PUBLIC POLICY AND LAND RECORDS: A "BIG DATA" PERSPECTIVE

SACHIN GARG, **PHILIP E AUERSWALD**

Schar School of Policy & Government, George Mason University, USA

sgarg6@masonlive.gmu.edu

Abstract

The current research puts data at the center of land records management as opposed to either the political economy viewpoint, or a view that overly focuses on the Information Technology aspects. We seek to identify key institutional challenges that underlie land data creation, and how policies impact the creation of land records which are "big data". We study India's National Land Records Modernisation Programme (NLRMP) as executed in the state of Madhya Pradesh. We interview key government officials involved in the land data creation process, and try to understand the main challenges they faced while executing the project and how they surmounted these challenges. The research finds that project success is highly dependent on the people driving it on the ground and "top down" directives and specifications that take a "one size fits all approach" do not work.

Key Words: India, land records, NLRMP, "big data", implementation

Public Policy and Land Records: A "Big Data" Perspective

Introduction

Land is central to the development of human society and it is a key input for economic activity. The crucial role of land has been acknowledged by the National Research Council "land ownership has been critical to the economic and philosophical development" [of the United States] (National Research Council, 2007). To address this, elaborate and complex laws and regulations evolved to manage and administer land in line with land policy, which is an overarching "governmental instrument". It guides the development of land management strategies and objectives, which in turn is implemented through land administration (Törhönen, 2004). Land administration provides the means of maintaining information about the land ("cadastre") and is key to proper land management and thus vital to economic development (Dale & Mclaughlin, 1999; Williamson & Ting, 2001).

Land administration serves four primary purposes: (a) regulating land / property[1] development, (b) using and conserving land, (c) gathering revenue from the land, and (d) conflict resolution (Dale & Mclaughlin, 1999). These lie in different functional domains—juridical, regulatory, fiscal and information management. There are specialized agencies which carry out the different functions—surveying and mapping, registering, and appraising the land (Dale & Mclaughlin, 1999). Each administrative function has key responsibilities defining the processes underlying the function. For example, the juridical function is concerned with holding and registration of rights in the land. It concerns itself with the processes that adjudicate land ownership, its boundaries and maintaining its records. Land use and development has to be regulated in a manner consonant with the larger public interest. The fiscal function's primary focus is on enhancing the economic utility of the land by collecting revenue and identifying ways to enhance it.

Land administration has evolved over time to accommodate the dynamic relationship between human society and land. Williamson and Ting (2001) have identified four phases in this changing relationship. Initially, in the agricultural period, land was a primary symbol and source of wealth. With the advent of the industrial revolution, land became the primary source of capital and land markets developed. Post the second world war, it was realized that land is a scarce resource which needs to be used in a planned fashion. Since the late twentieth century, the focus on land has turned towards reducing inequities and ensuring sustainable development. Information management is the linchpin of the land administration function and effective land administration requires sharing information amongst agencies, preferably in a common format called the "cadastre".

The cadastre is the prime input into effective land management. However, land records are often not clear, leading to disputes[2] and consequent productivity loss[3]. Narasappa and Vidyasagar's (2016) survey

---

[1] Dale and Mclaughlin (1999) differentiate between land as the "natural" object, while the term "property" is used to relate to the associated abstract use rights. They also identify that certain jurisdictions take land to mean the object with "soil and a surface", while property is taken to mean buildings and other man-made objects.

[2] Robinson's (2013) analysis of the Indian Supreme Court's workload found land related disputes to be almost 10%, which is a huge figure considering that the Supreme Court does not have original jurisdiction on land related matters and is a court of last resort. Although, theoretically, anyone can approach the Supreme Court, in practice it requires deep pockets to do so, and the real figures to look at should be those in the lower and state High Courts.

[3] According to a report by the McKinsey Global Institute, land market distortions in India accounted for up to 1.3% of lost growth annually (MGI, 2001). This report also alarmingly states "Most land parcels in India—90 per cent by one estimate—are subject

on the state of the Indian judiciary finds that at 66%, land and property related matter dominate civil litigation and this is consistent across income levels[4]. Deininger and Goyal (2012) empirically analyzed the economic benefits arising from making reliable information on property rights widely available. They find that clarity in land titles, coupled with the ease of verifying the same, can allow the land to be used as collateral and unlocking its value thus leading to increased credit uptake especially in urban areas. Venkataraman (2014) found that buyers in Bangalore, Karnataka, India, were willing to pay a premium of up to 4.3% for clear titles. These benefits of clear land titles have led to the emergence of a school of thought, led by the Peruvian economist Hernando de Soto that advocates the formalization of property rights as a means of alleviating urban poverty (Auerswald & Stefanotti, 2012; Payne, 2001; Törhönen, 2004).

