDIVISI VISIBLE NONE;Parcels.SUBLOCATIO
Parcels.SUBLOCATIO VISIBLE NONE;Parcels.ZONE Parcels.ZONE VISIBLE
NONE;Parcels.Acreage Parcels.Acreage VISIBLE NONE;Parcels.CLAIMDESC
Parcels.CLAIMDESC VISIBLE NONE;Parcels.Dispute_Typology Parcels.Dispute_Typology
VISIBLE NONE;LAND_DISPUTE_CLAIMS.Parcel_Registration_No
LAND_DISPUTE_CLAIMS.Parcel_Registration_No VISIBLE
NONE;LAND_DISPUTE_CLAIMS.Proprietor_Claim
LAND_DISPUTE_CLAIMS.Proprietor_Claim VISIBLE
NONE;LAND_DISPUTE_CLAIMS.Map_Cadastre_Claim
LAND_DISPUTE_CLAIMS.Map_Cadastre_Claim VISIBLE
NONE;LAND_DISPUTE_CLAIMS.Encumbrance_Claim
LAND_DISPUTE_CLAIMS.Encumbrance_Claim VISIBLE
NONE;LAND_DISPUTE_CLAIMS.Land_Right_Claim
LAND_DISPUTE_CLAIMS.Land_Right_Claim VISIBLE
NONE;LAND_DISPUTE_CLAIMS.Register_Cadastre_Claim
LAND_DISPUTE_CLAIMS.Register_Cadastre_Claim VISIBLE
NONE;LAND_DISPUTE_CLAIMS.Land_Delivery_Process
LAND_DISPUTE_CLAIMS.Land_Delivery_Process VISIBLE
NONE;LAND_DISPUTE_CLAIMS.Occupation_Claim
LAND_DISPUTE_CLAIMS.Occupation_Claim VISIBLE
NONE;LAND_DISPUTE_CLAIMS.Ascendant_Rel_with_P
LAND_DISPUTE_CLAIMS.Ascendant_Rel_with_P VISIBLE
NONE;LAND_DISPUTE_CLAIMS.Proprietor_Death_Claim
LAND_DISPUTE_CLAIMS.Proprietor_Death_Claim VISIBLE
NONE;LAND_DISPUTE_CLAIMS.Beacon_Claims
LAND_DISPUTE_CLAIMS.Beacon_Claims VISIBLE
NONE;LAND_DISPUTE_CLAIMS.New_Number_Claims
LAND_DISPUTE_CLAIMS.New_Number_Claims VISIBLE
NONE;LAND_DISPUTE_CLAIMS.Unregistered_No_Claims
LAND_DISPUTE_CLAIMS.Unregistered_No_Claims VISIBLE
NONE;LAND_DISPUTE_CLAIMS.will_left_claims
LAND_DISPUTE_CLAIMS.will_left_claims VISIBLE
NONE;LAND_DISPUTE_CLAIMS.will_execution_claims
LAND_DISPUTE_CLAIMS.will_execution_claims VISIBLE NONE;PuLG_OID.Expr1000
PuLG_OID.Expr1000 VISIBLE NONE;PuLG_OID.Prev_ID PuLG_OID.Prev_ID VISIBLE
NONE;PuLG_OID.Process_of_Acquisition PuLG_OID.Process_of_Acquisition VISIBLE
NONE;PuLG_OID.PARCEL_REG PuLG_OID.PARCEL_REG VISIBLE
NONE;PuLG_OID.ID PuLG_OID.ID VISIBLE NONE"

```

Start Time: Wed Nov 17 16:04:16 2010

Executed (Cadastral Matching 10) successfully.

End Time: Wed Nov 17 16:04:16 2010 (Elapsed Time: 4.00 seconds)