IMPLEMENTATION OF RESPONSIBLE LAND GOVERNANCE: A LAND INFORMATION SYSTEM FOR SUSTAINABLE DEVELOPMENT IN TURKANA COUNTY

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Abstract

A land administration system provides the infrastructure to implement land-related policies and land management strategies. The basic theoretical framework for all land administration systems in the world over is the delivery of sustainable development; this forms the bottom line for economic, social and environmental development as well as good governance. Land administration systems are the basis for conceptualizing rights, restrictions and responsibilities related to people, policies and places.

This paper describes the development of a land information system through an initiative which has been championed by the United Nation-Food Agriculture Organization in partnership with the Global Land Tool Network (GLTN) of United Nations Human Settlements Programme to support Turkana County Government's Ministry of Lands, Physical Planning and Urban Areas Management to maintain the official records pertaining to land parcels in urban areas including the corresponding land use and tenure types.

The land information system will be based on a customized version of the Social Tenure Domain Model (STDM) tool. The focus of STDM is on all relationships between people and land, independently from the level of formalization, or legality of those relationships.

Key Words:

1. INTRODUCTION

The global population is facing a range of large scale challenges, which create increased competition over land at the transnational, national, sub-national, local and family levels. This competition will increase over the next decades. By 2050 the world's population will grow to around 9.6 billion people. Current rates indicate a global population growth of 1 billion every 12 years (United Nations Department of Economic and Social Affairs, 2013). More than 50 percent already live in urban areas. All these people will need shelter and have to be fed in a sustainable way. The impact of this growth will be the greatest in the developing world, and particularly in Africa, where large scale urbanization is expected (United Nations Human Settlements Programme, 2013). Yet, 70 percent of most developing countries are not covered by a land administration system, and even in the 30 percent where land administration exists, often there is no digital data as the systems are manual and paper-based (UNGGIM, 2015). Also, often national mapping is very out of date. This means that while there may in some instances be geospatial data for the 30 percent, there is often no national coverage of geospatial data for developing countries.

Food security is also a major issue. The Food and Agriculture Organization of the United Nations (FAO) estimates that 805 million people were chronically undernourished between 2012–2014, particularly in Sub Saharan Africa and Asia (Food and Agriculture Organization of the United Nations, 2014). Average annual growth rates of yields (output per hectare) for grains have actually been slowing in both developed and developing countries since 1985. Water is key to food security. Already two-thirds of global water supplies for irrigation are drawn from underground aquifers at unsustainable rates (FAO). The growing of crops is exacerbated by climate change according to the 2014 report from the United Nations Intergovernmental Panel on Climate Change (IPCC). Climate change could reduce food production growth by 2 percent each decade for the rest of this century. The IPCC concluded that "Global temperature increases of 4°C or more above late-20th century levels, combined with increasing food demand, would pose large risks to food security globally" (Intergovernmental Panel on Climate Change, 2014).

What this means in human terms is that, millions of people around the world face difficulties related to the land where they live, work, grow crops, tend animals and run businesses. Even though they or their families may have lived on the land for many years, it is a serious obstacle that they have no formal relationship to the land. Perhaps it is too expensive to get the official paper that documents their claim, or possibly inheritance laws or local customs prevent them from even making a claim. There are many reasons for insecure tenure especially for women and young people who are the most vulnerable.

While there are various key strategies and interventions in addressing poverty reduction, and sustainable development in general, land governance initiatives are increasingly becoming critically important. Good governance in land tenure and administration is recognized as essential for promoting economic development and ensuring good management through all levels of society. In this context, the development of reliable land information systems becomes strategic and useful to bridge the information divide.

Various literatures have pointed out that the benefits of land administration systems are enormous which include contribution towards poverty alleviation, security of tenure, management of land disputes, inclusive planning, management of natural resources and protection of the environment, amongst others (Antonio 2006, Burns 2007, Williamson et al 2009, Zakout et al 2006). However, in developing countries, cadastres and parcel-based land administration systems only covers about 30% of the country and 70% are not covered by any formal land registration and information systems (Lemmen, Augustinus, & van Oosterom, The Social Tenure Domain Model - A Pro-Poor Land Rights Recording System, 2009). Most of the poor are part of the 70% who have no legal, documented and registered land rights. What they have are informal, customary, unwritten and over-lapping land rights and claims.

The Global Land Tool Network (GLTN), and its more than 68 international partners, has been exploring solutions to address the above challenges through the development of pro-poor and gender appropriate land policies and tools. GLTN, as facilitated by UN-Habitat, is a global partnership of key international actors who are working together to specifically address land tenure and land governance issues.