However, in many cases, especially in rural, farming communities with small holdings, security of tenure (which is *not* synonymous with formal titles) may be more important (Törhönen, 2004) and de Soto's "one size fits all" approach may not work (Payne, 2001). Törhönen's (2004) comparative analysis across three developing (Zanzibar, Zimbabwe and Cambodia) and one developed country (Finland) led him to unambiguously conclude that "*a secure, flexible, all-inclusive tenure form, whether customary or statutory, provides the best basis for development*". He identifies the main challenge in land administration and registration as the "*ability to quantify, recognise, record, regulate and manage land tenure, which consists of multiple layers that have volatile formal and informal significances*". This thinking has forced a re-look at current land administration practices and objectives so as to identify and address community interests, leading to a call for an integrated land management system, also called a "multi-purpose cadastre" which is a mechanism that can allow all information about land parcels to be fetched from a single source (Williamson & Ting, 2001).

Underlying the "multi-purpose cadastre" or the "integrated land management system" is the basic information about the land record itself, or the "cadastral record". This record has two main parts—the financial register and the legal register. Traditionally, the two have been managed by different agencies. While the fiscal register is maintained and managed by the executive apparatus, the legal registers are under the purview of the judicial system. While the fiscal register is a relatively simple entity containing spatial information like size and location, along with other information like value etc., the legal register contains temporal information like the complex chain of ownership records.

However, in many emerging economies, much of the the foundational land use and ownership data contained in the cadastre itself is missing. This missing data poses a huge obstacle to development, leading to disputes and an inability to unlock the value of real property. In 2008, the Indian Ministry of Rural Development started the National Land Records Modernisation Programme (NLRMP) to solve this missing data problem. In India's federal structure, land administration is a state subject. This program provides financial and technical assistance to the state governments for updating and upgrading their land

---

to legal disputes over their ownership".

[4]See figure 2 at `http://dakshindia.org/state-of-the-indian-judiciary/28_chapter_15.html`. Figure 3 at `http://dakshindia.org/state-of-the-indian-judiciary/29_chapter_15a.html\#_idTextAnchor328` shows that land and property related disputes make up almost two-thirds of the total civil litigation across the lower and middle class litigants. Retrieved March 3, 2017.

records management systems which can then be linked to create a "multi-purpose cadastre". However, there is a variation in how this program has been adopted across Indian states. This research uses interviews with key government officials, supplemented by secondary data to understand the key challenges faced in implementing this program in the Indian state of Madhya Pradesh (MP).

National Land Records Modernization Program

The National Land Records Modernisation Programme (NLRMP) now known as Digital India Land Records Modernisation Programme (DILRMP)[5], was started with the aim to usher in a system of conclusive, or "Torrens" titling and provide title guarantee in India (National e-Governance Division, 2011, pp 147–152). This scheme came out of the merger of two earlier centrally-sponsored schemes in 2008. The Information Technology (IT) centric Computerisation of Land Records (CLR) scheme was started in 1988 to move the maintenance and updation of land records into the digital domain. The scheme was further extended in 1997–98 to provide Records of Rights (RoRs) to landowners *on demand*. The transaction oriented Strengthening of Revenue Administration & Updating of Land Records (SRA & ULR) scheme, also launched in 1988 was designed to help the states and Union Territories (UTs) in developing capacities and capabilities for land administration by setting up and strengthening the survey and settlement organizations and revenue infrastructure, and modernizing the survey and settlement operations. However, as most of the activities included in the CLR and SRA & ULR schemes were aimed at strengthening the revenue administration, they did not necessarily focus on conclusive titling, which was a byproduct. The selection of activities to perform under the schemes was left to the states, and most of the activities chosen had little to do with moving towards conclusive titling, for example, construction of housing for revenue staff or provision of computerized offices. The activities chosen were not necessarily interconnected, and each had set a goal for itself, rather than part of a systematic process to reach the end-goal of "conclusive titling". Also, the schemes were formulated in a manner that no timeframe for the end-goal of conclusive titling could be set. Further, technology options for survey were not indicated and the schemes excluded inter-connectivity, Geographic Information System (GIS) based mapping and connectivity with financial and legal institutions. The NLRMP was conceived to fix these issues by undertaking the following set of activities:

- Completing the computerization of the Records of Rights (RoRs),
- Digitizing the maps and integrating them with updated land records,
- Survey/resurvey using multiple technologies including Geographical Positioning System (GPS), aerial photography and remote sensing,
- Computerization of the land registration process,
- Automatically generate mutation notices,
- Training of the revenue officials and field staff,
- Inter-connect the land records and registration offices, and
- Build modern record rooms/land records management centers at jurisdictional level.

