The National Land Records Modernization Programme
(NLRMP)

Guidelines, Technical Manuals and MIS
2008-09

Department of Land Resources
Ministry of Rural Development
Government of India

FOREWORD

For modernization of land records system in the country, a modified programme, viz., the National Land Records Modernization Programme (NLRMP) has been formulated by merging two Centrally-sponsored schemes of Computerization of Land Records (CLR) and Strengthening of Revenue Administration and Updating of Land Records (SRA&ULR). The NLRMP was approved by the Cabinet on 21.08.2008.

The programme has been rolled out with a technical workshop conducted on 24th – 25th September, 2008 in New Delhi which was attended by the officers from the Revenue and Registration Departments of the States. The ultimate goal of the NLRMP is to usher in the conclusive titling system with title guarantee, to replace the current presumptive title system in the country.

Detailed Guidelines and Technical Manual are enclosed for better implementation of the NLRMP. The Technical Manuals have been prepared after obtaining inputs from the leading technical agencies as well as from the field experience of States which have done commendable work in specific areas of the programme.

These Guidelines comprise three parts - **Part-A The Guidelines**, **Part-B The Technical Manuals** and Part-C The MIS. **Part A & B** have been prepared and are being issued herewith. Part C is being finalized and will be issued separately. The views/policy framework regarding open sources and open standards prepared by the Department of Information Technology, Government of India, are being circulated separately.

I wish to bring on record our thanks and appreciation for those Agencies and Individuals who spared their valuable time to contribute towards framing the Guidelines and Technical Manuals, namely:

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No work is ever perfect and I am sure the same is true for both these documents. Despite our best efforts, if any errors are detected or if there are further suggestions for improvement, we would be more than happy if this information is sent to us to help improve the documents before they go for publication.

If inadvertently, a name has been left out, it is highly regretted but we remain thankful, nonetheless.

(RITA SINHA)
Secretary
Department of Land Resources

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PART A - GUIDELINES

1. INTRODUCTION

The Government of India have decided to implement the Centrally-Sponsored scheme in the shape of the National Land Records Modernization Programme (NLRMP) by merging two existing Centrally-Sponsored Schemes of Computerization of Land Records (CLR) and Strengthening of Revenue Administration and Updating of Land Records (SRA&ULR) in the Department of Land Resources (DoLR), Ministry of Rural Development. The integrated programme would modernize management of land records, minimize scope of land/property disputes, enhance transparency in the land records maintenance system, and facilitate moving eventually towards guaranteed conclusive titles to immovable properties in the country. The major components of the programme are computerization of all land records including mutations, digitization of maps and integration of textual and spatial data, survey/re-survey and updation of all survey and settlement records including creation of original cadastral records wherever necessary, computerization of registration and its integration with the land records maintenance system, development of core Geospatial Information System (GIS) and capacity building. This document outlines the objectives of the NLRMP, major activities under it and implementation guidelines for the State Governments, UT Administration and the implementing agencies.

2. OBJECTIVE OF THE PROGRAMME

The main objective of the NLRMP is to develop a modern, comprehensive and transparent land records management system in the country with the aim to implement the conclusive land-titling system with title guarantee, which will be based on four basic principles, i.e., (i) a single window to handle land records (including the maintenance and updating of textual records, maps, survey and settlement operations and registration of immovable property), (ii) the "mirror" principle, which refers to the fact that cadastral records mirror the ground reality, (iii) the "curtain" principle which indicates that the record of title is a true depiction of the ownership status, mutation is automated and automatic following registration and the reference to past records is not necessary, and (iv) title insurance, which guarantees the title for its correctness and indemnifies the title holder against loss arising on account of any defect therein.

3. SCOPE OF THE PROGRAMME

3.1 The following is an outline of the components and activities to be taken up under the NLRMP:

I. Computerization of land records

a) Data entry/re-entry/data conversion of all textual records including mutation records and other land attributes data
b) Digitization of cadastral maps
c) Integration of textual and spatial data
d) Tehsil, sub-division/district Computer centers
e) State-level data centres
f) Inter-connectivity among revenue offices

II. Survey/resurvey and updating of the survey & settlement records (including ground control network and ground truthing) using the following modern technology options:

a) Pure ground method using total station (TS) and differential global positioning system (DGPS)
b) Hybrid methodology using aerial photography and ground truthing by TS and DGPS
c) High Resolution Satellite Imagery (HRSI) and ground truthing by TS and DGPS.

III. Computerization of Registration

a) Computerization of the sub-registrar's offices (SROs)
b) Data entry of valuation details
c) Data entry of legacy encumbrance data
d) Scanning & preservation of old documents
e) Connectivity of SROs with revenue offices

IV. Modern record rooms/land records management centres at tehsil/taluk/circle/block level

V. Training & capacity building

a) Training, workshops, etc.
b) Strengthening of the Survey and Revenue training institutes

VI. Core GIS

a) Village index base maps by geo-referencing cadastral maps with satellite imagery, for creating the core GIS.
b) Integration of three layers of data: (i) Spatial data from aerial photography or high-resolution satellite imagery; (ii) Survey of India and Forest Survey of India maps; and (iii) GIS-ready digitized cadastral maps from revenue records. Once the basic plot-

wise data is created by the States/UTs, seamless integration would be possible for micro and macro-planning and other relevant applications.

VII. Legal changes

a) Amendments to The Registration Act, 1908

b) Amendments to The Indian Stamp Act, 1899

c) Other legal changes

d) Model law for conclusive titling

VIII. Programme management

a) Programme Sanctioning & Monitoring Committee in the DoLR

b) Core Technical Advisory Group in the DoLR and the States/UTs

c) Programme Management Unit (PMU) in the DoLR and the States/UTs

d) Information, education and communication (IEC) activities

e) Evaluation

3.2 All the activities shall be taken up in a systematic, ladder-like manner. These have been framed in the form of two kinds of ladders – primary and secondary. The primary ladder covers activities for reaching the stage of conclusive titling, and the secondary ladder covers archival purposes and strengthening of the revenue administration. A diagrammatic depiction of the two kinds of ladders is provided at **Annexure-GL-I.** These are of an indicative nature, and the States/UTs may suitably adopt them as per their need and carry out the process re-engineering involved, wherever necessary.

4. IMPLEMENTATION OF THE PROGRAMME

4.1 The State Governments/UT Administrations will implement the programme with financial and technical supports from the Dept. of Land Resources, Government of India. Outsourcing to the extent necessary for meeting the critical gaps in technological resources shall be permissible, and the States/UTs may go for the public-private partnership (PPP) models in the non-sensitive areas.

4.2 The district will be taken as the unit of implementation, where all activities under the programme will converge. It has been decided to cover the entire country by the 12th Plan period. However, the States/UTs which wish to complete the work earlier can do so.

4.3 Initial funding will be provided to the States/UTs based on their eight-year perspective plan and annual plan for the first year. Thereafter, all sanctions will be done on the basis of detailed project reports (DPRs) prepared by the States/UTs in the prescribed proforma in Part-C-MIS. Funding will be conditional upon the

States/UTs signing the Memorandum of Understanding (MoU) with the DoLR and following its stipulations. A model MoU document is provided at **Annexure-GL-II.**

4.4 These Guidelines attempt to assign duties and responsibilities as far as possible from the national level. However, State/UT-specific details can only be locally delineated. States/UTs must identify a nodal Department for implementing the NLRMP. This Department must, in turn, put in place a Programme Management Unit (PMU) in the charge of an officer not below the rank of Secretary, to oversee the NLRMP in its entirety. This PMU must ensure coordination among all concerned Departments, as well as among the various units of the implementing Department. For each activity under this Programme, the duties and responsibilities of officials as well as of the vendors, if any, must be listed out in detail in harmony, as far as possible, with the Guidelines and also intimated to the DoLR. MoUs/agreements may be signed, wherever required. The PMU must ensure that milestones and timeframes, as well as physical and financial achievements, are monitored on a regular basis and online data are sent to the DoLR and other agencies as required.

5. CONTENT MANAGEMENT

5.1 Data Entry, Updation & Data Verification/Validation Process

5.1.1 Land records data are available as (a) textual data, and (b) spatial data (cadastral maps). All textual data including the records of rights (RoRs), mutation data and other land attributes data shall be updated and computerized. All pending mutations shall be updated and the data entry shall be completed on priority basis. All spatial data shall also be updated and digitized as described below.

5.1.2 Each State/UT should fix a reasonable cut-off date after which only computerized RoRs should be issued, and issue of manual RoRs should be discontinued thereafter. After the cutoff date, further mutation and updation of data shall be done in the computerized system on an ongoing basis, after following the procedure in the Land Revenue laws/manuals.

5.1.3 Responsibility of Revenue officials should be fixed to ensure 100% checking, verification and validation of the data entered. The patwari shall carry out 100% checking, and the Revenue Inspector, tehsildar or an officer of the equivalent rank, the SDO and the Deputy Commissioner/District Collector should randomly check 50%, 10%, 3% and 1%, respectively, of the data entered, so as to ensure the accuracy of the data entered vis-à-vis the

manual records, or as stipulated in the State/UT laws/manuals. A strict view should be taken where too many errors are found un-checked.

5.1.4 The States/UTs which have authorized Gram Panchayats to pass orders on mutation must ensure their inter-connectivity with the corresponding Revenue offices.

5.1.5 As for the encoding standards, the UNICODE should be used for data storage and local language display and support. Any database created using the ISCII or any other font-based solution should be converted to the UNICODE. The necessary assistance in data conversion may be taken from the Centre for Development of Advanced Computing (CDAC).

5.2 Procedural Changes

5.2.1 The States/UTs should carry out the procedural changes, wherever necessary, including the following:

1. Simplify/amend/revise/prepare the land records, manuals, RoR formats on land records maintenance procedures for the entire State/UT.
2. Standardize the codifications, feature codes etc. in case of cadastral maps, RoRs and other land attributes data. Standard data codes for land attributes have been prepared by the NIC and placed on the DoLR web site http://dolr.nic.in.
3. Confer legal sanctity to the computerized land record extracts as the official records.
4. Discontinue manual land record writing and issuing of hand-written copies of the RoRs, once the computerized system stabilizes.

5.2.2 Wherever a State Government/UT Administration adopts any procedure detailed in these Guidelines and Technical Manuals, it must ensure that it is duly inserted in the relevant State/UT laws/rules/regulations/manuals or that the same are duly amended to ensure their legal validity.

5.3 Digitization of Maps and Integration of Textual and Spatial Data

5.3.1 There is an urgent need to convert the existing paper maps into GIS-ready digital form in order to facilitate updating of cadastral maps in sync with the changes made in the RoRs. RoRs provide information on the plots held by individual or joint owners, indicating ownership of land, its classification, land use, source of irrigation, crops sown, etc. Detailed maps of individual pieces of land, called “parcels” or “plots”, are prepared accurately for each revenue village. In 1:3960 scale, the smallest piece

of land that can be measured is 1 decimal (1/100th part of an acre) i.e. 435.6 sq. feet. Changes in a cadastral map may take place due to various reasons, e.g., a plot of land may have been further sub-divided into two or more sub-plots and transferred to other persons by way of deed of gift or sale or inheritance, or conversion of classification of land use. The need for indicating these changes in the map arises every time a change as mentioned above takes place so as to depict the ground reality.

5.3.2 Broadly, there are two ways in which spatial data have been organized in the country. In certain States/UTs, village maps with parcel boundaries are used, whereas, in certain other States, ladder data on individual land parcels or tippans or field measurement books (FMBs) or gat maps are used. In most parts of the country, the land parcels depicted in village maps are covered in one or more sheets, depending upon the scale of mapping and area of the village. These village maps/sheets will be considered as the basic input for digitization and mosaicing of the cadastral maps in these States/UTs. In other States/UTs, where ladder data or gat maps/tippans/FMBs are used, the same will be taken for digitization and further mosaicing of the maps.

5.3.3 GIS-ready digitization of cadastral maps and their integration with RoRs involve the following steps:

1. Scanning of the village map or part of the village map and feeding this scanned map into the computer to create a computer image of the map which is known as a **raster map**.
2. The next step involves going over the outline of the village boundary on the computer image of the map with the mouse and marking the outlines of each plot. This process, known as **vectorisation**, provides the coordinates of each point on the map.
3. A printout of this vectorised map is given to the Revenue Department by the digitizing agency (which could be the vendor if the work is outsourced) for thorough checking with the original cadastral map. The Revenue Department checks the vectorized map on a glass table with the original map placed below it. This process is known as the **table check**. Every line and point on the two maps have to match. The correctness of the digitized map is certified by the Revenue Department. If any error is detected, the same has to be rectified by the vendor/digitizing agency.

4. The software used in the digitization process creates a number of files. Each of these files pertains to a GIS-based layer and each layer consists of three files.

The GIS data are organized in layers. Each layer contains a subset of information that would be present on a regular map, such as (1) geographic information (where something is located), (2) attributes information (what is located at a specific location), and (3) its interlinking information. These three sets of information are represented in three physical files in the computer. For example, the software used in West Bengal uses 9 GIS-based layers and creates 27 files. In addition, 8 to 11 other files, known as database files and image files, are also created, totaling from 35 to 38 files. All the files are put in a storage device (e.g., a CD) and given to the Revenue Department for checking. If any error is detected, the same has to be rectified.

5. The GIS layers are of three types: point layers, line layers & area layers. Each of the 9 GIS layers mentioned above belongs to one of the three types. Symbols (known as alamats in West Bengal) are used to record the legends that have been made on the map such as wells, temples, etc. These alamats are incorporated in all the three layers, i.e., point, line and area layers.

6. Once the Revenue Department has cleared the vectorised map and the files, the digitizing agency proceeds to add each of the handwritten information on the original map except the signature at the bottom given out neatly typed.

5.3.4 Integration of spatial database with textual RoR data involves the following process:

1. Each plot of land is represented on the digital map as a closed polygon. Each polygon is identified by a unique plot number, which, for example, in West Bengal is a 5 digit number. In the textual RoR database, each plot is also referenced by this unique plot number. This provides a basis for integration of digital map data with the textual RoR data.
2. The basic textual RoR database consists of several tables (in West Bengal, 7 main tables & several master tables) which provide information on ownership, land classification, etc. All the tables are linked by certain common data fields, for example, in West Bengal, by two common data fields, which are:

   Idn: a seven digit code to identify a Mouza (2 digit for District, 2 digit for Block & 3 digit for the Mouza)

   Plot No: a five digit Plot number

3. After integration of the textual and spatial RoR data, the digitized map is shown on the computer, which indicates through colour codes the plots which do not have a corresponding textual detail or plot number, or where the textual and spatial

data do not match each other. Such plots require patch survey using TS and GPS and re-entry of the correct data to produce a 100% correct digitized map. Thereafter, computerized and digitized RoRs can be issued to property owners.

5.3.5 Citizen Services

The integration software facilitates citizen services, some of which are:

1) RoR with plot map (parcel map), showing dimensions of each side, area & the adjoining plots.
2) Deriving various maps based on possessions, land use classifications, sizes of plots, sources of irrigation, types of crops etc.
3) Textual RoR updation in sync with spatial data updation.

5.3.6 The technical details are available in the Technical Manual-Chapter-1. Two models of digitization of maps have been described viz. Model-1 based on the West Bengal experience, and Model-2 based on the use of satellite imagery. The States/UTs may adopt either of the models as per their convenience or develop a model suitable to the State/UT, in which case the details may be communicated to the Department of Land Resources.

6. TEHSIL, SUB-DIVISION/DISTRICT COMPUTER CENTRES

A computer centre at the tehsil/sub-division is necessary for maintaining the village-wise property records and for easier services to the citizens. District-level databases may be maintained for data analysis, planning, verification, etc. at the district level. The tehsil/taluka/sub-division Computer Centre will consist of computer systems comprising of appropriate level server and client computers with local area connectivity (LAN), switches, storage area network (SAN) where feasible and necessary, UPS, printer (including map printer), scanner, touch screen kiosk, biometric/smartcard readers, and CD writers. The server room will be secured and separated from the public area. Proper arrangements shall be made for land records/data storage in compactors as well as computerized and indexed data retrieval system. There should be enough space for seating the public in a proper reception area. District Computer Centre will collate the land records data of all the sub-divisions and tehsils in the respective districts. These district data centres too will be equipped with appropriate level computer systems with sufficient storage provided with LAN connectivity and switches.

7. STATE-LEVEL DATA CENTRES

In order to maintain data repository and backup, each State/UT may need to establish a dedicated data centre for the land records data (including maps and registration data) at the State/UT level. This data centre would have estimated storage capacity scalable from 2 to 20 terabytes, depending upon the volume of records, along with high speed processors, switches, fiber optic channels, software and security devices. Further, these would have appropriate backup media (like CDs and tape devices, etc.) for high volume storage. Storage area network (SAN) may also be set up where feasible and necessary. Action for setting up of the SLDCs may be taken up when sufficient data has been created in the districts for storage at the State/UT level.

8. INTER-CONNECTIVITY AMONG REVENUE AND REGISTRATION OFFICES

All the land record offices, from the State/UT level to the tehsil or equivalent level, as well as the registration offices may be securely connected via local area network (LAN) or wide area network (WAN) in an appropriate configuration based on the functional and technical requirements. In order to achieve functional integration among the tehsils, districts, SROs and State data centres, each location would be provided with network connectivity with 2 mbps link for last mile connectivity from the point of presence (PoP) of the State Wide Area Network (SWAN). From there upwards, the data would ride over the NICNET network. In addition, each site would require one set of switch/ router and modem. Time required for this would vary, depending upon the progress made on the SWAN project of the Department of Information Technology. However, alternative approaches can be taken for connectivity in the interim period, such as broadband/leased line with virtual private network (VPN) infrastructure for secure data transmission. This network may have a centralized architecture connecting the tehsils, sub-registrar offices, sub-divisions, districts and the State/UT Data Centres for enabling online data updation, easy access and sharing of data. The network may be designed by or with input from the NIC and by enforcing the approved security protocols and access control protocols of the DIT, GoI. Where the SWAN is available, horizontal connectivity to tehsils or SR offices may be drawn from the nearest available PoP using leased lines or other secure connectivity. At places where the SWAN is yet to be implemented, other options such as broadband with VPN or VSAT connectivity could be established. From the district upwards, the system could ride over the NICNET network.

9. SURVEY/RE-SURVEY AND UPDATION OF SURVEY & SETTLEMENT RECORDS

9.1 India has about 6.4 lakh villages. Most of the villages were surveyed and corresponding village (cadastral) maps were prepared at 1:4,000 to 1:10,000 scales during late 19th and early 20th century. However, where original cadastral survey is yet to take place, the States/UTs will need to draft the laws/manuals/guidelines for the purpose, and Government of India would be willing to extend necessary help in this regard.

9.2 The cadastral survey of an area which has already been surveyed earlier is known as Resurvey. This may be required under the following circumstances:

- When the framework of survey in field has completely broken down. In such cases, the boundaries shown in the records do not tally with the actual conditions on the ground. This may happen due to obliteration of field and sub-division of boundaries and/or due to misplacement of a large percentage of the local ground control point markers, as a result of which it is difficult to identify the fields with reference to the records.
- Resurvey is also necessary in the case of sudden development of the area due to causes such as:
    - Sub-divisions
    - Transfer of dry lands into wetlands
    - Large scale transfer of holdings

9.3 Factors influencing the mode of survey/re-survey: In place of the conventional, chain survey, plane table survey and theodolite methods of survey, modernized technology in the form of Total Station (TS) and Global Positioning System (GPS) are now available. The selection of technology for cadastral survey depends upon several factors as shown in Flow Chart No.1 in Chapter-2, Model-I of the Technical Manual. These are enumerated below:

- Terrain conditions (hilly, undulating, plain)
- Vegetative cover (dense, sparse)
- Built-up areas
- Size of survey area
- Accuracy
- Timeliness
- Cost

9.3.1 Terrain conditions: Where the land area is within a gradient of 15%, aerial photography or high-resolution satellite imagery is expected to give adequately accurate output. However, in undulating terrain and hilly slopes, pure ground method using TS+GPS may be used for cadastral survey.

9.3.2 Vegetative cover: Dense vegetation obstructs the line of sight in the vertical direction, thus preventing the aerial and satellite images from capturing the field boundaries. Pure ground based methods using TS+GPS are suitable in these conditions. In open areas, devoid of vegetation, aerial photography or satellite imagery is likely to give adequately accurate output. However, sparse vegetative cover prevents pinpointing the field corners and in these conditions, aerial photography or satellite imagery should be supplemented by ground truthing.

9.3.3 Built-up areas: In urban areas, high-rise buildings prevent aerial/satellite images from capturing building corners and boundaries. A lot of shadow areas appear in the remote sensing data, depending upon the height of the buildings. In these conditions, pure ground based methods using TS+GPS are preferable for cadastral survey. Where there are lower built-up areas, aerial images or high-resolution satellite images are likely to give better results.

9.3.4 Size of survey area: In a small survey area, ground-based survey will give faster output, but in a larger area, such as a district, aerial photography or high-resolution satellite imagery is likely to suffice.

9.3.5 Accuracy: In cadastral survey, the scale of the map and precision of the instruments greatly influences its accuracy. The accuracy of the survey is the highest with TS followed by, plain table and chain survey, respectively.

9.3.6 Timeliness: Pure ground truthing methods of cadastral survey such as chain, plain table and total station, which require 100% measurement to be made on the ground, are time-consuming. Ortho-products from aerial photos and satellite images supplemented by ground validation greatly reduce the time factor in preparation of cadastral maps.

9.3.7 Cost: The cost is the driving force in adopting a particular technology for cadastral survey. High-resolution satellite images from CARTOSAT series are cost effective, compared to digital aerial images and pure ground methods.

9.4 For reaching the stage of conclusive titling, the States/UTs shall undertake survey/re-survey using modern technology of surveying & mapping, i.e., aerial photography or high resolution satellite imagery combined with ground truthing using TS+GPS so as to ensure true ground depiction on cadastral maps and land records, adopting the methodology most appropriate for the terrain, location, etc. and update the survey & settlement records.

9.5 For fresh survey, in areas where cadastral maps are not available, the following options are suggested:

(i) TS + DGPS

(ii) Aerial Photographs + TS + DGPS

In open areas, the process will be greatly facilitated by the use of aerial photography, combined with TS+DGPS for ground truthing. In densely vegetated areas, use of TS+DGPS is suitable. In hilly areas, use of terrain-corrected aerial photographs (digitally-rectified ortho-photographs) with TS+DGPS for ground truthing may be appropriate. All efforts should be made to arrange for aerial photography; however, where it is not possible to arrange for aerial photography, TS+DGPS must be adopted for completing the work with the desired level of accuracy.

9.6 For resurvey, aerial photography (wherever possible) and TS+DGPS for ground truthing is recommended.

9.7 Where large open areas and large land holdings are there, e.g., arid and semi-arid areas, and good quality and reasonably up-to-date cadastral maps are available, the vectorized cadastral maps may be geo-referenced using high resolution satellite data and GPS control points. The geo-referenced cadastral maps shall be overlaid on the high resolution satellite imagery (HRSI) to study the discrepancy, both qualitatively and quantitatively. If the discrepancies are high, ground truthing using TS+DGPS is recommended.

9.8 The technical details on different methodologies as mentioned above and setting up of the ground control network are given in Chapter-2 of the Technical Manual.

10. COMPUTERIZATION OF THE REGISTRATION PROCESS

10.1 Registration is one of the major components of the NLRMP. This component was not covered under the schemes of CLR or SRA&ULR. Computerization of registration is necessary not only for making property registration efficient and hassle-free but also for integrating land records and registration. The sub-registrars' offices (SROs) in the States/UTs carry out registration and recording of various types of documents related to the transfer of immovable property. Though functions and working procedures of the systems are as per the Registration Act, 1908, many States/UTs have made certain rules and procedures as per their Registration Manuals.

10.2 The manual (non-computerized) registration process involves maintenance of paper copies of all the registered documents. This procedure of maintaining and registering property documents often results in misclassification of documents, misrepresentation of facts, and other such losses. Searching of reports, records and issuance of non-encumbrance certificates also take long time and turn out to be cumbersome tasks.

10.3 Under the NLRMP, all the SROs will be fully computerized with adequate hardware, software, process re-engineering, staff training and connectivity with the revenue records maintenance system, banks, treasuries, etc. Also, the following functions will be computerized:

- Register of minimum guidance values or circle rates, so the transacting parties can ascertain stamp duty liability online. This may be done by preparing the list of prevalent rates, list of properties, list of plots, floor space, nature and year of construction, etc., or by computerizing the guidance values/circle rates for different kinds of land and properties.
- Re-engineer the process, wherever necessary, by fixing the formats of the deeds in 2-3 pages. The first page may contain the parties' details, second page property/land details, and the third page may contain legal issues and conditions, or as the State/UT may decide and place the format(s) on the web.
- E-stamping or franking system, etc. for depositing stamp duty should be implemented as soon as possible.
- Computerizing the registration process involves verification of identity of the presenting person, taking photographs, fingerprints, other biometric identification, verification of stamp duty, etc.

- Entry/scanning of legacy registered data for distribution of copies of registered deeds and non-encumbrance certificates.
- Integration of the registration process with the land records maintenance system so that mutation notices and mutation remarks in the corresponding RoRs are generated automatically after registration.

10.4 The technical details are available in Chapter-3 of the Technical Manual.

11. MODERN RECORD ROOMS/LAND RECORDS MANAGEMENT CENTRES

Support for upgrading modern record rooms/land records management centres with a) a storage area with compactors/storage devices for physical storage of records and maps, b) an operational area with computers/servers, storage area network (SAN), printers, etc., and c) a public services area for waiting/reception, etc. The land records details may be indexed and stored. A document management system, i.e., scanning of old records, digital storage and retrieval system should be introduced for online storage and retrieval of the records, indexing of data and images, etc. so as to move towards cyber record rooms/maintenance of land records in the dematerialized (demat) format.

12. TRAINING & CAPACITY BUILDING

12.1 States/UTs are required to draw up a comprehensive training programme to develop their human resources for effective maintenance and sustenance of the NLRMP, covering the policy makers, heads of the departments of revenue, survey, registration and their offices and staff, master trainers and field-level functionaries including the surveyors, village accountants and other revenue staff, who will be trained for operating the system including mutation and updating of land records, issue of authenticated copies of RoRs with maps-to-scale, handling modern survey equipment such as GPS, TS and photogrammetry.

12.2 Expert organizations like the Survey of India, NIC and Indian Space Research Organization (ISRO), etc. should be involved in imparting training to master trainers, who in turn, will train the State/UT staff on TS/GPS, survey methodologies, scanning, digitization, GIS and ICT activities. For better outreach, e-learning and video-conferencing facilities may be used. The capacity building programme should include awareness/appraisal workshops, long-term training programmes for field-level

officers with hands-on training, and short-term training modules for senior-level officers.

12.3 The capacity building programme should cover not only technical contents, but also quality procedures, technological advancements, outsourcing procedures, project management, etc. The States/UTs may tie up with leading training institutions for this purpose. A core group of officers and staff from the States/UTs may be sent on exposure visits to other States/UTs which have demonstrated considerable success in implementing the project. Discussion forums and help lines may be established to guide the field staff in solving technical problems.

13. CHOICE OF SOFTWARE AND STANDARDS

13.1 Based on the process and functionality requirements, user-friendly application software for capturing, editing and updating land records textual data, integration of textual data and maps, registration system workflow, integration of registration with mutation, and proper authentication mechanism using digital signature/public key infrastructure (PKI), etc. may be required by the States/UTs.

13.2 In order to have uniformity, standardization and integration, the software development and software maintenance support may be provided by the NIC, which may set up core development teams consisting of IT and GIS experts at the Central level, supported by State/UT-level teams for software customization, technical coordination and State/UT-wide support. While it will be open for the users to select the operating system for their client machines—Windows-based or Linux-based, but in so far as the server machines are concerned, open-source platforms that implement mandatory access control policies are preferred. A write-up on the choice of software and standards, prepared by the NIC, is given in **Chapter-4 of the Technical Manual**.

14. DATA SECURITY

14.1 Assuring security and effective performance

The land records information system management gives rise to new concerns and new functions that need to be properly understood and addressed. These concerns relate to security of information system assets and data integrity. One important information system function, therefore, is asset safeguarding and data integrity. At

the international level, two sets of standards have been codified by the International Organization for Standardization (ISO): one is the ISO/IEC 27001, also called the information security management system (ISMS) standard of 2005; the other is ISO/IEC 27002:2005, a codification of practices for information security management. The ISO/IEC 27001 (earlier called ISO/IEC BS-17799) lists the standards required from any management in implementing information system security function. This lays down standards for the management to perform four core functions: planning--determining the goals of information systems function and the means of achieving this goal; organizing--gathering, allocating and coordinating the resources needed to accomplish the goals; leading--motivating, guiding and communicating with personnel; and controlling--comparing actual performance with planned performance as a basis for taking any corrective action that may be needed. This also deals with management processes: plan-do-check-act (PDCA) model. The ISO 27002 lists the security controls (such as password controls). The two standards, together, imply that unless the management itself is serious about security and goes about doing it in a systematized way (ISO/IEC 27001), no amount of technical controls (ISO/IEC 27002) would suffice. Extracts from the report of the Committee of Revenue Secretaries on CLR, covering the Information Security Requirements and Authentication Mechanism are at **Technical Manual Chapter-5 (Section-A)**.

14.2 User and Data Authentication

14.2.1 User authentication is the process of identifying a user. The information system must satisfy itself that the user is the one who he/she claims to be. There are a number of ways a user can be authenticated. Password authentication is sufficient for the purpose of extracting user-related information. However, for users who are to have more privileges on the database than that of merely reading it, then stronger forms of authentication are recommended. For such users, a two-factor authentication scheme is recommended; for example, authenticating a user both with a password and the biometric technology.

14.2.2 Besides authenticating the user, every land record data that is entered into the database needs to be approved/authenticated by the officer who is competent for the purpose as per the local revenue manual. The land information system should provide a user interface for performing this task. Once a data item has been approved/authenticated, the application system does not allow any further changes to it. That is, there is no user interface provided to make any change directly to an approved record. If any change does occur, a new record is entered, verified and

authenticated. Thus, the information system also records a history of the changes occurring to any piece of data.

14.2.3 In a database environment, the database administrator (DBA) may have all privileges on the database, i.e., he/she can insert any record, change any record or delete any record, irrespective of the fact that he/she is not the approving authority as per the local revenue manual. Such overriding privileges with a single person must be used with propriety; otherwise, these can be abused. On the one hand, centralizing certain functions to be performed in the database environment improves communication, coordination and control. On the other hand, vesting substantial powers in the DBA role runs contrary to the fundamental principles of sound internal control. This problem is not unique to land management information system, but is common to all e-Governance initiatives that use databases. Therefore, the States/UTs must take remedial measures for reducing the risks associated with the DBA role. Certain suggestions in this regard are outlined in **Technical Manual Chapter-5 (Section-B).**

15. PURCHASE PROCEDURES

The States/UTs shall follow their Governments' rules and procedures in purchase of services, hardware, equipments, etc. with comprehensive 3-5 year warranty, wherever applicable.

16. PUBLIC-PRIVATE PARTNERSHIPS (PPP)

16.1 The NLRMP has generated an enormous workload on the existing Revenue and Registration machinery. It also requires a high level of technological inputs at almost every stage. Capacity building of the in-situ staff is essential but is likely to take time. In order to streamline the implementation of the Programme and to achieve the targets within the proposed timeframe, the States/UTs may like to go for the PPP models in respect of certain activities under the Programme or outsource them on a turnkey basis.

16.2 All outsourcing/PPP arrangements under the NLRMP shall be subject to the following conditions:

(a) No outsourcing or PPP should normally be allowed in the sensitive districts/areas, as identified by the appropriate Government.

(b) All legal duties/actions required under the State/UT laws shall continue to be performed by the designated officials.

(c) The State/UT must work out a modus operandi and affix responsibilities of Departmental officials to conduct and verify 100% quality check of the work done by the outsourcing/PPP vendor(s). Outsourcing/PPP is merely a convenience and will in no way absolve the State/UT from its legal obligations.

(d) Full control and responsibility for the execution and monitoring of the outsourced/PPP works, as well as of utilization of funds released by the DoLR, shall rest with the concerned State/UT, which will be responsible for rendering the accounts thereof, to the DoLR.

(e) No extra funding beyond the approved cost norms shall be provided by the DoLR.

(f) Proper tendering processes must be followed for outsourcing/PPP.

(g) The technical output of the outsourced/PPP works must be compatible with the IT system architecture/parameters being followed in the State/UT in areas relevant to the NLRMP.

16.3 Where the State/UT opts for a private agency for implementing any work under the NLRMP, it may be beneficial to the State/UT to involve the NIC in an advisory role in the following areas:

(a) Support and advice the State/UT on relevant technical matters.

(b) Help the State/UT in formulating the terms of references (ToRs) for outsourcing/PPP and in establishing the relevant milestones and timeframes.

(c) Vet the relevant deliverables including the architecture, standards, technical specifications, business process re-engineering (BPR), functional requirement specifications (FRS), software/system requirement specifications (SRS), etc. from the vendor(s) and give specific recommendations on these to the State/UT.

(d) Support the State/UT in the evaluation of the technical and financial bids.

(e) Assist the State/UT in reviewing the progress and quality of the work carried out by the vendor(s).

(f) Bring to the notice of the State/UT any deviations from the standards for software development on the part of the vendor(s) responsible for the development and integration of application software.

(g) Assist the State/UT in exercising strategic control over critical components including data, database, applications, network and security components for maintaining sovereignty and accountability of the State/UT, and to help the State/UT formulating a strategic control policy for the purpose.

(h) Interface with the certifying agencies for third-party certifications for the IT infrastructure and software developed and deployed by the vendor(s).