Achieving food security for all is at the heart of the Food & Agriculture Organization of the United Nations (FAO), meaning that people have regular access to enough high-quality food to lead active, healthy lives. Amongst FAO's main goals is the sustainable management and utilization of natural resources, including land, water, air, climate and genetic resources for the benefit of present and future generations.

GLTN through joint initiatives with FAO are motivated to find solutions to land tenure issues and are committed to assist governments, land professionals and poor communities in urban and rural areas to improve tenure security at scale. In this context that the Social Tenure Domain Model (STDM) as a pro-poor land information system emerged. STDM is a more flexible land information system that can handle various types of land rights and social tenure relationships particularly in informal and customary settlements. Its framework is based on free and open software packages. It is based on the approved ISO standard on the Land Administration Domain (ISO 19152) being promoted by the International

Federation of Surveyors (FIG), amongst others. STDM is a specialization of LADM and through this data standardization and integration is possible (Lemmen, 2010).

2. THE SOCIAL TENURE DOMAIN MODEL

The Social Tenure Domain Model (STDM) is basically about people. It is about all people and all types of 'people – land' relationships (see Figure 1). 'People – land' relationships can be expressed in terms of *persons (or parties) having social tenure relationships to spatial units*.

Parties are persons, or groups of persons, or non-natural persons, that compose an identifiable single entity. A non-natural person may be a tribe, a family, a village, a company, a municipality, the state, a farmers' cooperation, or a church community. This list may be extended, and it can be adapted to local situations, based on community needs.

Land rights may be formal ownership, apartment right, usufruct, free hold, lease hold, or state land. It can also be social tenure relationships like occupation, tenancy, non-formal and informal rights, customary rights (which can be of many different types with specific names), indigenous rights, and possession. There may be overlapping claims, disagreement and conflict situations. There may be uncontrolled privatization. Again, this is an extensible list to be filled in with local tenancies. A restriction is a formal or informal entitlement to refrain from doing something; e.g. it is not allowed to have ownership in indigenous areas. Or it may be a servitude or mortgage as a restriction to the ownership right. There may be a temporal dimension, e.g. in case of nomadic behaviour when pastoralist cross the land depending on the season.

Spatial units are the areas of land (or water) where the rights and social tenure relationships apply. According to the LADM/STDM ISO-standard those areas can be represented as a text ("from this tree to that river"), as a single point, as a set of unstructured lines, as a surface, or even as a 3D volume. This range of spatial unit representation can cover community-based land administration systems, or rural, or urban, or other types of land administrations, like marine cadastres and 3D cadastres. Surveys may concern the identification of spatial units on a photograph, an image or a topographic map. There may be sketch maps drawn up locally. A sketch map may be drawn on a wall where a photograph is taken from.

2.1. LAND GOVERNANCE AND TENURE SECURITY

Addressing the land issues at global, regional, country and city/municipal level is indeed one of the major challenges of our times, both in regard to addressing poverty issues as well as sustainability issues. Land

related issues include unequal access to land and other natural resources, unsustainable land use, insecurity of tenure, weak institutions to resolve conflict, dysfunctional land markets and institutions and inefficient and inappropriate land administration systems (Palmer, Fricska, & Wehrmann, 2009). Indeed, land is increasingly recognized as an important governance issue.

2.2. THE GROWTH OF STDM AS A LAND GOVERNANCE TOOL

The development of STDM is to implement the concept behind the continuum/range of land rights. This technical gap was identified as early as 1998 where experts identified that there were various types and range of tenure arrangements that could not be included or fit with the conventional land registration systems and parcel-based spatial description of the rights (United Nations Economic Commission for Africa, 1998). This thinking progresses until the beginning of 2000 where a number of key people in the land administration field became aware and convinced that the conventional land registration and administration systems is not sufficient and not always appropriate for the range of tenure types that exist such as for the pastoralists, customary and slums. (Fourie, 2001) further advanced the idea of the need for new forms of spatial information, not the cadastre, to provide tenure security in informal settlements and customary land.