---

[5] The name of the project was changed from NLRMP to DILRMP in early 2016 with certain changes in the way the program is funded and executed. As this research largely deals with the program's implementation prior to this time, I will use the earlier name—NLRMP.

The state governments are provided financial and technical assistance under the NLRMP to perform the following activities:

- Computerization of land records including digitization of cadastral maps, integration of textual and spatial data, data centers at *Tehsil*, Sub-division, District and State level, inter-connectivity among revenue offices (Central Government—100%),
- Survey/resurvey and update of the survey & settlement records (including ground control network and ground truthing) using modern technology options (Central Government—90%: Special Category States, 50%: other States),
- Computerization of Registration including connectivity to Sub-Registrar Offices (SROs) with revenue offices (Central Government—90%: Special Category States, 25%: other States),
- Modern record rooms/land records management centers at *tehsil* level (Central Government—90%: Special Category States, 50%: other States),
- Training & capacity building (Central Government—100%), and
- Core Geographic Information System (GIS) (Central Government—100%).

Madhya Pradesh State

Madhya Pradesh state, situated in central India is the second largest state by area and the fifth largest by population, when it was created from the merger of different regions and princely states. Each of these had their own revenue systems and collection methods.. Hence, the state witnessed a multiplicity of revenue systems which were replaced by a single revenue system in 1956 (Mishra, 2016). The implementation of this revenue code and the associated land reforms was extremely difficult owing to the presence of different measurement systems and chain lengths in use across the different regions. This was sought to be obviated by starting a survey and settlement operation in 1975 (for 26 districts) using the metric system and prepare maps at the scale of 1:4000. However, this exercise was halted owing to local opposition and most of the cadastral records date from 1920s–30s (Mishra, 2016, Table 13, pp51). A fresh survey/re-survey has now been initiated in 2014 under the aegis of the NLRMP.

Administrative Structure of Land Administration

The Madhya Pradesh Revenue Department comprises of five major departments looking after various activities. The maintenance and update of land records is done by the office of the Commisioner of Land Records (CLR) based in Gwalior. The CLR office looks after six major works for the entire state that include updating of land records, providing agricultural statistics, performing survey and settlements and implementation of land reforms and other land related policies. It is the designated agency for execution of the NLRMP project, other than registration (Mishra, 2016). The office has a sanctioned staff strength of almost 19,000 personnel out of which almost 12,000 are the village level revenue inspectors (*patwari*) responsible for all activities related to land records management. The *patwari* reports to a Revenue Inspector (RI) who in reports into the Assistant Superintendent and Superintendent Land Records who then report into the district level officials. There is a system of checks and balances which ensure that any one individual does not have the sole ability to alter land records, but the requests are actually approved by the

Tehsildar, who is a district officer not reporting into the CLR office. The system has also been designed such that no one can directly alter the database itself and all such requests have to be processed through the front-end using proper authentication mechanisms.

National Land Records Modernization Programme Implementation

Core GIS

The "Core GIS" is the foundation that will allow the integration of multiple services and creation of the multi-purpose cadastre. It consists of georeferenced satellite imagery of the village index base maps and integrates three layers of data, viz (a) Cadastral maps from revenue records, (b) Spatial data from aerial photograph or high-resolution satellite imagery, and (c) Survey of India and Forest Survey of India maps, and However, for this core GIS to be made available, the underlying data needs to be created. Various activities of the NLRMP contribute to creation of the core GIS. The "computerization of land records" activity provide support to creating the cadastral maps from revenue records, the survey/re-survey activity results in the creation of geo-referenced satellite imagery.