16.4 These must be ensured at the time of signing the MoU with the outsourced agency, and the State/UT may consider entering into a tripartite MoU with the vendor and the NIC in this regard. **However, the overall decision-making responsibility, supervision, monitoring and control in respect of these matters shall rest with the State/UT.**

16.5 Given below are some of the activities that can be considered for outsourcing/PPP:

1. Preparation of the NLRMP Perspective Plan/Detailed Project Report (DPR) for the State/UT and district, respectively.
2. Survey/resurvey work using modern survey technology.
3. Ground-truthing through TS/GPS.
4. Data entry/re-entry of textual records.
5. Preparation of records of undisputed mutations for the approval of designated authority as per the relevant laws.
6. Data entry of approved mutation records, subject to mandatory authentication by designated Departmental officials as per the State/UT laws.
7. GIS-ready digitization of cadastral maps and integration of digitized textual and spatial records.
8. Computerization of the Sub-Registrar's office.
9. Data entry of legacy data regarding property.
10. Data entry of property valuation details.
11. Scanning and preservation of old records.
12. Setting up of, preferably self-sustaining, information kiosks.
13. Training and capacity building.
14. Drafting of legal changes/framework for conclusive titling.
15. Information, Education and Communication (IEC) activities.
16. Evaluation.

17. ROLE OF THE PANCHAYATI RAJ INSTITUTIONS & NGOs

Gram Panchayats (GPs) can play a significant role in updation of land records and identification of property owners in the course of the settlement operations. The Gram Sabha could be involved to facilitate survey/re-survey, wherever necessary. The States/UTs can think of giving the power of doing undisputed mutations to the gram panchayats. Where GPs are involved in carrying out undisputed mutations, interconnectivity with tehsils may be worked out by the States/UTs with their own

funds or by dovetailing funds from other sources. The District Administration may take help from the Panchayati Raj Institutions and reputed NGOs in building up awareness about the Programme. The District Monitoring and Review Committee, of which the CEO/EO of Zila Parishad is also a member, may give due weightage to the recommendations of the PRIs in the implementation of the Programme.

18. TECHNICAL SUPPORT TO THE STATES/UTS AND IMPLEMENTING AGENCIES

The necessary technical guidance and hand-holding support to the States/UTs and the implementing agencies shall be arranged through the Core Technical Advisory Group created for the NLRMP in the DoLR with members from the national-level technical agencies such as the NIC, Survey of India, NRSC, ISRO, C-DAC, Forest Survey of India, Soil & Land Use Survey of India, and experts in the field. A copy of the order issued in this regard is given at **Technical Manual Chapter-6 (Section-A)**. The States/UTs may also approach the regional offices of these technical agencies, wherever necessary. The addresses of these technical agencies along with their regional offices are given at **Technical Manual Chapter-6 (Section-B).** Specifically, technical support of the following nature could be expected from these agencies:

(A). Survey of India: Training to the survey staff/master trainers, guidance in application of modern survey technology.

(B). NRSC/ISRO: Guidance in aerial photography and use of high resolution satellite imagery for survey/re-survey purposes.

(C). C-DAC: Guidance in Indian language computing.

(D). Forest Survey of India: Guidance in mosaicing of the cadastral maps with forest boundaries.

(E). Soil & Land Use Survey of India: Guidance in data coding of the relevant data.

(F). NIC: Software development and customization, training of staff/master trainers, ICT support to the State/UT staff in computer applications, data coding and digitization of map systems and standards, interfaces for integration of textual and spatial data, data centre specifications at various levels, inter-connectivity amongst revenue and registration offices, computerization of registration, technical guidance in setting up of land record management centres and strengthening of survey and revenue training institutes, data security/backup and disaster recovery, authentication mechanism, wherever necessary.

19. MONITORING AND REVIEW MECHANISM

The following monitoring and review mechanism at different levels is to be adopted under the Programme.

19.1 District-level Monitoring and Review Committee: All the districts need to have a District-level Monitoring and Review Committee under the Chairpersonship of the District Collector/Deputy Commissioner/District Magistrate, along with ADMs/SDMs dealing with land revenue matters, CEO/Executive Officer of the Zila Parishad, Sub-district Registrar, Survey & Settlement/Consolidation Officer having jurisdiction over the district, and District Informatics Officer of the NIC as members. Representatives from other technical agencies such as the SoI, NRSC/ISRO, C-DAC, FSI, and SLUSI may be involved as per the need as special invitees. The Committee will review the progress of implementation of the Programme at least once a quarter, and the District Collector/Deputy Commissioner shall submit report to the State-level Monitoring and Review Committee. Online monitoring reports shall be submitted by the District Collector/Deputy Commissioner to the State Govt. as well as to the DoLR as per the MIS reporting formats and periodicity prescribed.

19.2 State/UT-level Monitoring and Review Committee:

A State/UT-level Monitoring and Review Committee shall be constituted in each State/UT for the NLRMP under the chairpersonship of the Chief Secretary/Chairman, Board of Revenue. It is recommended that a representative from the Board of Revenue, Principal Secretary/Secretary of the Departments of Revenue, Registration, Finance, Planning and IT, the Divisional Commissioners, Inspector General of Registration, Commissioner/Director of Survey & Settlement and of Land Records, State Informatics Officer of the NIC and any other expert as decided by the State Government/UT Administration should be its members. The Committee shall monitor and review the progress of implementation of the Programme, facilitate the necessary process re-engineering, and guide the implementation authorities. The Committee shall submit quarterly progress reports in the prescribed format. The States/UTs shall develop a system of spot checks by the State/UT officers through field visits.

19.3 Monitoring and Review at the National Level:

At the national level, for sanctioning of projects and monitoring and reviewing of the programme, a Project Sanctioning and Monitoring Committee has been set up under the Chairpersonship of the Secretary, Department of Land resources. The Committee will monitor and review progress of the NLRMP work in the country. Area

officers from the Department of Land Resources would also be visiting the States/UTs to review the implementation of the Programme.

20. EVALUATION OF THE PROGRAMME

To get the impact assessment and feedback about the actual implementation of the Programme at field level, the DoLR will get the concurrent and terminal evaluation of the Programme carried out through reputed organizations such as the Lal Bahadur Shastri National Academy of Administration (LBSNAA), the National Institute of Rural Development (NIRD), State Administrative Training Institutes (ATIs), etc. The States/UTs are also advised to carry out concurrent evaluation and impact assessment through in-house teams/experts to assess the on-site progress vis-à-vis deliverables of the sanctioned projects and suggest the measures for improving the system. These concurrent evaluation results must be intimated to the DoLR for obtaining the second installment of Central funding.

21. FUNDING

21.1 Allocation of Funds and Fund Flow Mechanism

The NLRMP is a demand-driven scheme. Funds will be allocated to the State Governments/UT Administrations or their designated implementing agencies for carrying out the activities under the NLRMP. Funds for various components of the NLRMP will be provided at different scales by the Central Government. The assistance of Central Government will be restricted to its share based on the estimated cost approved by the Cabinet as given in **Annexure-GL-III**. The following will be the funding pattern and sharing of costs between the Centre and the States:

a) Computerization of land records (100% Central funding – maximum upto the approved unit cost norm)

- Data entry/re-entry/data conversion/mutation data entry
- Digitization of cadastral maps and integration of textual and spatial data
- Tehsil, sub-division, and district data centers
- State-level data centres
- Inter-connectivity amongst revenue offices

b) Survey/resurvey and updating of survey & settlement records (including ground control network and ground truthing) (Central funding - maximum upto 50% of the approved unit cost norm for the States and 100% for the UTs)

c) Computerization of registration (Central funding - maximum upto 25% of the approved unit cost norm for the States and 100% for the UTs)

- Data entry of valuation details

- Data entry of legacy encumbrance data
- Scanning & preservation of old documents
- Connectivity to SROs with revenue offices

d) Modern record rooms/land records management centres at tehsil/taluk/block level (Central funding - maximum upto 50% of the approved unit cost norm for the States and 100% for the UTs)

e) Training & capacity building (100% Central funding to the extent approved by the Project Sanctioning & Monitoring Committee)

- Training, workshops, etc.
- Strengthening of Revenue training institutes

21.2 Perspective Plans and proposals for the year 2008-09 would be submitted by the States and UTs in the prescribed format. Proposals would be scrutinized and approved by the National-level Project Sanctioning and Monitoring Committee. From the financial year 2009-10, the States/UTs should send their proposals in the revised formats. Proposals received from States/UTs will be discussed by the Committee, as far as possible, on every Thursday at 4.00 PM. States/UTs wishing to make presentations or have discussions on their proposals may intimate the DoLR in advance.

21.3 It has been decided that the Central share shall be released in two installments, the first installment being 75% of the sanctioned amount. The State Government shall ensure release of the Central share as well as the State share within 15 days from the date of receipt of the Central share. Upon utilization of 60% of the first installment, States/UTs will be eligible to get the second installment of 25%. Before releasing the second installment of 25%, the following documents would be required by the DoLR:

(i) Closing balance in respect of the grants sanctioned under the NLRMP for the project so far.

(ii) Utilization Certificate (financial year-wise) towards release of first installment, showing date of release of the State share and expenditure, i.e., 60% or more of the total amount of the first installment including the State share.

(iii) Audited Statement of Accounts (ASA), financial year-wise, where due.

(iv) Interim evaluation report.

(v) Physical progress achieved with the amount utilized.

21.4 Operational and Maintenance (O&M) Costs

States/UTs may make provision for O&M costs and also fix suitable user charges on deliverables for sustainability of the Programme and meeting the expenses of hardware maintenance and obsolescence, etc. The State/UT may consider putting in place appropriate institutional mechanisms for the purpose, wherever necessary.

22. PUBLICITY

States/UTs may arrange for wide publicity about the advantages of the Programme at the revenue village, gram panchayat, tehsil, district and State levels, involving elected representatives in different media and fora. States/UTs may highlight the success stories of the Programme through newspapers, radio, television, cinema slides, posters, video films, road shows, publications, literature, etc.

23. MISCELLANEOUS

23.1 In case any clarification is required on any point, the DoLR should be contacted whose decision on the matter will be final.

23.2 The DoLR may revise/update the guidelines and its annexures, technical manuals and the MIS formats, from time to time.

Annexure-GL-I

Primary & Secondary Ladders proposed under the NLRMP

- Primary ladder – for reaching the stage of conclusive titling

- Secondary ladder – for archival purposes and strengthening of revenue administration

Primary Ladder: approach 1

- Registration - computerization of SROs
- Integration of registration and land records maintenance systems
- Automatic mutation following registration
- Mutation – updating of pending cases and their computerization
- Integration of textual and spatial data
- **Survey**, including ground control networks and ground truthing
- Training and strengthening of training institutions
- Strengthening of technical organizations
- Record rooms at Registration/ tehsil levels
- Link up with development process
- Legal changes
- Conclusive titles

Primary Ladder: approach 2

- **Survey**, including ground control networks and ground truthing
- Mutation – updating of pending cases and their computerization
- Integration of textual and spatial data
- Registration -computerization of SROs
- Integration of registration and land records maintenance systems
- Automatic mutation following registration
- Training and strengthening of training institutions
- Strengthening of technical organizations
- Record rooms at Registration/ tehsil levels
- Link up with development process
- Legal changes
- Conclusive titles

Secondary Ladder

- Computerization of old records
- Scanning of old survey maps
- Computerization of legacy mutation data
- Establishing Record Rooms

Annexure-GL-II

National Land Records Modernization Programme

Memorandum of Understanding (MoU) Between the Department of Land Resources, Government of India and the State Government/UT Administration of……..

1. Preamble

1.1 *WHEREAS* the National Land Records Modernization Programme, hereinafter referred to as NLRMP, has been launched by merging two existing Centrally-sponsored schemes of Computerization of Land Records (CLR) and Strengthening of Revenue Administration and Updating of Land Records (SRA&ULR) for nation-wide implementation.

1.2 *AND WHEREAS* the main components of the NLRMP are computerization of land records, digitization of existing cadastral maps, integration of textural and spatial data of RoRs, undertaking survey/resurvey to depict true ground positions and boundaries, automation of the registration process, integration of registration process with mutation for updation of records, and strengthening the capacities of revenue and registration staff to handle new instruments/equipments and technologies.

1.3 *AND WHEREAS* the Department of Land Resources, Ministry of Rural Development, Government of India, and the concerned Department in the State Government/UT Administration shall be parties to this Memorandum of Understanding.

1.4 *NOW THEREFORE* the signatories to this Memorandum of Understanding (hereinafter referred to as MoU) have agreed as set out here in below.

2. Duration of the MoU

This MoU will be operative with effect from the date of its signing by the parties concerned and will remain in force till the end of the 12th Five-Year Plan. Thereafter, it can be extended with mutual consent.

3 Government of India Commitments

The DoLR will:

3.1 frame guidelines for the implementation of the programme, detailing the components, indicative methodology/technology and funding pattern under the scheme.

3.2 provide financial assistance as per the approved norms, out of the budget available under the NLRMP scheme.

3.3 coordinate the production of technical guidelines, at the national level, among the technical agencies such as NIC, Survey of India, NRSA and ISRO and others.

3.4 assist the State Governments/UT Administrations in capacity building to ensure that the NLRMP is properly implemented.

3.5 develop and disseminate uniform data codes, training modules and other materials necessary for effective implementation of the program.

3.6 host online monitoring system for real time monitoring of the scheme.

4. <u>State Government/UT Administration Commitments</u>:

The State Government/UT Administration of …… will:

4.1 identify a nodal Department for purposes of receipt of Central and State funding for the NLRMP and for implementing the same. This Department shall, in turn, put in place a Programme Management Unit (PMU) in the charge of an officer not below the rank of Secretary, to oversee the NLRMP in its entirety. The nodal Department shall submit monthly progress reports to the DoLR as delineated in **Part-C-MIS**.

4.2 set up a State-level Monitoring and Review Committee for the NLRMP to monitor and review the progress of the implementation of the programme, facilitate coordination and the necessary process re-engineering and to give guidance, wherever required.

4.3 provide the State share of financial assistance for the programme, as specified in the guidelines.

4.4 take the district as the unit of implementation of the NLRMP.

4.5 prioritize the activities under the NLRMP in the chosen district(s) in the systematic, ladder-like manner, as indicated in the Annexure-GL-I of the guidelines.

4.6 set up a District-level Monitoring and Review Committee in each district covered under the NLRMP, under the Chairpersonship of the District Collector/Deputy Commissioner to review the progress of implementation of the programme on a regular basis.

4.7 ensure submission of online monitoring reports from the District Collector/Deputy Commissioner of each district covered under the NLRMP, to the nodal department of the State Government/UT Administration, which in turn will submit the necessary monthly progress reports as indicated in para 4.1 above.

4.8 carry out concurrent evaluation and impact assessment in each district covered under the NLRMP and intimate the results to the DoLR.

4.9 bring the district(s) where the NLRMP activities have been completed under the law for conclusive titling.

4.10 make a Perspective Plan indicating the time-frame within which the State/UT Administration will cover all its districts under the NLRMP, preferably by the end of the 12th Plan period.

4.11 undertake all process re-engineering involved in implementing the NLRMP, including legal changes, wherever required.

4.12 undertake all necessary action for capacity building of the staff to ensure that the NLRMP is implemented properly.

4.13 make positive efforts towards deployment of the Revenue, Survey and Registration staff for their designated tasks under the NLRMP and divesting them of non-departmental duties.

4.14 provide "single window" service to citizens for distribution of RoRs and for registration.

4.15 set up a Core Technical Advisory Group for providing technical guidance in implementing the NLRMP.

4.16 place the updated property records on the official website(s) in such a manner that property owner(s)/enjoyer(s) have access to their property records.

4.17 make a time-bound programme for abolition of stamp paper and introduce payment of stamp duty and registration fees through banks/treasuries.

4.18 ensure adherence to the NLRMP guidelines issued by the Central Govt. or any other advisories issued from time to time.

5. Redressal Mechanism

5.1 Any irregularity brought to the notice of the State Government/UT Administration shall be enquired into promptly and corrective action taken thereupon. Non-compliance of the commitments and obligations set hereunder and/or lack of satisfactory progress may require the Department of Land Resources to review the financial assistance provided under the NLRMP, leading to suspension, reduction, cancellation and/or recovery thereof.

5.2 In the case of any dispute between the State Government/UT Administration and the DoLR on any matter covered under this MoU, the matter shall preferably be resolved mutually. In other cases, the decision of the DoLR on such matters shall be final.

6. This MoU shall be signed by the officers duly authorized by the State Government/UT Administration and by the DoLR.

Signed this ……day of……. ……. of ……....

(Date) (Month) (Year)

For and on behalf of the State Government/UT Administration of ……	For and on behalf of the Government of India, Ministry of Rural Development, Department of Land Resources
(Designation)	(Designation)

ANNEXURE-GL-III

Components and Activities under the NLRMP and their Estimated Costs

The following is an outline of the components and the estimated costs of the activities to be taken under the NLRMP:

I. Computerization of land records

(a) Data entry/re-entry/data conversion

For the NLRMP scheme, support would be provided for tehsil or equivalent level as the primary data entry point for RoR and other land attributes data, although variations may be allowed on proper justification. Monitoring and data repository, backup/disaster recovery arrangements will be at the State/UT head quarter level.

Based on the current status of the data entry work in States/UTs under the ongoing CLR scheme, and need-based cost estimates for completing the remaining work, States/UTs will need support for entry of mutation data and re-entry of already entered data or data conversion as per the uniform national land data codes developed by the NIC, plus entry of land attributes data other than the ownership data, on average, Rs.10 lakh per district and Rs.5 lakh per district where funds have been provided for data entry. Also, hardware and software support may be needed in 533 tehsils or equivalent locations, which is estimated to cost Rs.6 lakh per location.

Costs:

a) Mutation data entry and RoR data re-entry/conversion, backlog and other land register entry as per standard codes: = Rs.51.85 cr.

b) Verification & supervision costs: @ 10% of data entry costs = Rs.5.20 cr.

c) Software and hardware costs = Rs.31.98 cr.

Thus, it is estimated that approx. ***Rs.89 cr.*** *may be needed to complete the data entry work across the country as per the uniform standard codes.*

(b) Digitization of Cadastral maps

Digitization of revenue maps is necessary for integrating the spatial and textual data and adding the cadastral layer to the GIS system, in addition to the archival and preservation purposes. Average rate of digitizing one FMB and mosaicing to get the village maps is Rs.10 each. *Thus, the cost of digitization and mosaicing of the existing records to get the maps in 1.4 lakh villages of 9 States (*Average number of FMBs in a village is 30) is estimated *to (1,40,000 x 300 x 10) = Rs.42.00 cr.*

The States of North, Central and Eastern parts of the country are having village maps. Average rate for digitizing per map sheet is approx. Rs.1000, and many villages have more than one map sheet (generally, one to three map sheets

per village). The cost of digitizing the existing maps in these 5 lakh villages having village maps is estimated to be Rs.75.00 cr.

Thus, an amount of approx. Rs.117 cr. may be needed for this purpose.

Integration of spatial and textual data

Integration of textual data with spatial data for each plot will require specialized utility software and interface software which will help in matching and tuning textual record of each plot with corresponding plot map. This will be one time effort required to be performed at the time initialization. The necessary software may be developed by the NIC and made available to the States/UTs. This will help in establishing information security management system.

(c) Tehsil, sub-division and district Data Centres

Also, support may be required for hardware and software for land data management system at sub-divisions and districts, where needed, and for technology upgradation at some tehsil or equivalent locations on actual demand from the States/UTs. District-level database may be maintained at the district level, and the computer facilities on the sub-division level may also be used for data analysis, planning, verification, etc. Since 621 tehsils or equivalent were provided computers only at old scale of Rs.3.8 lakhs each instead of the later scale of Rs.6.00 lakh each, and 924 sub-divisions and 217 districts have not been funded for land record computer centres under the ongoing scheme of CLR, these tehsils or equivalent would need Rs.13.66 cr.; the sub-divisions may be provided Rs.1 lakh each, costing Rs.9.24 cr.; the districts may be given funds @ Rs.8.50 lakh per district, costing Rs.18.45 cr. The total cost for this item comes to Rs.41.35 cr., or say Rs.41 cr.

Thus, an amount of Rs.41.00 cr. is estimated for this purpose.

(d) State Level Data Centres (SLDC)

In order to maintain data repository and backup, each State/UT may need to establish a dedicated data centre for land records data (including maps and registration data) at the State/UT level. For this, approx. @ Rs.2.00 crore per SLDC for major States and Rs.1.00 crore for smaller States/UTs, **the total cost works out to Rs. 55.00 crore.**

(e) Inter-connectivity among revenue Offices

(i) Authentication mechanism

Authenticated land records data may be put on the Web from a central location in each State or UT under the control of a duly designated official of the State or UT govt. The aim is to view and/or generate authenticated reports (such as RoRs with maps-to-scale, other details) on demand in a secure manner via any

computer connected to the Web. The authentication mechanism would be decided in consultation with the NIC, financial institutions, Law Ministry, etc.

(ii) Web-enabling with access control

Data, duly authenticated at the *tehsil* or higher level in the revenue set up of the State/UT Govt., would be transferred over secure network to the State-level Data Centre (SLDC). The NIC may develop the security protocols, access control protocols and web portals, etc. for this purpose. The ISP servers (web servers, DNS servers, firewall, etc.) and other hardware and software may be arranged through the existing facility of the NIC for web hosting in each State/UT, without any extra cost.

(iii) Secure connectivity via LAN or WAN

All the land record offices, from the State level to the *tehsil* or equivalent level, as well as the registration offices may be securely connected via local area network (LAN) or wide area network (WAN) in an appropriate configuration based on the functional and technical requirements. This kind of comprehensive connectivity in this domain has not been arranged anywhere in the country at the present time, and so support may be needed by all the States and UTs for the purpose.

In order to achieve functional integration among the *tehsils*, districts, SROs and State data centres, each location would be provided with network connectivity with 2 mbps link. At current rates, the maximum cost per location would be Rs.5.00 lakh, but many locations would be situated at or near to the point-of-presence of the State wide area network (SWAN), and cost would be lower in such cases.

Thus, for about 600 districts and 5000 tehsils and other locations, total cost estimated at Rs.200 cr.

II. Survey/resurvey and updating of survey & settlement records (including ground control network and ground truthing)

The total geographical area of the country is 32.87 lakh sq. km. For the purpose of NLRMP, we have to cover approximately 21.6 lakh sq. km. area after excluding 34% of total geographical area (i.e. non-cultivable uses, forest, barren and uncultivable land) for survey/re-survey by using the following modern technology: viz. (a) Pure ground method using electronic total station (ETS) and positioning system (GPS); or (b) Hybrid methodology using aerial photography and

ground truthing by ETS and GPS; or (c) High Resolution Satellite Imagery (HRSI) and ground truthing by ETS and GPS.

Survey, revisional or original, would be undertaken for updating of cadastral maps and land records, as necessary. Original surveys are yet to be undertaken in some parts of the country, particularly in the North-Eastern States like Meghalaya, Mizoram, Arunachal Pradesh, parts of Manipur and Nagaland; parts of Chhattisgarh and Himachal Pradesh, and Lakshadweep, and also in some small parts in a few other States, because these States and UTs have large common property areas, and also are yet to be covered by cadastral surveys in entirety.

As per the cost indicated in the report of the Committee for examining the modern technology options for survey operations, 21.6 lakh sq. km. will be covered at the unit cost @ Rs.15,000/sq. km. ***Therefore, an amount of Rs.3,200.00 crore is estimated to be the cost for the purpose, 50% of which, i.e., Rs.1600.00 crore may be provided as Central share.***

III. Computerization of registration

Registration process computerization is a major component of the NLRMP scheme. This component is not covered in the schemes of CLR and SRA&ULR. Computerization of the registration process is necessary not only for making the property registration system efficient and hassle-free but also for integrating the title changes into the process of updating of RoRs (by automatic initiation of mutation notices and connectivity to the concerned revenue offices).

(a) Computerization of SROs

The majority of States and some UTs have initiated computerization of the registration process on their own. They have used their own funds, many have adopted a PPP model, and most have instituted user charges for cost recovery to a certain extent. A few States, namely Assam, Himachal Pradesh, Goa, Orissa, Punjab, Rajasthan, Sikkim, Tripura, West Bengal and Puducherry, have also received support from the GoI, Dept. of IT, for one district each as a demonstration project.

Support for computerization of SROs may be provided on a demand-driven basis to those states and UTs where this process has not started or the process has started but is lagging because of want of funds. For the NLRMP project, the estimated costs are Rs.10.00 lakh/SRO. Out of the 4018 SROs in the country, 2122 SROs have already been computerized. For the rest 1896, the required amount comes to Rs.189.6 cr., for the above purpose.

For the SROs that have already been computerized, there may be demand from some States for technology upgrade or ancillary items. Thus, the total fund required for this purpose would be Rs.53.05 cr. at the rate of Rs.2.5 lakh per SRO**.**

Total cost for the purpose is worked out to be approx. Rs 244.00 crore, 25% of which, i.e., Rs.61.00 crore may be provided as Central share.

(b) Data entry of valuation details

The States or UTs which have a system of guidance values may computerize the data for online availability of guidance values for payment of stamp duty and registration fees. Valuation will have to be fixed by local authorities for each survey number as per local criteria.

On average, records for approx. 25,000 survey numbers per SRO would be entered into the database, which, at the rate of Rs.2.00 per record, may cost Rs.50,000 per SRO. Assuming that support may be needed for this purpose at 2000 SROs, **an amount of Rs.10.00 cr. is required, 25% of which, i.e., Rs.2.50 crore may be provided as Central share.**

(c) Data entry of legacy encumbrance data for determined period

In order to create the quick search facility for encumbrances, data entry for legacy registered deeds and data, based on registration numbers, names and property address particulars would be required for a determined period, usually 13 years (15 years in some states, 30 years in Puducherry) for issuance of encumbrance certificates, etc., and the cost of this activity will depend upon the number of documents to be digitized. However, tentatively, support up to Rs.50,000 per SRO may be provided for this. Assuming that support may be needed for this activity at 2000 SROs, **an amount of Rs.10.00 crore may be required, 25% of which, i.e., Rs.2.50 crore may be provided as Central share.**

(d) Scanning and preservation of old documents

For preserving and archiving the old deed documents for future reference, such documents would need to be scanned and stored at each SRO. On average, a SRO may be having about 25,000 documents of 10 pages each, for scanning. At the rate of Rs.0.50 per page, this would cost Rs.1.25 lakh per SRO, on average. Assuming that support may be needed for all the SROs for this activity, for the 4018 SROs, **an amount of Rs.50.00 cr. is required for this purpose, 25% of which, i.e., Rs.12.50 crore may be provided as Central share.**

The available banking and treasury networks could be appropriately interfaced for having secure access to the SROs for facilitating payment of stamp duties (in place of stamp papers) and registration fees.

(e) Connectivity to SRO with Revenue Offices

In order to achieve functional integration among the tehsil and State data centres as well as the corresponding Sub-Registrars' offices, it would be required that each SRO location is provided with network connectivity. *Notices will be automatically generated after registration to all recorded interested persons and the general public to effect changes in the Records of Rights (RoRs).*

The connectivity cost for the 4018 SROs is estimated to be ***Rs. 150 crore,*** **25% of which, i.e., Rs.37.50 crore may be provided as Central share.**

Thus, approx. Rs.464 crores may be needed for this purpose, of which 25%, i.e., Rs.116.00 crore may be provided as Central share.

IV. Modern records rooms/land records management centres

Generally, Central funding will not be provided to the States/UTs under the NLRMP for construction and allied activities such as renovation of buildings, purchase of furniture, furnishings, etc. However, support may be provided for such activities directly connected with physical security of the computer and IT infrastructure, storage and retrieval of the records, and citizen service delivery.

In this connection, after detailed discussions with the States and UTs, it has been decided that support for **modern record rooms** with compactors and other necessary infrastructure as *storage ar*ea with compactors, *operational area* with computers, printers, storage area network (SAN), etc., and *public service area* with arrangements for reception, waiting, etc. at tehsil (or equivalent) level may be provided. Although the actual fund requirements may vary from location to location, on average, the estimated unit cost may be taken at Rs.25 lakh, and accordingly, the total cost for about 4880 tehsils or equivalent locations is estimated to be Rs.1,220 crore, 50% of which, i.e., Rs.610.00 crore may be required as Central share.

V. Training and capacity building

States will draw up a comprehensive action plan to develop their human resource for effective maintenance and sustenance of the NLRMP scheme. Support would also be provided by way of grants to the States/UTs for strengthening/upgrading Revenue Training Institutions and arranging professional support teams at various levels.

(a) Training and Workshop

The estimated cost for imparting training, organizing the workshops over the period of 5 years is kept at **Rs.10.00 crore.**

(b) Revenue training Institutes

Capacity building, professional support and strengthening revenue training institutes to the States/UTs is kept at **Rs.55 crore**.

Thus, an amount of Rs.65.00 cr. may be required for this purpose.

VI. Core GIS

(a) Village Index base maps from satellite imagery for creating the Core GIS

Three layers of data: (a) spatial data from high resolution satellite imagery/aerial photography, (b) maps and data from the Survey of India and the Forest Survey of India, and (c) revenue records data from cadastral maps and the RoR details will be integrated and harmonized on a GIS platform.

In this regard, the thematic GIS layers are already available or would become available (including the periodic updates) through the NIC, the National Spatial Data Base (NSDB) of the Planning Commission, the National Spatial Data Infrastructure (NSDI) partners, the National Natural Resource Management System (NNRMS), etc., with the NIC and the NLRMP national mission playing the coordinating and leadership roles. The cadastral layer will become available from the States and UTs once the maps and other data get digitized. However, village index base maps may have to be obtained from satellite imagery vendors, and for which **an estimated amount of Rs.180 cr. is required for this purpose,** for covering the area of approx. 21.6 lakh sq. km. @ Rs.850 per sq. km.

VII. Legal Changes

The following actions are to be undertaken in order to reach conclusive titling system in the country: (a) Amendments to the Registration Act, 1908; (b) Amendments to the State Stamp Acts; (c) Other legal changes; and (d) Model law for conclusive titling. The cost for these activities will be covered under Programme Management Cost.

VIII Programme Management

Programme Sanctioning and Monitoring Committee in DoLR: At the national level project sanctioning and monitoring committee be constituted, which will periodically review progress of the scheme and resolve issues/difficulties faced by the States and

give suitable instructions for implementation of the scheme. It will also take necessary decisions about changes in technology, security of data, records to be computerized, City surveys and urban land records, amendments in the guidelines, sanctioning innovative projects, etc.

For monitoring the implementation of the works under the NLRMP at the State/UT level, there may be a State-level Monitoring and Review Committee and the members would include the Secretaries of the concerned departments including Information Technology, Science and Technology; State Informatics Officer of the NIC, Director of Survey and Settlement, Director of Land Records, and the head of the State Revenue Training Institute. The Committee would review the progress of on-going works on a monthly basis.

(b) Core Technical Advisory Group in the DoLR and the States/UTs

The NLRMP will be implemented in a mission mode. For this, a core technical advisory group at the national level as well as at the state level may be formed although the exact nomenclature, composition, etc. may be determined in due course.

(c) Programme Management Unit (PMU) in the DoLR and the States/UTs

In the DoLR, a programme management unit would be constituted which would have responsibility of running the project and coordinating with all concerned departments with agencies responsible for the work. The States/UTs may also set up the PMUs at their level.

(d). IEC

The States/UTs would be advised to carry out wide publicity of the advantages of the NLRMP through *Gram Sabhas*, publicity campaigns, and revenue camps, involving local elected representatives. The success stories may be highlighted through newspapers, video films and road shows, etc.

(e). Evaluation

DoLR may authorize a competent external agency to get impact assessment and feedback on implementation of the programme at the field level. The States/UTs would also be advised to carry out concurrent evaluation studies and independent audits through experts to assess the progress of the sanctioned projects and the suggested remedial action, if any.

An estimated amount of Rs.25.00 cr. for a five-year period may be needed towards the above mentioned programme management costs.

PART-B: TECHNICAL MANUALS

NLRMP Technical Manual

Chapter-1

Digitization of Cadastral Maps and Integration with RoR Data

Model-I

(Based on the system followed in West Bengal)

The following technical details may be helpful to the digitizing agency or the vendor, if the work is outsourced, in GIS-ready digitization of cadastral maps and their integration with the textual RoR data:

2. Mouza Map: West Bengal has geo-referenced Mouza (a revenue village) maps showing plots (land parcels) in the scale 16" = 1 mile which is equivalent to 1:3960. In densely populated areas such maps are prepared on bigger scales i.e. 32"=1 mile (1:1980) or 64"=1mile (1:990). There are 66,348 such map sheets in A0/A1 size paper covering all the 42042 Mouza of West Bengal, prepared by well established detailed cadastral survey techniques. Each Mouza map contains 1200/1500 plots (property parcel boundaries) on the average surveyed true to scale by Theodolite traverse and chain survey. Later on, the length of each side of the plot and plot area are extracted from the paper map using acre comb. No field dimensions of the individual plots are noted on the map. Each Mouza map has the following features-

1. Sheet heading (Mouza Name & North Direction.)
2. Scale of the map
3. Plot boundaries with Plot numbers
4. Legends
5. Conventional signs (Alamats), Bata Plot nos. & Missing Plot nos.
6. Contents of the certificate block i.e. contents of the rectangle bearing the signature of the Revenue Officer certifying the contents of the map

3. Scope of work for digitization: In order to prepare GIS-ready digitized cadastral Mouza maps, they should be digitized in 3 layers i.e. area layers, line layers and point layers so as to facilitate digital capturing of all the features of the existing paper map. Maps, digitized in this way, provide flexibility required for future corrections. Each plot of land is viewed as a closed polygon and digitized in area layer to provide the area of the plot. A 5 digit number, which is written within the

paper map itself, is used for unique identification of the digital polygon. Maps should be scanned to their true scale, vectorized and converted into shape file format consisting of three files i.e. the shape file (*.shp), the index of the shape file (*.shx) and the data associated with the shape file (*.dbf) [item 2 & 3 above], .gif (graphic interchange format) formats [item 1,4, 5 & 6] along with the data in .dbf format [item 5] as detailed in the scope and methodology of the work.