Over time, it became clearer that this gap, aside from impacting on the security of tenure of the poor, was contributing directly to chaotic and unsustainable cities, mismanagement of the scarce natural resources (e.g. forest), environmental degradation, delays in conflict management and proliferation of slums and informal settlements (Augustinus, Improving Access to Land and Shelter - Innovations in Land Rights, Recognition, Administration and Governance, 2009). Christian Lemmen of the Faculty of Geo-Information Science and Earth Observation (ITC) of the University of Twente took the lead in developing the solutions to fill this technical gap from 2002 onwards by starting to develop the Social Tenure Domain Model (STDM) at the conceptual level alongside with the development of the FIG-led Land Administration Domain Model (LADM) (Augustinus, Lemmen, & van Oosterom, 2006). University of Twenty (ITC) was then financially supported by GLTN to further develop the design of the model including the technical aspects. FIG, through the leadership of then President Stig Enemark, has supported its development including the peer-reviews of STDM designs (i.e. conceptual, technical and functional) by known land professionals. In 2009, the initial version of the STDM prototype was tested by UN-Habitat and ITC in the context of the rural land administration in Ethiopia, particularly in Amhara region in collaboration with the World Bank (Zevenbergen & Haile, 2010). The STDM prototype was then launched during the FIG Congress in Sydney, Australia, April 2010 including the new joint publication with FIG and ITC: 'The Social Tenure Domain Model - A Pro-Poor Land Tool. STDM was

also highlighted in the Sydney Declaration (www.fig.net). Finally, the tested STDM prototype including the designs was finally handed over by ITC to UN-Habitat/GLTN Secretariat in August 2010.

Since then, UN-Habitat/GLTN Secretariat has been working on its enhancement and further development in three areas: adding more functionality, improving the user-friendliness of the software and reshaping STDM system to cater for the information needs and requirements across different application contexts. In addition, GLTN has been put in place an outreach strategy that seeks to create awareness and build capacity in the use and application of STDM across a wide range of stakeholders.

FAO and GLTN, see the importance of prioritizing and addressing issues related, but not limited, to customary land because of its huge potential to contribute to poverty reduction and positive potential impacts at a global level. In this regard, the two agencies have embarked to support the Ministry of Lands, Physical Planning and Urban Areas Management, Turkana County Government, Kenya, to develop and rollout a land information system for managing tenure with regard to urban and customary land within the County.

3. THE STDM IMPLEMENTATION IN TURKANA COUNTY

FAO's pilot project *Support for the responsible governance of land and natural resources in communal lands of Kenya*, is funded by the European Union and implemented directly by FAO in two predominantly pastoralist counties. The project is an implementation of the Voluntary Guidelines on Responsible Governance of Tenure of Land, Fisheries and Forests in the context of National Food Security and the Framework and Guidelines on Land Policy in Africa. The project contributes to FAO's strategic objective 2 i.e. increase and improve provision of goods and services from agriculture, forestry and fisheries in a sustainable manner. The Voluntary Guidelines are intended to contribute to the global and national efforts towards the eradication of hunger and poverty, based on the principles of sustainable development and with the recognition of the centrality of land for development by promoting secure tenure rights and equitable access to land, fisheries, forests other natural resources.

Turkana County is one of the counties of support and is at least 90% under customary tenure though with increasing large scale investments in oil and other minerals. FAO agreed to support the county in the framework of the referred project in three areas: strengthening community land rights, county land use planning, and establishing a land information management system (LIMS), which would include the registry. The obvious relationship between all three areas of support behooved a central management system that could make the technological links and capture the information through a centralized information system.

From May to August 2015, FAO and GLTN discussed on how to jointly support the County Government of Turkana in securing land tenure for the local communities and support recordation of urban land in major towns in the County through technical support, capacity building and institutional reforms. In October 2015, they signed a joint Agreement to design, develop, deploy and build capacity on a land information system for the Ministry of Lands, Physical Planning and Urban Areas Management with an initial pilot focusing on capturing tenure information in Lodwar town.

3.1. SYNOPSIS OF TURKANA COUNTY, KENYA

Situated in northern Kenya, about 700km from Nairobi, Turkana County is the second largest county in Kenya covering 68,680 square kilometres (see Figure 2). Turkana shares its borders with four counties: Marsabit to the East, Samburu to the South-East, Baringo and West Pokot to the South-West. The county also borders with South Sudan to the North, Uganda to the West and Ethiopia to the North-East. The geo-political location and ecological variability of Turkana County has influenced resource use and political conflicts with neighboring pastoral groups, as well as neighboring countries, in the past and present. Access to land, especially in the rural areas within the County, is more widely discussed from a livelihood perspective under the right to food as opposed to as an economic right (Gottero, 2015).