Computerization of land records

This activity has four main components which are (a) data entry aspects, (b) digitization of cadastral maps and integration of textual and spatial data, (c) data centers at district, sub-division and tehsil level, and (d) providing inter-connectivity among the revenue offices. A sum of almost INR 120 million was spent on the digitization of the RoRs. However, this was done without any attempts to perform a verification of the details, that is get to the ground truth. Because of this initial lack of planning and delays in the digitization of cadastral maps, the project was completed in five years (2013) instead of the stipulated eighteen months. Further, while the estimates for digitizing an A3-sized record was INR 1,060, in reality it ranged from INR 1,160 to INR 1,260. The scanning of the maps sheets has been a huge exercise—almost 134,000 map-sheets spread across 53,480 villages. Two main reasons were highlighted by the interviewees for the delay in digitization of cadastral maps: (a) bureaucratic apathy, and (b) vendor incompetence.

Bureaucratic Apathy. Many district level officers were not co-operating with the vendors responsible for the digitization process. They either withheld or delayed providing maps to be digitized to the vendors. Some of this was resolved was by tying the progress of the records digitization with the performance appraisal of the district's Superintendent of Land Records. However, there were still two hundred and ten villages that were classified as "mapless" villages, while five hundred and eighty-one village maps were in a dilapidated condition. However, the maps are stored at three different places: (a) tehsildar office, (b) patwari, and (c) record room. For maps to disappear from all three places is pretty inconceivable and bureaucratic apathy was thought to be a major reason behind this non-availability of maps. To get around this, an ingenious solution was devised in the form of filing a police complaint against the custodians of maps: Record Room Incharge, tehsildar and patwari, thus triggering a deeper investigation. This resulted in the unearthing of one hundred and forty maps, reducing the number of "mapless" villages to only seventy genuine cases. Further, it was attempted to use land records maps available with the irrigation department to fill the void. For the villages still missing maps, a survey and

settlement which requires going door to door to gather the actual ground position and tallying with the previous settlement was ordered.

Vendor Incompetence.   This was a new and fresh exercise and not all five vendors were equally competent. Two were found to be grossly incompetent leading to the digitization work for those districts being hampered. One vendor had been paid eighty percent of the amount upfront, but the soft copy was missing metadata which prevented creation of a "mosaic" tehsil map when multiple village maps were combined. Further, the vendors were supposed to train five revenue personnel in the use of the software. It was expected that these would train further staff leading to augmented capabilities. However, many vendors were apathetic to this resulting in a lack of trained resources. It is being proposed to float a short term tender to fix this issue. It should be underscored that the interviewers refrained from mentioning the usual excuses like a lack of clarity in specifications or of funds to perform the job as key factors.

Regarding data centers and setting up of interconnections between the revenue offices, the state had already built a wide area network and the datacenters were already in place.

Survey/resurvey and updating of the survey & settlement records

The aim of the NLRMP is to usher in "Torrens" titling in India. This registration system is founded on the "mirror principle"—that is the maps have to mirror the ground realities so as to not require going through the chain of documents conveying title. Regular surveying of the land is a means to ensuring that the maps accurately reflect the ground position and this is critical to the development of an integrated land management system that can be utilized to get real-time information on the land. As discussed by Mishra (2016) and corroborated with personal visits, the last large-scale surveys were done before Indian gained independence (1947). Despite the presence of multiple map scales and areas of measurement, the first state-wide survey operation was initiated only in 1975. Even this was stopped after covering only seventeen of the fifty one districts. Thus, almost two-thirds of the state is still working with maps that are almost a century old.

Since then, the population has increased manifold due to which the village residential area (*aabaadi kshetra*) has also increased and other artifacts like canals and roads changed. These change can be observed when trying to superimpose recent satellite imagery with the extant cadastral maps. Also, there has been a significant increase in the urban area which has not been included in the earlier surveys. There is also the challenge that records of Nazul land (land acquired by local developmental authorities and provided on lease) is largely unavailable, which leads to widespread encroachment of government land. The current map scales are 1:4000, which although adequate for rural land management is grossly inadequate for dense urban areas that requires maps to a finer scale of 1:1000 or less like 1:500.

Madhya Pradesh (MP) has been at the forefront of implementing modern survey practices using Electronic Total Station (ETS) and the machines have been made available to all districts and *tehsils* from state funds. The revenue inspectors are trained in the usage of ETS only, while the *patwaris* are also trained in surveying using the traditional chain method. The survey/re-survey has been completed in twenty districts (September 2016).

