LIS Activities in Nepal : An Overview in prospect of DoLIA

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Abstract
Modern age is the age of Information Communication Technology (ICT). Every sectors are enhancing their performance, capacity and quality of job through the use of ICT. So implementing Information Communication Technology in the field of Land Administration is highly essential. Indeed it's a need of time. On this way, in our context DoLIA is vigorously working on modernizing land administration and approaching towards paper and pencil free land administration and establishing Land Information System (LIS) in Nepal with full effort and dedication with limited manpower and resources.

Background
Actually land is the basis of life. From it, we get everything for survival. We get food, clothing, fuel, shelter etc. from land. We born and die on land. Every activities and existence of human is related to land directly or indirectly. It is the major source of revenue collection and an only means for agriculture, industry, forestry, settlements and so on. It is a fundamental source for agriculture and thus directly linked to food and security. It is a primary source of collator for obtaining credit from financial institutions and have the economy activities. Due to these various reasons demand of land is increasing day by day as land is fixed and population is increasing in every sunrise. Hence its distribution, uses are of vital importance. Land, being such a crucial thing should be well managed and well administered, not only for existence; but also for social justice & equity, poverty reduction, economic growth, natural conservation and sustainable development.

Being land such a very vital and crucial thing, maintaining land records are of great concern of all government. As usual, in our prospective also land records are maintained traditionally having the cadastral survey and maintaining their records (Maps and Registers). Systematic cadastral survey in Nepal was started in 1964 A.D and was completed in 1995 A.D except some dense areas, as village blocks and government and public lands lying beyond the cultivated and residential area.

Introduction
Gradually concepts of land management have been changing with the motion of development of science and technology and information system. As the demand increases day by day land records are also necessary to be highly accurate, complete, update, reliable and easily accessible. All these things are possible only through the use of Information Communication Technology (ICT). Moreover, planners, policymakers, decision makers and also the general public deserve for good, qualitative, prompt and transparent services through the use of information technology. A modern concept of Geographical Information System (GIS) has evolved for capturing, storing, processing, managing, analyzing, and dissemination of geographic information. LIS (Land Information System) as a subset of GIS is a system for acquiring, processing , managing, storing and distributing the information of land. LIS is a tool for obtaining the relevant information for formulating effective land polices and effective decision making process. It will provide clear, complete, concise and comprehensive information for efficient land management. However for the complete Land Information System (LIS) there is a need of both spatial and non-spatial (attribute) information about land. In our context these data are being handled by Survey Department and Department of Land Reform & Management separately. Department of Land Information and Archive (DoLIA) is established in 2057 B.S. realizing the concepts of Land Information System (LIS) and central cadastral archive center by Nepal Government.

History of Land Information System in Nepal.
In 13th conference of United Nation Regional Cartographic Conference for Asia Pacific held in May 9-18 in Beijing and 14th United Nations Regional Cartographic Conference for Asia and Pacific in 3-7 February 1997 at Bangkok and 1st Cartographic Conference of south Asia Association for Regional Cooperation (SAARC) countries held during 14-15 March 1995 in Kathmandu, application of land information system (LIS) was committed by the member countries. The international initiatives such as Bathurst Declaration (FIG, 1999) and other international workshops on land administration focus on development of land

information system (LIS). In Nepal, government has realized the importance of LIS as an important tool and proposed in 8th five years plan (1992-1997) to establish LIS in Nepal. In 1993 government introduced information technology in land administration in Nepal. A unit called Central Integrated Land Information System was established within the Department of Land Revenue under the Ministry of land Reform and Management (MLRM). A new project Integrated Land Information System (ILIS), directly under the MLRM was set up for incorporating the spatial and attribute aspects of land administration. Various studies and piloting was done to develop at that time. The Swedish International Development Agency (SIDA) had provided the technical assistance in that period. Later, in 9th five Years Plan (1997-2002), government had realized to strengthen LIS activities in Nepal thence the council of ministers decided to establish a well dedicated Department in 2000 A.D. and gave the name Department of Land Information and Archive (DoLIA). From the date of establishment of Department, DoLIA has been working with full dedication and efforts for establishing LIS system in Nepal.

Archive in DoLIA:

Besides, DoLIA had also given the mandate of maintaining the central archive of cadastral maps and supporting documents. Initially maps and other important land records were archived in Survey Department from 2050 B.S. After the establishment of DoLIA , it started to keep archive of such cadastral records and also give initiation for making complete archive of cadastral maps and fieldbooks from different survey offices throughout the countries. This process is still in process of collection of cadastral maps ammonia copies and images of fieldbooks. Collection of ammonia copies for archive is almost complete except Achham district DoLIA is also collecting the ammonia copies of cadastral maps prepared from resurvey.

In addition, archive after preparations of images of fieldbooks of 37 districts has been almost completed and preparation of images of fieldbooks of 36 districts is in progress. Other old maps Mauja Naksa of Kathmandu are also archived in DoLIA. Also microfilms of cadastral maps and fieldbooks of Kathmandu Valley and fieldbooks of Kavre, prepared in assistance of German government have also been archived in DoLIA. In these days in unclear, doubtful, torn office records and in remaining parcel registration, microfilm verification and image\written copy of those records are being provided as per official request. Ammonia copies of cadastral maps in archive play a very important role on recovery of maps of survey offices from being torn, unclear and lost. DoLIA is also working on preparing hard copies to soft copies making image and store in DVD and Hard Disk. This archive will play a vital role for recovery of records, if such records at concerned office demaged from terrorism activities, fire, flood and other natural calamities.