However, the discovery of oil has opened up Turkana County to further explorations and exploitations of the oil fields. For decades the community living in Turkana has largely been excluded, marginalized and locked out of the formal economy through lack of security, access to education, infrastructure and other public services. They are also among the most marginalized communities in Kenya and often experience drought, famine and starvation resulting in reliance solely on relief food. However, the recent developments in oil exploration by multi-million investors, both regional and international community, and upstream oil companies has subsequently led to the local community raising concerns over land rights as well as environmental rights.

Turkana is customarily community land and has never been adjudicated as such or as any other category of land, and therefore it is held in trust by the County Government on behalf of communities. Most of the land owners (a handful or urban dwellers) only have allotment letters. The County Government has embarked to ensure that all land users and practices under pastoral tenure conform to the principles of sustainable development; that there is equitable access to land and security of land rights.

3.2. PURPOSE, PARTNERSHIP, PROCESS

PURPOSE

The specific objective of the partnership was to pilot the use and application of STDM in the context of a County Land Information System for managing tenure in the context of urban and rural land, and to document the processes as well as build capacity on its use and capabilities - with the opportunity of scaling it up to also manage customary rights for communities within the County. The long-term objective is to address the land information requirements of women and men in pastoral communities. Consequently, this is meant to reduce conflict for grazing and water resources between communities; improve tenure security; form a basis for inclusive planning and enhancing access to basic services and infrastructure.

PARTNERSHIP

There are various partners in the project and they can be classified according to their roles and responsibilities i.e. the facilitator, the supporter and beneficiary. The partners and their respective roles are discussed below:

The 'Facilitator'

Food and Agriculture Organization (FAO) – Aside from being the implementing agency for the Project, FAO strategically placed the Project as a pilot case study for implementing the Voluntary Guidelines on Responsible Governance of Tenure (VGGT) in arid and semi-arid regions of Kenya. The initial successes, challenges and lessons learnt will be carried over in the upscaling of similar initiatives in other counties in the country.

The 'Supporter'

UN-Habitat/GLTN Secretariat – Aside from co-financing and leading the technical implementation of the Project, UN-Habitat/GLTN Secretariat provided technical support and facilitate capacity development initiatives. Specifically, UN-Habitat/GLTN Secretariat led in the customization of STDM to suit the local context and facilitated the implementation of the associated capacity development initiatives.

The 'Beneficiary'

Citizens from the urban and adjacent rural lands of Lodwar town. Although this has been the focus so far, as the project continues the coverage will expand and community engagement will also increase. The Ministry of Lands, Physical Planning and Urban Areas Management (MLPPUAM), Lodwar, Turkana County – The Ministry, through its leadership particularly the Chief Officer, has provided enormous support to ensure that the project deliverables have been met. Aside from hosting staff from FAO and

UN-Habitat/GLTN Secretariat during the entirety of the project, it has allowed its limited staff to fully participate and provide inputs during the entire process including system design and modeling, review of survey plans and ground truthing.

PROCESS

Below were the key processes and activities adopted and implemented by the Project:

Planning and consultations – Prior to project kickoff, GLTN and FAO conducted a joint scoping mission in order to identify the scope and requirements of the Project. This involved interviews with key staff in the Ministry; reviewing existing datasets, both spatial and tabular; walking through the existing billing system for capturing land rates payments and reviewing the business processes within the Ministry. Upon signing the Agreement, the technical exchanges continued and these yielded in the understanding of STDM and its application in the context of the County Land Information System; the development of an implementation plan, the recruitment of onsite consultants to provide technical support in the project implementation; agreement on the roles and responsibilities as well as the identification and mobilization of the needed support and resources.

System design – Interviews with key staff from the Ministry – Chief Officer, System Administrator, Chief Planner, and County Surveyor – assisted in identifying and refining the system requirements for the Land Information System. A Software Requirements Specifications document was developed and which formed the framework of developing, testing and evaluating the system functionality. The Turkana County Land Information Management System is a desktop Windows-based client-server system which provides a centralized and integrated framework for:

- Managing land parcels in a GIS environment including the land-use types;
- Linking the land parcels to their corresponding owners;
- Handling land rate payments made by or on-behalf of the parcel owners;
- Designing and generating map-based documents and reports;
- Feeding and receiving feedback of information captured from the land use planning process.

See figure 3 showing the architecture model of the system.

Data collation – This involved reviewing parcel boundaries from the existing survey plans that had been prepared by the Survey office in the Ministry. These were digital copies in DXF format which were subsequently auto-traced to polygons, projected to the local coordinate system and imported to the spatial

database. Unique parcel numbers and corresponding land use types were finally assigned to each parcel. Existing person records from the billing system were imported from MS-Access, formatted in MS-Excel and finally imported into the central database. Tenure relationships were created for individual land owners as well as for institutions with lease agreements.