The survey/re-survey activity is fully funded by the central government and the program allows for

either a pure ground method (using ETS, Differential Geographical Positioning System (DGPS)), or a "hybrid" approach that combines this with aerial imaging and satellite remote sensing. This hybrid approach uses satellite imagery to capture the land parcel data and compares it with the existing records to demarcate the land parcels. A sample is cross-checked with ground surveys using ETS to verify the accuracy of the satellite imagery and existing records.

After the parcel data has been verified and the maps updated, the vendors update the land records data with additional personal information of the owner[6] and the other details needed to prepare the RoRs. These draft land parcel maps are then delivered to the administration for checking and then to the landowners for further verification and comments. There are public interactions between the landowners and the administration which also involves the vendors to refine the database as well as to resolve issues as far as possible. As per law, if the owners do not have issue with the new survey boundaries, area and other details recorded in the Record of Rights (RoR), these are finalized. However, if the owners find mismatches between the new and old data its is marked as disputed. A solution to the disputes has to be suggested by the administration within three days of hearing all the parties. If this is accepted, then dispute is marked as "closed", else it is kept pending and moves up the administrative chain. For this hybrid approach of survey/re-survey to work, two items are critical.

Establishment of GCPs. A Ground Control Point (GCP) is a point on the ground with well-known Geographical Positioning System (GPS) co-ordinates. A number of such points are needed to correlate the satellite imagery and actual ground positions. Three types of Ground Control Points (GCPs) have been proposed to be setup, and the entire state of MP has been divided into a (a) 16 km × 16 km grid for the Primary GCPs, (b) 4 km × 4 km grid for the Secondary GCPs, and (c) 1 km × 1 km grid for the Tertiary GCPs. Each GCP is conspicuously marked ("monumented")such that they are clearly and unambiguously visible in the satellite imagery. The GCPs are calibrated using GPS. While the primary GCP is calibrated over a 72-hour continuous observation (to a ten digit precision), the secondary and tertiary GCPs are observed for 3 hours and forty-five minutes respectively. Law and order situation was a challenge in some districts and vendors were unwilling to go the field. The interviewee recounted an anecdote about GPS equipment worth around $70,000 being stolen in Morena district while a primary control point was being established. Despite this, the work of setting up the GCPs has been completed in all the fifty-one districts.

Satellite Imagery. High resolution stereo imagery taken without cloud cover and "no crop season" times is needed to adequately build the cadastres. The National Remote Sensing Centre (NRSC) of Indian Space Research Organisation (ISRO) is the nodal agency in India for providing satellite imagery. However, according to the interviewee, NRSC served primarily as an agent, and did not play the role of a full-fledged remote sensing consultant as was possibly expected by Commissioner, Land Records and Settlement (CLR). Therefore, the entire negotiation (including technical specifications) was done by officials of the CLR itself. The initial price quoted was US$ 43 per sq km and it was suggested that apart from the imagery, one additional item (that was not included in the Request for Proposal (RFP)) was being provided free of charge. However, when the CLR officials started the negotiation process, it was found that the extra item (that was not really needed) was actually being provided at a cost and the price was brought down to

---

[6]This information includes photograph, Aadhar id etc.

$38 per sq km. This resulted in a savings of INR seventy millions for the more than three hundred thousand sq km of the state for which imagery was to be bought.

The satellite imagery was initially procured for eighteen districts. Now, a further seventeen districts have been added. The survey exercise in MP differs from many other states in that the administration is also attempting to maps of not only farmland, but also the detailed maps of village residential areas (*aabaadi kshetra*) and the urban areas. The issues and requirements of these are different as they have to be of a greater scale (1:1000 or 1:500). Further, many buildings are multi-storied and may have different owners (apartment complexes) or commercial spaces. A pilot project is going on in Dabra tehsil, Gwalior district for urban survey.

Computerization of Registration

Maintenance of the legal cadastre is done via the registration of property documents. A registered document becomes part of the public record and is used to show priority. In the current "presumptive titling" scheme, a chain of registered documents is used to show the conveyance of property from one person to another. Therefore, it is critical to integrate the registration process with management of the RoR.

