

Flexible Land Information System Championing Reform Towards Formal Cadaster in Developing Countries

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Summary

Establishing flexible land information system is crucial in developing countries where land governance and service delivery are weak as a result of ineffective land administration systems. The current global challenges related to climate change, food security and drought cannot be addressed without reform to the traditional approaches in land administration. The over-reliance on these system has continuously failed to address land tenure question and in effect fueled escalation of land conflicts leading to displacement of people, informal settlements and poverty. Access to land for majority of the urban and rural poor has become untenable because of the complex procedures and high technical standards that are required for land registration thus making them way too expensive. This also means the ability to invest on the land is limited and cannot access any form of credit for economic development without official document on land. Due to these constraints a paradigm shift in the development of cadastral system is needed to improve on these gaps and accelerate recording of land. New innovations are emerging towards flexible land information system that are less technical, fast and affordable. Cadastre 2014 and Beyond provides guiding principles for establishing these system towards a more responsive land administration system.

Key Words: Land information, fit for purpose, mobile computing, post conflict, land reform

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List of Acronyms

DRC	Democratic Republic of Congo
FFPLA	Fit-For-Purpose Land Administration
GIS	Geographic Information System
GLTN	Global Land Tool Network
GPS	Global Position System
LADM	Land Administration Domain Model
LIS	Land Information System
ODK	Open Data Collection Kit
STDM	Social Tenure Domain Model
UCBC	Christian Bilingual University of Congo

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1. INTRODUCTION

Establishing flexible land information system is crucial in developing countries where land governance and service delivery are weak as a result of ineffective land administration systems. The current global challenges related to climate change, food security and drought cannot be addressed without reform to the traditional approaches in land administration (FAO,2008). The over-reliance on these system has continuously failed to address land tenure question and in effect fuelled escalation of land conflicts leading to displacement of people, informal settlements and poverty (UN Habitat, 2012). Access to land for majority of the urban and rural poor has become untenable because of the complex procedures and high technical standards that are required for land registration thus making them way too expensive (Enemark.et.al, 2014). This also means the ability to invest on land is limited without access to formal credit due to lack of official document on land. A paradigm shift in the development of cadastral system is required to address the constrains and limitation within the traditional approaches (FIG, 2010; Agustinus, 2010). For the past one decade, we have seen emerging innovations towards flexible land information system that are less technical, fast and affordable. Cadastre 2014 and Beyond provides guiding principles for establishing these system towards a more responsive land administration system (Steudler, 2014).

It is recognized that people to land relationship (rights, responsibilities and restrictions) can take a variety of forms which may or may not be actually within the legal framework. According to the Continuum of Land Rights concept, the concerns should be how to improve recordation and recognition of a diversity of land rights, and resources in integrated information systems (UN Habitat, 2008; Agustinus et.al, 2015). Many land tenure systems are outside legal framework because they do not conform to the defined rights and restrictions in a particular jurisdiction. In many communities especially in African context, customary and informal land tenure dominate in this category and have been considered outside the formal land administration system. The process of developing effective legal frameworks and reforming land policies to influence plurality of land right recognition and the institutional change has been very slow. However, it is the mandate of the government to close this gaps, innovative approaches and tools that includes development of flexible land information systems are already mature and available for rollout in the different contexts. These are driven by the recent trends in Information and Technology (IT), Mobile Computing and they operate within a broad framework that recognizes the increasing diverse role of cadastral systems (Danilo 2010; Lemmen, 2012; FIG, 2014; UN Habitat, 2016)

In the international context land information system are seen as a new way of establishing cadastral system to support the evolving role of functioning land markets, land use planning, environmental protection and sustainable development (Enemark, 1999; Enemark, 2005). Similarly, land information systems (LIS) are also viewed as enablers of good land governance through public access to information, improved service delivery and coordination mostly implemented as e-government solutions (Van der Molen, 2007), one-stop- shop (Akingbade et.al, 2012; Jing, Bennet, Zevenbergen, 2014), multipurpose cadastral systems (Steudler, 2014) and web-GIS system (Kuria, et. Al, 2016). These developments are championed by emergence of standards in information modelling and inclusion of geographic information and spatial capabilities in system design as well as standardization efforts such as the ISO T211 Geographic Information/Geomatics (Van Oosterom, et.all 2002; Lemmen 2012). As a result, new tools and

technologies are continuously being developed that are free available based on these standards to support wide application of geographic information system and mapping needs (Stuedler, 2010). Essentially, these form the basis for LIS and the governments can now choose to work with free and open software packages or proprietary systems in developing modern land administration systems.