STDM customization – The process involved customizing the system's data fields to match those for entities specified in the UML class diagram. Additional modules were also developed to enable seamless management of survey data from the field. Customized modules for performing spatial queries and generating map reports were tested and integrated into the tool.

Refactoring the billing system – The initial billing system for recording land rates payment was based on an MS-Access database. Part of the capacity building involved providing technical guidance in refactoring the VB.NET source code so that the system could now connect to the central repository, based on a PostgreSQL/PostGIS database.

Data validation and continuous updating – As part of quality assurance, the gathered information were validated by the key staff from the Ministry. Ground truthing was conducted for select parcels to ensure that the respective coordinates captured in the system matched the observed field coordinates. This process enhanced the acceptability of the information and all stakeholders appreciated the fact that the turnaround time between the field surveys and the production of results was relatively fast. After the validation period, the Ministry's surveyors and accounts officers continued updating the information in the system. Key personnel from the Ministry were trained to manage the system and to continue the updating process.

3.3. INITIAL IMPACTS, CHALLENGES AND LESSONS LEARNT

Key personnel from the Ministry including their clientele, of whom parcel owners were a part of, appreciated the added value of the LIS in addressing their information requirements. Moreover, they appreciated the system as a potential tool for much larger urban development objectives. Previously, the key challenge was manually synchronizing data updates where data on parcel owners, land rates payments and parcel location was stored in separate workstations; however, with the deployment of the LIS, data was now managed from a single central repository which ensured that data updates could be accessed in real-time across the local area network.

In summary, here are the initial impacts/achievements of the partnership in the framework of FAO's Land Governance Project:

- STDM, as a LIS, was tested and proven to be technically sound to address the information requirements of Turkana's County Government Ministry of Lands;

- Key staff from the Ministry are able to use and interact with the system and are confident to continuously manage and update the information;

- The LIS will greatly assist the County Government in implementing and realizing the strategic urban plan for Lodwar sub-County;

- The recently initiated land use planning process for the entire county will produce data that can be captured by the same LIS, including the community land rights as the legal framework will final allow for it during 2016;

- The use of administrative area codes (built from the corresponding hierarchy) for numbering parcels provided a uniform and consistent addressing system which could be adopted in other sub-counties;

- Increasing demand to use and apply STDM in other counties in Kenya.

The key challenges encountered by the Project include the following:

- Some apprehension in using a new tool as STDM. As expected, there were some apprehensions in using STDM because some staff were used to using other tools in mapping and database management and some staff were concerned about introducing a system like STDM might introduce delays or complexities;

- Transition from a Municipal to County Government led to a situation where not all land records were handed over to the Ministry. As such, we had a situation where hard copy survey plans previously held by the Municipal Government were still not accessible by the County Government. However, discussions are ongoing on the modalities of handing them over to the Ministry;

- In order to fully cover the rural areas, the Community Land Bill must be enacted (deadline for Parliament is August 2016). Although the national land policy protects communities, the legal procedures for securing community land is not yet in place;

- The Ministry had limited technical staff and as such, it was a challenge to dedicate a business process owner to drive the project implementation from the Ministry's side. This led to delays in gathering and refining the requirements as well as coordinating system testing and compiling feedback;

- There was no ICT strategy in place and associate network infrastructure to support deployment of the system in the Ministry. As such, considerable resources had to be invested in building ICT capacity within the staff and setting up the required network and server infrastructure for the system;

- More time is required for sensitization and training. It is clear that more time should be allocated in training the technical staff in using and maintaining the system.

There are valuable lessons learned during the project design and implementation, these are:

- The Project is a good model for partnerships. The partnership between the international organizations, national institutions and local authorities proved to be the 'facilitating' agents of change and innovations. The Project was well received because all stakeholders were part of the implementation and existing projects/initiatives were considered in the design and implementation.

- The Social Tenure Domain Model (STDM) was proven to be technically sound and simple to use. Also, key personnel from the Ministry appreciated the capacity of STDM to customize and generate reports and as well as perform spatial analysis as soon as the data has been captured or entered into the system;

- Ownership by the Ministry of the process is critical for success.

- Capacity development is a catalyst for sustainability. The project is clear that one of the most important elements of sustaining the development of a land information system like STDM is about capacitating the key users on its use and on data updating and management. In addition, the business processes for managing the data need to be clearly documented and incorporated in the standard operating procedures for the surveyors and accounts officers.