JOB DESCRIPTION

Sl. No.	
1.	Accurate scanning of original paper-based maps (generation of raster image of the map).
2.	Digitization of plots (drawing digital line on each plot boundary of the scanned map).
3.	Topology creation and closed polygon generation in area layer.
4.	Creation of plot numbers in polygon area layer.
5.	Creation of rendered plot numbers (RPN) and centroid point of each polygon in point layer. The centroid, which is the geometric centre point of the polygon, is where the plot number is indicated. When the size of the polygon is too small for the number to be written within it, then the last one or two digits are written to represent the original number. This plot number is called **rendered plot number**.
6.	Creation of in-situ lines, i.e., geographically fixed lines and point alamats (line and point layers).
7.	Thoka lines of mouza (i.e., boundary lines of the other two neighbouring mouzas) and sheet control points (fixed points on earth used while preparing the maps which are also used for future references), tri-junction pillars (pillars fixed at the meeting point of three neighbouring mouzas), permanent features or marks, old control stations used in earlier surveys, roads, railway tracks, rivers or streams, relay lines of acquisition plans (i.e., demarcation lines of the land proposed to be acquired – relevant only in land acquisition cases), etc., in .shp format of line, point and area layers.
8.	Creation of DBF files for point/area alamats and bata (sub-divided) plots (point and area layers).
9.	Creation of GIF files of non-map features (sheet heading, north direction, legends, list of conventional signs, contents of certificate block).
10.	Creation of text files in point layer.

4. Four Database Tables

The following four database tables should be developed from the data available in the paper map. This is done by carefully observing each plot in the map sheet.

Table No. 1 - The conventional signs or alamats have to be codified along with the reference of bata plot number in the following dbf:

Mouza Code	Sheet No	LR/RS (L or R)	Plot No.	Alamat Code	Reference of bata plot numbers
1	2	3	4	5	6

The original plot numbers are to be written in Column 4 and any reference of parent plot number from which the original plot has been created is to be written in Column 6.

Table No. 2 - Data developed with respect to alamats in point layer is master data information and should be developed and maintained centrally, and not developed separately, for each map. It should contain the following information:

Alamat Code	Alamat name	Actual file as OLE (Object linking and embedding) object
1	2	3

Table no. 3 - This table contains the information on the first plot and the last plot number in a sheet of cadastral map for a particular mouza.

Mouza Code	Sheet no.	L or R for LR / RS	First plot no.	Last plot no.
1	2	3	4	5

Table no. 4 - This table will keep track of missing plots and missing plot numbers within the 1st and last plot numbers in a particular sheet of a mouza.

Mouza Code	Sheet no.	L or R for LR / RS	Missing plots.
1	2	3	4

5. Stringent accuracy requirement:

The digitized map should exactly match the original map, like a contact print, since the dimensions and area of plots, or the whole village, are to be extracted from the map itself. As such, a difference of 0.25 mm of sheet measurement in 1:3960 scale between the original map and its copy, whether conventional or digitized, gives rise to a difference of about 1 metre on the ground. So, an accuracy of 0.25 mm or higher is desirable and tolerance may be treated as nil to 0.25 mm per metre.

6. Outputs of digitization:

6.1 Vectorised map can be stored in any open GIS format without any loss of freedom, as the conversion from one format to another is built into the software for raster to vector conversion. One of the popular open formats is SHP format, which is essentially a bundle of three formats to store spatial objects in .shp, text data attached to spatial objects in .dbf, and the format for linkage of .dbf and .shp, i.e., .shx. Many popular raster to vector digitization software are available, which can be used, such as R2V or AutoCAD map. These GIS files are to be provided by the digitizing agency/vendor to the Revenue Department in CD media along with a printout of the digitized map.

6.2 About 35 files are generated for a typical GIS-ready mouza map, namely:

Serial No.	File Name	Description
1.	JlNo.shp	Shape file for Mouza Map Sheet
2.	JlNo.shx	Shx file for Mouza Map Sheet
3.	JlNo.dbf	Dbf file for Mouza Map Sheet
4.	Alml. shp	Shape for Alamat in line layer
5.	Alml. shx	Shx file for Alamat in line layer
6.	Alml.dbf	Dbf file for Alamat in line layer
7.	Almp.shp	Shape file for Alamat in Point layer

8.	Almp.shx	Shx file for Alamat in Point layer
9.	Almp.dbf	Dbf file for Alamat in Point layer
10.	Bnd.shp	Shape file for Sheet Boundary, it denotes the extent of the sheet.
11.	Bnd.shx	Shx file for Sheet Boundary
12.	Bnd.dbf	Dbf file for Sheet Boundary
13.	Centroid.shp	Shape file for the points where to place the Plot Numbers
14.	Centroid.shx	Shx file for the points where to place the Plot Numbers
15.	Centroid.dbf	Dbf file for the points where to place the Plot Numbers
16.	Img.shp	Shape file for the points where to insert the GIF files
17.	Img.shx	Shx file for the points where to insert the GIF files
18.	Img.dbf	Dbf file for the points where to insert the GIF files
19.	Mbnd.shp	Shape file for Mouza Boundary
20.	Mbnd.shx	Shx file for Mouza Boundary
21.	Mbnd.dbf	Dbf file for Mouza Boundary
22.	Scale.shp	Shape file for Scale of the Mouza Sheet
23.	Scale.shx	Shx file for Scale of the Mouza Sheet
24.	Scale.dbf	Dbf file for Scale of the Mouza Sheet
25.	Text.shp	Shape file for Texts of the Mouza Sheet
26.	Text.shx	Shx file for Texts of the Mouza Sheet
27.	Text.dbf	Dbf file for Texts of the Mouza Sheet
28.	sign.gif	Gif file for Certificate book
29.	alm_bata.dbf	Dbf file for conventional signs or alamats along with the reference of bata plot no.
30.	missp.dbf	Dbf file for Missing Plots in Mouza Sheet
31.	first_last.dbf	Dbf file for First & Last Plot Number for Mouza Sheet
32.	lege.gif	Gif file for legends
33.	name.gif	Gif file for Map Heading, i.e. it contains the District name, Mouza name, Idn etc.
34.	bata.gif	Gif file for list of bata
35.	Idn.tif	TIF image file for Mouza Map Sheet (raster

		image)

Sometimes, the legend is broken into more than one file. These files are named lege1.gif, lege2.gif, lege3.gif and lege4.gif. Accordingly, the total number of files varies from 35 to 38.

7. Methodology for digitization:

7.1 The Directorate of Land Records and Survey is the nodal organization under the Govt. of West Bengal. Currently, the organization is involved in digitization of mouza maps from existing manually-prepared maps. The process involves (i) scanning of maps to produce raster data, (ii) checking the dimensional accuracy of the raster data, (iii) garbage cleaning in the raster data, (iv) vectorising the raster data, (v) cleaning the vector data, (vi) topology building, i.e., building each plot polygon as a totally connected entity, to ensure that all the polygons are closed and connected; (vii) data integration, (viii) map composition from different layers, and (ix) integration of regional language script as label.

Sl. No.	JOB DESCRIPTION	Responsibility
1	Putting label of mouza code, whether RS or LR map and the sheet number sticker on the map sheet	Department Employees (DA)
2	Handing over the labeled map to the vendor for digitization	DA
3	Scanning of original paper based maps.	Agency (EA)
4	Study of original paper map for dimension extraction. This is to measure the dimensions of any two points in the horizontal and vertical directions in the original paper map	EA
5	Adjustment of scanned raster map with the measurement as available in Sl. No. 2.	EA
6	Digitization of plots using R2V or AutoCAD software	EA
7	Cleaning up of map, topology creation and closed polygon generation using AutoCAD map software	EA
8	Creation of plot numbers and attaching text database with the spatial data	EA
9	Quality checking to account for all plots and plot numbers available in the map	EA
10	Printing for dimensional accuracy-checking of all plots	EA
11	Comparison of print with original for accuracy checking	EA
12	Refinement of digitized map with respect to Sl. No. 9 and repeat of Sl. Nos. 9 and 10 till desired accuracy is achieved	EA
13	Quality checking for correctness of plot numbers as attached	EA
14	Creation of rendered plot numbers (RPNs) and centroid points	EA
15	Creation of in-situ lines and point alamats	EA
16	Quality checking to ensure that all alamats are considered and coded correctly	EA
17	Creation of DBF files for point/area alamats and bata plots	EA
18	Creation of GIF files	EA

19	Handing over the print copy for checking correctness	EA
20	Checking of print copy with the original	DE
21	Handing over the soft copy	EA
22	Soft copy check (availability of files - 35-38 numbers)	DE
23	Generation of complete map from the files available and also digital RoR database using software developed by the NIC	DE
24	Printing of composed map in 120 GSM paper for preservation	DE
25	Software checking of areas extracted digitally with that available in the RoR for each plot. This provides an error report showing plots whose areas in the RoR do not match with the areas extracted digitally.	DE
26	Error report is sent to districts for review and correction	DE
27	Integration of RoR data with spatial data using the software developed by the NIC (explained in detail below)	DE
28	Map and record correction through the software developed by the NIC (explained in detail below)	DE

7.2 Scanning and dimensional accuracy

7.2.1 The original map is scanned to produce the raster form. For cadastral map, scanning may be done in 400 dpi (dots per inch). Special attention should be given to see that the map is not deformed dimensionally. For this purpose, “X” (cross) marks are placed at corners of the original map before scanning. In the next step, the lengths between the “X” marks of the original map are compared with those of the scanned map to check whether any differences exist. Finally, raster editing is done for the elimination of unwanted patches in order to enhance vectorisation of the raster data.

7.2.2 Dimensional accuracy of the raster data implies total correspondence between the raster data and the original map. The following procedures are used to achieve dimensional accuracy:

1. Checking for expansion.
2. Checking for contraction.
3. Checking for translation.
4. Checking for rotation.

Raster form of the map may appear to be expanded or contracted as compared to the original map, which in turn affects the vector data. The checking for expansion and contraction is based on the principle that ‘area is invariant’. The Land Records Department has Jurisdiction List (JL) in which the total mouza area is defined and the land records information contains each plot area of an owner. These two are compared with the vector data of the map to check for the expansion or contraction of the map with respect to the original map. Using a GIS tool, the NIC West Bengal

State Unit has developed software which can easily integrate the land records data with the digitized data based on the plot numbers. Using the software, one can easily compare the total mouza area (as defined in JL) with digitized mouza data as well as digitized plot area with the individual plot area defined in the land records database.

Translation and rotational error may occur during the scanning process. Checking for this purpose is done using the check point. A calibrated plotter HP 1050C or higher is used to plot a map from the vector data. This map is then compared with the original map to find complete correspondence between the lines of the two maps. Any mismatch between the two reveals the existence of the abovementioned errors. These errors may be removed by accurate scanning of the original map and confirming its correctness with the original.

7.2.3 While digitizing, the scale should be maintained accurately, so that the output corresponds 1:1 with the original. Either flat-bed scanner or roller-type scanner can be used for scanning. For maps that are brittle, flat-bed scanners would be more suitable.

7.3 Vectorizing, topology building and data integration:

7.3.1 The raster data may be converted to vector data using raster-to-vector converting software. This software works in three distinct methods as mentioned below:

1. Fully automated method
2. Semi-automated method
3. Completely manual method

The Semi-automated method is preferable, because traverse lines may have some breaks which can be corrected through this method during the process of vectorisation, but which create problems with the fully automated method.

7.3.2 No plot on the map is isolated; hence one should posses some knowledge about its adjacent plots. That is why topology building is necessary. This is done by treating each intersecting point as a node. Overshoot, undershoot and duplicate lines are the major problems, which are to be eliminated during the process of topology building. The overshooting lines are deleted and the undershooting lines are extended to their nearest node.

7.3.3 Non-spatial data (plot number, area, etc.) are included in the database containing the spatial data for the map, during the process of data integration.

7.4 Testing of correctness of the digitized map:

7.4.1 The printed copy of the digitized map should be thoroughly checked so that all the plot boundaries and other line works match with the original like a contact print. Plot numbers assigned should also match with the original. In-situ alamats should be placed at exactly the same points as they are located in the original map. A glass table, lighted from below, is used to match such accuracy.

7.4.2 Software checking is done through the “Map Management System” software developed by the NIC to find all the files deliverable for a map sheet.

8. Map composition and query retrieval:

8.1 Different layers (point, line, area) are used for map composition. Line layers are required for the map composition part, while area layers are mainly required for both map checking and composition. However, map composition not only involves construction of the map from a particular layer, but also the inclusion of various non-map features such as the legend for the map, the label of the map specifying its identification from the point of view of Police Station Code, Jurisdiction List Number, etc., bata information for the mouza, the authentication seal of the Government, etc. and various geographical features (the alamats) such as the railway lines, the traverse stations, letter boxes, etc., which can be represented by symbols. The NIC West Bengal State Unit has developed software to compose map by integrating different layers and alamats.

8.2 The non-map features are mostly available in the form of images. A point layer is provided for the insertion of these images. The point layer contains the coordinates of the points where the images are to be positioned. During map composition, the images are to be placed on the map (already composed from the line layer) at their appropriate positions. The geographical features (alamats) can be displayed on the map by using the line, area and point layers. Specific symbols are used for this purpose and the layers contain information regarding these symbols. The final output is a completely composed map identical to the original one.

9. Specifications and alamats

9.1 Images

The images (in *.gif format) provided for map composition must be accompanied with a point layer in which each point coordinate would give the **lower-left** corner of the image. The layer must have a separate attribute column, named “**image**” along with the necessary columns (specific to a point layer table). This attribute column will contain the file name of the image files corresponding to each point of the point layer.

There is no restriction on the names of the image files, but it must be noted that the file names mentioned in the "**image**" column of the point layer must correspond to the file names of the images provided. The base name of the files for this point layer must be "**img**". Thus, the ".shp" file for the above mentioned point layer must be "**img.shp**". The names of other necessary files (.shx, etc.) for the same point layer must be given accordingly. All the images (*.gif or *.tif) of a particular sheet must be given in the same directory, i.e., the **JL**-No. sub-directory.

Note: i) The scale of the map must not be an image, but must be digitized and provided in the line layer.

ii) Attribute naming: The "image" attribute column must be a character field and have a maximum length of 8 characters.

9.2 Alamats

9.2.1 At point layer

Some of the alamats that can be represented by points should be provided in a point layer. The point layer required for this purpose must contain the attribute field "alamat symbol code" along with other necessary fields. The following Table 1 contains the "alamat symbol code" column for the above mentioned point layer. The other columns are given as descriptions to the "alamat symbol code" column. The column named "Sl. No." is the serial number of the various symbols as per the conventions followed by the Directorate of Land Records and Survey. The base name of the files for the point layer for the alamats must be "almp" i.e. the ".shp" file for the point layer must be "almp.shp". The names of other necessary files (.shx, etc.) for the same point layer must be given accordingly.

Note: i) Some alamat notations comprise of a line and several points on the line. In such cases, the points are to be provided in the point layer and the lines are to be provided in the line layer that is described below.

ii) Attribute naming: The "alamat symbol code" attribute column must be a character field and have a maximum length of 4 characters.

Table 1

Item		Alamat symbol code as specified by the NIC	Descriptions	Required features for West Bengal (NR: Not Required, R: Required) (*)
Municipal/Notified Town Boundary		1	1) Only the circles on the boundary line should be given in the point layer (the broken line being on the line layer as described in the next table). 2) The center of each circle should lie exactly on the line representing the boundary.	NR
Wire fencing/railing along property boundary (showing ownership)		2	Only the 'X' marks should be given in the point layer, the line being given in the line layer (as mentioned in the next table).	NR
Village (or plot) boundary cutting across river or road		3	Only the dots on the boundary should be given in the point layer.	R
Village boundary cutting along the length of river/ road		3	Only the dots on the boundary should be given in the point layer.	NR
Village boundary along one bank/ edge of the river/ road not common to two units		3	Only the dots on the boundary should be given in the point layer.	NR
Geodetic Triangulation Station (GTS)		4	1) Appropriate name of the GTS should be given as an image. 2) The dot in the middle of the symbol should be at the 'surveyed in situ' position of GTS	R
Bench Mark with number		5	1) The dot in the symbol should be at the position of the Bench Mark as surveyed in situ. 2) The figure indicating height should be the appropriate height of the Bench Mark concerned above the Mean-Sea.	NR
Tri-junction Pillar		6	Only the dot at the center of the triangle should be given in the point layer.	R
Traverse Station	(i) Present Survey	7a		R

	(ii) Last Survey	7b		R
Boundary Mark (pillar)	(i) Permanent pillar	8a		R
	(ii) Iron pillar	8b		R
Swampy Land or Marsh		10	Several points in close proximity should be given such that entire marsh is covered.	NR
Overhead Tank		11	Only the center of the symbol should be provided in the point layer.	R (.dbf)
Pucca well		12	Only the center of the symbol should be provided in the point layer.	R (.dbf)
Kutcha well		13	Only the center of the symbol should be provided in the point layer.	R (.dbf)
Tube well		14	Only the center of the symbol should be provided in the point layer.	R (.dbf)
Deep Tube well / Shallow tube well		15a	Only the dot at the center of the symbol should be given in the point layer.	R (.dbf)
		15b		
Hillock with peak of known height		16	Only the center of the symbol should be provided in the point layer.	NR
Hillock without peak of known height		17	Only the center of the symbol should be provided in the point layer.	NR
Mill / Factory		18	Only the base of the symbol should be provided in the point layer.	R (.dbf)
Coal pit		19	Only the center of the symbol should be provided in the point layer.	R (.dbf)
Temple		20	Only the base of the symbol should be provided in the point layer.	R (.dbf)
Mosque		21	Only the base of the symbol should be provided in the point layer.	R (.dbf)
Church		22	Only the base of the symbol be provided in the point layer.	R (.dbf)
Gurudwara		23	Only the base of the symbol should be provided in the point layer.	R (.dbf)
Graveyard		24	1) Several points (each point representing one symbol) should be given such that the entire plot is covered. 2) Only the base of each symbol should be given in the point layer.	R (.dbf)
Pucca building within a plot		25	Only the base of the symbol should be provided in the point layer.	R (.dbf)
Pucca building within a plot not surveyed in situ		26	Only the base of the symbol should be provided in the point layer.	R (.dbf)
Kutcha house		27	Only the base of the symbol should be provided in the point layer.	R (.dbf)
Tin/tiled shed having pucca plinth		28	Only the base of the symbol should be provided in the point layer.	R (.dbf)
Daily market with		29	The point must be taken inside the	R (.dbf)

plot boundary		plot and preferably on the lower-left corner of the plot such that the symbol can be fitted completely within the plot.	
Tree	30	Only the base of the symbol should be provided in the point layer.	R (.dbf)
Trees in grove (not surveyed in situ) other than orchard	30	Several points in close proximity should be given such that entire grove is covered.	R (.dbf)
Forest (reserved / protected) with name	31a	1) Several points in close proximity should be given such that entire forest is covered. 2) Only the base of each symbol is to be provided in the point layer.	R (.dbf)
	30 & 31b		R (.dbf)
	30, 31a & 31b		R (.dbf)
Bush jungle	32	Several points in close proximity should be given such that entire bush jungle is covered.	R (.dbf)
High grass	33	Several points in close proximity should be given such that entire High grass is covered.	R (.dbf)
Uncultivable fallow	34	Several points in close proximity should be given such that entire uncultivable fallow is covered.	R (.dbf)
Bamboo clumps	35	Several points in close proximity should be given such that entire bamboo clump is covered.	R (.dbf)
Cluster of palmyra	36	Several points in close proximity should be given such that entire plot containing cluster of palmyra is covered.	R (.dbf)
Cluster of coconut palm	37	Several points in close proximity should be given such that entire plot containing cluster of coconut palm is covered	R (.dbf)
Cluster of date palm	38	Several points in close proximity should be given such that entire plot containing cluster of date palm is covered	R (.dbf)
Cluster of betel palm	39	Several points in close proximity should be given such that entire plot containing cluster of betel palm is covered	R (.dbf)
Orchard (perennial – like mango, litchi, etc.)	40	Several points in close proximity should be given such that entire plot containing the orchard is covered.	R (.dbf)
Flower garden	41	Several points in close proximity should be given such that entire plot containing flower garden is covered.	R (.dbf)

Light house	42	The symbol should be drawn at some convenient space inside the plot concerned.	R (.dbf)
Burning ghat	43	The point must be taken inside the plot and preferably on the lower-left corner of the plot such that the symbol can be fitted completely within the plot.	R (.dbf)
Power house	44	The symbol is to be drawn at some convenient space inside the plot concerned.	R (.dbf)
Electric sub-station	45	The symbol is to be drawn at some convenient space inside the plot concerned.	R (.dbf)
Transmitting/ microwave station	46	The symbol is to be drawn at some convenient space inside the plot concerned.	R (.dbf)
Trestle of ropeway	47	The center of the baseline of the symbol should be provided in the point layer.	R (.dbf)
Pylon/electric/ telegraph/ telephone post with line	48	Only the dots at the center of the symbol should be given in the point layer.	R (.dbf)
Lamp post	49	Only the dot at the center of the symbol should be given in the point layer.	R (.dbf)
Letter box (immovable) of P&T Deptt.	50	Only the dot at the center of the syml given in the point layer.	R (.dbf)
Kilometer post	51	Only the mid-point of the base of the symbol should be given in the point layer.	R (.dbf)
North Direction	52		NR
Text scripts mentioned on the map	53a, 53b, 53c, …		NR

(*) These may be customized as per the need of individual states.

9.2.2 At line layer

9.2.2.1 Some of the alamats that can be represented by lines are to be provided in a line layer. The line layer required for this purpose must contain the attribute field “style” along with other necessary fields. The following table contains the “style” column for the above mentioned line layer. The other columns are given as descriptions to the “style” column. The column named “Sl. No**.**” is the serial number of the various symbols as per the conventions followed. The base name of the files for the line layer for the alamats must be “alml” i.e. the “.shp” file for the line layer

must be “alml.shp”. The names of other necessary files (.shx, etc.) for the same line layer must be given accordingly.

9.2.2.2 In order to define the extent of the total map area, it is essential to have a sheet boundary. This boundary is to be provided in a separate line layer, which must contain similar attribute fields as defined previously for the above mentioned line layer. This layer should contain a single line with thickness of style number 16. The base name of the files for the line layer for sheet boundary must be “bnd”, i.e., the “.shp” file for the line layer must be “bnd.shp”. The names of other necessary files (.shx, etc.) for the same line layer must be given accordingly.

Note: i) Some alamat notation comprises of a line and several points on the line. In such cases the lines are to be provided in the line layer and the points are to be provided in the point layer that is described in Table 1.

ii) Attribute Naming: The “style” attribute column in the following Table 2 must be a character field having a maximum length of 4 characters.

Table 2

Item	Style (specified by the NIC)	Description	Required features for West Bengal (NR: Not Required, R: Required) (*)
Specific lines on the village boundary	0	The portion of the village boundary drawn with broken lines must be digitized in a continuous fashion as a separate line and provided with the mentioned style no.	R
Village boundary	1	The alignment of the village boundary is along the middle of the thick line.	R
Municipal/Notified Town Boundary	2	Only the broken line of the boundary should be given in the line layer.	NR
Ward (municipal) boundary	2	This is for the broken line denoting the boundary.	NR
	4	This is for the small line segments that are perpendicular to the broken line.	NR
Forest boundary	3	Only the line representing the forest boundary should be given in the line layer. The entire boundary may be divided into different segments such that each	NR

		segment is an entity in the line layer, provided all these segments contain the same style no.	
Wire fencing/railing along property boundary (showing ownership)	4	Only the line representing the property boundary should be given in the line layer (the 'X' marks had already been given in the point layer as mentioned in the previous table). The entire boundary may be divided into different segments such that each segment is an entity in the line layer, provided all these segments contain the same style no.	NR
Village boundary cutting along the length of river/road	2	Only the line representing the village boundary should be given in the line layer. The entire boundary may be divided into different segments such that each segment is an entity in the line layer, provided all these segments contain the same style no.	R
Village boundary cutting across a water body	2	Only the line representing the village boundary should be given in the line layer.	R
Plot boundary where there is a water body across it	2	Only the line representing the plot boundary should be given in the line layer.	R (.dbf)
Tram line	5	Only the line representing the Tram line should be given in the line layer. The entire line may be divided into different segments such that each segment is an entity in the line layer, provided all these segments contain the same style no.	NR
Railway	6	Only the line representing the Railway line should be given in the line layer. The entire line may be divided into different segments such that each segment is an entity in the line layer, provided all these segments contain the same style no.	R
Trekking route in hilly areas (too	7	Only the line representing the Trekking should be given	NR

narrow for both sides of the path to be surveyed separately).		in the line layer. The entire line may be divided into different segments such that each segment is an entity in the line layer, provided all these segments contain the same style no.	
Culvert	4	Only the small line segments representing the culvert should be given in the line layer.	NR
Road (flyover) over Railway	4	1) Style 4 is used for the edges of the Road (flyover) above the Railway. 2) Style 6 is used for the Railway line under the Road (flyover). 3) The Railway line as shown in the figure comprises of two line segments on either side of the road (flyover).	NR
	6		NR
Railway (flyover) over road	4	1) Style 4 is used for the edges of the railway (flyover) above the road. 2) Style 6 is used for the road under the railway (flyover). 3) The road as shown in the figure comprises of two parts on either side of the railway (flyover).	NR
	6		NR
Railway (flyover) over railway	4	1) Style 4 is used for the edges of the flyover. 2) Style 6 is used for the railway line passing under the flyover. 3) The railway line as shown in the figure comprises of two line segments on either side of the road (flyover).	NR
	6		NR
Subway (underground) under railway	2	1) Style 2 is used for the broken line denoting the subway under the railway line. 2) Style 6 is used for the railway line.	NR
	6		NR
Subway (underground) under road	2	1) Style 2 is used for the broken line denoting the subway under the road. 2) Style 4 is used for the road above the subway.	NR
	4		NR

Road (flyover) over road	4	The road lying below consists of two parts on either sides of the road lying above it	NR
Level crossing	7	It is assumed that the railway line is already present as an item as given in Sl. No. 19.	NR
River with, ferry and direction of flow of water	4	1) Style 4 is used to denote the direction of water flow along the river. 2) The entire arrow showing the direction should be digitized. 3) Style 7 is used denote the ferry.	NR
	7		NR
Tidal stream	4	The entire arrow is to be digitized.	NR
Jhora (rivulet in hills)	4	1) Style 4 is used to indicate the edges of the jhora as surveyed in situ. 2) Style 8 is used to indicate the middle of the deepest courses of the jhora as surveyed in situ.	NR
	8		NR
Narrow water channel along the plot boundaries with direction of flow of water (having width too small to be surveyed).	9	The arrows on the line (boundaries) must be digitized such that it shows the proper direction of the water flow.	NR
Drain/nala (in basti or town areas) with direction of flow of water.	4	The arrow showing the direction of flow of water should be given in the line layer.	NR
Pylon/electric/ telegraph/telephone post with line	2	Only the broken line is required in the line layer, the dots being provided in the point layer as mentioned in the previous table.	NR
The north-west sides of the water bodies including tank drawn with thick lines in the map	16	Only the thick lines are to be provided with the mentioned style number. Any other lines inside the mouza having a line thickness identical to the north-west side of the water bodies should be allotted the same style.	NR

(*) These may be different for individual States.

9.2.3 At area layer

Some of the alamats (in-situ) that are to be represented by areas must be provided in an area layer. The area layer required for this purpose must contain the attribute field “shade” along with other necessary fields. The following table contains the “shade” column for the above mentioned area layer. The other columns are given as descriptions to the “shade” column. The column named “Sl. No.” is the serial number of the various symbols as per the conventions followed by the Directorate of Land Records and Survey. The base name of the files for the area layer for the alamats must be “alma” i.e. the “. shp” file for the line layer must be “alma.shp”. The names of other necessary files (.shx, etc.) for the same line layer must be given accordingly.

Note: i) Some alamat notation comprises of a line and several points on the line. In such cases the lines are to be provided in the line layer and the points are to be provided in the point layer that is described in Table 1.

ii) Attribute Naming: The “shade” attribute column must be a character field having a maximum length of 4 characters.

Table 3

Item	Shade (specified by the NIC)	Description	Required features for West Bengal (NR: Not Required, R: Required)
Pucca buildings (in situ)	1	Specific to State	NR
Pan baroz	2	Specific to State	NR
Sand char	3	Specific to State	R (.dbf)

Note: IMPORTANT

1. The ".shp", ".shx" and the ".dbf" files for the mouza containing the area and the line layer should be named as "<JLNo>.shp", "JL.shx" and "JL.dbf" respectively. Thus, if the JL No. of a mouza is 100, then the three abovementioned files should be "100.shp", "100.shx" and "100.dbf" respectively. The files are to be placed in the "JL No." subdirectory under the corresponding "PS Code" directory in the following format:

<PS Code> \ <JL No.> \ <JL No>.shp
<PS Code> \ <JL No.> \ <JL No>.shx
<PS Code> \ <JL No.> \ <JL No>.dbf

Thus, if for a particular mouza, the PS Code is 50 and the JL No. is 100, then the files corresponding to the layers of that mouza should be organized as follows:

50 \ 100 \ 100.shp
50 \ 100 \ 100.shx
50 \ 100 \ 100.dbf

2. If the mouza map comprises of more than 1 sheet, then the files for all the sheets are to be given the same names and as per the convention mentioned in point 1 above. However, in order to avoid controversy, the files must be kept in different subdirectories denoting the sheet number under the "JL No" directory, which itself is kept under the "PS Code" directory. Thus, if the mouza map with JL No. 100 (see the example in point 1) comprises of 2 sheets then the file should be organized as follows:

For sheet no. 1	For sheet no. 2
50 \ 100 \ 1 \ 100.shp	50 \ 100 \ 2 \ 100.shp
50 \ 100 \ 1 \ 100.shx	50 \ 100 \ 2 \ 100.shx
50 \ 100 \ 1 \ 100.dbf	50 \ 100 \ 2 \ 100.dbf

3. The layers for the images and the alamats need not be qualified with their corresponding JL Nos., but they must be kept in the same directory along with the layer files mentioned in the above two points. The files will be named as centroid.shp, almp.shp, alml.shp, scale.shp, bnd.shp, mbnd.shp, img.shp, alm_bata.dbf, first_last.dbf, missp.dbf, name.gif, lege.gif, bata.gif, sign.gif, etc.

4. The attribute field giving the plot number of each plot of the mouza is a compulsory field. It must be a 5-character field and have the name "plotno".

5. The list of conventional symbols for the alamats as followed by the department should be referred whenever required.

6. For symbols, which are not "in-situ", the points of insertion of the symbol are to be given at the approximate center of the symbol in the point layer for alamats.

7. The scale for each map should be digitized and provided as a separate line layer along with the other layers for the mouza. The base name of the files for the line layer for the alamats must be "scale", i.e., the ".shp" file for the line layer must be "scale.shp". The names of other necessary files (.shx, etc.) for the same line layer must be given accordingly.

8. The values in the different attribute fields in the various layers should be left justified.

10. Integration of map with RoR

10.1 Each plot of land is represented on the digital map as a closed polygon. Such polygons are identified by a unique 5 digit number, that is, its plot number. In the RoR database, such plot numbers are referenced. This provides a basis for integration of digital map with the digital RoR data. The RoR database consists of several related tables (7 main tables and several master tables) of information that provide ownership, land classification, etc. information which are essentially text data types. All the tables are connected by two common data fields. These are:

Idn: a seven digit code to identify a Mouza (2-digit for District, 2-digit from Block & 3-digit for the Mouza)

Plot No.: a five digit Plot number

10.2 For digital map, data (contained in more or less 36 files) are distributed in three tables under various columns having the above two common fields (Idn. and Plot No). Shape files (.shp, .shx and .dbf) are binary files, and are stored in BLOB data format -- a facility available in the MS-SQL Server 2005 DBMS. The existing RoR database is added along with the above three tables containing map information to form an extended database of RoR.

10.3 Data, both spatial and textual, are used by the application software “BHUCHITRA” (developed by the NIC, West Bengal State Unit) to provide the necessary integration of data. Such integration provides all the flexibility to manipulate textual data and spatial data without any constraint and provides a platform for various improved citizen-centric services and MIS reports. Some of them are given as follows:

1) Providing plot map (parcel map), showing dimensions of each side and area along with the RoR.
2) Generating various derivative maps based on possessions, classifications, legal sections applicable, size of the plot, etc.
3) Generating analytical reports on area in the RoR with respect to the digital map so as to help in data correction, both text as well as map.
4) Integrating the RoR updation with its map updation.

11. Map updation

11.1 Problem definition and purpose

Every digitized map needs to be updated every time when classification of a portion of the plot changes or ownership of a portion changes. Such plot divisions are effected on the digital map based on field measurements data.

11.2 Scope

It aims to realize the following processes and database requirements:

I) Divide the mentioned plots as per requirement with the help of field measurements.

II) Calculate the areas for newly-generated plots along with their mother plots and update the RoR data in the database.