Unfortunately, many governments have tended to go proprietary way to build high technology systems with the aim of collecting revenue mainly driven by large corporations requiring large investments and long term visions towards full realization (Williamson, et.al, 1999; Dale & McLaughlin 2000; Onwumere, 2014). The challenge has been that these projects have not impacted the local people; the approach has been too ambitious and not tailored to local demands. Also, the initial investment is too high, requiring sophisticated equipment and the software packages that are not adopted to the local needs (UN-GGIM, 2018). In addition, the political interest, corruption and kickbacks usually slows down the take off for these projects. In many cases, the capacity of the local institutions is limited to manage these technologies and usually rely on external support to make them functional. Therefore, Implementing LIS in developing countries has been a challenge mainly because of the approach has not been practical and not user driven.

1.1 Purpose of Flexible land information system

The world population continue to increase and its estimated that soon majority of people will be leaving in urban areas creating enormous pressure on land. Similarly, land use patterns have continued to change due to worsening climatic conditions resulting to unpredictable harvest, drought and loss of productivity (UN Habitat, 2011; Oliver & Morecroft 2014) According to the New Urban Agenda, the role of technology in spatial development must be appreciated if we are to achieve positive outcome in urbanization (UN Habitat,2016). This will include meeting security of tenure for all and developing fit-for-purpose solutions to support the plurality of tenure types as championed in the continuum of land and property rights. Tenure security is key and must be a priority for all irrespective of gender. Sustainable Development Goals advocate for inclusion of women and marginalized to end poverty by 2030. Land remains the key enabler and a source of livelihood for many urban and rural communities. Future generation depends on the sustainable management of its resources.

It is in this background that good land administration system should take into account equitable, just and transparent mechanism for ownership, transfer, control and land use (LGAF, 2012, FAO 2012). Equally, the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security promotes secure tenure rights and equitable access to land, towards eradicating hunger and poverty if we are to achieve sustainable development (FAO, 2012). The land recording gap has been difficult to close and it is acclaimed that only about 30% of registrable land is recorded in the existing cadastral system. Thus, majority of the people fall outside the bracket of secure tenure rights necessitating change of approach (Agustinus, 2010).

According to International Federation of Surveyors, developing cadastral system does not need to be very ambitious and could start with simple procedure and recognizing the priorities for a country and incrementally working towards a robust and more inclusive system (FIG, 2014). Such systems are said to implement the Fit-Purpose-Approach in Land Administration

(FFPLA) that emphasis utilizing local technology and knowledge of the local people as a first step in building cadastral system (UN Habitat, 2016). FFP LA approach has been applied in many contexts by the UN Habitat and the Global Land Tool Network in countries of Nepal, Namibia, Uganda and Democratic Republic of Congo in reforming the current land administration system (UN Habitat, 2018). In these context, the focus has been towards application of participatory mapping and enumeration approaches in eliciting the desires and vision of the people towards recording land in post-conflict disaster, resettlement efforts, informal settlements and customary land areas.

KEY PRINCIPLES		
Spatial framework	Legal framework	Institutional framework
<ul style="list-style-type: none"> • Visible (physical) boundaries rather than fixed boundaries. • Aerial/satellite imagery rather than field surveys. • Accuracy relates to the purpose rather than technical standards. • Demands for updating and opportunities for upgrading and ongoing improvement. 	<ul style="list-style-type: none"> • A flexible framework designed along administrative rather than judicial lines. • A continuum of tenure rather than just individual ownership. • Flexible recordation rather than only one register. • Ensuring gender equity for land and property rights. 	<ul style="list-style-type: none"> • Good land governance rather than bureaucratic barriers. • Integrated institutional framework rather than sectorial silos. • Flexible ICT approach rather than high-end technology solutions. • Transparent land information with easy and affordable access for all.