4. OPPORTUNITIES FOR SCALING UP AND WAY FORWARD

With the successful implementation of the LIS, the demand for its application and implementation has steadily increased including for potential use/application in other counties in Kenya. It is becoming clear that STDM is one significant tool that local governments can adopt for development objectives like inclusive planning, tenure security improvement and provision of basic services and infrastructure. As FAO scales up its pilot project form mid 2016 into a larger program that covers a total of 8 counties, a similar model will be replicated to address land information management needs.

Both FAO and GLTN are actively involved in the development of standards and guidelines for National Land Information Management System (NLIMS) for the National Land Commission of Kenya (NLC), and this partnership will provide a valuable case study for NLC on how to roll out and integrate the NLIMS with county-level land information systems. The NLIMS is based on LADM and since STDM is also a specialization of LADM then it is anticipated that the integration of the two systems will be as seamless as possible with minimal challenges expected.

In regards to further development of STDM as an information system, it is envisioned that more partnerships will be forged and mobilized including tapping the support and cooperation of other GLTN partners, universities and research organizations, developers' community and key individuals. While STDM has proved to be technically sound as a functional land information system for cadastre and land registration systems and other conventional approaches, the objective of its development will continue to focus on providing alternative solutions towards bridging the information divide and targeting the information requirements of the urban and rural poor. STDM development is expected to be focusing on addressing affordability issues, scalability, user-friendliness and simplicity.

A clear challenge ahead in implementing STDM, as indicated earlier is how to turn around the mindsets of technical people in various institutions such as in the land ministries, universities and private sector including those land professionals working with civil society groups and local communities, to embrace the concepts behind an open source and people oriented software and start working outside the 'conventions'. For example, it will be difficult to convince an experienced technician to build or manage land information systems using open and free software packages.

The opportunities for further piloting and implementation of STDM in different contexts and countries will surely provide more lessons and experience over time. But at this stage, the documentation of the processes, challenges, lessons learnt and opportunities will provide valuable overview of the Project as well as act as a general reference guide for improving future implementations in other counties.

5. CONCLUSION

For the last decade, land professionals have been instrumental in coming up with technical solutions to improve land administration and management systems in every country. With the modernization of the information and communications technologies, such solutions become more powerful, faster, more efficient and relatively cheaper. Nowadays, local governments and their networks are already using advanced technologies and systems and they are finding them to be a vital tool. Indeed, the use of IT systems, remote sensing technologies (i.e. satellite imagery products), GNSS technologies (i.e. GPS units) and GIS systems to create a land information system is no longer the 'exclusive privilege of the educated elites'.

Using open source software such as the STDM offers these related opportunities for land professionals, researchers, grassroots organizations and government authorities. It also offers great opportunities for land professionals as they can now extend their services to all, they can now offer people-centered and affordable solutions and they can also contribute to the further enhancement of STDM framework. With STDM, it is now possible to bridge the information divide and to serve all members of society and to undertake development interventions such as tenure security for all at scale. Government authorities and decision makers will definitely benefit from its use, recognition and implementation.

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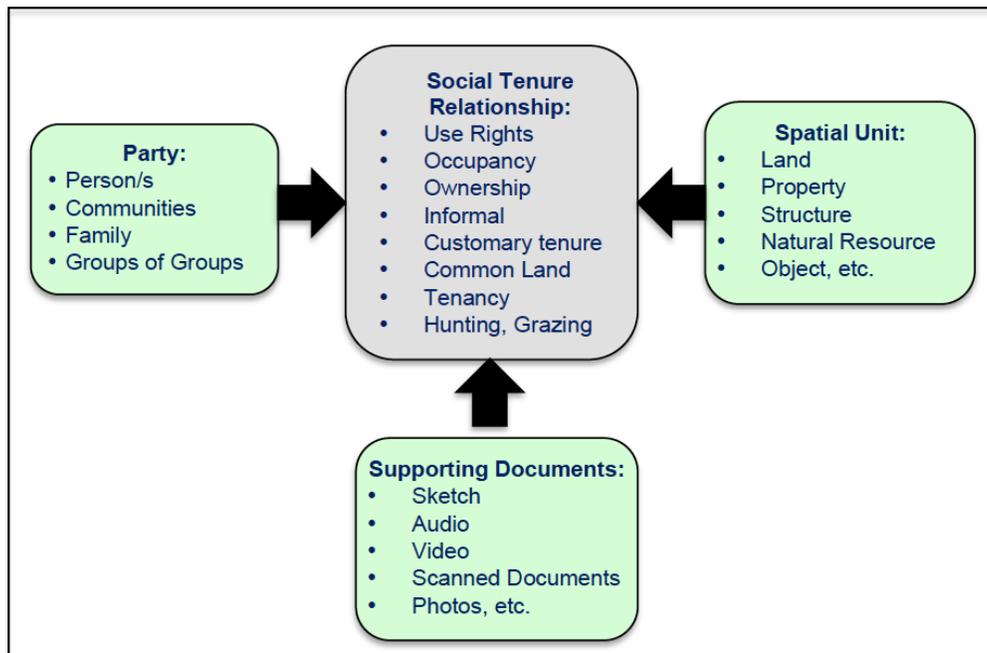
FIGURES