11.3 Techniques

Digital map looks like the following:

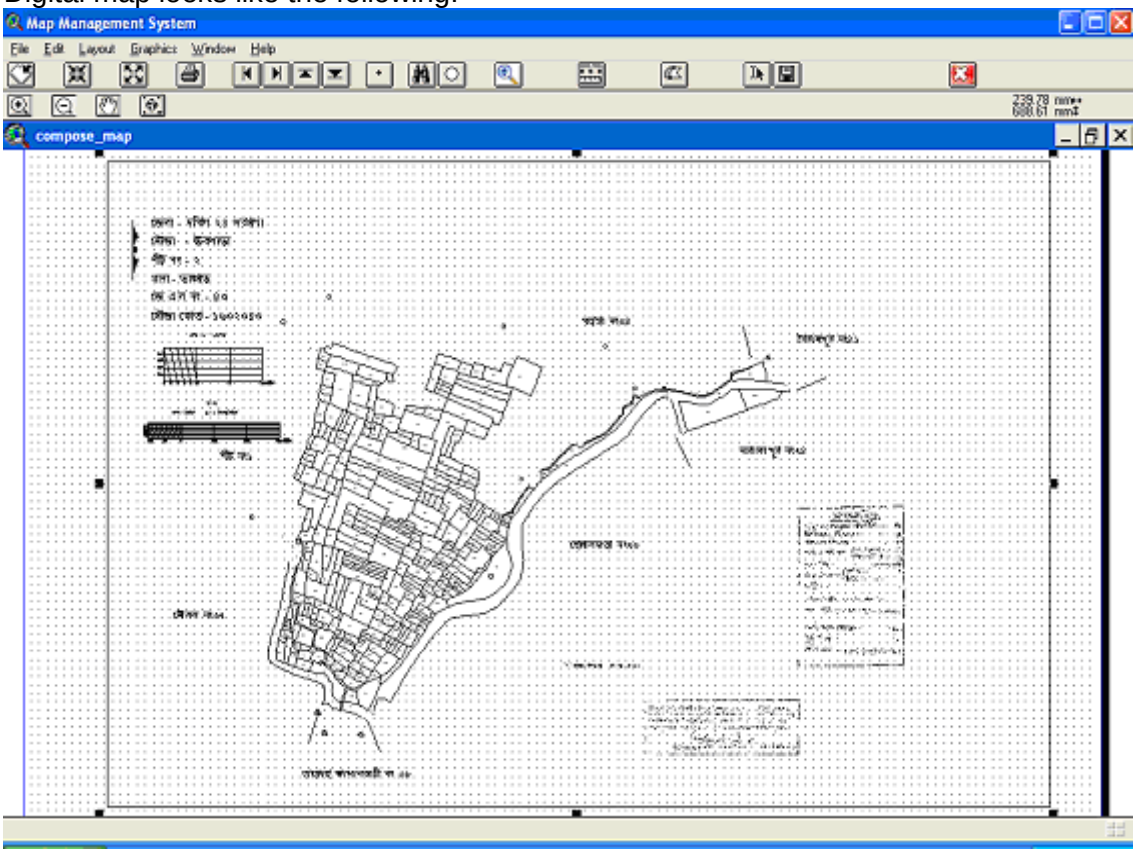


Figure 1: Composed Digitized Mouza Map

11.3.1 Updating the digitized map with the help of the field measurements

There are mainly four types of processes following which updation may happen. Those are:

1. Division by straight-line having end points at boundary.
2. Division by poly-lines.
3. Division by parallel lines.
4. Division by perpendicular lines.

These sub-processes with their graphical representation are discussed below.

11.3.1.1. Division by straight-line having end points at boundary

This is the simplest and easiest amongst all other techniques. The user just needs to supply the distances. For example, one has to supply the distance from vertex D along the line DA to get new vertex E. As well as, one has to give the distance from vertex B along the line BC to get new vertex F. MUS will need to create a poly-line (EF) between those new vertexes to split the old polygon (as given in Figure 2b). Then, one has to provide new plot number for the newly-created child plot (closed polygon, CDEF). The information (ownership details, area, etc.) of the newly-created polygon will be added into the database (RoR and DBF) and the information of the older one (closed polygon, ABFE) will be edited in same database (RoR and DBF).

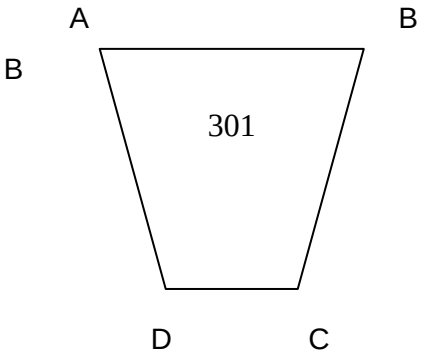


Figure 2a: Before updating

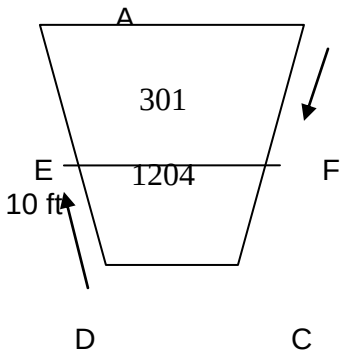


Figure 2b: After updating

11.3.1.2. Division by poly-lines

This technique is applicable when multi-segmented division is required (as given in Figure 3a). According to the picture given below, the polygon ABCD needs to be segmented in several subparts. Such as AEGF, HIJB, MNDC.

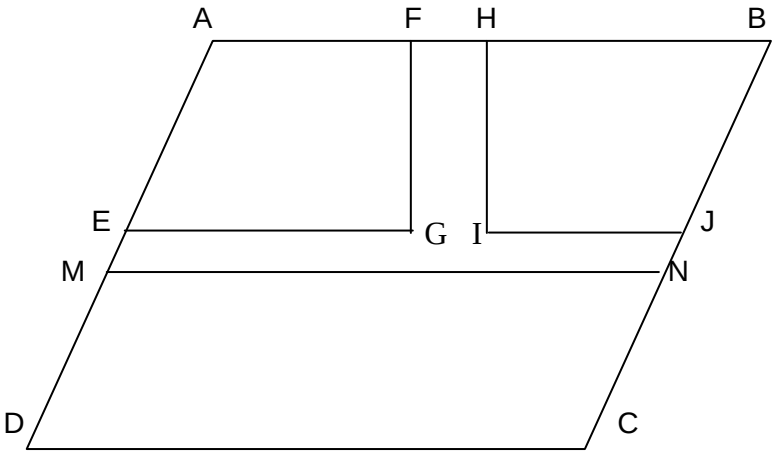


Figure 3a: After Updating ABCD with poly-lines

To find out the actual points, one needs to apply the bisecting radius method (as given in Figure 3b). Suppose the user wants to split a polygon AEGF from ABCD polygon. To get the point G, two circles will be drawn taking E and F as their corresponding centers. The bisecting point of these two circles will be the new vertex G (as shown in the figure). After getting the point G, one needs to join GE and GF to get the resultant polygon (AEGF).

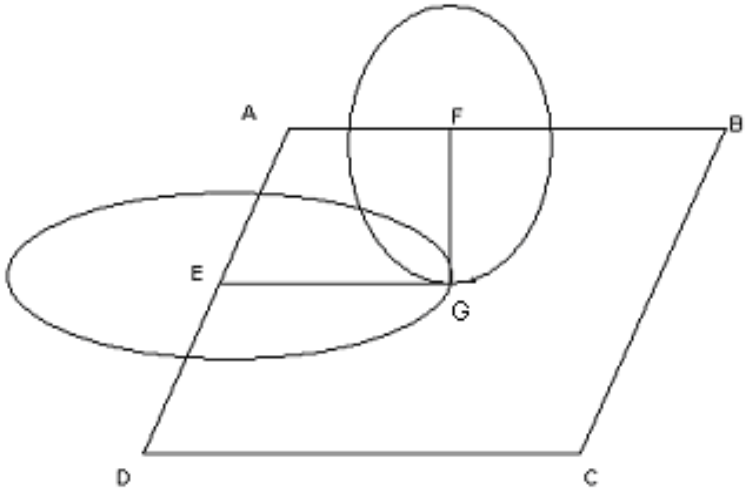


Figure 3b: Getting the bisecting point

11.3.1.3. Division by parallel lines

This technique is very useful when users require a parallel division with respect to any side of the older polygon (as shown in Figure 4). According to the figure, ABCD

is the parent polygon and EFCB is the child one. MUS will need to calculate two different points E and F along the line BA and CD respectively. MUS will also need to join the points E and F to get the line EF for the resultant polygon (EFCB).

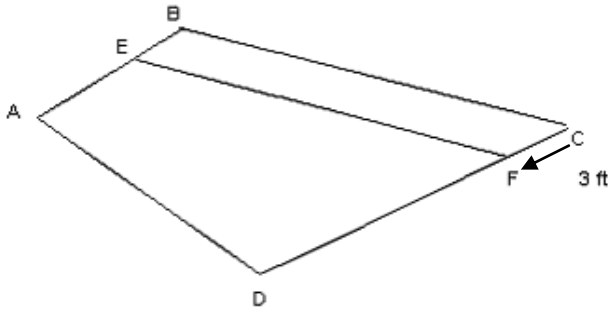


Figure 4: After updating ABCD with parallel line

11.3.1.4 Division by perpendicular lines

This technique is applicable when perpendicular deviation is required (as shown in Figure 5). As shown in the figure given below, the point E is 8 ft. far from the point D along the line DA and the point G is 12 ft. far from the point C along with CD. Then, one will draw a perpendicular EF at the point E on the line DA. The line EF is 6 ft. long. FG will be joined. Now, one gets the resultant polygon EFGD.

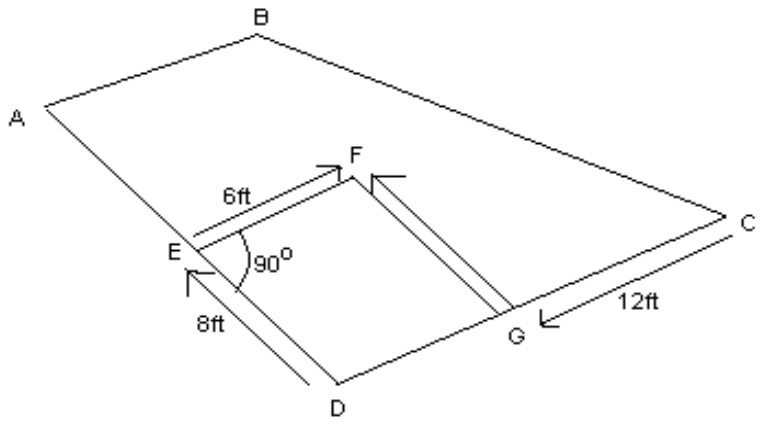
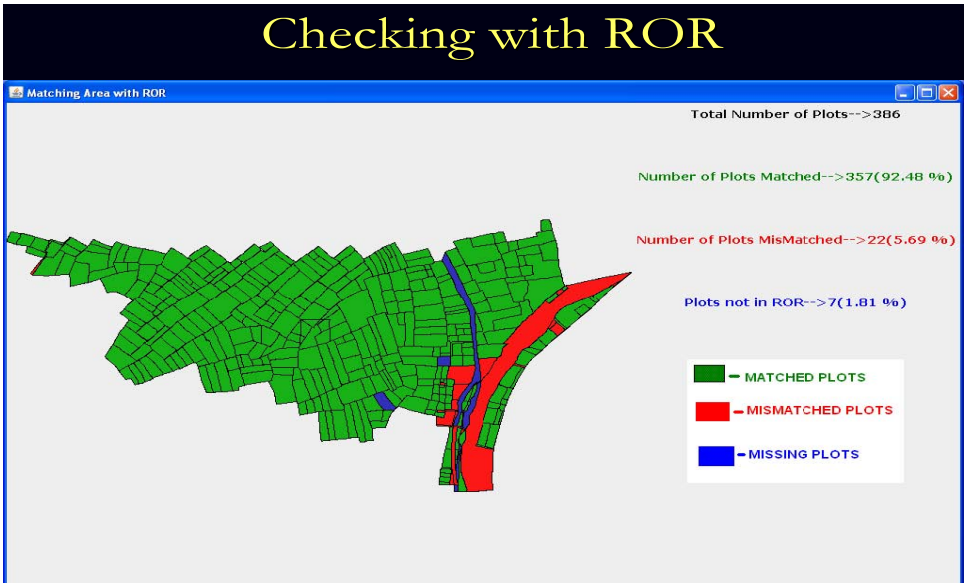


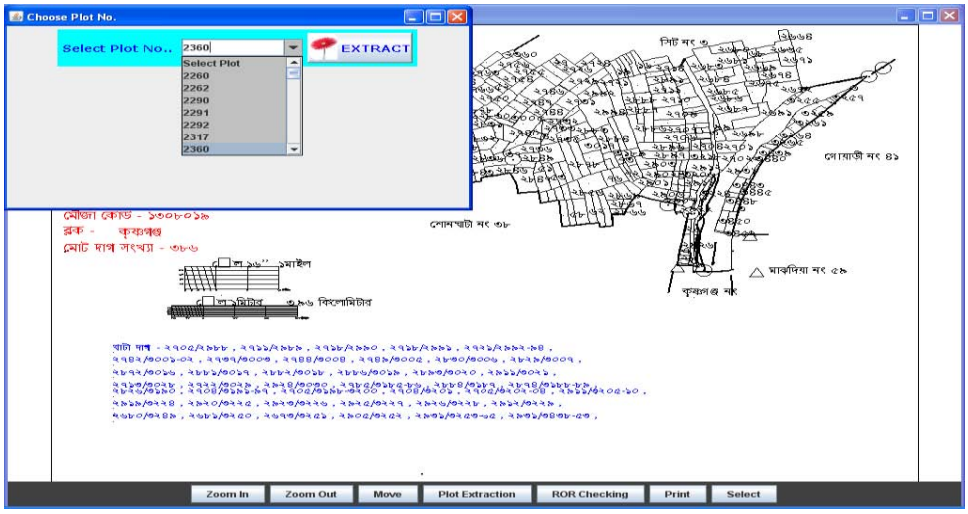
Figure 5: After updating ABCD with Perpendicular line

12. Some screen shots

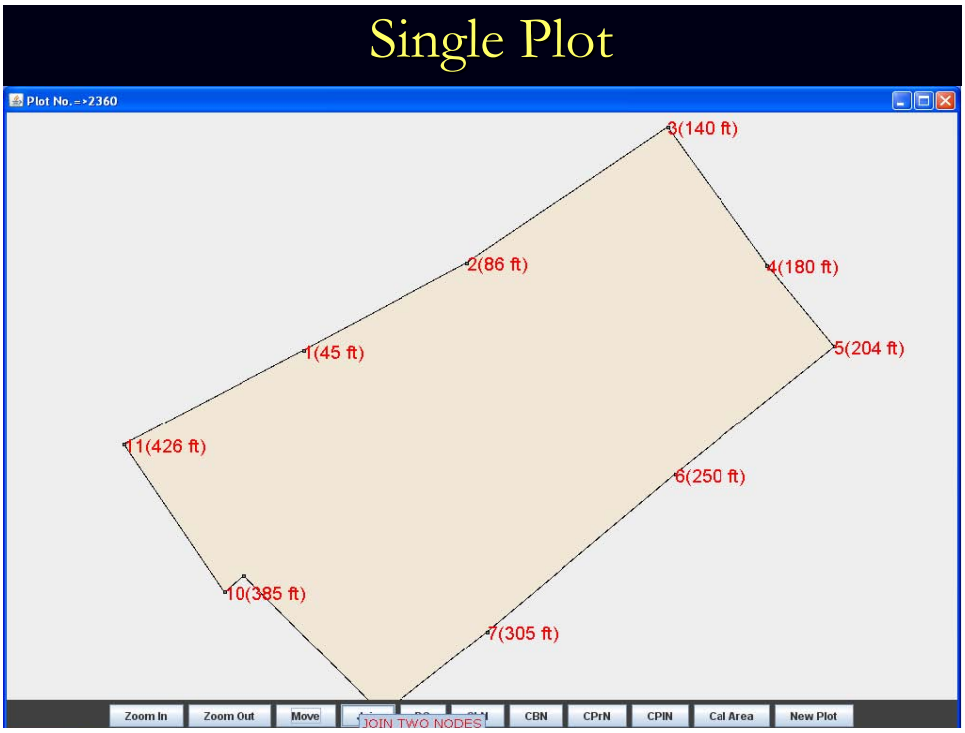
a) Comparison the Composed mouza map with the ROR data:



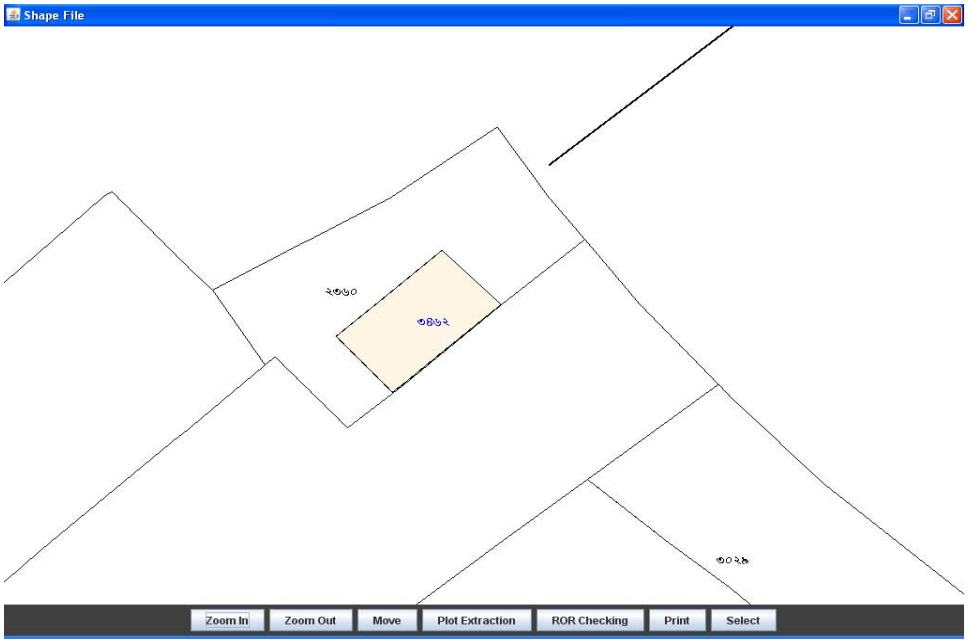
b Extraction of a single plot:



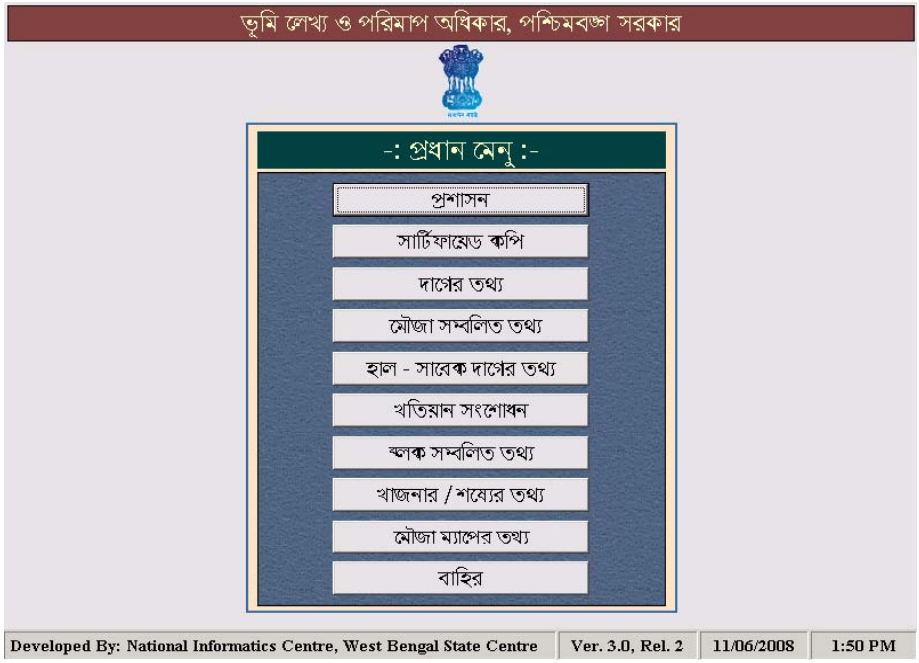
c Single Extracted Plot:



d. Updating a Plot in the Mouza map:



e Integration of Map with RoR text data


ভূমি লেখ্য ও পরিমাপ অধিকার, পশ্চিমবঙ্গ সরকার
-: প্রধান মেনু :-
প্রশাসন
সার্টিফায়েড কপি
দাগের তথ্য
মৌজা সম্বলিত তথ্য
হাল - সাবেক দাগের তথ্য
খতিয়ান সংশোধন
ব্লক সম্বলিত তথ্য
খাজনার / শষ্যের তথ্য
মৌজা ম্যাপের তথ্য
বাহির
Developed By: National Informatics Centre, West Bengal State Centre
Ver. 3.0, Rel. 2
11/06/2008
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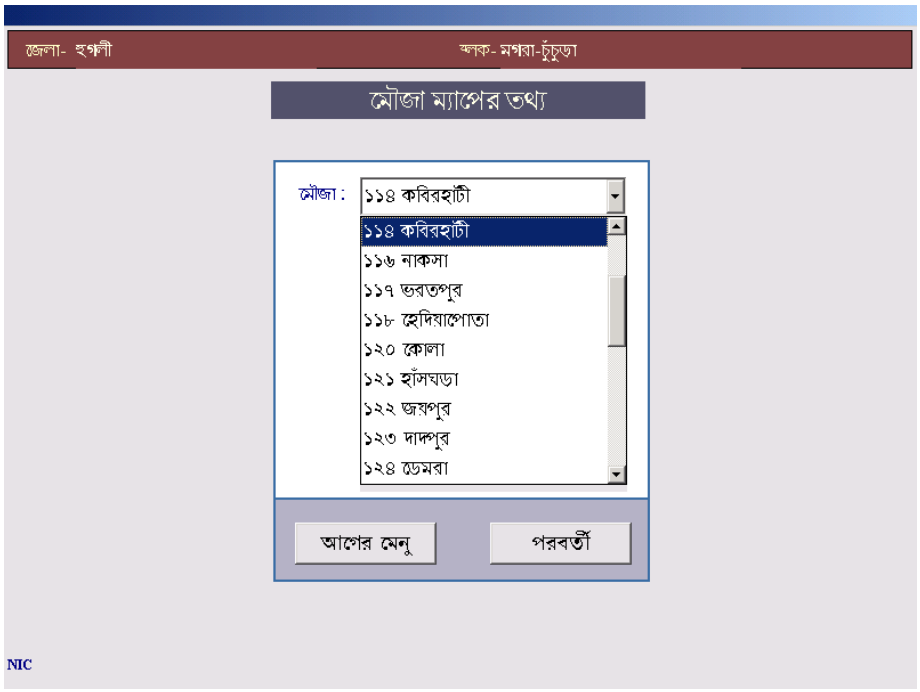
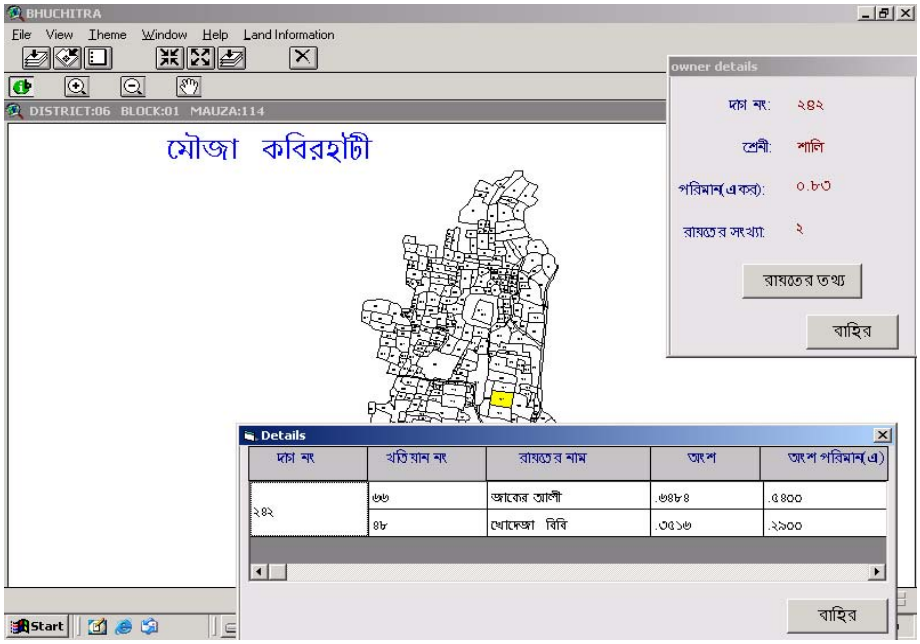
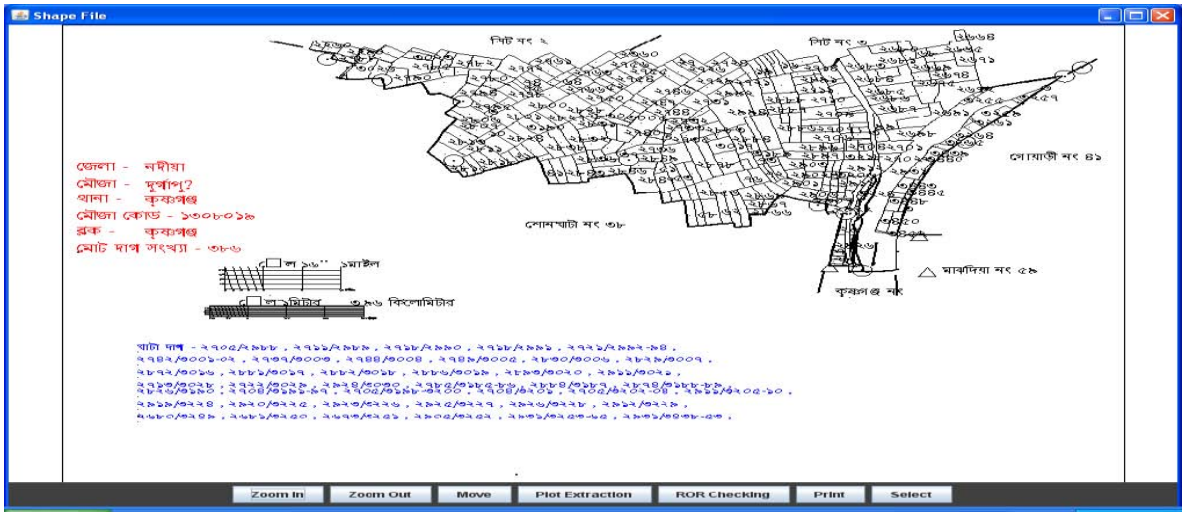

জেলা- হুগলী
ব্লক- মগরা-চুঁচুড়া
মৌজা ম্যাপের তথ্য
মৌজা :
১১৪ কবিরহাটী
১১৪ কবিরহাটী
১১৬ নাকসা
১১৭ ভরতপুর
১১৮ হেদিয়াপোতা
১২০ কোলা
১২১ হাঁসঘড়া
১২২ জয়পুর
১২৩ দাদপুর
১২৪ ডেমরা
আগের মেনু
পরবর্তী
NIC

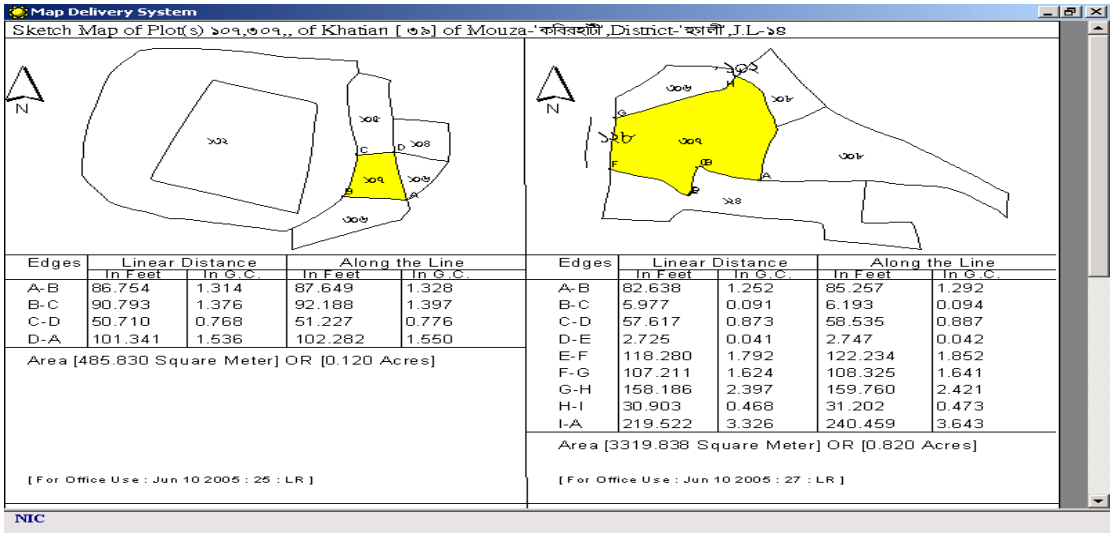
f. Displaying ROR text data within the composed mouza map:



g. A complete digitized map showing alamats, also called “Composed map”



h. Service of Plot map along with certified copy of ROR:



Edges	Linear Distance		Along the Line	
	In Feet	In G.C.	In Feet	In G.C.
A-B	86.754	1.314	87.649	1.328
B-C	90.793	1.376	92.188	1.397
C-D	50.710	0.768	51.227	0.776
D-A	101.341	1.536	102.282	1.550

Area [485.830 Square Meter] OR [0.120 Acres]

[For Office Use : Jun 10 2005 : 25 : LR]

Edges	Linear Distance		Along the Line	
	In Feet	In G.C.	In Feet	In G.C.
A-B	82.638	1.252	85.257	1.292
B-C	5.977	0.091	6.193	0.094
C-D	57.617	0.873	58.535	0.887
D-E	2.725	0.041	2.747	0.042
E-F	118.280	1.792	122.234	1.852
F-G	107.211	1.624	108.325	1.641
G-H	158.186	2.397	159.760	2.421
H-I	30.903	0.468	31.202	0.473
I-A	219.522	3.326	240.459	3.643

Area [3319.838 Square Meter] OR [0.820 Acres]

[For Office Use : Jun 10 2005 : 27 : LR]

NIC

Digitization of Cadastral Maps and Integration with RoR Data

Model-II

(Based on inputs from the ISRO/NRSC, involving use of High-Resolution Satellite Imagery)

1. The cadastral map for each village is available on larger scales like 1:4000 to 1:10,000. These maps depict the survey boundaries with survey numbers, cultural features like transport network, location features viz. temple, trees, abadi and natural features like drainage etc. These cadastral maps have been prepared using plane table survey and chain survey. These maps need to be brought under standard projection/coordinate system for effective linkage of the developmental plans generated in the GIS environment. The following is the general description of the scope of the work of digitization of the cadastral village maps, geo-coding and their integration with textural data (RoR):

- The village cadastral maps will be traced on to tracing film/paper wherever required, scanned and grid-corrected.
- These maps will then be vectorized and labeled, parcel-wise.
- The parcel-wise information will then be attached uniquely to identify with the help of key identifier to obtain the details of each parcel.
- A grid-corrected map of the original sheets has to be provided in hard copy format.
- The sheets will be edge-matched, mosaiced, and the topology created as per the conventions specified.
- The mosaiced digitized maps will then have to be converted to GIS format and transformed using ortho-rectified geo-coded High Resolution Image.
- The accuracy standards should be maintained as per the pre-specified spatial framework, projection system, co-ordinate units, tolerances, feature-coding scheme, etc.
- The deliverables have to be provided in proper format, structure, precision and metadata, as specified, so that they are ready for use with other revenue-related activities.

2. STEPS FOR DIGITIZATION OF CADASTRAL VILLAGE MAPS

The process of digitization can be summarized in following steps (Fig 1):

1. Collection of analog cadastral village maps (sheet-wise)
2. DQC-1 (Input data evaluation)
3. Tracing or re-production of the analog map
4. Sheet indexing and scanning of the analog maps (converting analog to raster cadastral images)
5. DQC-2 (check DPI, format, quality, speckle removal and cleaning)
6. Grid correction of the scanned (raster) map
7. DQC-3 (grid overlay checking with scanned map)
8. Feature abstraction from the scanned map
9. DQC-4 (check for the accuracy of the type, location and attributes)
10. Layout and printing hard copy for evaluation by the Land Revenue Department (LRD)
11. DQC-5 (detailed checking of the digitized features by the LRD)
12. Incorporation of the corrections suggested by the LRD
13. Sheet mosaicing of a village
14. DQC-6 (feature continuity and attribute carry forward)
15. Conversion of the digitized data into topologically-correct GIS data format
16. DQC-7 (checking for GIS feature conversion, attributes, null and duplicate errors)
17. Final deliverables (hard copy print and GIS data for geo-coding)
18. Metadata preparation

2.1 Collection of the sheet-wise analog cadastral village maps

Before executing the project, availability of sheet-wise cadastral maps have to be ascertained. The maps should be up-to-date and in good condition. The condition should be such that it can be scanned through a contact (roller) scanner or a flat-bed scanner (prefer flat-bed scanner). The DQC-1 has to be performed at this stage before it is sent for scanning. The quality check procedure will include the condition of the map – it should not be a cloth mounted, nor be torn or ragged, and not have too many folds. The control points (tics) should be available. The features of the map should be clear and distinguishable. Parcel number (khasra no.) should be distinct and readable. All symbols (*alamats*) should be distinct and properly understandable. Once found acceptable on all the above-mentioned characteristics, the sheet is tagged suitable for scanning.