Figure 1: FFP LA Approach, UN Habitat, 2016

The development of Social Tenure Domain Model (STDM) tool can be viewed as a form of flexible land information system that promotes FFPLA and Continuum of Land Rights in specific context while taking into account local situations and requirements. Their development consider flexibility in the way land tenure is defined and also how quickly and effectively it can be recorded. As such, it is based on the application of IT, Database Management Systems and unified modelling language standards. It is meant to provide a quick and affordable solution where national level land information systems are costly and limited. STDM complements conventional land administration system by transforming land recording practices towards bottom up approaches eliciting support of local communities which builds good land governance (LGAF, 2012). As such, it provides a model for business process reengineering and institutional reform aimed at eliminating lengthy bureaucratic processes and complex organisation procedures (Pierre,2016). Hence, UN Habitat and the Global Land Tool Network in conjunction with International Federation of Surveyors have developed this tool among other concepts that supports flexible implementation of land information system. People awareness and participation in the documentation of land facilitates transparent process for addressing conflicts (Danilo et al, 2013)

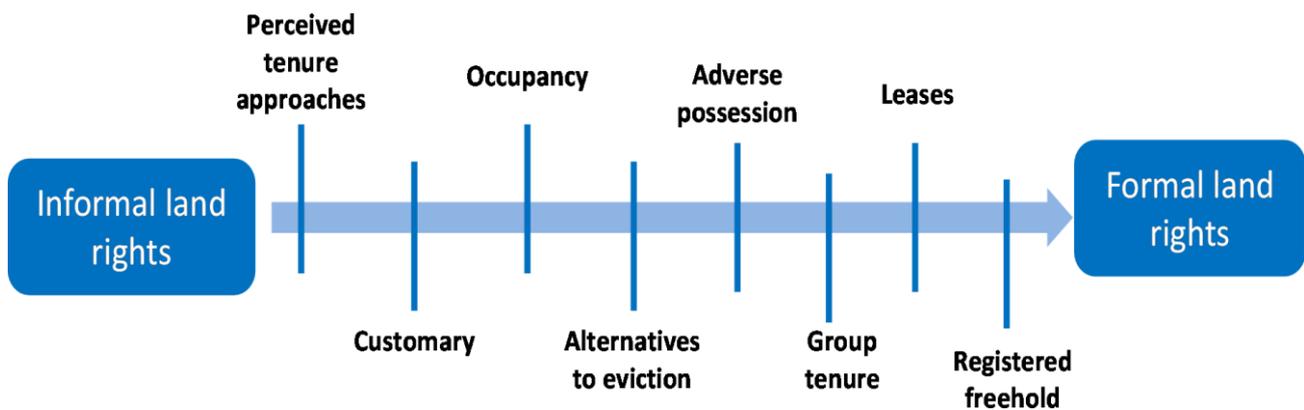


Figure 2: Continuum of land rights, UN Habitat 2012

1.2 Driver for these innovations and the link with cadastre

Cadastre is central to LIS in that it forms the basis for assessing legal and fiscal characteristics of the land in land management and administration. The International Federation of Surveyors (FIG, 1995) defines a cadastre as a parcel based and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). The vision of cadastre as presented in the UN Bogor Declaration 1996, is to: “develop modern cadastral infrastructures that facilitate efficient land and property markets, protect the land rights of all, and support long term sustainable development and land management”. Essentially, the role of cadastre is thus broadened to include wide functions towards promoting inclusive economic development and investment in land. Equally, application of technology has been mentioned as a catalyst that will effectively enable achievement of its goal.

Conversely, innovative tool like Social Tenure Domain Model (STDM), a specialization of the ISO certified Land Administration Domain Model (LADM) and the FFP LA principles are based on the underlying framework of appropriate technology for land administration. The technology role facilitates revision of standards, metadata and data formats to make the system interoperable and relevant. At the institutional level, land information systems are required to transform business process and support automation of workflow systems within an integrated environment. Use of Information Communication and Technology has facilitated intra-office communication, revision of roles, conversion to digital archives and exchange of information over the World Wide Web. More so, data requirements are changing in both technical and social with the growing repository of open data concepts, Voluntary Geographic Information (VGI) and crowd sourcing requiring big databases for storage and integration of tools for data mining in large environments. These are concerns that modern land information system need to address in both local and national system.