Figure 1: The STDM Conceptual Model explains the interrelationship between parties, social tenure, and the spatial units supported by relevant documents. (Source: UN-HABITAT/ GLTN, 2014)
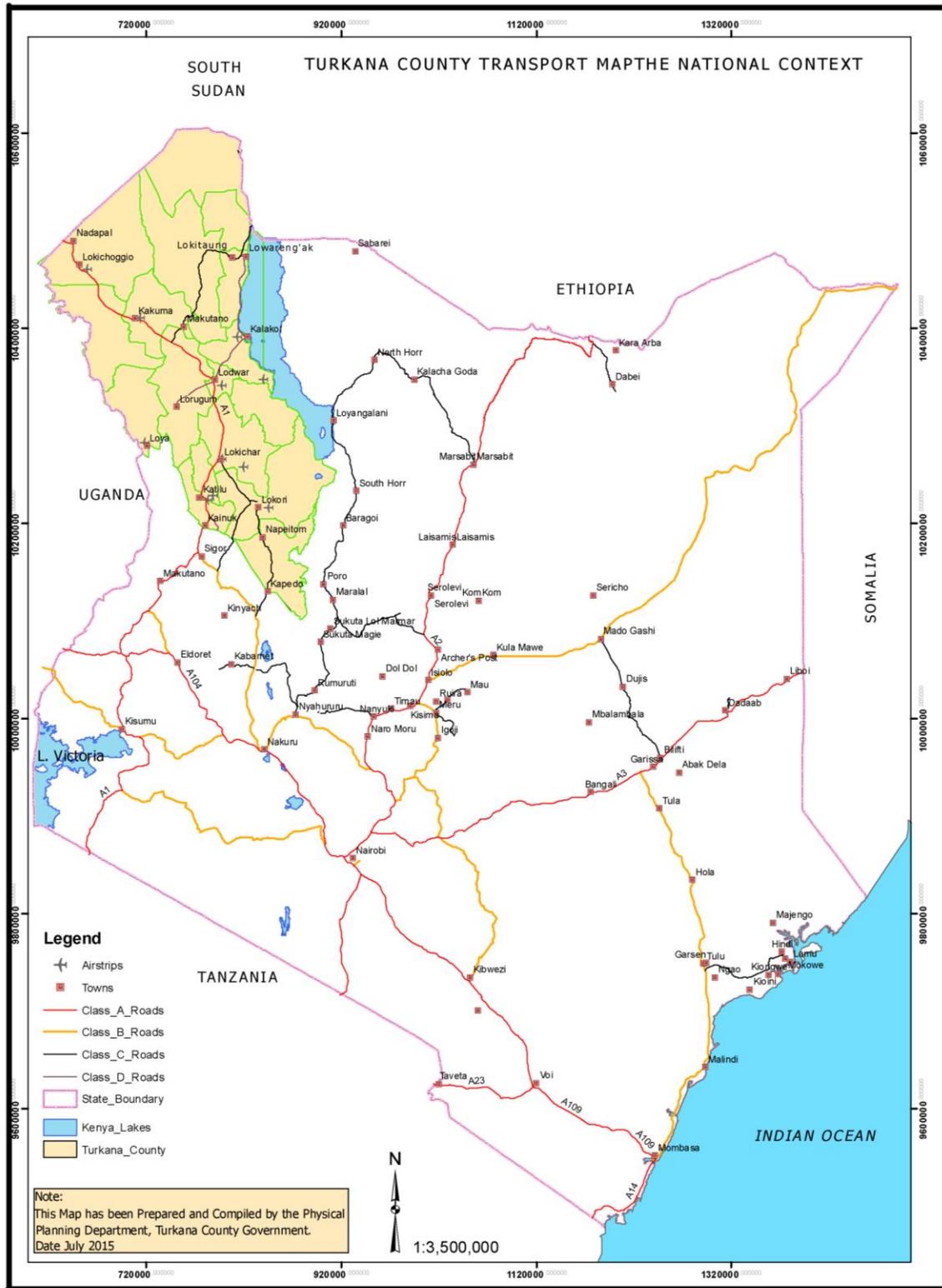
Figure 2: Map of Turkana County, Kenya. (Source: Turkana County Government, 2015)