2.2 Tracing or re-production of the analog map

If the sheet is not suitable, then the sheet has to be sent for tracing (preferably on a 75-100 GSM mylar film) or reproduction of the sheet by the LRD. The reproduced sheet has to be quality checked (DQC-1) and finally sent for scanning. The maps are to be traced using the following specification:

- Tracing to be done on 75 micron polyester film.
- Tracing should be done with 0.1 pen using black ink only.
- All the features should be traced.
- The labels should be placed neatly in the center of the feature with free hand drawing.
- In case the feature is too small to accommodate the label, it should be placed at a convenient location with a marker arrow.
- The heading and legend data should also be traced along with scale, north arrow, sheet no., etc. along with map border.

2.3 Sheet indexing and tics (tick-marks) highlighting

2.3.1 All sheets have to be indexed with appropriate index numbers. The index number is to be generated using the village metadata with respect to the various administrative codes (State, district, tehsil, and revenue inspector/patwari/thana/mouza and village code). The index number should be a unique number with information of the administrative hierarchy of the village. A typical example of index number may be I120501007035101 (IDDTTRRHHHVVVVnn).

2.3.2 One of the very important processes before scanning is the highlighting the tics (wherever they are present) and transferring of the tics (where absent). The following procedure should be followed in this regard:

- **Gridlines & tics are available** - The tics on the maps may be faint or in the form of grid lines. Uniformly distributed tics should be highlighted with a cross (X) depicting the exact intersection of the gridlines or tic position. The distance between the tics/gridlines, based on the scale, has to be ascertained and measured. This will be useful in selecting the mathematical grid for grid correction.

- **Four corner tics available** – The tentative distance of the corner tics has to be measured, based on the scale, and highlighted with a cross (X) depicting the tics position.
- **No gridlines or tics available** – This map will have no reference points, but to remove the scanning error, if any, the situation may be rectified by using the transferred tics. The tics from standard mathematical grid (grid will change depending upon the scale) have to be transferred on the analog sheets by overlay method on light-table. These transferred tics will rectify any distortion during scanning of the sheet. However, the map sheet can be corrected by registering the graphical scale with the standard template scale.

2.4 Scanning of the analog maps (converting analog to raster cadastral images)

2.4.1 The cadastral maps are scanned using AO size raster scanner. While scanning, the important parameter -- DPI (dots per inch) -- has to be precisely set. The DPI is based on drawing characteristics and information required. In general, the following minimum specifications should be adopted while scanning the cadastral sheets: Maps should be scanned at 100-200 DPI Black/White (8 bit gray tone) mode depending upon the density of the features. If all the details are not picked up during scanning, the scanning parameters should be changed to 400 DPI on 24-bit color. While scanning, the sheet has to be fed in straight upright position and smoothened so that any fold is not generated while scanning. In the flat-bed scanner, the map has to be laid flat on the glass, smoothened and scanned; and bulging should be avoided.

2.4.2 After successful scanning, the DQC-2 procedure has to be followed. The raster image of scanned map should be stored in TIFF format (*.tif or tagged image format). The scanned map orientation should be upright (north oriented). The scanned map should be cleaned and free from noise (i.e., unnecessary pixels or darkness in the image). To remove the noise, de-speckling should be applied. The measured length and width within the bounding box of the scanned map should be +/-0.1% of the map manuscript measurements. The scanned image should not be skewed or warped; if there are any, it should be de-skewed or necessary correction should be applied, or it should be re-scanned. The scanned image should not have any line dropouts or stretched pixels; otherwise, it will have to be re-scanned. The scanned file will take the name of map index name, such as **I120501007035101.tif**

2.5 Grid correction of scanned cadastral map

2.5.1 Even after appropriate quality checks during the scanning process, there can be few errors due to machine specification and scanning techniques. There can be also some distortion in the input manuscript (analog cadastral map). The scanned map may carry forward the errors due to differential scanning, wear and tear or differential shrinkage/expansion. The net result may be non-uniform scale at parts of the map, deflection in north orientation, etc. To make the map plani-metrically accurate, rectifying the map with the vector grid is suggested.

2.5.2 Prior to the correction, selection of the appropriate grid has to be made. The grid is scale-dependent. Generally, the grid found on 1:3960 (16”=1mile) will be placed at a distance of 10 zaribs (i.e., 50.8 cm or 2.00000008 inch); the maps with 1:4000 scale will have a metric system grid and will be placed at a distance of 25 cm. Each sheet will have 10 X 14 grid blocks in 1:3690 scale, or 20 X 28 grid blocks in 1:4000 scale sheet. After ascertaining the scale of the maps under consideration, appropriate mathematical grid has to be generated.

2.5.3 After selecting the appropriate grid, the cadastral scanned maps have to be registered with the grid.

- **Gridlines and tics are available** - The highlighted tics in the scanned map have to be stitched/tagged with its appropriate intersections of the gridlines of the mathematical grid and then transformed.
- **Four corner tics available** – The highlighted four corner tics in the scanned map have to be stitched/tagged with its appropriate intersections of the gridlines of the mathematical grid and then transformed.
- **No gridlines and tics available** – This needs to be executed in two steps:

  (a) The transferred tics before scanning are to be stitched/tagged with its appropriate intersections of the gridlines of the mathematical grid which was used to transfer the tics. Then first transformation is made. This will remove the scanning distortion, if any.

  (b) Comparing the available graphical scale of the map with the mathematically generated graphic scale of the same type and then registering the scale and transform. This may correct the distortion of the map scale, if any.

2.5.4 The process should eliminate the possible warping effect of cadastral maps. High accuracy and low residual error are to be achieved in grid correction of cadastral images. The transformed rectified cadastral scanned image is termed as 'registered scanned cadastral map' and can take the name such as **R120501007035101.tif**. The quality check DQC-3 is performed on the image to see whether the gridlines overlay with the tics of the map. If the errors are not within the acceptable limits, re-registration has to be performed.

2.6 Feature abstraction from the grid-corrected scanned cadastral images

2.6.1 Template creation: Before starting the vectorization, a standard template has to be created. In the template, the layer name, line type, color and thickness for each feature (e.g., parcel, roads, canals, river, etc.) present on the map is standardized. Different graphical representation (symbol-*alamats*) in the map is to be standardized as point features with proper layer name, symbol and colour. This maintains uniformity in all the map outputs. The template also holds various mathematical grids, graphical scales, and other map features like north arrow, boundary lines, headings and other permanent annotations. A symbol library is created, which contains the various symbols shown in a village map. The symbol library gets depicted in the legend of the template. The main intention behind this is to maintain the uniformity over all the village maps that are digitized. The template should also address the font type of the annotation in the maps. Generally, UNICODE system is adopted with proper font for depicting the local language script. However, the template standards may vary from State-to-State and have to be regenerated with changes in the input specifications.

2.6.2 Feature abstraction is the process of capturing the point, line, and polygon features as vectors and text as annotation. The grid-registered scanned cadastral map sheet is displayed in the background, the required environment settings for digitization are set, and the required features are captured into different layers (based on the feature type). During digitization, attributions to the features will also be done. Only heads-up manual digitization should be carried out. Auto-vectorisation should not be attempted. Error should be within permissible limits for digitization, viz., weed tolerance, coordinate movement tolerance, sliver polygon tolerance, coordinate unit, planimetric errors, fuzzy tolerance, etc.

2.6.3 The uniformity in layers, line type, color, annotation, etc. during digitization will be maintained by using the template, as described above, to capture all the features in their respective layers. The final output of this process will be a digital map which will be a true copy of the paper map, along with necessary legends, scale bar, north arrow, borders, etc.

2.6.4 Once the digitization process is over, the DQC-4 is performed. This process assures the features abstracted from the scanned map sheets are true in its type (i.e. point, line or polygon), accurate in location and its attributes. Tag should be maintained wherever the feature/annotation could not be read along with null and duplicate errors. The errors have to be reported in the draft output map, which will be sent to the LRD for through checking (*for details refer to the Quality assurance*)

3. Guidelines for feature digitization/abstraction

3.1 The general specifications for digitization are given below:

- The data is to be digitized using heads-up digitization.
- The features are to be captured such that the polygon features are put in one layer, the line features are in another layer while the points are in a different layer.
- The lines are to be digitized as polylines only, coincident lines are to be digitized once and copied to appropriate layer.
- Feature specific codes are to be assigned uniquely as given in the format.
- The data should be topologically correct for each of the layer.

3.2 The accuracy requirement and specifications for each of the type of features is indicated below:

3.2.1 Polygon feature specifications

- The parcel boundary should be digitized in such a manner that the resulting vector line falls in the center of the raster data image element being vectorized.
- The parcel boundaries are generally straight, hence should be digitized using 2 nodes/vertices in keeping with the shape of the polygon.
- The feature should be digitized in such a manner that there is no overshooting or undershooting of arcs, or duplicate arcs.
- The feature should be captured with specked symbol.

- The feature should be digitized with minimal number of vertices while, at the same time, maintaining the smoothness or angularly of the lines, as the case may be.
- The feature should be a closed polygon without any dangles or sliver.
- Each polygon should have a unique PIN as per the coding scheme indicated below.
- The tolerance values for arcs, node snapping and vertices should be such that the features snap within the pixels defining that feature and do not snap outside.
- All features like parcels, roads, rivers, etc., which form the polygons, are to be digitized and coded as per the coding scheme.
- The connectivity of the rivers/roads is to be maintained and should not be disjointed.
- The label (parcel no.) should be placed in the center of the feature.
- Nodes are to be added wherever symbols are depicted on the parcel boundaries.

3.2.2 Point feature specifications

The features shown on maps as points, like wells, temples, trees, etc., are to be digitized as point features, for which the digitizing rules and coding scheme are given below:

- The feature should be digitized as a point placed at the center of the raster image defining it.
- There should only be one point at one location.
- Each feature should have a unique ID.

3.2.3 Line feature specifications

The linear features shown as single line arcs on the map or linear double line features or symbols like rivers, roads, pipelines, etc. are to be digitized and compiled into the line layer for the village. The single line arc features, whether shown as continuous lines or broken lines, are to be captured from the map image. In addition to this, the double line roads, rivers, pipelines, etc. from the polygon coverage are also to be put into the line coverage. The feature coding guidelines are given below:

- The river/roads depicted on the image represent the outside edges in case of double line features and should be digitized as such. The resulting vector should not deviate from the pixels defining it. These features should be

captured only once and copied into the appropriate layers before building the topological relationships.

- The feature should be vectorized in such a manner that the shape is captured and retained as it is.
- The feature should be vectorized using optimum member of nodes/vertices so that the shape is retained and does not appear jagged.
- The continuity of the features such as rivers, roads, etc. must be maintained across the map sheets.
- At crossings, the features should be digitized with or without intersection, as the case maybe.
- In case of single line features, they should be captured as a single continuous feature from one end of the feature to the other end without break.
- In case of double line features the centerline should not be digitized. This will be represented by appropriate symbol.
- There should not be any gap between two connecting features, nor any over-shoots; the features should be snapped to connecting features.
- The features should be coded as per the coding scheme.

3.2.4 Attribute data specifications

Attribute data for each parcel is attached in the text layer. The parcel number and parcel land use are the two main attributes that are linked to the village polygons. Parcel number is the primary key for linking of RoR details.

4. Layout and printing hard copy for evaluation

4.1 Hard copy color output would be generated using the template decided upon by the State/UT concerned for the purpose, as described above. The first draft hard copy is generated at the original scale of input map for each sheet. Good quality paper is used for printing the digitized map. The color scheme and paper thickness should be according to the standards specified for printing and is to be decided by the State/UT.

4.2 The officers from the concerned department dealing with land records/maps should carry out 100% validation of the hard copy color output (DQC-5). The output will be validated completely for physical dimensions, parcel size, shape, numbering,

feature location and coding, annotation, etc. The corrections are marked on the output and are to be incorporated in the digitized digital data.

4.2.1 Quality check guidelines on hardcopy output by Land Revenue Department

Input:

- Plotter output at A0 size generates at the true scale
- A4 size output depicting zero fills and duplicate labels

Process:

The quality check is carried out on total population (100% data) and there is no sampling involved in this quality check.

- Check for the color scheme in the hardcopy output with reference to the template designed for this project
- Check for content, size and color of the various elements of the map
- Check for the logo details:
    - Group number
    - Village number
    - Bandobust number
    - Village name
    - Halka number
    - Halka name
    - Revenue Inspector (RI) circle name
    - RI circle number
    - Tehsil name
    - District name
    - Year
    - Scale
    - Sheet number
- Check for legend details
- Check for title disclaimer details
    - Project name
    - Map title
    - Generated for ____
    - Generated by _____
- Check for sheet index
- Check for north arrow

- Check for the dimensions of the grid cells and the map with reference to the original map used for digitization
- Check for feature matching
    - parcel boundaries
    - parcel number
    - parcel attributes – zero fills, duplicate labels
    - part parcels, combined parcels, etc.
- The features to be checked are:
    - Permanent parcel boundaries, temporary parcel boundaries, paddy bund boundaries, village boundaries, etc.
    - Drainage and water body details
    - Road network, rail network, cross drainage details, etc.
    - Vegetation details, etc.
    - Traverse lines and points details
    - Forest boundary details
    - Historical, religious places, etc.
    - Amenities details
    - Settlement locations, etc.
- After validation by the LRD, check for the signature of the validation officer from LRD for authenticating the quality check
- Check for the list of all parcel numbers provided on A4 size with reference to the details available from the LRD

4.2.2 Incorporation of the corrections suggested by the LRD

The draft hard copy color output, checked and corrected in all aspects by the Land Records Department is compared with the digital data. The corrections suggested by the LRD are incorporated in to-to. Special checks have to be preformed to certify the incorporation of the error-corrections. After the correction of each sheet, the sheets pertaining to each village is mosaiced.

5. Sheet mosaicing of a village

Village-level mosaicing is done by joining the individual map sheets of the village to form a complete village map. Edge matching is done by bringing two different map sheets of the same village into the same file and matching their edges with reference to the grid and the features on the maps. Continuity should be maintained for all the features at the edges and its attributes. Care is taken to eliminate all dangles

(undershoot/overshoot) and label errors. On-screen checking is done to check the common edge between the mosaicing maps. One has to ensure the completeness of the polygon features such as parcels, continuity in line features such as rivers, roads, etc. Duplicate features along the edge, especially symbols have to be removed. Finally, topologically correct features for the entire village have to be generated and quality checked. The DQC-6 quality check procedure is for ascertaining the feature continuity and attribute carry forward.

6. Conversion of the digitized data into topologically correct GIS data format

6.1 After mosaicing, the digital data is converted into topologically-corrected GIS data features. The GIS data will have separate point, line, polygon and annotation features. The strength of the GIS features is the establishment of the spatial relationships within and between the various features with respect to position, containment, contiguity, proximity, adjacent and intersection. After establishing the topology, the attribute data in the standard structure should be filled up. The unique primary key and the foreign key are generated. The completeness and accuracy of the attributes are checked by both display and automatic S/W method.

6.2 Null and duplicate attributes' lists are generated, both as text file and spatial data outputs. This forms part of the DQC-7 procedure. The error report is again evaluated and checked. Wherever possible, corrections are incorporated, or else tagged with appropriate error codes. The data, at this stage, is ready for the further process of overlaying on the satellite data and query.

7. Final deliverables (hard copy print and GIS data for geo-coding)

The final hard copy print is taken on a paper of specified thickness (preferably 150 GSM of A1 size) of the actual sheet size for archival. The GIS data in prescribed format has to be stored in the central data warehouse and used for further processing of linking with the RoR data.

8. Metadata preparation

8.1 The system and procedures of database generation should evolve a strong metadata, for which the metadata standard has to be designed. The objectives of the standard are to provide a common set of terminology and definitions for the

documentation of digital geospatial data. The standard establishes the names of data elements and compound elements (groups of data elements) to be used for these purposes, the definitions of these compound elements and data elements, and information about the values that are to be provided for the data elements.

8.2 The major uses of metadata are:

- to maintain an organization's internal investment in geospatial data,
- to provide information about an organization's data holdings to data catalogues, clearinghouses, and brokerages, and
- to provide information needed to process and interpret data to be received through a transfer from an external source.

8.3 The information included in the standard are based on four roles that metadata play:

- Availability -- data needed to determine the sets of data that exist for a geographic location.
- Fitness for use -- data needed to determine if a set of data meets a specific need.
- Access -- data needed to acquire an identified set of data.
- Transfer -- data needed to process and use a set of data.

Finally, developed metadata will store information pertaining to the each cadastral village map layer and tabular data available from all sources. Future metadata should also describe the updation rate, time and history of the land transaction.

9. QUALITY ASSURANCE

9.1 A comprehensive quality control program for ensuring the quality of data has to be followed based on the criteria provided and permissible accuracy. The measure of accuracy derived based on the allowable limits would fall under one of the following heads, viz., physical accuracy and logical accuracy.

9.2 Physical accuracy

In any data conversion, some amount of variations would creep into the data sets depending on the type of digitization procedures followed and the subsequent projection and transformation methods followed. Following tests would be made to ensure that all the features in a dataset are within the permissible limits:

Point features

- Location of a feature with reference to a standard layer would be the same or within the prescribed limits.
- A feature carries the same information after migration.

Line features

- Variation in length of a line segment selected based on an attribute or combination of attributes.

Polygon features

- Variation in the number of lines that makes the polygon, their length (perimeter) and subsequently amounting to area.

9.3 Logical accuracy

This accuracy corresponds to completeness and correctness of data when a data set is analyzed. Following tests would be performed to ensure the logical accuracy of the data sets:

An attribute query run on the datasets should give a consistent result in terms of

- Number of features selected;
- The content of the features selected.

Any data set resulting out of analysis of two or more datasets should be logical.

Any spatial query run on the datasets should give the same result in terms of

- Number of features selected;
- The content of the features selected.

10. DATABASE DESIGN & STANDARDS

10.1 A data design provides a comprehensive architecture for the database to be viewed in it's entirely and evaluated as to how the various aspects of it need to interact. A good design results in a well constructed, functionally- and operationally-efficient database that –

- Satisfies the objectives and supports requirements.
- Contains only required data without redundancy.
- Organizes data so that different users access the same data.
- Accommodates different versions of the data (i.e., allows manipulation and updates).
- Distinguishes applications that maintain data from those that use it.
- Appropriately represents codes and organizes geographical features and their relationships (topology).
- Support interoperability.

10.2 Database standards are an important element of the database design. Standards enable applications and technology to work together, they encourage efficiency and effectiveness, help reduce costs, protect investments in data against technological change, and lead to availability of accurate, compete and current data. Tools, applications and data affect each other, and the standards are established with this condition.

10.3 Database construction guidelines

The digital database prepared under the NLRMP should form the base of any further activities, viz., revenue data management (RoR), spatial data management (geo-database), development and updation of land records, etc. Strong database standards, supported with the link to survey/resurvey procedures and future operational and maintenance procedures, are a must. This helps in backward and forward integration of the existing database with the ever-changing database management technology. Broadly, the database construction guidelines can be divided into four major categories under the present scope of digitization of cadastral maps, overlay on the satellite data and integration with textual data:

1. Satellite image database preparation.
2. Digitization (analog to digital conversion) of cadastral village maps.
3. Geo-referencing of digitized GIS data with satellite image data.
4. Metadata generation and achieving of the database for transactional use.

10.4 Procedures for building the database

10.4.1 The elements of the database are to be created as per the standards herein and the vendors/agency/service provider has to take care that digitization is as per the standards. The inputs are subject to validation at each stage and will include qualitative as well as quantitative checks for input and output accuracy.

10.4.2 The creation of a clean digital database (topologically-corrected and geo-coded) is the most important and complex task upon which the usefulness of the database lies. Two aspects need to be considered here: one is the geographic data necessary to define where the parcel of land or, for that matter, any other feature is located, and second is its unique identification for associating attributes that link to the records. At every stage, there should be necessary and proper data verification to

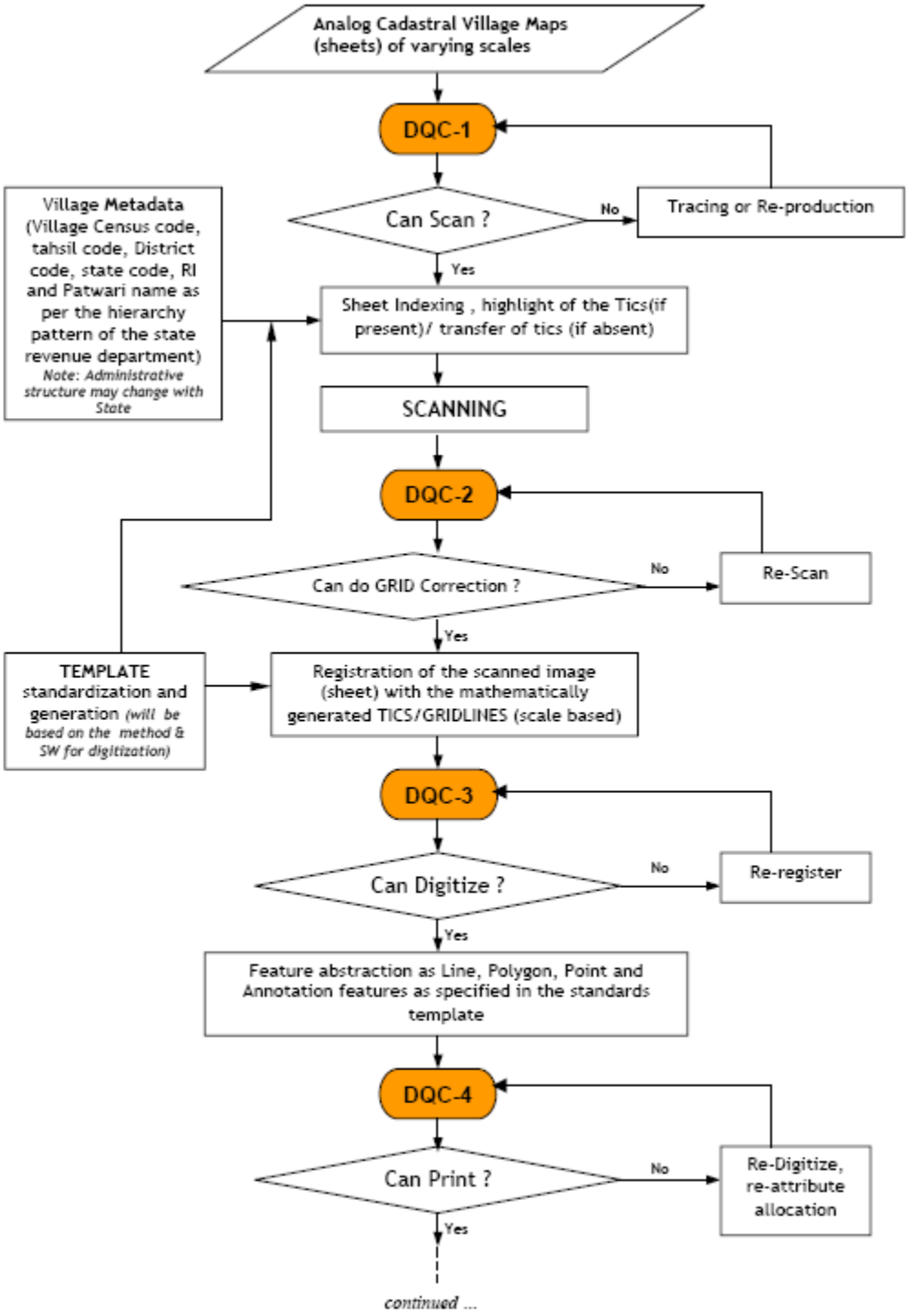
ensure that the resultant database is as free as possible from error. Errors would generally be of the following types:

- Spatial data are incomplete or double.
- Spatial data are in the wrong place.
- Spatial data are at the wrong scale.
- Spatial data are distorted.
- Spatial data are linked to wrong attributes.
- Non-spatial data are incomplete.

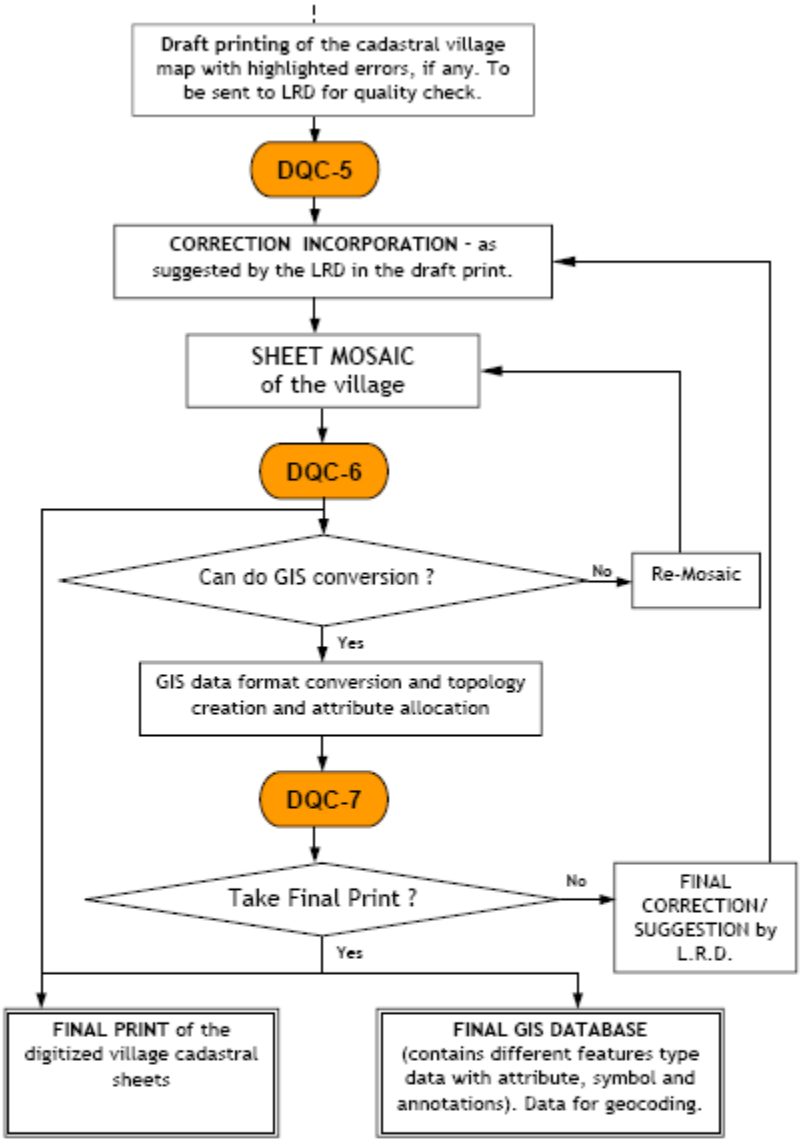
10.4.3 For evaluating the digital data, the following guidelines/parameters would be followed:

1. Assuring that appropriate digitization methods with proper template, accuracy, precision and quality check procedures are followed.
2. Verification of the co-ordinate system (in CAD); projection and datum (in geo-database).
3. Checks for digitization errors like silvers, dangles, and topology rules.
4. Attribute verification providing the correctness of feature coding by listing it out and comparing with the manuscript maps. Randomly checking a few parcels for shape and form listing of polygons with null and duplicate attributes.
5. Verification of edge-match with adjacent sheets and villages by displaying them side by side.
6. Comparison of the total area of the village by aggregating the parcels, etc. vis-à-vis the area reported in census handbooks or available with the Land Records Department in the RoRs.
7. Verification of geo-referenced control points (GCPs) and RMS (Root Mean Square) error for the transformation model.
8. Checks for mosaicing of maps and overlay on the satellite data.
9. Attachment of appropriate metadata at all stages of the database preparation.

Flow chart of the Digitization process in NLRMP



Flow chart of the Digitization process in NLRMP



Digitization Quality Check (DQC 1 to 7) :

DQC-1 : Visual quality check of the analog sheets for visibility, readability, folds/straightness and scan worthy.
DQC-2 : Checking of the digital scanned sheets for DPI, format, quality, speckle removal, scan lines dropout, feature clarity and GRID correction worthy.
DQC-3 : Final checking of the GRID corrected scanned image with overlaid mathematical grid (scale dependent) and approval for the final feature abstraction.
DQC-4 : Quality assurance of the features abstracted from the sheet for its type, location and attribute. Also checking has been done for the unread attributes, features, null attribute and duplicate errors, if any.
DQC-5 : Detail quality checking of the digitized sheet be the Land Record Department (LRD) with detail error reporting and suggestion, if any.
DQC-6 : Checking for the feature continuity and attribute carry forward or loss of features of attribute during the mosaic process.
DQC-7 : Checking for the topologically corrected GIS feature conversion, its attribute allocation, duplicate IDs and Null IDs.

Digitization of FMB/Tippans

1. In the States where ladder data is the basic records, the same is fed into the computer to generate tippan. The tippans are mosaiced to generate village maps.

2. Field Measurement Book (FMB)

FMB is a sketch showing measurement boundaries of the survey number. It is a rough sketch and not to scale. It provides a record of measurement and boundaries. Field Measurement Book contains several field measurement sheets covering measurements of all lands in a village. In some cases it is drawn to a scale of 1:1000 or 1:2000 showing all field and subdivision boundaries and their measurements. It is also called the atlas of field maps. A record of measurement of individual fields and subdivisions is thus provided, which will enable any inspecting officer to identify the boundaries, and whatever is required for investigation of boundary disputes, detection of encroachments, and for the measurement of further sub-divisions, etc.

2.1 Various components of the Field Measurement Book are discussed below:

2.1.1 *G-line*

This is an imaginary line (Guess Line) which converts the map into various sizes of triangles in order to accurately fix the boundary lines and the various points in the map. This line is the foundation on which the entire map is built. Any error in a G-line will affect all calculations based on that G-line.

2.1.2 *F-line*

It is the outer boundary line in a sketch, which signifies the actual field boundaries of the outer lines of the sketch. The F-line points are fixed with reference to its offset distance from the G-line.

2.1.3 *Subdivision lines*

These lines demarcate a small parcel of land within a survey number. A sub-divisional polygon's extent is directly correlated to the extent found for the particular sub division. The sub-division lines are generally defined through a ladder, except for the graphical representation in the FMB.

2.1.4 *Ladder*

As mentioned earlier, the field line points are defined with reference to an offset distance from the G-line. The offset distance may be to the left or right side of the G-line. This left or right angle deviation (offset) is depicted by the ladder. By converting the ladder details into electronic data, once can produce the outline of the FMB

sketch. The ladder details get attracted whenever there is a change in the field line, involving a bend.

2.1.5 *Extension lines*

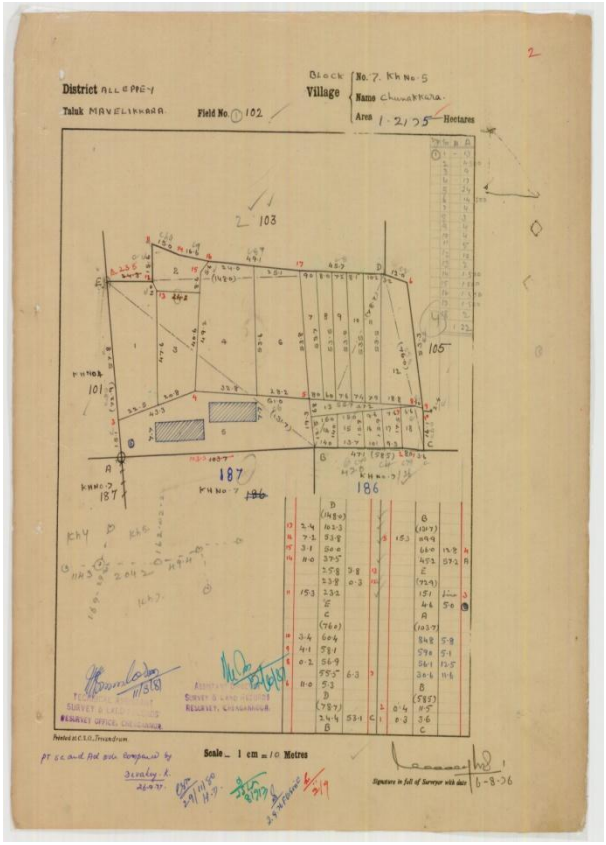
Each survey number field is an integral part of the village map and hence other fields surround each sketch. The exact direction in which the subject field joins the neighboring field is shown on the FMB as an extension line.

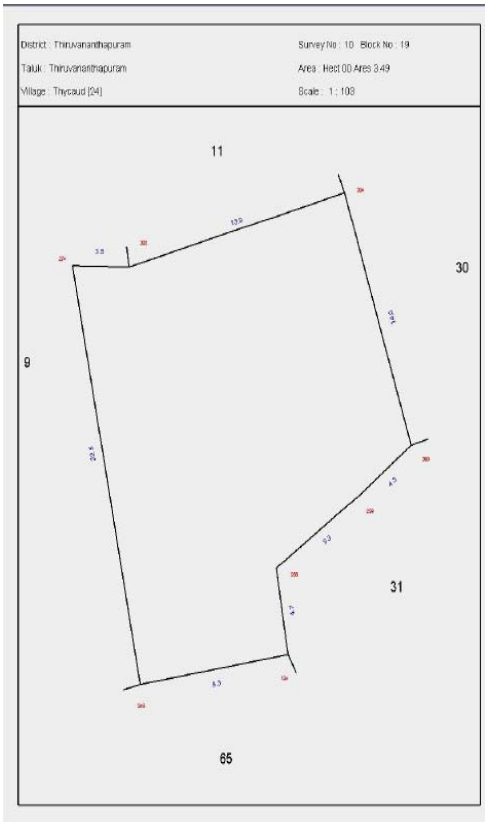
2.1.6 *Neighboring field survey numbers*

As mentioned earlier, each survey sketch is surrounded by other fields. These surrounding field numbers are marked around each FMB. This enables mosaicing of FMBs into D-sketches and village maps and so on.