Coupled with the recent trends in technology, the power of mobile computing is reaching new level in influencing our interaction with mobile devices. Their application potential has tremendously improved. The hardware in these devices has integrated with many powerful sensing technologies that can monitor environmental conditions, body temperature, navigation,

proximity services and potential for positioning and location mapping. For instance, the GPS sensors in the smartphones is capable of providing up to 3 meters' accuracy comparable to cheapest recreational handheld GPS device. Interestingly, the cost of these devices keep getting cheaper as the technology improves. Simultaneously, access to applications and open source software has continued to grow allowing users to access millions of applications free of charge. Popularity of certain applications especially around crowd sourcing and voluntary geographic information mapping has accelerated development of state of the art tools to support global application in the humanitarian context utilizing GPS sensors in the smartphones to send location data remotely over the internet. Such tools such as Ushahidi, Ona and ODK are quite popular in the recent post disaster incidents providing access to millions of users to contribute location data and related information to rescue operations (Brunette et. al, 2013).

These tools combined with the use of high resolution Imagery and handheld GPS can provide a fast and effective way to collect data on land use, and facilitate first registration on land. Additional data such as fingerprints of the owner, boundary marking of the parcel, signature and picture of all the family members in the presence of neighbours can be collected by taking photos using smartphones and linking them to the map data. This is useful information in providing transparent land information and improving tenure security in rural areas where formal cadastre has not been setup. Therefore, LIS have facilitated expanding of scope for data requirements thus supporting enumeration and survey data to be included in the data collection phase. Possible data collected using smartphones include cross cutting issues such as gender dimension in land, youth, conflicts, social economic and recording of diverse range of documentation such as audio-visual, finger prints and bills as supporting documentation for social tenure relationship.

2. Application in the country context

Experiences at country applications has shown that development of innovative solutions towards reform in land administration is inevitable. Impact is largely depended on particular data collection methodology that enables customization of tools to suit local context and needs. The Global Land Tool Network in partnership with country implementing partners has been able to leverage interest of government through tailoring the tools and methodologies to work within the framework of national and local governments thus promoting faster adoption of the technologies. As such, it is agreed that hardly can have one size fit for all solutions. Usually, the tools and methodologies are depended on the expectation of the people, application contexts and alignment to the ongoing programs by the government. Hence, these interventions are seen as complementing the broader national vision which really improves the outcome and impact at the national level. Essentially, in each country, the flexible land information system use cases have necessitated adoption of new methodologies, review of semantics and tweaking of language for easier applications.

2.1. Democratic Republic of Congo

Democratic Republic of Congo (DRC) is the second largest country in Africa. For the last three decades, the country and particularly the eastern region has continued to experience conflicts over land resources and minerals. According to the UNCHR report, the country records the

highest number of displaced population with over 700, 000 people said to have fled due to escalating conflicts while half a million others are inside DRC as internally displaced persons (UNHCR, 2018). By 2017, USAID estimates about 7.7 Million people who are facing acute food shortage of which 4.6 million accounts for the children. Continuous political instability and decade long conflicts have affected many sectors and crippled country development.

With the current land administration system dysfunctional, access to land and related services especially for the poor, youth, women and vulnerable groups remain a challenge (Leeuwen & van der Haar, 2014). In North Kivu alone, it is estimate that only about 2% of the rural land is registered (UCBC, 2017). This is critical gap that has contributed to the conflicts in the region resulting to many loss of life crippling the development in the region. Capacity of the staff and the level of infrastructure is low in the country despite its enormous endowment with minerals and natural resources. All the benefits accrued from agricultural and mining sector has been squandered in the hands of few politicians and rebels who continue to destabilize the region to sustain their business activities.