The activities allowed by NLRMP project under this head include (a) computerization of the Sub-Registrar Offices (SROs), (b) data entry of details of property valuation, (c) scanning and preservation of old documents, and (d) providing inter-connectivity among the SROs. MP started the computerization of registration without central funding support and using state funds. The registration department in MP consists of more than two hundred Sub-Registrar Offices (SROs). The facility of e-registration has been made available across all districts. using this facility, users may complete the initial registration formalities from anywhere and book an appointment to complete the process which requires capture of biometrics of all transacting parties. The property valuation is updated every year and the process of entering legacy encumbrance data is in process. However, the registration system is still not integrated with the RoRs and thus online mutation is not possible.

Modern Record Rooms

A key task of a land management system is document management. It is necessary to keep the old and legacy records in physical form for both historical and legal reasons[7]. The NLRMP has provided funding to upgrade the existing *tehsil* level record rooms to Modern Record Rooms (MRRs) that will both preserve the existing documents, as well as allow the documents to be retrieved on an as needed basis. Towards this end, each document is cataloged using barcodes and scanned into the system with the necessary metadata. The existing Geological Survey of India reference points were used to georeference the scanned map sheets.The originals are laminated and kept in climate controlled record rooms with compact shelving to minimize space requirements. This project has both civil as well as IT activities associated with it.

The center provides full funding for MRRs at the rate of INR 2.5 million per *tehsil*. This funding is based on an assumption of there being an average of sixty-six thousand revenue records per *tehsil*. Further,

---

[7]The judicial system requires authenticated originals and does not accept scanned copies.

no new construction was allowed and the district administration was asked to provide a room no larger than 1200 sq ft to be renovated at the fixed rate of INR 288 per sq ft. This renovation includes provisioning of false ceiling, air conditioning, IT systems (computers, scanners and printers), fire suppression systems and a heavy duty vault door. According to my interviewee, the heavy duty door has strict specifications which make it extremely heavy (unsuitable for many walls), and very expensive (INR 90,000 or upto one-fifth of the total budget). Further, the room size is strictly to be adhered to and no payment was to be made for anything exceeding 1200 sq ft in a *tehsil*.

The document scanning was to start after the room had been setup with all the equipment. However, this phase was dependent upon the Superintendent (Land Records) (SLR) providing the records to be scanned to the on time. Many times SLRs did not provide documents on time and thus the deadlines were missed. Another challenge was the gross underestimation of the number of records. While the budgets were estimated based on there being around sixty-six thousand revenue records per *tehsil*, the actual number ranged from a minimum of one hundred and fifty thousand up to one and a quarter million per *tehsil*, which meant the potential of enormous cost overruns. Also, these rates were based on the L1 basket rate, which was not appropriate for all situations.

Midway (in 2013–14), the Chief Secretary decided that not only revenue records, but also other non-revenue district records be digitized. For this purpose, additional funding to the tune of INR 190 million were provided by the state government. However, due to the initial wrong estimates, the revenue records themselves were not being fully digitized, and the additional funds lapsed. Further, the NLRMP provide d funds only for twenty seven districts, but be re-appropriating from other heads like data centers and connectivity, this work was extended to the entire state. Also, judicious vendor management allowed the work to be done with minimal cost overruns.

The issues that emerge from the design of the MRR component of the NLRMP are that strict specifications and wrong estimates along with bureaucratic apathy led to cost and time overruns. Further, there is the challenge of regular upkeep and maintenance of the MRR as no funds are explicitly provided for this purpose and upkeep has to be done through the regular funding available to the government's Public Works Department (PWD).

Training & capacity building

Continuous training and capacity building exercises are key to ensuring long term success of the NLRMP. One aspect of the program is the building of an NLRMP Cell to provide training and continuously update the skills of the staff. Towards this end two such cells have been setup in the state. These cells augment the training provided by the nine *patwari* training centres, two revenue inspector training schools and one state training institute. Another aspect has been the enhancement of the minimum qualifications needed to be a land records inspector. Earlier, the *patwari* only needed to have completed twelve years of schooling. But now, the minimum qualification of a *patwari* is a three year diploma in computer applications recognized by the University Grants Commission (UGC). Apart from training on administrative aspects, the *patwaris* are also trained in surveying using both the traditional chain survey and also the use of ETS. After five years, the *patwari* is eligible for promotion as a "revenue inspector".

Every year, half of the revenue inspector vacancies are filled by fresh civil engineering graduates, and the remainder by promoted *patwaris*.The eligible *patwaris* have to take a pre-examination. Selected candidates then undergo a nine month revenue inspector training after which they take the revenue inspector examination.