3. In FMB, the traverse coordinates are provided in five columns. The FMBs also depict the dimensions of each field boundaries and the sub-divisions. As mentioned earlier, the field line points are defined with reference to an offset distance from the G-line. The offset distance may be to the left or right side of the G-line. This left or right angle deviation (offset) is depicted by Ladder. By converting the ladder details into electronic data, once can produce the outline of the FMB sketch. The ladder details get attracted whenever there is a change in the field line, involving a bent.

4. At present, Field Measurement Books are drawn and maintained manually. Digitisation of Field Measurement Books will result in faster processing of the FMB sketches including creation of new sub-divisions, modification of existing sketches, portability of data, facility to draw the FMB sketches to different scales leading to higher clarity, and quicker delivery of copies of FMBs to land-owners.


District ALLEPPEY
Taluk MAVELIKKARA
Field No. 102
Block No. 7, KK No. 5
Village
Name Chunakkara
Area 1.2135 Hectares
Scale _ 1 cm = 10 Metres


District : Thiruvananthapuram
Survey No : 10 Block No : 19
Taluk : Thiruvananthapuram
Area : Hect 00 Ares 3.49
Village : Thycaud [24]
Scale : 1 : 100
11
30
9
31
65

Chapter-2
(A) Survey/Re-survey
Model-I
Pure Ground Method using TS and DGPS

1. Methodology: This model should be adopted for survey/re-survey of the areas for which the ortho-photos from aerial photography or high-resolution satellite imagery (HRSI) are not available, or it is decided to carry out the survey work using TS+DGPS and without going for aerial photography or HRSI. The technical details are also applicable to ground truthing in the hybrid methodology involving aerial photography or HRSI. The major steps involved will be:

1.1 Notifications, survey plan and publicity

a) Publication of notifications under the relevant rules of the State Government/UT Administration in the State/UT and District Gazettes by the Department concerned with the survey and settlement work.

b) Opening of a publicity cell at the district level, which will generate awareness among the owner(s)/enjoyer(s) in the area notified for survey, emphasizing the need for them to be present at the time of visit of the survey team, and to show the boundaries of their land parcels and participate in the survey and settlement process. The establishment of the publicity cell shall be the responsibility of the Department concerned with the survey and settlement work.

c) Preparation of a detailed schedule, tehsil/taluk-wise, of the visit of the survey team to each village, and to publish them at the district, tehsil/taluk and village levels. The program should be given wide publicity. The detailed schedule should be prepared by the survey agency, and, where the agency is outsourced, approved by the Department concerned with the survey and settlement work.

d) Circulating the detailed schedule of the visits of the survey team among the heads of the land-owning departments, so that the officials from those departments help the survey agency in the identification of the boundaries of the land parcels owned by their departments.

e) Publication of the village-level survey-plans, showing details of the day-wise program of survey in the concerned tehsil/taluk/village, at least 10 days before commencement of field survey. The revenue village should be taken as a unit for survey.

1.2 Preparations for the survey work using TS+DGPS

a) There should be adequate number of survey teams and adequate number of adjudicating teams to complete the work as per the schedule.

b) Each survey team should have at least one TS operator, one plane-tabler and four support staff.

c) Each survey team should have adequate number of field workers and supervisory staff conversant with the local language.

d) The adjudication team shall consist of the survey adjudicator, who will invariably be a Government official, assisted by one surveyor and one TS operator. Where the work is outsourced, the vendor will provide the TS operator along with a TS.

e) A well-equipped survey centre shall be established in each village by the survey agency. Where the work is outsourced, the State Government/UT Administration may decide upon sharing of the expenses between the government and the vendor.

f) A Gram Sabha meeting should preferably be called, to which the concerned local officials should be invited, and the entire action plan (including the day-wise survey schedule) should be discussed before commencing the survey work to facilitate further cooperation for the survey exercise.

g) Two tertiary control points and one auxiliary control point should be established with the help of the DGPS by extending the primary/secondary control network, before the commencement of ground truthing.

h) The tertiary and auxiliary control points should be plotted on a blank plane-table (PT) section on 1:2000 scale, on which the Universal Traverse Mercator (UTM) grids (X,Y) have been drawn.

1.3 Participatory ground truthing

(a) The field work shall commence as per the schedule published.

(b) Delineation of parcel boundaries shall be carried out using TS and plane-tabling, as indicated below:

i) The surveyor with TS will start the work from a tertiary control point, using the auxiliary control point for back sighting. The vertices/corner points of the land parcel will be surveyed as offsets from various traverse stations. The traverse will finally be closed on the second tertiary point for checking the accuracy of the traverse. The systematic errors in the traverse will be distributed for computing the final co-ordinates of vertices/corners of the land parcel. The work will be carried out with reference to the existing land records and as per the procedure laid down in the relevant Revenue manual, in the presence of the concerned owner(s)/enjoyer(s) and the owner(s)enjoyer(s) of the adjacent land parcels.

ii) The land parcel boundary, as surveyed using the TS, will be plotted on the PT

section in the field itself. For this purpose, the plane-tabler will position himself/herself close to the TS, so as to enable plotting of the parcel boundaries simultaneously.

iii) Wherever there is reserved forest or land transferred to the Forest Department, or Government/community land is involved, the concerned officials should be involved in identifying the relevant parcel boundaries.

iv) The survey team should take care that the ridges which are not actually boundaries of the parcels, are not taken into account for delineation of the parcel boundaries.

v) In cases where collective cultivation is done, or where boundaries are not demarcated, the parcel boundaries should be recorded only after their demarcation on the ground has been carried out with reference to the existing land records and as per the procedure laid down in the relevant revenue manual, in the presence of the concerned owner(s)/enjoyer(s).

vi) Each land parcel should be identified by its owner(s)/enjoyer(s) and should be given a unique ID which shall be used for linking the attributes data collected in respect of the land parcel.

vii) The land owner(s)/enjoyer(s), who intend to affix stones at their field junctions, may be shown the points where stones can be affixed.

viii) The current land use, irrigation status and other land attributes data shall also be collected by the survey team. All such information should also be incorporated on the PT and its auxiliary records.

1.4 Survey of Government/community lands

(a) The village-wise list of Government/community lands with area and the list of private lands adjoining those lands shall be prepared by the survey agency. The Government/community lands shall be surveyed first, preferably in the presence of officials from the concerned departments/PRI representatives, who should bring necessary records with them, and the owner(s)/enjoyer(s) of the adjoining parcels.

(b) The land parcel maps pertaining to the Government/community land parcels should be handed over to the concerned officials, who shall record objections, if any.

(c) Details of the land parcels should be recorded in the prescribed formats.

1.5 Acknowledgement, responsibilities and quality control

After surveying the parcel boundaries and plotting them on the plane-table sections, the authorized representative of the survey team shall affix his/her signature and seal

on the spatial record so created, and, thereafter, shall proceed to obtain the signatures of the owner(s)/enjoyer(s) and also those of the concerned Revenue official(s), in case the survey work is outsourced, certifying that the survey has been carried out in their presence and to the satisfaction of the owner(s)/enjoyer(s). Information containing the details of the surveyors, who have carried out the survey, should also be recorded. 100% verification and validation shall be carried out, by the Department concerned with the survey and settlement work, for quality control, against each field PT section.

1.6 Digital topographic database (DTDB) and final plotting

The boundaries of parcels surveyed shall be downloaded from the TS and linked with the attributes data collected, in the GIS format so as to create the DTDB. The final plotting and softcopy DTDB of the land parcels and other topographic details shall be generated from the TS data and associated software by the survey agency.

2. Preparation and distribution of draft land parcel maps (LPMs) and linking attributes

(a) The draft LPM should be prepared for each land parcel, in duplicate. The draft LPM shall be given to the concerned owner(s)/enjoyer(s) preferably by the same evening, or latest by the next morning, for receiving objections, if any.

(b) The draft LPM shall contain:

i) The LPM sketch at a suitable scale to fit to an A4 size paper. The scale should be rounded off to the next scale of 50 (e.g., if the scale is coming to 1:446, then it should be fitted to a scale of 1:450; in case the scale is coming as 1:421, then it should be fitted to a scale of 1:450; and in case the scale required to fit in the paper is 1:496, then it should be fitted to a scale of 1:500).

ii) The actual dimensions of the parcel and details of the adjoining survey numbers should be indicated on the sketch.

iii) The attributes of the land parcel should also be printed in a tabular form, at the back of the sketch.

3. Recording objections

A register shall be maintained by the survey agency to record and track the objections raised by the owner(s)/enjoyer(s). The objections should also be flagged in the DTDB for better control and monitoring.

4. Objections redressal/adjudication

(a) Individual notices in the prescribed format, as per the provisions of the applicable revenue manual, shall be given to all recorded owner(s)/enjoyer(s) with a copy of the land parcel map and measurement details, marked on the same notice. The notices shall be served, either personally, or sent by registered post with acknowledgement due, if the land owner(s)/enjoyer(s) live outside the concerned area. On the expiry of the stipulated period, if any objection is raised by the owner(s)/enjoyer(s), it shall be recorded in the Objections Register.

(b) The survey team shall assist the Government officers in resolving the objections. The survey team will resurvey the field of the owner(s)/enjoyer(s), if required and incorporate the necessary changes and generate the revised LPM.
(c) The survey team shall maintain the Objections Register. The objections shall also be tracked in the DTDB in GIS form.

5. Survey completion report

After completion of the survey, the survey team shall submit the completion report to the Department concerned with the survey and settlement work.

6. Promulgation of survey

(a) Subsequently, the draft record of land register, village map, and individual parcel maps of agricultural and non-agricultural lands would be displayed for the stipulated period in the office of the Gram Panchayat and tehsil/taluk for the information of the public.
(b) A record of the complaints received during the above-mentioned period, should be maintained, and each complaint received should be acknowledged by a receipt.
(c) The complaints received shall be verified and necessary corrections, if warranted, shall be carried out. The survey agency shall carry out the resurvey of the land parcel, if required.
(d) The adjudication team will take up the objections, village-wise. They should draw up a day-wise program for redressal of the objections and inform the concerned owner(s)/enjoyer(s) within the prescribed timeframe as per the State/UT laws/manuals. They shall dispose of all objections as per the relevant Acts/rules.
(e) As soon as the disposal of objections is completed, a final notification under the relevant Acts/rules/regulations will be published as per the prescribed procedure, completing the process of survey.
(f) The land parcel register will be updated by the survey agency as per the information received from the adjudication team, after the latter has redressed the

objections.

7. Importance of quality check

Since these survey records will form the basis of the conclusive titling system, they must be prepared with utmost care and accuracy. Hence, the Department concerned with survey and settlement will be responsible for ensuring 100% quality check at each stage of the preparation of the survey records and the responsibilities for this checking must be clearly spelt out among the Departmental officials. The patwari shall carry out 100% checking, and the Revenue Inspector, tehsildar or an officer of the equivalent rank, the SDO and the Deputy Commissioner/District Collector should randomly check 50%, 10%, 3% and 1%, respectively, or as stipulated in the State/UT laws/manuals. A strict view should be taken where too many errors are found un-checked in the survey records.

Model-II

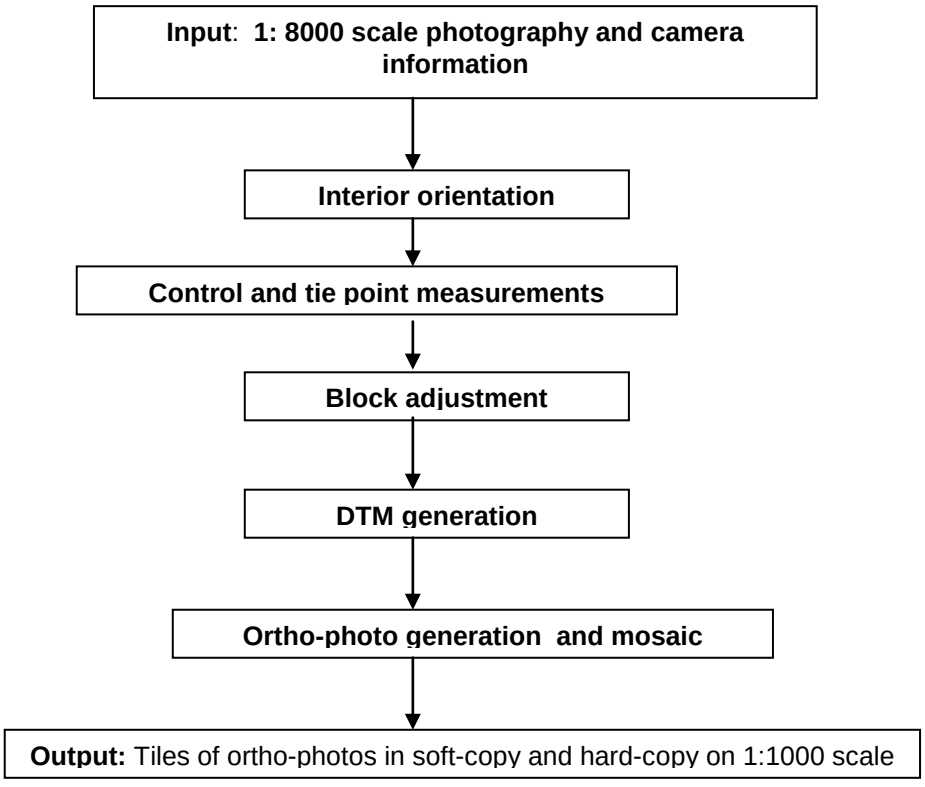
Hybrid Survey Methodology using Aerial Photography and Ground Truthing using DGPS/TS

(Based on the system followed in Gujarat)

1. Survey methodology

1.1 The major steps involved in cadastral survey using aerial photography and ground truthing by TS/DGPS are:

1.1.1 Generation of ortho-photos, i.e., terrain-corrected digitally-rectified aerial photographs in softcopy and hardcopy (bromide/coated paper prints) by digital photogrammetric techniques by the technical agency/vendor designated for the purpose by the State Government/UT Administration. The following flow chart indicates the technical process involved:



1.1.2 Notifications, survey plan and publicity

a) Publication of notifications under the relevant rules of the State Government/UT Administration in the State/UT and District Gazettes by the Department concerned with the survey and settlement work.

b) Opening of a publicity cell at the district level, which will generate awareness among the owner(s)/enjoyer(s) in the area notified for survey, emphasizing the need

for them to be present at the time of visit of the survey team, and to show the boundaries of their land parcels and participate in the survey and settlement process. The establishment of the publicity cell shall be the responsibility of the Department concerned with the survey and settlement work.

c) Preparation of a detailed schedule, tehsil/taluk-wise, of the visit of the survey team to each village, and to publish them at the district, tehsil/taluk and village levels. The program should be given wide publicity. The detailed schedule will be prepared by the survey agency, and, where the agency is outsourced, approved by the Department concerned with the survey and settlement work.

d) Circulating the detailed schedule of the visits of the survey team among the heads of the land-owning departments, so that the officials from those departments help the survey agency in the identification of the boundaries of the land parcels owned by their departments.

e) Publication of the village-level survey plans, showing details of the day-wise program of survey in the concerned tehsil/taluk/village, at least 10 days before commencement of field survey. The revenue village should be taken as the unit for survey.

1.1.3 Preparations for ground truthing

a) There should be adequate number of survey teams and adequate number of adjudicating teams to complete the work as per the schedule.

b) Each survey team should have at least one TS operator and two support staff.

c) Each survey team should have adequate number of field workers and supervisory staff conversant with the local language.

d) The adjudication team shall consist of the survey adjudicator, who will invariably be a Government official, assisted by one surveyor and one TS operator. Where the work is outsourced, the vendor will provide the TS operator along with a TS.

e) A well-equipped survey centre shall be established in each village by the survey agency. Where the work is outsourced, the State Government/UT Administration may decide upon sharing of the expenses between the Government and the vendor.

f) All tiles of ortho-photos (on bromide/coated paper prints) covering a village shall be handed over to the village-level survey team well before the commencement of field work.

g) Before the commencement of survey in the village, quality checking of the ortho-photo images shall be carried out for clarity of details in the bromide/coated paper prints. A report shall be submitted by the survey team regarding the suitability/unsuitability of the print for ground truthing. If the print is of poor quality or

of poor brightness/contrast, or if there is any problem relating to plotting, a fresh print will be taken out.

h) A Gram Sabha meeting should preferably be called, to which the concerned local officials should be invited, and the entire action plan (including the day-wise survey schedule) should be discussed before commencing the survey work to facilitate further cooperation for the survey exercise.

1.1.4 Participatory ground truthing of land parcels

a) The field work shall commence as per the schedule published.

b) The field team shall mark boundaries of the land parcels on the bromide/coated paper prints, as shown by the concerned owner(s)/enjoyer(s) in the presence of the owner(s)/enjoyer(s) of the adjacent land parcels.

c) After identifying boundaries in the presence of the owner(s)/enjoyer(s) and marking them in the bromide/coated paper prints, the survey team should obtain an acknowledgement from the owner(s)/enjoyer(s)/concerned officials that the boundaries and details of the land parcel are recorded in their presence and to their satisfaction. The details of the surveyors, who have carried out the survey, should also be recorded.

d) In case the parcel limits are obscured in the ortho-photo, or the ortho-photo is not available, parcel boundaries, as shown by the concerned owner(s)/enjoyer(s) in the presence of the owner(s)/enjoyer(s) of the adjacent land parcels, shall be surveyed using TS/DGPS. In such cases, the survey agency shall generate the land parcel map based on their TS readings and obtain acknowledgement of each plot/parcel from the owner(s)/enjoyer(s).

e) The tertiary control point should be used as the reference station for DGPS. The tertiary control point and auxiliary point should be used for TS survey. The plot boundaries can also be surveyed using the offsets from the details appearing on the ortho-photo, in which case, tertiary control and auxiliary points will not be needed.

f) The survey team should take care that the ridges, which are not actually boundaries of the parcels, are not taken into account for delineation of the parcel boundaries.

g) In cases where collective cultivation is done, or where boundaries are not demarcated, the parcel boundaries should be recorded only after their demarcation on the ground has been carried out with reference to the existing land records and as per the procedure laid down in the relevant Revenue manual, in the presence of the concerned owner(s)/enjoyer(s).

h) Each land parcel should be identified by its owner(s)/enjoyer(s) and should be

given a unique ID, which shall be used for linking the attributes data collected in respect of the land parcel.

i) The land owner(s)/enjoyer(s), who intend to affix stones at their field junctions, may be shown the points where stones can be affixed.

j) The current land use, irrigation status and other land attributes data shall also be collected by the survey team as per the Data Model Structure (DMS).

1.2 Survey of Government/community lands

a) The village-wise list of Government/community lands with area and the list of private lands adjoining those lands shall be prepared by the survey agency. The Government/community land shall be surveyed first, preferably in the presence of officials from the concerned Departments/PRI representatives, who should bring necessary records with them and the owner(s)/enjoyer(s) of the adjoining parcels.

b) The land parcel map pertaining to the Government/community land parcels should be handed over to concerned officials, who shall record objections, if any.

c) Details of land parcels should be recorded in the prescribed formats.

1.3 Acknowledgement, responsibilities and quality control

After surveying the parcel boundaries, the authorized representative of the survey team shall affix his/her signature and seal on the spatial record so created, and, thereafter, shall proceed to obtain the signatures of the owner(s)/enjoyer(s) and also those of the concerned Revenue official(s), in case the survey work is outsourced, certifying that the survey has been carried out in their presence and to the satisfaction of the owner(s)/enjoyer(s). Information containing the details of the surveyors, who have carried out the survey, should also be recorded. 100% verification and validation shall be carried out, by the Department concerned with the survey and settlement work, for quality control.

1.4 Creation of Digital Topographic Database (DTDB)

The boundaries of parcels delineated in the presence of owner(s)/enjoyer(s)/officials should be digitized in GIS format and the attribute information collected in prescribed proforma should be linked as GIS to create the Digital Topographic Database (DTDB).

2. Preparation and distribution of draft land parcel map (LPM) and linking attributes

2.1 The draft LPM should be prepared for each land parcel, in duplicate. The draft LPM shall be given to the concerned owner(s)/enjoyer(s) preferably by the same

evening or latest by the next morning, for receiving objections, if any.

2.2 The draft LPM shall contain:

a) The LPM sketch at a suitable scale to fit to an A4 size paper. The scale should be rounded off to the next scale of 50 (e.g., if the scale is coming to 1:446, then it should be fitted to a scale of 1:450; in case the scale is coming as 1:421, then it should be fitted to a scale of 1:450; and in case the scale required to fit in the paper is 1:496, then it should be fitted to a scale of 1:500).

b) The actual dimensions of the parcel and details of the adjoining survey numbers should be indicated on the sketch.

c) The attributes of the land parcel should also be printed in a tabular form, at the back of the sketch.

3. Recording objections

A register shall be maintained by the survey agency to record and track the objections raised by the owner(s)/enjoyer(s). The objections should also be flagged in the DTDB for better control and monitoring.

4. Objections redressal/adjudication

a) Individual notices in the prescribed format, as per the provisions of the applicable revenue manual, shall be given to all recorded owner(s)/enjoyer(s) with a copy of land parcel map and measurement details, marked on the same notice. The notices shall be served, either personally or sent by registered post with acknowledgement due, if the land owner(s)/enjoyer(s) live outside the concerned area. On the expiry of the stipulated period, if any objection is raised by the owner(s)/enjoyer(s), it shall be recorded in the Objections Register.

b) The survey team shall assist the Government officers in resolving the objections. The survey team will resurvey the field of the owner(s)/enjoyer(s), if required, and incorporate the necessary changes and generate the revised LPM.

c) The survey team shall maintain the Objections Register. The objections shall also be tracked in the DTDB in GIS form.

5. Survey completion report

After completion of the survey, the survey team shall submit the completion report to the Department concerned with the survey and settlement work.

6. Promulgation of survey

a) Subsequently, the draft record of land register, village map, and individual parcel maps of agricultural and non-agricultural lands would be displayed for the stipulated period in the office of the Gram Panchayat and tehsil/taluk for the information of the public.

b) A record of the complaints received during the above-mentioned period, should be maintained, and each complaint received should be acknowledged by a receipt.

c) The complaints received shall be verified and necessary corrections, if warranted, shall be carried out. The survey agency shall carry out the resurvey of the land parcel, if required.

d) The adjudication team will take up the objections, village-wise. They should draw up a day-wise program for redressal of the objections and inform the concerned owner(s)/enjoyer(s) within the prescribed timeframe as per the State/UT laws/manuals. They shall dispose of all objections as per the relevant Acts/rules.

e) As soon as the disposal of objections is completed, a final notification under the relevant Acts/rules/regulations will be published as per the prescribed procedure, completing the process of survey.

f) The land parcel register will be updated by the survey agency as per the information received from the adjudication team, after the latter has redressed the objections.

7. Importance of quality check

Since these survey records will form the basis of the conclusive titling system, they must be prepared with utmost care and accuracy. Hence, the Department concerned with survey and settlement will be responsible for ensuring 100% quality check at each stage of the preparation of the survey records and the responsibilities for this checking must be clearly spelt out among the Departmental officials. The patwari shall carry out 100% checking, and the Revenue Inspector, tehsildar or an officer of the equivalent rank, the SDO and the Deputy Commissioner/District Collector should randomly check 50%, 10%, 3% and 1%, respectively, or as stipulated in the State/UT laws/manuals. A strict view should be taken where too many errors are found un-checked in the survey records.

Model-III

Survey Methodology using Satellite Imagery and Ground Truthing with DGPS and TS

(Based on inputs from the ISRO)

1. The DGPS survey is a very critical element in this methodology. The high-resolution satellite imagery is geo-coded using precise ground control survey. The GPS coordinates for each ground control point (GCP) are collected and processed in a precise manner. The sequence of steps of the DGPS survey is given below:

- Identification of the reference station in the centre of the study area
- GPS data collection, using dual frequency geodetic GPS receivers, for 72 hours
- Determining the reference station coordinates with reference to International Geodetic Survey (IGS) stations
- Identification of GCP locations in the satellite image
- Collection of GPS data at GCP locations for 3 hours
- Determining the GCP coordinates, with reference to the reference station, in DGPS mode
- Quality verification of GCP coordinates

2. Where multiple over-lapping images are taken and control points established, all images can be adjusted for parallax simultaneously. This process is known as Bundle Block Adjustment. Digital photogrammetric bundle block adjustment of multi-resolution and multi-mode satellite data, all together, is carried out in DPS COTS (Digital Photogrammetric Station Commercial Off-the-Shelf) packages:

- Cartosat-1 Stereo-scopic data for entire area
- LISS-IV MX nadir mono-scopic data for entire area
- Cartosat –2/2A nadir mono-scopic data limited area.

The final adjusted block is seamless among Cartosat-1, LISS-IV and Cartosat-2. The photogrammetric processing will ensure perfect one-to-one correspondence between different data sets facilitating optimum utilization of multi-resolution satellite data set.

3. Digital Elevation Model (DEM) Generation: DEM can be generated by semi-automatic techniques to the accuracy required for ortho-rectification. A regular DEM is generated from the point clouds produced by forward intersection via triangulation and interpolation. DEM editing via cloud- and water-masks, etc. is

carried out to generate error-free DEM. CartoSAT-1 stereo products are used to generate DEM.

4. Ortho-Product Generation, i.e., generating an image corrected for terrain- induced distortions for achieving better planimetric accuracy

- Ortho-rectification of Cartosat-1 Aft images for the entire study area
    - Physically separate images, but virtually seamless
- Ortho-rectification of LISS-IV MX images for the entire study area
    - Physically separate images, but virtually seamless
- Ortho-rectification of Cartosat-2/2A images for few areas
    - Physically separate images, but virtually seamless with Cartosat-1 and Linear Imaging Self-Scanner (LISS)-IV images

5. Data Fusion, i.e., synergistic merging of higher resolution black-and-white (panchromatic) data with coarser resolution colour (multi-spectral) data for getting colour-coded images of high resolution

- Fusing of CartoSAT-1 PAN and LISS-IV MX ortho-images to obtain high resolution (2.5m) MX images, individually for the entire area.
- Fusing of Cartosat-2/2A PAN and LISS-IV MX ortho-images to obtain high resolution (1m) MX images, individually for selected dense cadastral area.

6. Quality Verification

- Accuracy of fused ortho-products (1.0 m and 2.5 m) is carried out using GPS-based ground check points.
- Positional accuracy of individual product or image, internal distortions within an image and seamlessness across images (image-to-image) are carried out through checkpoints.
- Only those products which pass through this quality verification should be used.

7. Overlay of Cadastral Maps on High-Resolution Satellite Image (HRSI)

The vectorized cadastral maps are overlaid on high-resolution satellite images to find out the changes in parcel quantity and quality in terms of size and shape. Based on the changes, the areas are identified for re-survey and updation. The procedure is described in Flow Chart 4 and the details are given below:

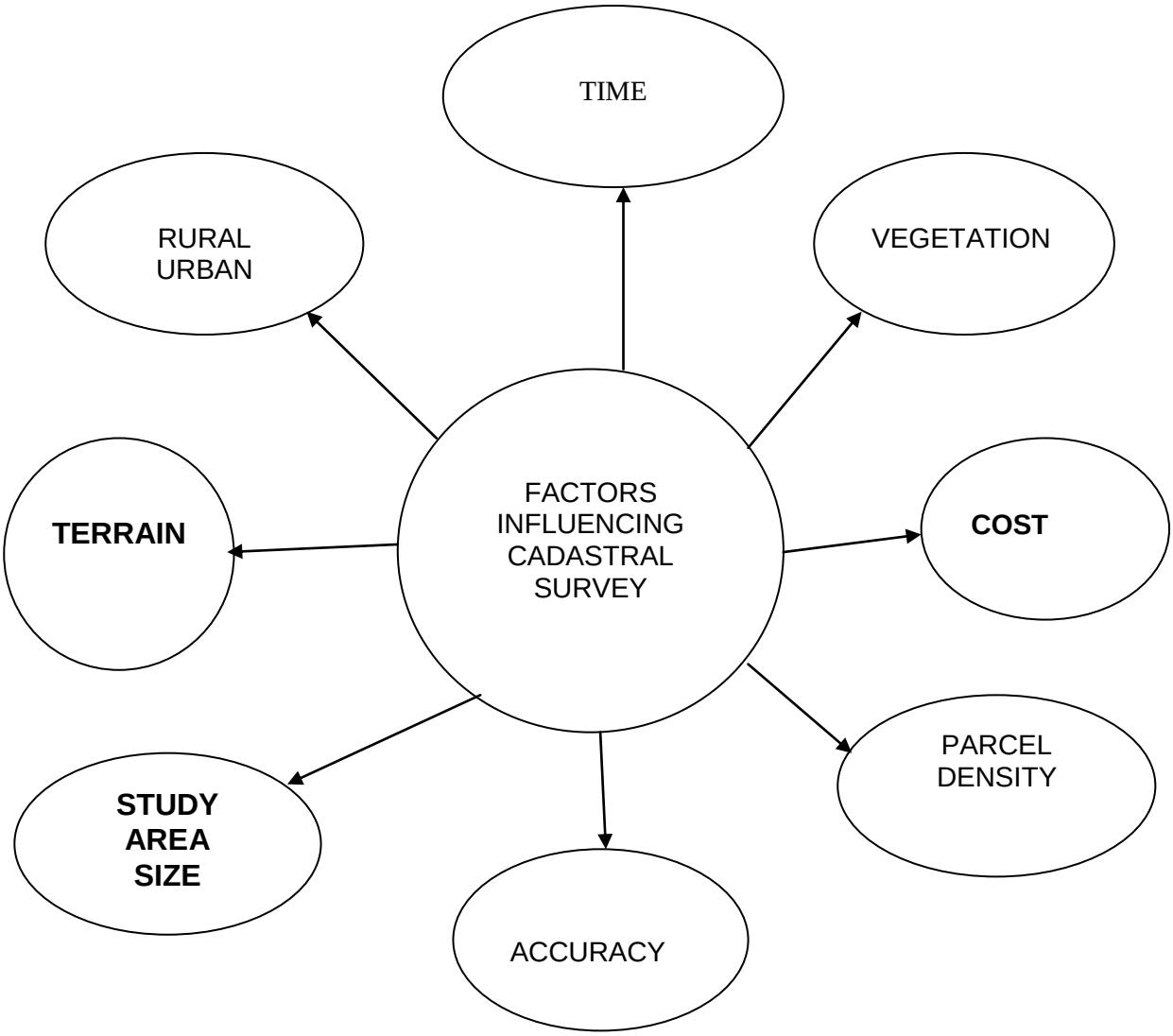
- The high-resolution satellite images are generated from fused ortho-products from CartoSAT-1, CartoSAT-2/2A and LISS-IV MX images.

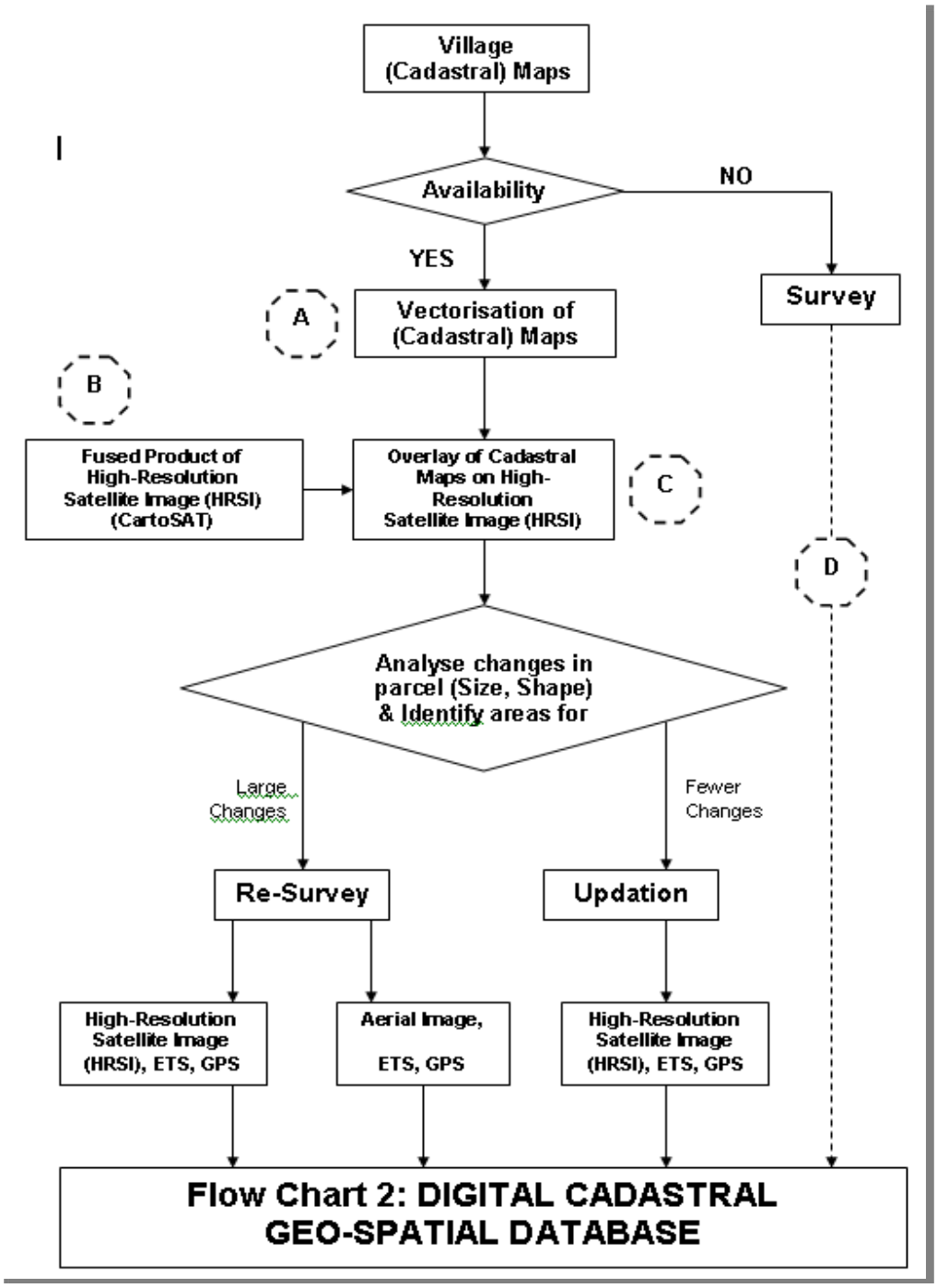
- The analog cadastral maps are vectorized and village-level digital cadastral maps are prepared. Few ground control points are collected using DGPS survey.
- For each village, 15 to 20 GCPs are collected with reference to HRSI. The GCP numbers and their distribution play a major role in overlaying the cadastral maps on HRSI with good accuracy.
- For transferring the cadastral map to the HRSI image, the mathematical model used is the affine transformation model. The model is validated in terms of residual error at each GCP location and root mean square value of the model. In general, the threshold for RMS value and residual error is 1-pixel and 2-pixels respectively.
- Based on the validated model, the village cadastral maps are geo-referenced and new outputs are generated.
- The individual geo-referenced vectors are overlaid on HRSI. The primary network of each village map, i.e., road network, drainage network, water-bodies and *abadi* is verified across the village. Well-defined field boundaries are also validated.
- Using a similar process, all villages in a tehsil/taluk are geo-referenced and validated.
- All the villages in a tehsil/taluk are overlaid on the satellite data and validated for under-lap and over-lap across the villages as per the acceptable threshold defined for the purpose.
- Based on the thresholds, appropriate corrections are carried out.
- After due corrections, a single mosaic of all the village parcels in a given tehsil/taluk is generated.
- This is the final product that is used for identifying the areas for resurvey and updation.