For past decade, the government has been quiet on land issues with all land administration depended on the 1973 laws with no supporting land policy (UCBC, 2018). The law fails to recognize the customary tenure system which is practiced in at least 70% of the country. It is also silent on land ownership by women, inheritance and transfer of land in customary tenure system. This loophole has been exploited by the wealthy and the political class through corruption, land grabbing and forced acquisition. The traditional authorities in charge of customary land have not been left behind usually bribed by the rich to sell community land for a token. These transaction has been rampant to cause conflicts due to lack of documentations and over overlapping claims and double selling.

2.1.1. Methodology for LIS implementation

Since 2012, the new land policy draft has been proposed but lacked institutional support due to lack of human, financial and technical capacity from the government. In 2016, UN Habitat through funding support from Department for International Development (DFID) engaged on a project aimed at improving community land use planning and documentation of land tenure towards social economic development. The project covered three provinces in the eastern region with the Global Land Tool Network providing technical support in the establishment of land information system and digital archiving. By the end of 2018, the project had customized a functional land information system operational at land administration system at the provincial level supporting digital capture of land survey data, verification and production of land certificate.

Several awareness raising meeting with all women, men and youth and local leaders were done in the initial phases of the project. Also, trainings on land governance and transparency were done by the implementing partners in the region targeting local leaders, provincial administration, surveyors and land administrators. This influenced change of mind set as well as building consensus on the need for participatory approaches in land registration processes. Technical trainings followed focussing on the technical staff in the land offices as well as selected community representatives that would lead in field demarcation processes. High resolution Orthorectified Satellite Imagery of 50cm was procured including tablets and handheld GPS. Local committees were also established that would follow up on mobilizing

communities, awareness raising as well as data validation campaigns for local ownership of processes.

2.1.2. **Impacts**

The surveyors have shifted from the use of tapes to use of Satellite Imagery, GPS and smartphones for land demarcation including household surveys. Consequently, this led to improvement in business process especially on cadastral workflows and electronic document management. A LAN system installed in the land administration offices is enabling sharing and retrieve of information across different offices. The establishment of land information system based on the Social Tenure Domain Model (STDM) was able to record parcel map and owner information including supporting documents such bills and photos of the family members. This approach has raised attention at the national level with clear evidence that the government want to promote national land information system development as witnessed in the new project-Central Africa Forest Initiative (CAFI) program. Currently, draft land policy is undergoing public review which is expected to be finalized before May 2020. This has been a tremendous achievement for the country to adopt use of alternative approaches to accelerate cadastral coverage. This has impacted the lives and empowered women who can now feel comfortable to claim the land ownership. The relationship with traditional authority towards coordination of approaches with the government has improved. During this period over 500 parcels have been registered in the system.

2.2. **Nepal**

The Nepalese land administration system mainly deals with the formal land registration. Unrecognized land tenure has prevented local people from accessing grants and compensation from government whenever disaster strikes. Lack of documentation for the unregistered land means one cannot prove ownership of land denying them right to just compensation to rebuild their lives and livelihood. Since the earthquake strike in 2015, the Nepalese government renewed its commitment towards ratifying the draft national land policy, a process that had stalled in the past years. During this time, it was estimated about 10 million parcels are outside the formal system and could not be registered without reform to the land law. Therefore, innovative approach that resonated with the Fit-for-Purpose (FFP) approach to land administration was seen as an entry point towards integrating informal land tenure to the formal cadastre, thereby implement the provisions in the proposed land policies and newly enacted Constitution of Nepal (Raj Ram and Danilo, 2018).

Even though, winning public trust with innovative solutions must be viewed through different lens since government land projects have always been ineffective and unreliable especially on service delivery lacking transparency and this was no different in Nepal. Building the trust and improving land tenure for the poor needed a quick and scalable solution that represented the aspirations of the people. The FFPLA approach adopted participatory methodologies eliminating the need for expensive technology that could affect the speed of delivery. Likewise, the demand for better services from the people continue to rise and therefore, it was imperative to quickly roll out the processes on the ground.