Proposed Architecture of Land Information Management System for the Ministry of Lands, Physical Planning and Urban Areas Management (MLPPUAM), Turkana County
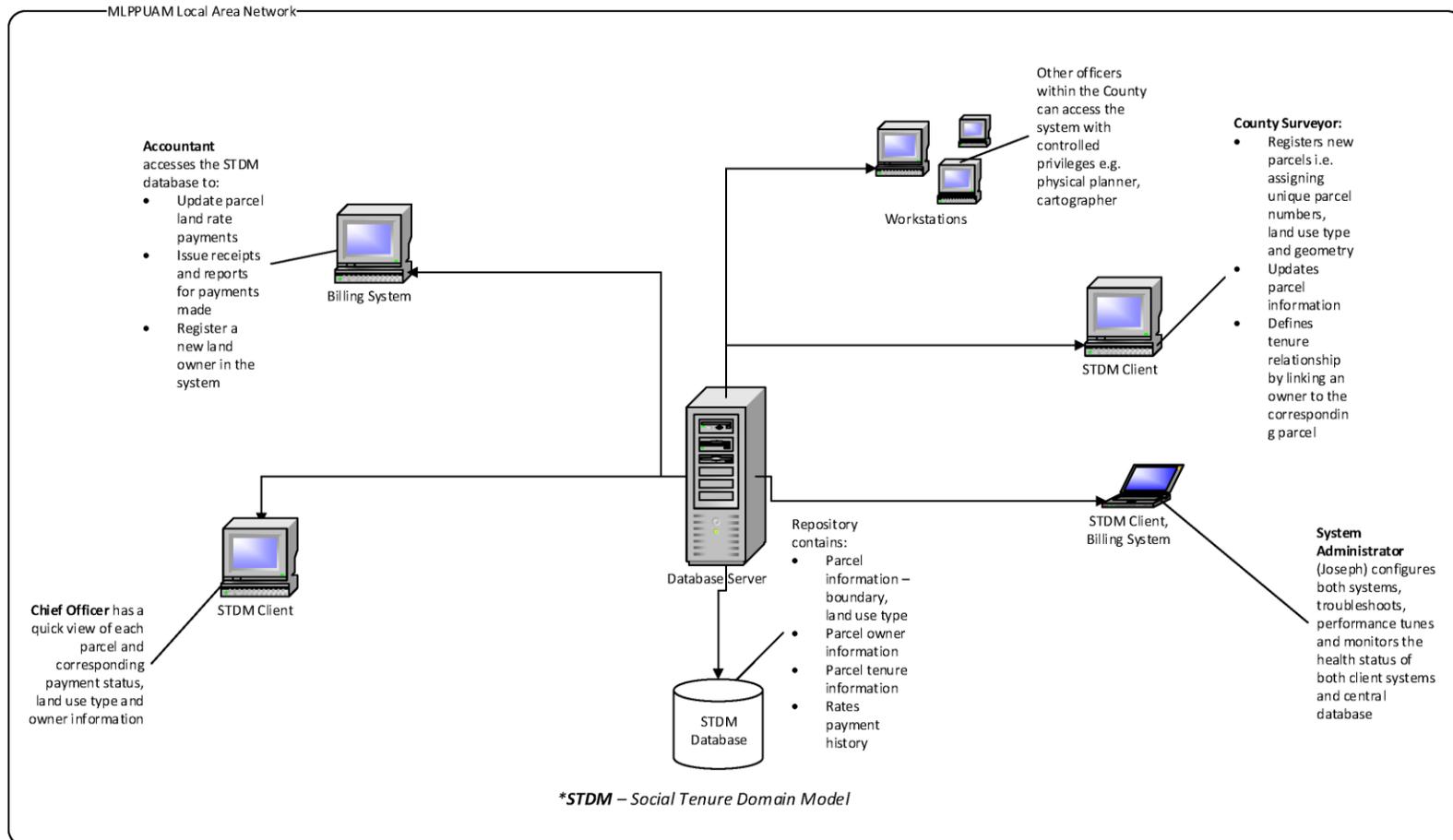

Figure 3: Architecture model of the Turkana County Land Information System. (Source: UN-Habitat/GLTN, 2015)