8. Ground Truthing

For ground truthing and other steps in completing the survey and settlement process, the Model-I (Ground Method of survey/resurvey using TS and DGPS) may be referred to.

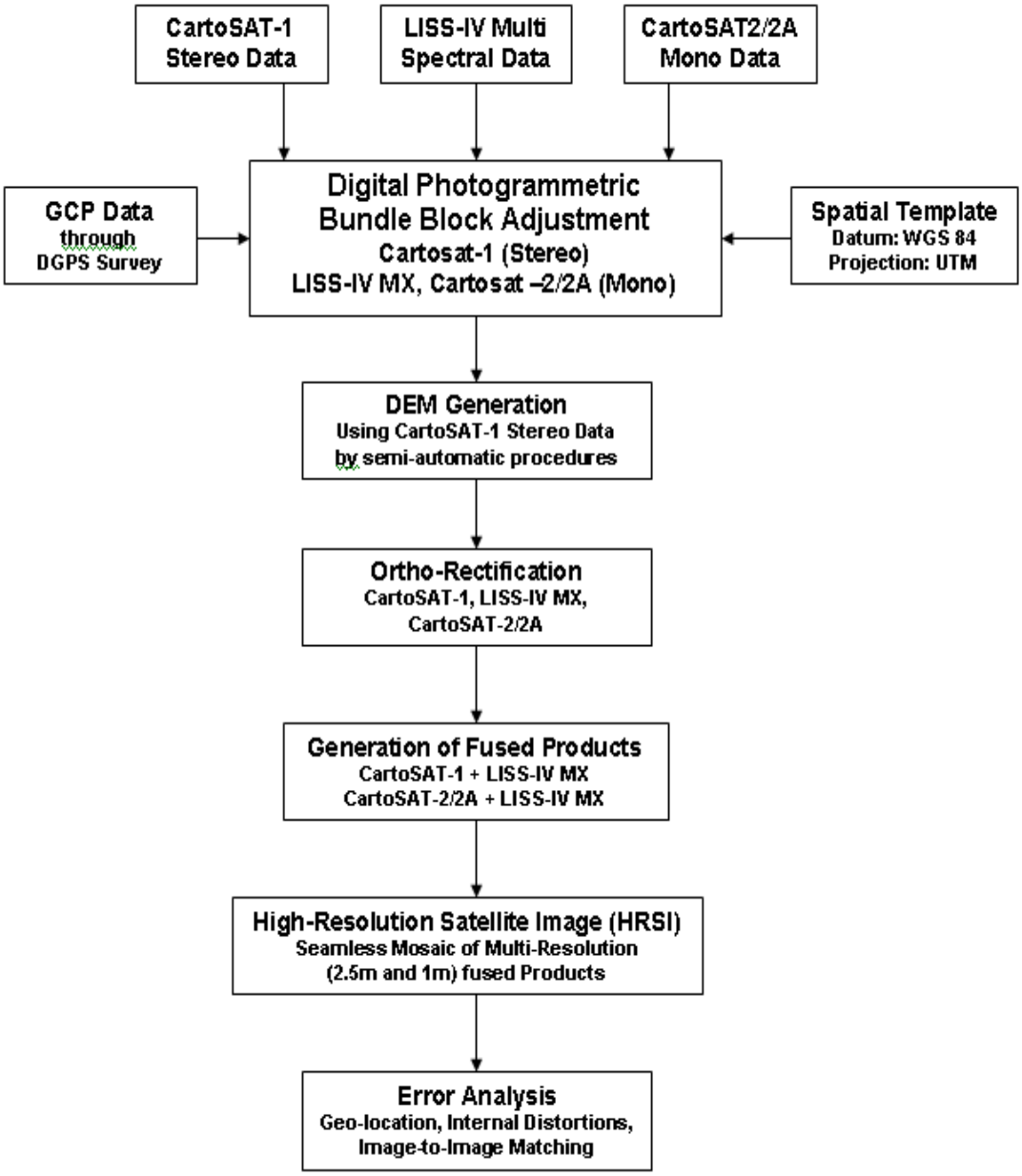
Flow Chart 1: Factors influencing Cadastral Survey



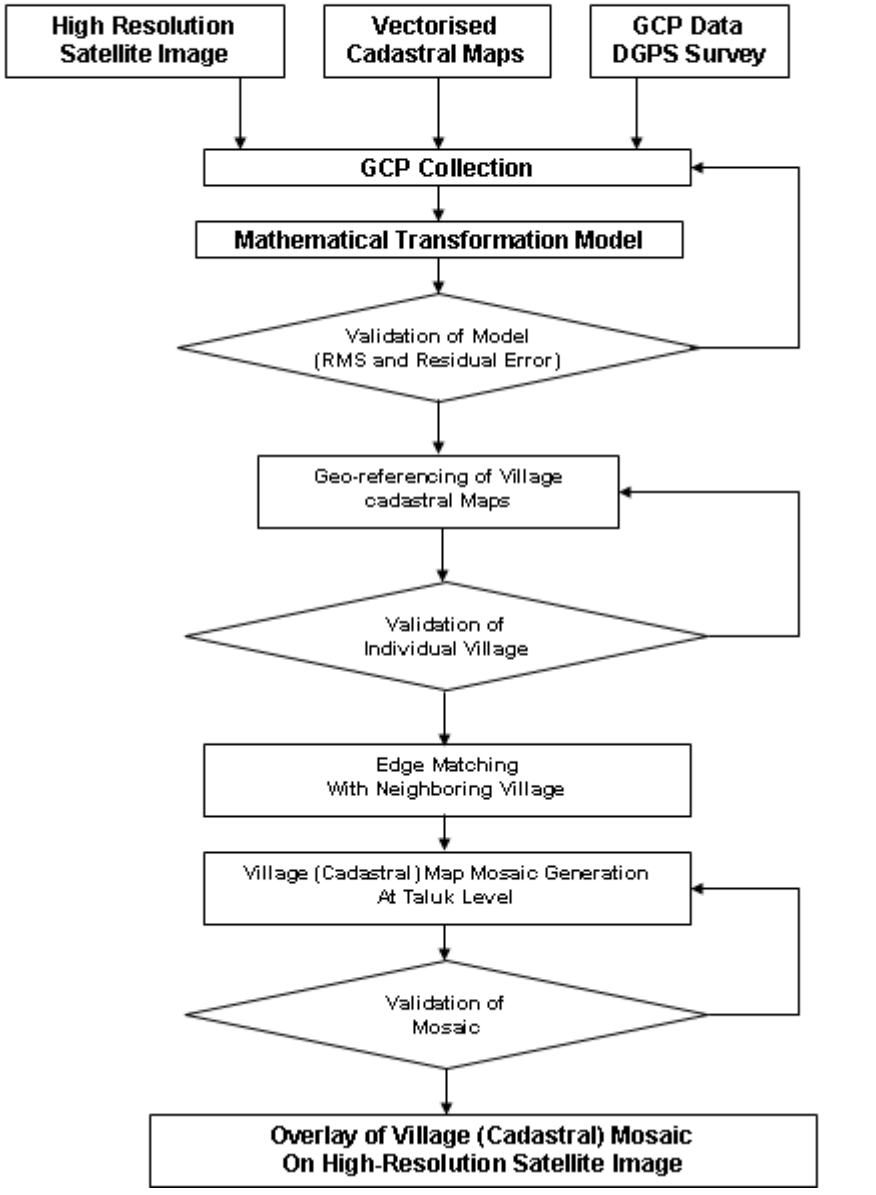


Flow Chart 2: DIGITAL CADASTRAL GEO-SPATIAL DATABASE

Flow Chart 3: High-Resolution Satellite Image (HRSI) Products



Flow Chart 4: Overlay of Cadastral Maps on High-Resolution Satellite Image (HRSI)



(B) Setting up the Ground Control Network

1. INTRODUCTION

The Survey of India is undertaking the task of establishing a ground control point library (GCPL) for the entire country. In the first phase, 300 points of GCPs have been established at a spacing of 200 to 300 km apart. 2200 points, at a spacing of 30 to 40 km apart are to be established in the second phase of their project. In the third phase of GCPL development, control points are planned to be established at a distance of about 8 to 10 kms. GCPs at a distance of 8 to 10 km are likely to be of help in ground-truthing. States/UTs can consider coordinating the establishment of ground control points for ground-truthing in coordination with the Survey of India, in order to avoid duplication of efforts. However, this need not hold up the work of survey and ground-truthing of States/UTs.

2. All the control points should be based on datums given below:

Horizontal Datum: WGS-84 (i.e., the latest version of the World Geodetic System standard for use in cartography)

Vertical Datum: MSL, i.e., the Mean Sea Level.

3. Primary Control Points

3.1 Horizontal

The primary control points of the Survey of India (SoI), provided by static GPS observation (72 hours) with dual frequency GPS receivers, should be used. The primary control points of the SoI have been post-processed with precise ephemeris adjusted with the help of Bernese s/w to the ITRF co-ordinate system. All the secondary and tertiary control points should be connected to the primary control points of the SoI, to ensure connection to the National Framework.

2.2 Vertical

The precision Bench Marks of the SoI should be used as primary vertical control.

3. Secondary Control Points

3.1 Horizontal

The secondary control points of the SoI should be used, wherever available. In areas where the requisite density of secondary control points (16 km) are not available from the SoI, these should be provided.

i. **Best places for affixation:** In protected areas like premises of government buildings including school buildings, veterinary hospitals, etc. and other protected structures, etc. The selected site should be open and clear to sky with a cut off angle of 15º. High-tension power lines, transformers, electric sub-stations, microwave towers, high-frequency dish antennas, radars, jammers, etc., which interfere with GPS signals, should be strictly avoided.

ii. **Densification:** 16 km average

iii. **Instrument to be used:** Dual-frequency GPS receivers

iv. **Accuracy levels required:** 1 cm as determined by the residuals of the network adjustment with 95% confidence interval

v. **GPS network design:** Secondary control points should be observed with a geometrically sound network plan, connected to primary control points of the SoI.

vi. **Schedule of observations:** Observations should be scheduled with proper mission planning, considering the optimum availability and geometric dilution of precision (GDOP) of satellites (i.e., geometric strength of satellite configuration on GPS accuracy). Minimum observation time should be 3 hours.

vii. **Monumentation of secondary control points**

a. Rock-stone or Sand-stone 23*23*75 cm or RCC.
b. The control point should be 15 cm above the ground and 60 cm inside the ground.
c. The control points should be fixed to the ground using at least 15 cm of cement block.
d. Monuments shall bear a triangle on top with a plummet hole in the middle and a 15 cm steel rod inserted (flush with concrete surface).
e. The control point number should be inscribed on the monument.

3.2 Vertical

All the secondary control points should be connected by spirit-leveled heights. The leveling lines for such connections should terminate at precision control points of the SoI and all errors adjusted within them.

Permissible error for leveling line: 0.025 ♪k (in metres), where k is the length of leveling line in km.

4. Tertiary Control Points

i) **Distribution:** These shall be governed by the photogrammetric requirements of the block of imagery for which photogrammetric survey is to be carried out. The distribution and location of horizontal, vertical and full control points should be decided after preparing the photo-index with the help of input images.

ii) **GCP selection criteria:** The selection of location for a control point on the photograph will depend on the identification of the image point and the measurement characteristics of the image point. But, at the same time, they should also meet the horizon parameters (15º cut-off angle). Thus, the criteria for selection of such points should be:

a) GCP should be precisely identifiable on aerial imagery as well as on the ground.
b) GCP should be a sharp point on image and ground.
c) The selected GCP shall be open and clear to the sky, without any obstruction to the sky.

iii) **Post-pointing:** All tertiary control points should be post-pointed on imagery (i.e., the points should be identified on the image), preferably in softcopy. If post-pointing on hardcopy is to be done, the control point should be post-pointed at full resolution. In addition, a sketch magnifying the vicinity of control points and their detailed description should be prepared on the ground, to aid the photogrammetric operator.

iv) **Additional points:** In addition, tertiary control points may be provided on structures like village boundary tri-junction or bi-junction, existing govt./non-govt. buildings like gram panchayat offices, school buildings, veterinary hospitals, etc., as per the field survey requirements.

v) **Instrument :** Single/Double-frequency GPS, Total Station

vi) **Accuracy levels required:** 5 cm

vii) **Monumentation of tertiary control points**

Since the location of control points will be governed by photogrammetric requirements of the block of images and the selection criteria of the GCP, it will not be possible to construct a monument at most of the tertiary control. However, some additional control points provided with the objective of further survey by TS may be monumented. The specifications of monumentation are as given below:

a. Pillar should be of rock-stone or sand-stone 15*15*45 cm.
b. The pillar should be 10 cm above the ground and 35 cm inside the ground.
c. The pillar should be fixed to the ground using at least 15 cm of cement block.
d. Monuments shall bear a triangle on top with plummet hole in the middle

and a 15 cm steel rod inserted (7.5 cm inside and 7.5 cm outside).

e. Provision of a strip of granite to put GPS reading on.
f. The control point number should be inscribed on the monument.
g. In case some modern technology develops later, the details will be circulated separately.

viii) **GPS network design:** Tertiary controls should preferably be observed as triangular offsets. Single offsets should generally be avoided.

ix) **Schedule of observations:** Observations should be carried out with proper mission planning. Minimum observation time should be 45 min to 1 hour.

x) **Vertical control:** Single GPS offset upto 5 km from secondary vertical control may be allowed for connection of GPS heights in WGS 84 datum to MSL heights. However, such offsets should not be extended.

5. Auxiliary Control Points

i) **Best places for affixation**: Each secondary and monumented tertiary control point shall be paired with one auxiliary control point, which should be located on permanent structures like bridges, culverts, permanent building corners, etc. The auxiliary control points should be within the line of sight from the primary, secondary and tertiary control points.

ii) **Densification:** There shall be one auxiliary point for each secondary and tertiary control point, typically 200 m or more.

iii) **Instrument:** Dual/Single-frequency GPS Receiver (as used for main control).

iv) **Accuracy levels required:** same as their respective primary, secondary and tertiary control points.

Note:

1) The co-ordinate list and description of the location of all the control points shall be submitted to the State Land Revenue and Survey authorities. The locations and IDs of all the control points should be maintained in GIS form.

2) The co-ordinate list should be supplied both for geodetic system (Lat/Long) and Projected System – Universal Traverse Mercator, i.e., the UTM projection of the respective zone.

3) In case a village tri-junction has not been marked and monumented by a primary, secondary or tertiary control point, the same should be monumented as per the parameters.

6. General Requirements

1. Village boundaries are to be marked.

2. The (X, Y, Z) coordinates for the control points should be given in spherical coordinates, i.e., geometric figures in three dimensions using three coordinates, as well as in Cartesian coordinates, i.e., each point defined uniquely in a plane through two numbers, called the *x-coordinate* or abscissa and the *y-coordinate* or ordinate of the point, separately.
3. The (X, Y) coordinates should be in WGS 84.
4. The survey agency should specify the specifications of the instruments used to achieve the required accuracy.
5. Some baselines for calibration of the monumentation should be maintained at selected locations.
6. A sketch for each category of the control points shall be submitted, showing the location of the control points along with their description for easy identification.
7. A district map showing all the primary, secondary and tertiary control points along with their coordinates shall be submitted to the State Land Revenue and Survey authorities.
8. The survey agency shall submit a village map showing the primary, secondary and tertiary control points along with their description and coordinates in the prescribed format to the State/UT Land Revenue and Survey authorities.
9. The grid supplied by the State Land Revenue and Survey authorities has to be superimposed on the geodetic network of the Survey of India to derive the control point numbering.
10. Control points should be on the boundaries of the land parcels and not in between.
11. When located in govt. premises, the control point should be at a corner of the building or the premises.

Chapter-3

Computerization of Registration and Integration with the Land Record Management System

(Based on the system followed in Haryana)

1. Introduction

In the deed registration system as followed in India today, property registration deals with the registration of deeds and documents involving transactions related to immovable property. Registration of property transactions triggers about 90% of the changes in land records. Integration of the property registration and land records maintenance systems is very important and a necessary step for achieving the goal of maintaining real-time revenue records. This, in turn, will help in reducing the risk factor due to reduction in the number of frauds and litigations. Thus, the integration of the Revenue and Registration systems through IT services is imperative.

2. Working of the Integrated System

The steps leading to the integrated system are given below:

(i) Pre-Registration
(ii) Registration
(iii) Post-Registration
(iv) Citizen Services

Each of these steps consists of a number of activities, as delineated below:

2.1 Pre-Registration – This stage includes the following activities:

a) **Obtaining a copy of the Record of Right (RoR)** after paying the vendor service charges and the Government fee.

b) **Calculation of the stamp duty** – on the basis of the value of the property as per the approved collector/circle rates.

E-Stamping - E-Stamping will be implemented in collaboration with the nationalized banks. Under E-stamping, the transferee will deposit the requisite stamp duty in the designated Bank and the latter will issue a receipt printed on security paper from Security Press, Nasik, containing security features such as watermarking, unique number, special sticker, etc. This special receipt will be pasted on the deed. At the time of registration, the Registration staff will check the particulars of the receipt online from the website of the Bank, which will issue the username and password to the staff

of SR office for checking the details of stamp duty received by the Bank. One hard copy of the scroll of the transactions will be sent by the Bank to the concerned Sub-Registrar's office and to the Treasury office for verification purposes. Nominal charges may be levied by the Banks for providing the E-stamping service. It is recommended that all State Governments and UT Administrations make concerted efforts to introduce E-stamping services as early as possible, as part of the citizen services charter, and abolish the cumbersome use of stamp papers.

c) **Deed Preparation** – For drafting a deed, three options are available:
   - ❖ Self-drafting
   - ❖ Drafting by a deed writer
   - ❖ Drafting by an advocate

   It will be convenient and time-saving if templates of standard deeds are created for deed preparation with facility for editing, wherever required. Deeds prepared by the software will be treated as the self-drafted deeds.

d) **Deed Presentation** – Interested parties will appear before the concerned sub-registrar to present the above-mentioned deed. Sub-registrar will mark the deed to the Registry Clerk (RC). The RC will check the deed and the attached annexures. If the deed has all the requisite annexures attached with it, then the RC will put the stamp "Checked and Found OK" on the deed and send it to the Registration counter. Otherwise, the software will print the list of objections.

2.2 Registration – Registration stage is one of the most important stages in the whole document registration process.

a) **Data entry of basic details of the deed** - like property location and area, and details of the parties.

   For the areas having land records integrated with the registration system, the details of the property, as well as of the sellers, will be verified from the land records database. Since the transferor cannot sell the property without mutation in the land records first, this process will help eliminate mutation pendency and fraudulent sales on the basis of fake RoRs will no longer be possible.

b) **Capturing of fingerprints and photographs** – of the parties and the witnesses using a fingerprint device and a webcam. Photographs and fingerprints will be stored in the database.

c) **Generation of endorsement and certificate of registration** – Endorsement will be printed on the backside of the first page of the deed. To check errors

in the data entry, some of the details of the deed such as property location, area, consideration amount, stamp duty and Registration fee should be printed along with the endorsement. Endorsement will be in the local language. Certificate of registration will be printed on the backside of the last page of the deed. It will also contain the photographs of the parties and witnesses.

d) **Signatures of the Sub-Registrar** – Finally, the deed will be again presented to the Sub-Registrar for signatures. After the signatures of the Sub-Registrar, the deed will be regularized in the software to freeze the transaction. The regularization process will send a remark to the relevant RoR, automatically. This remark will contain the registration no., date of registration and names of seller(s) and buyer(s), and may be recorded in red colour until the time the mutation process is completed. While the mutation is pending, it will also alert any other prospective buyer that a transaction has already taken place in respect of the property. In this way, any fraudulent attempt at multiple sale of the same piece of land will be checked.

e) **Post-Registration audit of deed** – will be done by the auditor of the Registration Department within the specified time period.

f) **Document delivery** – After the post-registration audit, the deed will be returned to the Registry Clerk, who will deliver it to the concerned party within the specified time period. In case of areas having land records integrated with the registration process, mutations will be entered in the software immediately after the deed is signed by the SR and a hard copy of this mutation can be given to the buyers for their reference.

This entire process of computerized Registration should be completed within half-an-hour to one hour.

2.3 **Post-Registration** activities include deed scanning and the mutation process (mutation notice generation, data entry, verification, sanction and incorporation of the mutation in the RoR).

i. **Deed scanning** will be a background operation, which is required in order to provide copies of the registered deeds to the buyer(s). In the process of deed scanning, digital index will be created for locating the scanned deeds in the computerized registration record maintenance system.

ii. **Mutation notice generation –** The mutation notice mentioning the tentative date, venue and time when the concerned Revenue authorities shall carry out

the required formalities for sanctioning the mutation, will be generated by the software, the copies of which shall be given to the buyer(s) and seller(s).

iii. **Mutation data entry –** The mutation data entry will be done through the registration software. First of all, the Sub-Registrar will mark the particular deed for mutation data entry. The mutation data will be entered for the marked deed, capturing the details of the seller(s) and buyer(s) from the registration database. In the RoR, this data entry will remove the red remarks created during the registration process and generate the "pencil" remarks for further action by the Revenue authorities. This linkage of the registration and mutation processes will also track the pending mutation cases and help the Revenue officers to reduce mutation pendency.

iv. **Mutation verification and sanction –** The Kanoongo or equivalent Revenue Officer will verify the mutation and send it to the Circle Revenue Officer (CRO)/Tehsildar/Assistant Collector or equivalent Revenue Officer for sanctioning. The CRO will hold a public hearing to sanction or reject the mutation. The Tehsildar can reject the mutation on the grounds mentioned below. After the mutation is sanctioned, the color of the remarks in the Parat Patwar of Jamabandi will automatically change to red, by the software, in the RoR in place of the pencil remarks.

Grounds for rejection

- Non-payment of fee.
- Absence of buyer.
- Legal heirs not confirmed by the Nambardar/designated official in case of inheritance.
- Land mortgaged to bank.
- Registration is not in confirmation with Jamabandi/village-level land record.

Procedure to be followed after rejection

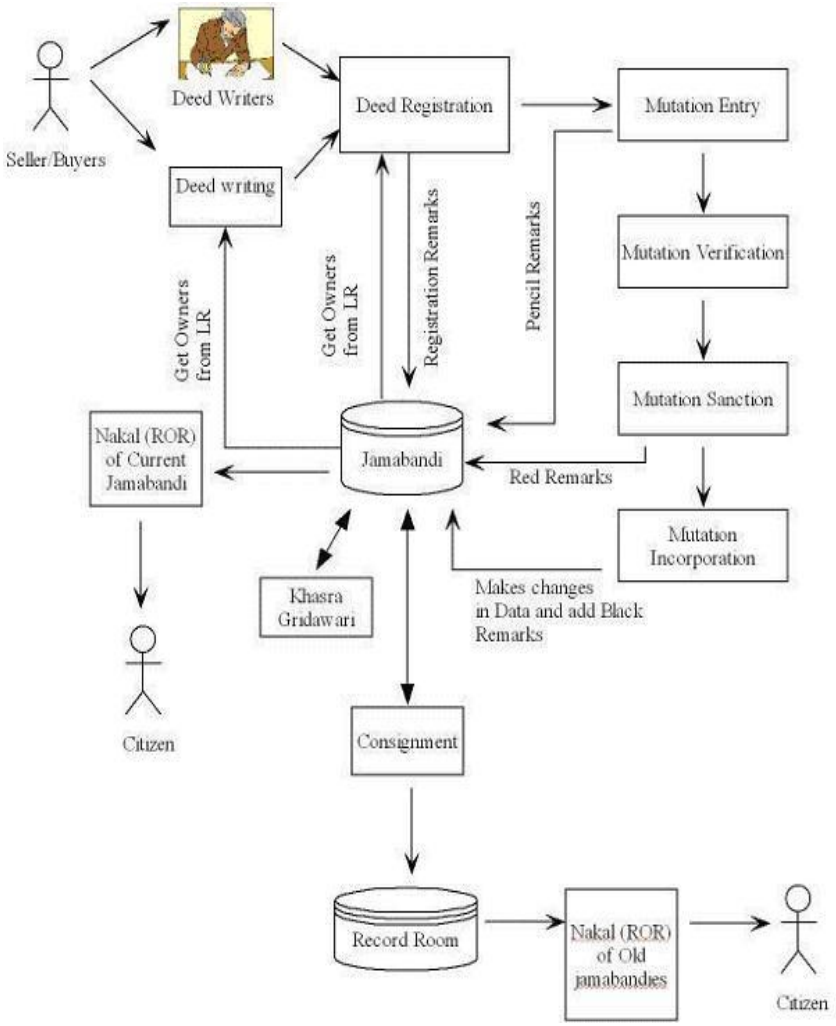
- Mutation fee will be refunded to the concerned party.
- Party can appeal within 30 days to District Revenue Officer (DRO) or Sub-Divisional Magistrate as per the location of the property. If decided in the favour of party a mutation will be sanctioned otherwise

party can further appeal to Collector. Appeal of collector will go to Divisional Commissioner and appeal of Divisional Commissioner will go to Financial Commissioner Revenue (Principal Secretary). If the party is not satisfied with the decision of Financial Commissioner they can go to civil court.

- If the rejection was because of absence of buyer or due to some mistake in the earlier mutation then a fresh mutation will be written.

v. **Mutation incorporation and scanning** – All the sanctioned mutations will be incorporated in the RoR by the designated officer. Red remarks for the sanctioned mutations will be converted to black remarks in the next Jamabandi/updation of village-level land records. The Tehsildar records his order on the mutation register generated by the software. The detailed order of the Tehsildar is scanned so that copies can be issued to the concerned parties.

"Integrated Registration and Mutation workflow"



2.4 Citizen Services

The following services will be available to the citizens due to integration of registration and land records system:

(i) Title Search

Using this feature, a citizen can enquire about the details of the property including its current and past ownerships.

(ii) Issue of non-encumbrance certificates/certified copies

- All details of past transactions in respect of a property including the old registered deeds and index registers, i.e., the historic data, will be digitized/scanned and entered into the computerized system.

Chapter-4

Choice of Software and Standards

1. Open Standards

Open standards are technical specifications and policies governing information flow across projects. They cover domain, interconnectivity, data integration, e-services, access and content management. The principles and practice of operating the standards make them “open”, i.e., they are available for all to read and use. This creates fair and competitive market for implementation of the standards and do not lock the customer to a particular vendor or group. Generally, open standards are available free of cost to the user.

1.1 Benefits of using open standards

i) Ease of inter-operability and communication with other systems or data sets.

ii) Open specifications, i.e., the outputs are known to all.

iii) Protection against obsolescence of the data and files created using standards.

iv) Easier porting or transfer of data and application from one platform or format to another, since the technical implementation follows known guidelines and rules, and the interfaces, both internally and externally, are known.

v) No dependence on, or locking with, any single technology or product.

1.2 Some examples of the standards that can be used under the NLRMP are listed below:

i) Scanning process:

a) 300 dpi in black and white.

b) Image should be stored in .tiff (tagged image file format) or .gif (graphic interchange format) only.

c) The image orientation should be upright.

d) The image should be cleaned and free of noise.

e) Legibility features should be good.

f) Measured length and width with in bounding box of the maps.

g) The image should not be skewed or wrapped.

h) Quality printout of 100% matching (1:1) scanned map on 90-micron transparent sheet for verification with original sheet.

i) Final printout: One printout of verified scanned map on 75-micron matt polyester paper.

ii) Digitization of cadastral maps

a) Layers to be computerized

i) Administrative boundaries of a revenue village with name of village, tehsil and district
ii) Parcel boundaries with plot numbers
iii) Road network along with road code and type
iv) Railway network
v) Major water bodies and drainage network

b) File format

i) Shape file (.shp)
ii) 100% matching (1:1)
iii) Final printout – 75-micron matt polyester paper

c) Scale: 1:4000

d) Accuracy: 0.025%

iii) Registration Process

a) Database standards

SQL-92 (Relational Model) /SQL -1999 (Object Model) to be adopted as standard for relational database management systems (RDBMSs).

iv) Indian language computing

UNICODE – character encoding for each and every alphabet of all the languages. The most commonly used encodings are UTF-8 (Unicode transformation format) and UTF-16.

v) Survey

a) Scale: 1:2000
b) Format –Shape format or geo-database format
c) Projection System = UTM (Universal Transverse Mercator)
d) Datum: WGS 84 (World Geodetic System-1984)
e) Reference with survey stone details/bench mark point
f) Contour interval: 1 meter contour with height information
g) Village/taluk/district boundaries with annotation
h) Village boundaries with tri-junction pillars

i) District/tehsil/village codification as per Census 2001

j) Distances in meters

k) Area in hectares/sq meters

l) Output:

   i) Accurate geo-referenced digital map using established control survey network around existing Survey of India permanent reference points

   ii) Proper indexed map with proper sheet number

   iii) Sheet-wise as well as complete mosaic map of village/tehsil/taluk/district

   iv) Open file format (.shp)

   v) Spatial and non-spatial data dictionary with feature codes, feature type (point, line and polygon)

   vi) Feature description and symbols

m) Accuracy: horizontal accuracy of 20 cm for rural areas, 10 cm for urban areas, or better.

vi) Location codification – As per the Census codes, as further updated by the NIC.

1.3 The use of open standards is mandatory for the States/UTs for data sharing and inter-operability among different systems.

2. Open Source vs. propriety software

2.1 Open Source Software (OSS)

OSS is defined as computer software for which source codes are available in the public domain. This permits the users to use, change and improve the software and to redistribute it in a modified or unmodified form. It is developed in a public and collaborative manner.

2.1.1 Advantages of OSS

a) Most OSS products are available free of royalties and fees.

b) The OSS have qualities of adaptability to standards and integration with other systems.

c) It has better software security, because of the availability of source codes and multi-user, network-centric environment.

d) It offers wider testing and faster fixation of problems and is, therefore, more reliable and stable.

e) Near-zero vulnerability to viruses, thereby eliminating the need for virus checking, data loss and downtime.

f) Since it is collaborative development and source codes are freely available, the same can be easily customized as per the user requirements.

g) Small footprint allows use on older computers.

h) Service orientation, rather than product orientation, for induction of IT solutions in e-Governance.

2.1.2 Disadvantages of OSS

a) Lack of professional support, since there is no direct obligation or responsibility on anyone.

b) There is no co-ordination of different releases and version upgrades. Since new developments keep coming up, the support vendors find it hard to provide the immediate solution.

c) Several updates keep getting released without any centralized mechanism to handle them, leading to erratic updates.

2.2 Proprietary software

It is the computer software which is legal property of one company. The terms of use for the buyer are defined by contract and licensing. The terms may include restrictions on privileges to share, alter, dissemble and use of the software.

2.2.1 Advantages of proprietary software

a) Better vendor professional services.

b) Better user interface.

c) Regular and easy availability of updates and patches to the users.

d) These systems are available in packaged and modular form.

2.2.2 Disadvantages of proprietary software

a) Proprietary software comes at a significantly higher cost.

b) Complete dependence on the vendor.

c) Source codes are generally not available to the end-user, leading to lack of freedom to modify or adapt the software to changed requirements.

d) At times, proprietary software may be locked to a proprietary standard, making inter-operability difficult.

e) Vulnerability to withdrawal of support by, or collapse of, the vendor.

f) Unforeseen gaps may be discovered in the course of software deployment, causing gaps in functionalities.