2.2.1. **Methodology**

Eventually, after a series of consultation with the public, combined with literature review, focus group discussions and experts' opinions, the constitutions on land policy were aligned towards

integrated solutions for land administration and management. Therefore, with these benchmark, it was easy to introduce FFPLA for pilot in various context such informal settlement and areas affected by disasters. Participatory enumeration and mapping methodologies were used to demarcate land parcels printed on Satellite Imagery with neighbours and local representatives identifying the borders of adjacent parcels on the Imagery. The residents also provided documents such as electric bill payments, residence certificate and telephone connection bills as well as recommendations from local institutions as the proof that the land is being used by them. Later, the spatial location of each parcel was digitized and recoded in open source customized GIS system and the documents recorded together with socio-economic data collected through the structured questionnaire during the field visit ((Raj Ram and Danilo, 2018; UN Habitat, 2018).

2.2.2. Impacts

The resultant system was a land information system customized to the local system that had capacity to interface with the formal land administration system. As matter of fact, these interfaces were explored and demonstrated with confidence that the low-cost solutions provided an alternative and rapid approach to addressing the land tenure gap in Nepal. The land policy was also ratified where FFPLA has been captured as a plausible alternative for recording land in informal areas.

2.3. Uganda

In Uganda, a significant proportion of the population access land through customary land tenure system governed by the customs and norms of the respective area where the land is situated. Normally, these customs do not align with the formal land registration system and therefore customary land tenure has remained outside the legal system for a long time. Notably, customary land tenure system is the dominant tenure system covering over 70% of the country that relies on agriculture (Becker, 2019). With the rising population, pressure to access land is leading to conflicts, land grabbing and fragmentation of land rendering it unproductive to sustain many family livelihoods. Informal land transactions within customary land have also resulted to disputes due to lack of proper documentations and disinheritance of women land rights.

The Land Act of 1998 was formulated to govern land administration process under customary tenure. It stipulates the various ways land can be held under customary tenure that included; individual, family, and common. According to the Uganda constitution, the citizens can own land under customary tenure through application of certificates of ownership as prescribed by the Land Act. Enabling registration and policies have also followed to be enacted to promote official recognition of customary land certificate. However, there are significant gap that have led to slow implementation of the law including lack of financial support, technical innovations and solutions, to register customary land (Musinguzi, Enemark & Mwesigye 2018).

2.3.1. Methodology

A Fit for Purpose country strategy study was done in 2018 to inform on the need for the innovative approaches to record customary land tenure ownership. The study gave the roadmap for implementing FFPLA strategy to accelerate implementation of the law. UN Habitat through the Global Land Tool Network in partnership with the Government of Uganda came together to implement a project to improve land tenure security for rural households - particularly

women, youth and vulnerable groups - in select areas in Uganda. The project was funded by Embassy of the Netherlands to Uganda and envisioned to reduced land conflicts through issuance of certificate of customary land ownership (UN Habitat, 2018).

The participatory approaches that are advocated by FFP LA were considered in the design of the participatory methodology. High resolution orthorectified Satellite Imagery from the Ministry was given to the project. Additional equipment included handheld GPS for mapping of household parcel boundary and smartphones used to record household survey. The customization of the Social Tenure Domain Model to suit the local needs enabled design of the customary certificate that was later approved by the ministry to be considered as the official document for registering customary land. Data from the field was fed into the database by trained local community members with GLTN and Ministry of Lands, Housing and Urban development providing technical support and quality control. Several training were conducted to raise awareness including technical capacity of key stakeholders to support in the running of the customized land information system.

After data validation by the community, it was required to issue certificate. By end of 2019, over 3000 certificate of customary ownership (customary land titles) had been issued with support from the office of the president and president himself. In the past it cost upwards of USD \$600 to have one plot accurately mapped and land rights registered. These innovative approaches and tools brought the process cost down to between USD \$20 to \$40. This is a significant price drop in a country where so little of the land has been formally mapped and registered (UN Habitat, 2019). The provided system will greatly impact on the improvement of land administration which enabling access to the local people for transparency, updating of transactions and continued issuance of titles.

2.3.2. Impacts

The acceptance of the FFPLA approach has restored confidence of the government by the people to promote customary land ownership and protection of land rights for the poor women, youth and marginalized. The transparent process facilitated resolution of disputes as well as enhancing voicing of women land issues. By the end of 2019, over 1000 women had acquired land titles thus inspiring the plight of many poor and marginalized groups. The support of the government provided official recognition of the certificates generated through the customized land information system. This system will be customizable and adaptable to other customary setting driven by the local capacity that has been installed in the three pilot areas.