Conclusion

The findings of our research underline that the project success is highly dependent upon the importance top officials place on it. In MP much of the NLRMP implementation was driven directly by the CLR with senior administration officials being involved. However, the design of the program itself had severe lacunae. The program specifications are centrally-managed and driven top-down by the Department of Land Resources in the Ministry of Rural Development. This one-size fits all approach does not distinguish between the large and small states or those with varying degrees of complexity in the land administration system as can be seen in the extremely low estimate of sixty-six thousand records per *tehsil*, with the real world figures being much higher. Another aspect is the strict requirements of the Modern Record Room (MRR), which did not take into consideration many civil construction aspects. Another challenge that emerged was that of co-ordination between different agencies as evidenced in the purchase of satellite imagery. While the state administration wanted the National Remote Sensing Centre (NRSC) to be a guide in its purchase of satellite imagery, their perspective was that of a vendor agent. This underlines the need to have in-house technical expertise in the field of remote sensing similar to the one in the state of Haryana.

References

Auerswald, P., & Stefanotti, J. (2012). Integrating Technology and Institutional Change: Toward the Design and Deployment of 21st Century Digital Property Rights Institutions. *innovations*, *7*(4), 113–123.

Dale, P., & Mclaughlin, J. D. (1999). *Land Administration*. New York: Oxford University Press.

Deininger, K., & Goyal, A. (2012). Going digital: Credit effects of land registry computerization in India. *Journal of Development Economics*, *99*(2), 236–243. Retrieved from `http://www.sciencedirect.com/science/article/pii/S0304387812000181` doi: 10.1016/j.jdeveco.2012.02.007

MGI. (2001, August). *India: The growth imperative* (Tech. Rep.). McKinsey Global Institute. Retrieved from `http://www.mckinsey.com/insights/india/growth_imperative_for_india`

Mishra, S. (2016). *Identifying Existing Capacities to Execute the National Land Records Modernization Programme in Madhya Pradesh: An Appraisal* [resreport]. Centre for Rural Studies, Lal Bahadur Shastri National Academy of Administration. Retrieved from `http://centre.lbsnaa.gov.in/crs/admin/upload/Publication_Int/Madhya_Pradesh_Study2016.pdf`

Narasappa, H., & Vidyasagar, S. (2016). *State of the Indian Judiciary* [resreport]. Retrieved 2016-03-01, from `http://dakshindia.org/state-of-the-indian-judiciary/00_cover.html`

National e-Governance Division. (2011). *Saaransh: A compendium of Mission Mode Projects under NeGP* [resreport]. Retrieved from `http://deity.gov.in/sites/upload_files/dit/files/Compendium_FINAL_Version_220211.pdf`

National Research Council. (2007). *National Land Parcel Data: A Vision for the Future* (Committee on Land Parcel Databases, Ed.). Washington, DC: The National Academies Press. Retrieved from `http://www.nap.edu/catalog/11978.html` (ISBN: 0-309-11031-9, 172 pages, 6 x 9, (2007))

Payne, G. (2001). Urban land tenure policy options: titles or rights? *Habitat International*, *25*(3), 415–429. Retrieved from `http://www.sciencedirect.com/science/article/pii/S0197397501000145` doi: 10.1016/S0197-3975(01)00014-5

Robinson, N. (2013). A Quantitative Analysis of the Indian Supreme Court's Workload. *Journal of Empirical Legal Studies*, *10*(3), 570–601. doi: 10.1111/jels.12020

Törhönen, M.-P. (2004). Sustainable land tenure and land registration in developing countries, including a historical comparison with an industrialised country. *Computers, Environment and Urban Systems*, *28*(5), 545–586. Retrieved from `http://www.sciencedirect.com/science/article/pii/S0198971503001133` (Cadastral Systems {III}) doi: 10.1016/j.compenvurbsys.2003.11.007

Venkataraman, M. (2014). What is Title Guarantee Worth in Land Markets? Evidence from Bengaluru, India. *SSRN (December 2, 2014)*. Retrieved from `http://ssrn.com/abstract=2532874` (IIM Bangalore Research Paper No. 473) doi: 10.2139/ssrn.2532874

Williamson, I., & Ting, L. (2001). Land administration and cadastral trends—a framework for re-engineering. *Computers, Environment and Urban Systems*, *25*(4–5), 339–366. Retrieved from `http://www.sciencedirect.com/science/article/pii/S0198971500000533` doi: 10.1016/S0198-9715(00)00053-3