3. Choice of software

While making a choice of the software, State Governments/UT Administrations should keep in mind the cost and inter-operability of the system, as well as the time taken for designing software. Since inter-connectivity, inter-operability and completion of projects within set timeframes have been emphasized as major planks in the NLRMP, isolated systems may present a major difficulty in the future. It has been seen that where IT penetration is less, proprietary software services and solutions are better and reliable assistance is available from the supplier. However, open source provides distinct cost advantages where the number of installations are large. The States/UTs should bear in mind that they have to meet the required funding for software from their own resources.

With regard to further updates on open sources and open standards, the website of the Department of Information Technology, i.e., www.mit.gov.in may be seen from time to time.

Chapter-5 (Section-A)

Data Security

Information Security requirements and Authentication Mechanism

(Revenue Secretary Committee Report)

Purposes and Scope:

One of the terms of reference of the Committee was to deliberate in depth about the security framework for the CLR domain and suggest a suitable framework for security of the system and digital land record data sets. NIC has prepared detailed Security Guidelines for Computerization of Land Records listing the purpose, procedure and security framework, which also envisages creation and adoption of an Information Security Policy and Standards for the Land Records Information System domain. The committee discussed the security framework and agreed to the following guidelines;

The Security guidelines primarily focus on the following:

- To extend necessary guidance and lay standards for the land revenue department on various IT-security related issues such as physical, technical and administrative concerns, which need to be addressed from the implementation/operational perspective of Land Records Computerization at the Tehsil (Revenue circle) level.
- ISO/IEC BS 17799 has been recommended for cyber security standards. ISO –BS 17799 is the internationally recognized security framework, which extensively deals with almost all security mechanisms in terms of 127 controls. According to domain needs 60 security controls have been short listed out of these 127 controls for the security mechanism of the land records domain.
- Information for designers & developers of applications software and databases that should be taken into account by technology service providers.
- Security Audit and Risk assessment that are necessary constituents for reducing vulnerabilities.
- Important technological devices and methods to strengthen security in the operational workflow environment.

Requirements for building a Security Framework:

It has been observed by the committee that several states have successfully implemented Computerization of Land Records without following proper security standards. In such a scenario, it is necessary to create a security management system for land records and documents, as these are of immense significance due to rising land values. It may be mentioned that without adequate physical and administrative security, reliable digital security is not possible. In the case of digital data, issues and concerns regarding integrity and authentication of data need to appropriately addressed. Necessary provision for backup, storage, archiving of digital data is to be made to fit the requirements of the domain.

The extent of security management is directly dependent on risk assessment. It will be very difficult to determine the severity of the risk without any critical assessment study. In case of total automation, any damage to the IT system will have a very serious impact especially when the manual system of records is done away with. Therefore, the importance of security management cannot be over emphasized.

Observations of the Committee:

After detailed deliberations on the issues relating to security, the Committee made the following observations:

- It was noted that the existing manual system has various safeguards, descriptive procedures, roles and responsibilities, set out in the State land administrative manuals. It is necessary that while switching over to an IT enabled system for LR, appropriate steps be initiated to incorporate suitable provisions catering to the requirements for a secure computerized environment for Land Records. Therefore, it is necessary to accord high priority to confidentiality and Integrity of the available data, records, process and systems.
- The Committee observed that as of today, prime security concerns relate to PHYSICAL as well as CYBER security. Accordingly, it is necessary to have a composite strategy for domain security.
- The Committee is of the opinion that there are several areas pertaining to physical, technological and administrative security that need attention in the existing scenario of computerized operations at the Tehsil level.
- Security requirements are dynamic in nature. To build an appropriate security management system, it is necessary that each state should follow the Security

policy guidelines. Moreover, each state should create a mechanism to continuously assess the risks and vulnerabilities and strengthen security measures through rules, procedures, responsibilities and technology.

- The Committee understands that ISO/IEC BS 17799 is an internationally accepted standard, which could be used to define the standard framework for the Land Record domain. ISO/IEC BS 17799 standards cover various aspects on policy, review mechanism, risk assessment, confidentiality and integrity needs for an Information Security management system.

Recommendations:

In view of these observations, the Committee recommends that the suggestions given below must be initiated to strengthen the existing security provisions.

- Adoption of Security policy guidelines and annual audit of security of data software and hardware.
- Risk assessment for operational sites and security breaches.
- Policy for hardware, software, system software configuration management.
- Policy for Password, Confidentiality and Accountability required
- Policy and procedures for backup of data and software for a defined period.
- Policy for access control of system, data and other resources.
- Arrangement for physical security of the digital infrastructure.
- Technical updates for users and responsible officials.
- Policy for data access over network and distribution.
- Provision of documented procedures for legal compliance and security.
- Budgetary allocation for an accepted level of security

Approaches for Security Management & the Information Security Management System:

The Committee agreed that there is a need for uniformity in standards and protocols for security management amongst the states. "ISMS" is an approach by which management can monitor and control information security to reduce risk to an acceptable level to fulfill corporate, customer and legal requirements. Implementation of Security management requires that:-

- Security controls are in place and are effective;
- Residual risks are acceptable; and
- Assumptions about threats remain valid.

These security controls as specified in the ISO/IEC specification will help in minimizing the risks of human error, theft, fraud or misuse of facilities. These measures may be adopted to secure confidentiality, accountability and integrity of the system. For this purpose, it is necessary to address various issues concerning Physical and Cyber Security in the LR domain, Access Control, Security Awareness and Training, System Configuration, Data Management, etc.

The document on security guidelines provides a detailed description of various security measures to be adopted to reduce risk and curtail vulnerabilities.

Cyber security is an ongoing process and it is desirable that security concerns should be addressed and resolved through a permanent mechanism.

Security Audit:

Security audit is important for protecting digital data. Keeping this in mind, the Committee agreed that each state should create a security review mechanism and mitigation management plans. Further, it is also recommended that security audit should be carried out for each state by a third party/expert once the policy is implemented. It is suggested that NIC should take necessary steps to ensure application software security. The major steps involved in LR Information system security are:

a) System study;
b) Application Security audit; and
c) Infrastructure audit for known vulnerabilities & configurations.

The security audit should be carried out as per guidelines issued by the Government of India in this regard. The following approach could be followed at various levels:

(i) **At site of operation:**

a. Physical security and access control at Taluk level
b. System hardening and Incident detection /reporting at site of operation.

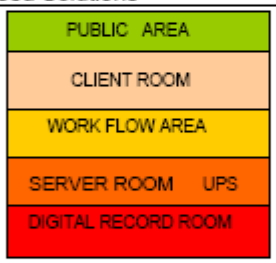
c. Workflow authentication, non-repudiation and record management.
d. Backup and Archival data, software and records.
e. Security updation, Version control and Configuration management

(ii) **At State Level:**

a. Steering committee to review the security of operations periodically;
b. Incident management mechanism and support;
c. Technological and financial support;
d. Address various legal & policy issues emanating from field experiences.

Recommended Technical measures for Secured Operation at Tehsils/SRO:

The committee recommends the following security measures:

	Issues	Proposed Solutions
1	**Physical Security of the Site** Access Control - For Public - Work- flow area - Server Area - Client Area - Digital Record Room Equipped with Access Control Device and Log Register	
2	**Electrical and Fire Safety:**	As per the fire safety and electrical requirements. (Expenditure to be supported under site preparation fund as provided in existing CLR guidelines – unit cost per Taluk)
3.	**LAN Connection:** - Server and Client - Network Device - kiosk	Protected connectivity to avoid interception of the clinet/server over/through LAN.Entire set-up should be within restricted access area. (No cost as of now. In future hub may be replaced with switch)

4.	**HARDWARE:** - Server - Clients - Printer - Scanner	All servers/clients/printers/scanner should be as per the configuration prescribed in the CLR guidelines. All these devices should be entered in stock register . Each machine should be authenticated.
5.	**System Software & updates:**	Valid copy of System Software should be used for installation. The Hard Disk should be partitioned for the Operating System(OS) and data. Funds for this has been provided under the revised tehsil unit cost.
6.	**Password:** - Administrator - Default accounts - Guest accounts - BIOS level password - Bio Metric Thumb impression - Digital Signature (Digital Signature Certificate to authenticate server and client with secure communication may be taken from NIC)	The administrator password should have a minmum of eight characters incorporating the special characters and alphanumeric. All guest and default accounts should be disabled. System should have BIOS password The user is accountable for keeping the password with himself. Only specified finger is to be used in bio-metrics device. Funds for Biometrics are already allocated under revised unit cost of tehsil. Digital Signature Certificate(DSC) for each site may be acquired from NIC which requires Rs. 3600 per site for card & readers (one for each machine).
7.	**Virus and Intrusion Detection System:** - Disabling unwanted ports	Updation of Virus protection with latest Updates
8.	**Version Control:** - Key validation - Key revalidation with request - Same version of s/w at all sites	Application Software with key Duration of the Land Record application s/w can be extended by request and keys granted by the administrator. One version at all sites.
9.	**Disabling of Floppy Drive/Desktop:** - Desktop should be disabled	Floppy Drive may be disabled Application s/w should run directly at the system startup
10.	**Installation of DATABASE:** - Certified copy - Database users password	SQL database should be installed using the authorized CD. System Administrator "sa" password

		should be changed and protected regularly
11.	**Creation of LRC Users:** - **Authentication and authorization** - Role bases Access - Unused accounts	Authenticated users with password / biometrics. Role based authentication and function All unused accounts/guest should be disabled.
12.	**Backup/Restore of Database:**	Backup of database with password. Stored at different location. Backup under the custody of the officer in charge System before shutdown must prompt for backup.
13.	**Routine Check up of the System for unwanted s/w and games:**	Only authorized s/w should be installed in the server/client
14.	**Use of LR s/w beyond schedule hours:** - Use of s/w on holidays - Use of s/w beyond working hours	Use of the computer center and application s/w beyond schedule hours should be recorded and permitted only on permission from competent authority.
15.	**Security breaches log/report:** - Breaches of security - Unintended use of a module - Wok flow violation	Documentation of all breaches & reporting.
16.	**Audit log:**	Periodic log will be kept separately in CDs with time stamp
17.	**Backup of Application & Language s/w:**	LR s/w and Language Related Application s/w will be backed up in CDs with all keys.

Chapter-5 (Section-B)

Data Security

Evaluating and implementing ISO/IEC 27001 and ISO/IEC 27002 security standards

1. For any Land Records Information System, asset safeguarding (that includes data security) and data integrity are important objectives. Regular assessments need to be carried out as to how well these objectives are being met. This is an Information System Audit function. Information system (IS) auditing is the process of collecting and evaluating evidence to determine whether a computer system safeguards assets, maintains data integrity, allows organizational goals to be achieved effectively and uses resources efficiently. Information system auditing must be carried out by an agency other than the implementing agency (which in most cases is the NIC) and holds necessary competency/accreditations. IS Audit is carried out by organizations empanelled by the Indian Computer Emergency Response Team (CERT-In), an organization that works under the auspices of the Department of Information Technology, Government of India. Carrying out of periodic (at least twice a year) IS Audit of a computerized land records management system is strongly advised. Such auditing will increase usability of computerized land records and bring in more confidence among institutional users, such as banks, who may base some of their decisions on these records.

1.1 It is recommended that State Governments/UT Administrations may strive to achieve ISO 27001 certification as regards the computerized land records system. CERT-In website (www.cert-in.org.in/ProgressiveSteps.htm) lists the progressive steps that a State Government/UT Administration may take to achieve this certification. The certification process can be set into motion as soon as even one component of the land records system, say the text-database has been put in production use.

2. Making the data secure as per the ISO standards and drawing up the security policies

While it is debatable whether an IT audit organization should be associated right from the inception stage of the computerized land records system, yet with the growing complexity of information systems, auditors do need to have in-built tools and outputs to test various internal system processes and collect evidence. Auditors may also

suggest various controls at system development stage that may reduce threats to system. If these suggestions are taken into account at system development stage itself, a more integrated and robust system evolves. Therefore, there is a growing tendency among organizations implementing IT-based solutions to also associate an accredited IT system auditor at the system development stage itself.

2.1 This IT system auditor should also be assigned the important task of helping the State Government/UT Administration in writing and promulgating across the State/UT various security policies/best practices-related memoranda/circulars in line with the ISO standards. However, to maintain audit independence and objectivity, the IT system auditor team who was associated at the system development stage may not be engaged later at the actual auditing of the computerized lands records system, i.e., after the system has started functioning.

3. Supervising the security policy implementation

Formulating and implementing security policies and internal control practices give rise to another organizational issue, that is, of a requirement of overseeing such functions within the State/UT. There is a need for an information system security and internal controls administrator at the State/UT-level with the responsibility for ensuring that the information system assets are secure and data integrity is maintained. One major function of the security administrator is to conduct security program. A security program is a series of ongoing, regular periodic reviews conducted to ensure that assets (including data) associated with the information system function are safeguarded adequately. Each review leads to changes in security and internal control policies. The very first security review (possibly conducted in association with the IT system auditors and the NIC) is often a major exercise. Subsequent security reviews, carried independently, might focus on changes that have occurred since the last review. A formal approach to security review has eight major steps: (1) preparation of the security review plan, (2) identification of the assets, (3) valuation of the assets, (4) threats identification, (5) threats likelihood assessment, (6) exposures analysis, (7) controls adjustment, and (8) report preparation.

3.1 Result of a security review is a security policy in respect of nine major threats, as: (a) unauthorized intrusion — access controls must be designed to prevent both logical and physical intrusion; (b) hackers — strong logical access controls mitigate expected losses from the activities of hackers; (c) viruses and worms —controls

should be implemented to prevent use of virus infected programs and to close security loopholes that allow worms to propagate; (d) misuse of software, data and services — a code of conduct should govern the actions of information systems employees that should also prominently take into account user privacy concerns; (e) fire — well-designed, reliable fire-protection systems must be implemented; (f) water — facilities must be designed and sited to mitigate losses from heavy rain, moisture and flooding; (g) energy variations — voltage regulators, circuit breakers and uninterrupted power supplies be used; (h) structural damage — controls must exist to safeguard against structural damage occurring from earthquakes and other disasters; (i) pollution — regular cleaning of facilities and equipment should occur; also, take steps to prevent heavy corrosion in equipments installed at sea-side locations.

Chapter-6 (Section-A)

Core Technical Advisory Group

No.18014/01/2008-LRD
Government of India
Ministry of Rural Development
Department of Land Resources

G-Wing, NBO Building
Nirman Bhawan, New Delhi

Dated the October, 2008

ORDER

Subject: Setting up of a Core Technical Advisory Group for the National Land Records Modernization Programme (NLRMP).

A Core Technical Advisory Group, with the composition and terms of reference as indicated below, is hereby constituted to advise the Department of Land Resources, Government of India and the States/UTs on the technological aspects related to the implementation of the NLRMP:-

(i)	Secretary, Deptt. of Land Resources	Chairperson
(ii)	Additional Secretary, Deptt. Of Land Resources	Member
(iii)	The Director-General, National Informatics Centre (NIC), or his representative	Member
(iv)	The Surveyor General of India, or his representative	Member
(v)	A representative of the Indian Space Research Organization (ISRO)	Member

(vi)	A representative of the National Remote Sensing Agency (NRSA)	Member
(vii)	The Director-General, C-DAC, or his representative	Member
(viii)	The Director General, Forest Survey of India, or his representative	Member
(ix)	The Director, Soil and Land Use Survey of India, Ministry of Agriculture, or his representative	Member
(x)	The Registrar General of India, or his representative	Member
(xi)	A representative of the Ministry of Home Affairs, Govt. of India	Member
(xii)	A representative of the Ministry of Defence, Govt. of India	Member
(xiii)	Shri Vinod Agrawal, IAS, Govt. of Andhra Pradesh	Member
(xiv)	Shri Rajeev Chawla, IAS, Govt. of Karnataka	Member
(xv)	Dr A.K. Singh, IAS, Director (LR), Deptt. of Land Resources	Member
(xvi)	Director (NLRMP), Deptt. of Land Resources	Convenor

2. The terms of reference of the Advisory Group would be to advise the Department of Land Resources and the States and UTs on the technological aspects of the implementation of the NLRMP including its following components and activities:

I. Computerization of land records

a) Data entry/re-entry/data conversion of all textual records including mutation records and other land attributes data
b) Digitization of cadastral maps
c) Integration of textual and spatial data
d) Tehsil, sub-division/district data centers
e) State-level data centres
f) Inter-connectivity among revenue offices

II. Survey/resurvey and updating of the survey & settlement records (including ground control network and ground truthing) using the following modern technology options:
a) Pure ground method using electronic total station (ETS) and global positioning system (GPS)
b) Hybrid methodology using aerial photography and ground truthing by ETS and GPS
c) High Resolution Satellite Imagery (HRSI) and ground truthing by ETS and GPS

III. Computerization of registration
a) Computerization of the sub-registrar's offices (SROs)
b) Data entry of valuation details
c) Data entry of legacy encumbrance data
d) Scanning & preservation of old documents
e) Connectivity to SROs with revenue offices

IV. Modern record rooms/land records management centres at tehsil/taluk/circle/block level

V. Training & capacity building
a) Strengthening of the Survey and Revenue training institutes

VI. Core GIS

a) Village index base maps from satellite imagery, for creating the core GIS

b) Integration of three layers of data: (i) Spatial data from aerial photograph or high-resolution satellite imagery; (ii) Survey of India and Forest Survey of India maps; and (iii) Cadastral maps from revenue records

VII. Programme management

a) Information, education and communication (IEC) activities

b) Evaluation

3. The Advisory Group may associate any other official/non-official expert for guidance.

4. The TA/DA of the non-official experts shall be borne by the Department of Land Resources, Ministry of Rural Development, Govt. of India.

(A.K. Sahu)
Director (NLRMP)

To

1. All members of the Committee
2. PS to MRD
3. PPS to Secretary (LR)
4. PS to AS(LR)

Chapter-6 (Section-B)

Addresses of Technical Agencies

1. **National Informatics Centre (NIC)**

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Punjab Mini Secretariat
Sector 9, Chandigarh - 160009
E-mail : **punjab@chd.nic.in**

Rajasthan

NIC State Centre

Sikkim

NIC State Centre

318 N. W. Block
Secretariat C-Scheme
Jaipur - 302005
E-mail : **sio@raj.nic.in**
URL : **http://www.raj.nic.in**

Tamil Nadu

NIC State Centre
E-2-A Rajaji Bhavan
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Chennai - 600090
E-mail : **sio@tn.nic.in**
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Uttar Pradesh

NIC State Centre
E-Floor Yojana Bhavan 9
Sarojini Naidu Marg
Lucknow - 226001
E-mail : **upstate@up.nic.in**
URL : **http://www.up.nic.in**

West Bengal

NIC State Centre
Gr. Floor Bidyut Bhavan
DJ Block Sector-II
Salt lake
Kolkata - 700091
E-mail : **sio@wbsu.wb.nic.in**

Tashilling
Sikkim Secretariat
Gangtok - 737103
E-mail : **sio-sik@hub.nic.in**
URL : **http://sikkim.nic.in**

Tripura

NIC State Centre
New Treasury Building
Secretariat Complex
Agartala - 799001
E-mail : **sio-trpr@hub.nic.in**
URL : **http://tripura.nic.in/nictu.htm**

Uttaranchal

NIC State Unit
Secretariat Compound
Subhash Road
Dehradun - 248001
E-mail : **utrnchal@up.nic.in**

Andaman & Nicobar(UT)

NIC State Centre
11 Old Pradesh Council Building
Secretariat Complex
Port Blair - 744101
E-mail : **andaman@hub.nic.in**

2. SURVEY OF INDIA

Surveyor General's Office

Survey Of India,
Post Box No. 37,
Hathibarkala Estate,

DEHRADUN-248001
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sgo@nde.vsnl.net.in
sgo@sancharnet.in

GEO-SPATIAL DATA CENTRES

Sl.No.	Name of the Geo-spatial Data Centre	Mailing Address
1	Andhra Pradesh Geo-spatial Data Centre, Hyderabad	Additional Surveyor General, Andhra Pradesh Geo-spatial Data Centre, Survey of India, UPPAL, Hyderabad-500039 Fax: 040-27206064 & 27200359 E-mail: addlsgapgdc@yahoo.com
2	Assam and Nagaland Geo-spatial Data Centre, Guwahati	Director, Assam and Nagaland Geo-spatial Data centre, Survey of India, Ganeshguri Chariali Dispur G S Road, Guwahati - 781006 Fax: 0361-2261725 E-mail: angdcguwahati@yahoo.co.in
3	Bihar Geo-spatial Data Centre, Patna	Director, Bihar Geo-spatial Data Centre, 164, Sheikhpura House (Near JD Women's College), PO- B.V. College, Patna-800014 (Bihar). Tel:0612-2280756, 2280261 Fax: 0612-2280265 Email: bihargdc@yahoo.co.in
4	Chhattisgarh Geo-spatial Data Centre, Raipur	Director, Chhattisgarh Geo-spatial Data Centre, Survey of India,Reena Apartment 3rd Floor,Pachpedi Naka, Dhamtai Road, Raipur - 492001 Fax: 0771-2411135 E-mail: cggdc@sancharnet.in
5	Gujarat, Daman & Diu Geo-spatial Data Centre, Ahmedabad	Director, Gujarat, Daman & Diu Geo-spatial Data Centre, Survey of India, Motor Sales & Service Building,2nd Floor, Ashram Road, Ahmedabad - 380009 Fax: 079-26576696 E-mail: dirgddgdc@yahoo.com
6	Haryana Geo-spatial Data Centre, Chandigarh	Director, Haryana Geo-spatial Data Centre, Survey of India, SOI Complex, Dakshin Marg, Sector 32 A, Chandigarh - 160030 Fax: 0172-2604671. E-mail: addlsg_hgdc@sify.com
7	Himachal Pradesh Geo-spatial Data Centre, Chandigarh	Director, Himachal Pradesh Geo-spatial Data Centre, Survey of India, SOI Complex, Dakshin Marg, Sector 32 A, Chandigarh - 160030 Fax: 0172-2613398. E-mail: hpgdcsoi@yahoo.com
8	Jammu & Kashmir Geo-spatial Data Centre, Jammu	Director, Jammu & Kashmir Geo-spatial Data Centre, H No.65, Zorwar Stadium,Channi Himmat, Jammu - 180015 (J & K) Phone: 0191-2466556, Fax: 0191-2450185 E-mail: jkgdcjammu@yahoo.co.in
9	Jharkhand Geo-spatial Data Centre,	Director, Jharkhand Geo-spatial Data Centre, Survey of India, Survey of India Complex, Near

	Ranchi	Magistrate Colony, Doranda, PO - Hinoo, Ranchi - 834002 Fax: 0651-2482789 E-mail: jgdc@sancharnet.in
10	Karnataka Geo-spatial Data Centre, Bangalore	Director, Karnataka Geo-spatial Data Centre, Survey of India, Sarjapur Road, Koramangala, 2nd Block, Bangalore - 560034 Fax: 080-25533595 E-mail: soikargdc@yahoo.com
11	Kerala and Lakshadweep Geo-spatial Data Centre, Thiruvananthapuram	Director, Kerala and Lakshadweep Geo-spatial Data Centre, Survey of India, CGO Complex, Poonkulam, Vellayani PO, Thiruvananthapuram - 695522 Fax: 0471-2481852 E-mail: surveykerala@asianetindia.com
12	Madhya Pradesh Geo-spatial Data Centre, Jabalpur	Additional Surveyor General, Madhya Pradesh Geo-spatial Data Centre, Survey of India, Survey Colony, Vijay Nagar, Jabalpur- 482002 Fax: 0761-2643182 E-mail: dccsvy@sancharnet.in
13	Maharashtra and Goa Geo-spatial Data Centre, Pune	Additional Surveyor General, Maharashtra and Goa Geo-spatial Data Centre, Survey of India, Phulenagar, Alandi Road, Pune - 411006 Fax: 020-26614665 E-mail: mgdcsoipune@vsnl.net.in
14	Meghalaya and Arunanchal Pradesh Geo-spatial Data Centre, Shillong	Director, Meghalaya and Arunachal Pradesh Geo-spatial Data centre, Survey of India, Post Box No.89, MALKI, Shillong - 793001 (Meghalaya) Fax: 0364-2224937 E-mail: soi1@sancharnet.in
15	Orissa Geo-spatial Data Centre, Bhubaneshwar	Director, Orissa Geo-spatial Data Centre, Survey of India, Survey Bhawan, PO - RR Laboratory, Bhubaneshwar - 751013 Phone: 0674-2300355, Fax: 0674-2301418 E-mail: ogdco5@sancharnet.in
16	Punjab & Chandigarh Geo-spatial Data Centre, Chandigarh	Director, Punjab & Chandigarh Geo-spatial Data Centre, Survey of India, SOI Complex, Dakshin Marg, Sector 32 A, Chandigarh - 160030 Fax: 0172-2606916. E-mail: pbchdgdc@yahoo.co.in
17	Rajasthan Geo-spatial Data Centre, Jaipur	Additional Surveyor General, Rajasthan Geo-spatial Data Centre, Survey of India, Great Arc Bhawan, Plot No.19, Sector-10, Vidyadhar Nagar, Jaipur- 302023 Fax: 0141-2236891/2236286. E-mail: surwest@datainfosys.net
18	Survey (Air) and Delhi Geo-spatial Data Centre, New Delhi	Director, Delhi Geo-spatial Data Centre, Survey of India, West Block No.4, R.K. Puram, New Delhi - 110066 Fax: 011-26196301,26107035 E-mail: dsa@nda.vsnl.net.in
19	Tamilnadu, Pondicherry and Andaman & Nicobar Island Geo-spatial Data Centre, Chennai	Director, Tamilnadu, Pondicherry and Andaman & Nicobar Island Geo-spatial Data Centre Survey of India Block-III,Electronics Complex, Thiru-Vi-Ka Industrial Estate, Guindy Chennai-600032

		Fax: 044-22328145 E-mail: soitnpani@dataone.in
20	Tripura, Manipur and Mizoram Geo-spatial Data Centre, Silchar	Director, Tripura, Manipur and Mizoram Geo-spatial Data Centre, Survey of India, P.O.Rangir Khari, N.S. Avenue, Haila Kandi Road, Silchar - 788005 Fax: 03842-240555
21	Uttar Pradesh Geo-spatial Data Centre, Lucknow	Additional Surveyor General, Uttar Pradesh Geo-spatial Data Centre, Survey of India, B-2, 2nd Floor, Pickup Bhavan, Gomati Nagar, Lucknow - 226010 Fax: 0522-2720634 E-mail:upgdc_lko@yahoo.com
22	Uttaranchal Geo-spatial Data Centre, Dehradun	Director, Uttaranchal Geo-spatial Data Centre, Survey of India, 17 E.C. Road, DehraDun-248001 Fax: 0135-2656402. E-mail: surveynco@sancharnet.in
23	West Bengal & Sikkim Geo-spatial Data Centre, Kolkata	Director, West Bengal & Sikkim Geo-spatial Data Centre, Survey of India, No.13, Wood Street, Kolkata - 700016 Fax: 033-22800196.22879038 E-mail: social@vsnl.net
PRINTING GROUPS		
Sl.No.	**Name of the Printing Group**	**Mailing Address**
1	Eastern Printing Group, Kolkata	Director, Eastern Printing Group, Survey of India, No.14, Wood Street, Kolkata - 700016 Fax: 033-22834694 E-mail: epgkol@vsnl.net
2	Northern Printing Group, Dehradun	Director, Northern Printing Group, Survey of India,Post Box No. 28, Hathibarkala Estate, Dehradun - 248001 Fax: 0135-2744402 E-mail: dmpsoi@sancharnet.in
3	Southern Printing Group, Hyderarbad	Director, Southern Printing Group, Survey of India, CST & MP Campus, Uppal, Hyderabad - 500039 Fax: 040-27205663 E-mail: dirspg@yahoo.com
4	Western Printing Group, New Delhi	Director, Western Printing Group, Survey of India, Palam Village Road, Near Railway Crossing, Palam Delhi Cantt. E-mail: wpg_del@indiatimes.com Map sales Office of WPG:- Map Sales Office, August Kranti Bhawan Shop No. 151 & 152, Bhika Ji Cama Place, New Delhi. Telephone No. 011-26184388
SPECIALISED DIRECTORATES		
Sl.No.	**Name of the Specialised Directorate**	**Mailing Address**

1	Business & Publicity Directorate, Dehra Dun	Director, Business & Publicity Directorate, Survey of India, Hathibarkala Estate, Post Box No. 28, Dehra Dun (Uttarakhand). Telephone:- 0135-2747051-58 Fax: 0135-2749793
2	GIS & Remote Sensing Directorate	Director, GIS & Remote Sensing Directorate, Survey of India, Uppal Hyderabad-500 039 Fax: 040-27200430 E-mail: hyd2_dmchdsoi@sancharnet.in
3	Geodetic & Research Branch, Dehra Dun	Director, Geodetic & Research Branch, Survey of India, 17 E.C. Road, Dehra Dun - 248001 Fax: 0135-2654528 E-mail: gandrb@vsnl.net.in
4	National Geo-spatial Data Centre, Dehra Dun	Director, National Geo-spatial Data Centre, Block 6, Hathibarkala Estate, Dehra Dun (Uttarakhand) Fax: 0135- 2747623 E-mail: ngdcsoi@yahoo.co.in
5	National Spatial Data Infrastructure (NSDI), New Delhi	Director, National Spatial Data Infrastructure(NSDI),East Block No. 7,Level-5 R K Puran ,New Delhi - 66 Fax: 011 - 26519530 E-mail: Siva_k@nic.in
6	Indian Institute Of Surveying & Mapping , Hyderabad.	Director, Indian Institute Of Surveying & Mapping, Survey of India, Uppal, Hyderabad - 500039 Fax: 040 - 27200286 E-mail: hyd2_surtrain@sancharnet.in Website: www.soisti.gov.in
7	Digital Mapping Centre, Dehradun	Director, Digital Mapping Centre, 17 EC Road, Dehra Dun - 248001 (Uttarakhand) Phone/Fax: 0135- 2656945

3. **NATIONAL REMOTE SENSING CENTRE**

3. ISRO/NRSA	
Delhi Office	SHRI SHANTANU BHATAWDEKAR Scientist & Officer on Special Duty Department of Space 3rd Floor, Loknayak Bhavan, Khan Market, Prithivaj Lane, New Delhi
Bangalore Office	DR. VS HEGDE, Director EOS ISRO HQs, Antariksha Bhavan New BEL Road, Bangalore-560 231
	DR. YVN KRISHNA MURTHY, Director, RRSSCs RRSSC-CMO, ISRO HQs, Antariksha Bhavan New BEL Road, Bangalore-560 231
Hyderabad Office	DR. V. JAYARAMAN, Director National Remote Sensing Centre DOS, Balanager Hyderabad- 500 037

4. **FOREST SURVEY OF INDIA**

4 Forest Survey of India		
1	Forest Survey of India-HQ	Forest Survey of India (Ministry of Environment and Forests) Kaulagarh Road, P.O. IPE Dehradun- 248195 Uttarakhand (India) Nodal Officer : **Shri Sushant Sharma** Deputy Director(P&A) **91135-2755840 (o), +919411110764(mobile)**
2	Regional Director(Central Zone)	Forest Survey of India **(CENTRAL ZONE)** C.G.O. Complex, A-Block Ground Floor, East Wing Seminary Hills **NAGPUR – 440 006** Phone: 0712 – 2510194 & 2510432 FAX: 0712 – 2510194
3	Regional Director(South Zone)	Regional Director (SZ), Forest Survey of India, 8th Floor, B-Wing, Kendriya Sadan, Koramangala, Bangalore - 34.
4	Regional Director (Eastern Zone)	Deputy Director Forest Survey of India, 97/1-B, Hazra Road, Kolkata - 700 026.
5	Regional Director (North Zone)	Regional Director (North Zone) Forest Survey of India (Northern Zone), Himlok Parisar, "Shivalik Khand", Batsley Longwood, Shimla, Himachal Pradesh – 171001.

5. **NATIONAL SOIL AND LAND USE SURVEY**

5. National Bureau of Soil and Land Use Survey	
HEADQUARTERS (NAGPUR)	**KOLKATA**
Director, NBSS&LUP Amravati Road, Shankarnagar PO, Nagpur-440 010 Tel : (0712) 2500386, 2500319, 2500545, 2500664, (0712) 6451643 (R) Fax : (0712) 2500534 E-mail: director@nbsslup.ernet.in	Regional Head, NBSS&LUP Salt Lake City,D.K.Block, Sector-II,. Bidhan Nagar Calcutta-700 091 Tel : (033) 23586926, 23590727(O) (033) 24301461(R) Fax : (033) 23215491 E-mail : nbsscal@wb.nic.in
BANGALORE	**JORHAT**
Regional Head, NBSS&LUP P.B. No. 2487, Hebbal, Agricultural Farm P.O. Bangalore-560 024 Tel : (080) 3412242, 3415683, 3410993(O) (080) 3532641, 3331499(R) Fax : (080) 3510350 E-mail: nbsslup@kar.nic.in	Regional Head, NBSS&LUP NER Centre, Jamujuri Road, Rawriah Jorhat-785 004 Tel : (0376) 2340089(O) (0376) 2341164(R) Fax : (0376) 2340089 Email: utpalb@sancharnet.in
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Regional Head, NBSS&LUP IARI Campus, NTC Building New Delhi - 110 012 Tel : (011) 25840166,25841624 (O) (011) 25833471 (R) Fax : (011) 25840166	Regional Head, NBSS&LUP University Campus Udaipur-313 001 Tel :(0294) 24171421(O) (0294) 2464754(R) Fax : (0294) 2471326

6. **C-DAC: Centre for Development of Advanced Computing**

1. C-DAC

Pune University Campus

Ganesh Khind

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2. GIST

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Part-C: MIS