3. Lesson and Experiences

It is clear in these country experiences that a well-conceived approach for building flexible land information system has great potential for reforming the traditional system of land administration, triggering institutional change and land sector reform. It is clear evidence that FFP LA has many opportunities for application in country context with the right technology and inclusion of bottom up processes. These tools require to be packaged and championed by the local people for endorsement and acceptability. FFPLA is not an end in itself but a means through which barriers in the conventional land administration can be overcome.

Essentially, adducing from the above country experiences, we can confidently say that flexible land information systems can support these three roles in a country:

1. Changing the land tenure dialog in land sector
2. Triggering institutional change through business process reengineering
3. Accelerating evidence based land policy reform.

The key success for these experiences is seen in the engagement with communities to elicit dialogue and to capture aspiration of the poor. This way, the final system is shown to be user driven responding the issues identified and setting the agenda for land reform. However, it is notable that land is a very sensitive subject in many cases and technology can have both positive and negative impacts based on the approach. The experiences from these country have shown that success was possible because the project were tailored around ongoing national or regional initiatives, thus the processes were seen complementing the bigger picture. For instance, in DRC, land use planning was at the top of the agenda for peaceful development in the region. However, land tenure component was brought in to complement those activities and LIS was used to deliver both land use and land tenure solution.

Participatory approaches contributed to shaping of the dialog around sensitive land issues such as access to land by women, inheritance and transfer, land conflicts and land grabbing. These issues were captured during awareness campaign and formed a basis for building consensus for better and transparent system where all people participated in the process. Eventually, all the data was accepted by the community enabling resolution of disputes in the field during data collection phase. Most notable process was recognition of the rights of each and appreciation of the provision of the laws in protection and management of land tenure rights. Hence, the land governance aspect could be shared during forums, and trainings impacting on the future management of land and its resources, appreciation of gender issues in land as well as sharing available mechanism for conflict resolutions The process was able to build women champions in terms of articulation of land issues in national and local processes. Genders approaches were promoted through existing platforms to contribute towards policy discussion and voice their issues based on local experiences.

Generally, flexible land information can provide a platform for reforming land governance and improving service delivery in the following areas:

- Public access to information
- Articulation of issues by women on land discussion
- Use and manipulation of technology by the local people
- Support application in many contexts to address different land issues
- Application of low cost technologies and Satellite Imagery to collect land tenure data
- Application of gender appropriate tools to promote inclusion and participation by all
- Use of free and open software packages that are cheap to maintain
- Sharing of information

However, even with successful implementation, there are potential challenges that require prior planning to reduce the negative impact. They revolved around aligning the initiatives with government programs due to added cost and political will. Also, there were inconsistencies in

project delivery due to different perceptions and slow decision making among many partners and poor capacity for the beneficiary communities including land administrators. In other cases, there was sheer lack of infrastructure, difficult terrains and power to make the project work within the stipulated timeline.

4. Recommendation and conclusion

The positive outcomes of flexible land information systems provide an opportunity for accelerating land reform in developing countries where conventional systems have failed. This facilitates closing the land recording gap and to spur economic development for the local communities. It is therefore necessarily that government projects embrace the FFPLA approach in land related interventions.

Application of the Social Tenure Domain Model as a framework for flexible land information system has the potential for promoting the continuum of land right approaches by enabling recording of different forms of land rights and claims. This is applicable in many contexts such as informal settlements, customary, pastoralism and squatter settlements and so on.

It is also evident that these technologies are simple and require basic knowledge to operate thus enabling sustainable adoption in their applications.

Flexible land information system broadens the data requirements in building cadastral system and this should be a notable opportunity for promoting inclusion of women, youth and marginalized in the system reflecting various concerns and challenges affecting them. These can only be successful through bottom up approaches.

From these experiences, there are great opportunities for further research and refinement of methodologies with the enormous data and evidences available at the community level. This will impact on the perception of the decision makers and perhaps accelerate reform in institutions processes. Further, the research will provide a cost benefit analysis of running incremental process for systematic land registration as compared to the traditional processes.

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Autobiography:

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