LIS Activities in Nepal:

For the effective and efficient land management LIS has been proved as an appropriate tool. According to the FIG (International Federation of Surveyors) "LIS is a tool for legal, administrative and economic decision making and for planning and development which consists on the one hand of a database containing spatially referenced land related data for a defined area and on the other hand of procedures and techniques for the systematic collection, updating, processing and distribution of the data. The base of a LIS is a uniform spatial referencing system for the data in the system which facilitates the linking of data within the system with other land related data." So for establishing LIS, both spatial data and aspatial (attribute) data are necessary. DoLIA has developed different softwares for handling spatial and attribute data, and support in establishing LIS in Nepal.

- DLIS (District Land Information System).
- SAEx (Spatial Application Extension).
- IRMS (Image Reference Management System).
- PRMS (Plot Register Management System).

DLIS:

DLIS (District Land Information System) is an application software designed and developed for handling the attribute data of land revenue offices. Basically details of the Moth Shresta and Rokkas are captured by the DLIS system. It has been designed not only for data capture but also for the various queries e.g. searching by parcel number, searching by owner name, searching by Moth pana numbers etc as well as data retrival and ultimately providing the computerized land ownership certificates to the general public in a quick, prompt and computerized system. Previously Bhu-Laxmi software was made in 1995 by LIS project based on Windows 95 through National Computer Center which was not so advanced and user friendly. Then after DLIS was made in Microsoft Office 97 version having database in MS-Access. At that time Land Revenue Offices; Kaski , Chahabil and Bhaktapur were chosen for attribute data capture and transactions. Being some limitations, again DLIS was modified and upgraded to Microsoft Office 2000 with MS-Access database. It was in implementation for many years for attribute data capture and transactions. Again there had been realization of some limitations in application having database in MS-Access in the context of database storage capacity, multiuser capacity, data security and integrity. The DLIS system has then upgraded to MS- SQL having the large database capacity, high data security and integrity with the platforms of dot net and C# frameworks in 2010. The entire MS- Access databases prepared before are then migrated to MS-SQL database.

Implementation Status

Data capturing of Moth Shresta and Rokkas of land revenue offices (LRO) have been completed except Achham. Almost all the land revenue offices are updating their

database according to the daily transactions. Moreover, more than 50 land revenue offices are providing the computer printed ownership certificates to the general public. All the remaining LRO's are in the process for providing the computers based ownership certificates to the general public. The most important task on DLIS proceeded by DoLIA is the step towards maintaining the central database in the central server so that every information about ownership and ownership transfer can be easily studied and analyzed as per requirement from the central server. For this, LRO's of Kathmandu valley are uploading the updated database through the internet and other LRO's outside valley are sending updated database at the end of every months through CD/DVD to DoLIA so that central server at DoLIA is maintaining the updated attribute information.

SAEx (Spatial Application Extension) :

SAEx is an application software and is an extension of ArcGIS. Initially it was customized as an extension version of ArcGIS 8x. This extension has been developed for acquisition of the spatial data from the hard copy of cadastral sheets that is digitization and geodatabase Creation in a very consistent way maintaining the uniformity and integrity, and ultimately for providing the quick, prompt and qualitative computer based cadastral services to the general public and other stakeholders from survey offices. Piloting was done in Bhaktapur and Chabahil survey offices in 2000 B.S. Later SAEx was then upgraded to ARcGIS 9x due to the some limitations in functionality and user friendliness in old version. Basically SAEx consists of three features classes

- Parcel
- Construction
- Segments

Parcel: Each and every parcel is digitized in parcel feature class. It consists the information of grid sheet number, dist code, vdc code, ward no, parcel no, parcel type and parcel key in its attribute table. Parcel key is of 23 characters and is generated from aggregating grid sheet number, parcel number, district code, vdc code and ward number which is essential to link with attribute data. Coded values are also used for the distinction and automatic symbolization of government, private, institutional type of parcel.

Construction: The different constructions existed in the cadastral maps are digitized in this feature class. E.g. permanent building, temporary building, damaged building wall etc. It consists of the information of parFID, construction type, area in its attribute table. Coded values are also used for dinstiction and automatic symbolization of permanent building, temporary building, damaged building etc .

Segments: It consists of the information of various linear features of administrative boundary, map sheet boundary and boundary type. Administrative boundary consists the information of ward boundary, VDC\municipality boundary, district boundary, zonal boundary and national boundary. Similarly parcel boundary consists the information of wall, shared wall, fence, building footprint, line kulo, gate etc. Mapsheet boundary consists the information of boundary of the cadastral map sheets. It consists of ParFID, length, boundary types, seg no. in its attribute table. ParFID maintains the relationship with parcel and segments. Coded values are also used for the distinction and automatic symbolization of different boundary types .

There are the options of checking the parcel number duplication and Geometry check e.g overlap between the parcels in SAEx application.

SAEx has been designed and developed not only for the purpose of digitization but also for providing the computer based cadastral services eg. parcel split (kitta kat), parcel merge (kitta Akikaran), map print etc. to the general public very promptly in an efficient manner. Therefore there are different methods for parcel split, to split parcel by different methods and parcel merge, to merge different parcels as per demand of the general public. Furthermore there is an option of Area conversion and facility to provide the cadastral map prints in different paper size in different map scale.

Digitization Status

Digitization and Geodatabase Creation has been almost completed in 29 survey offices. Digitization and Geodatabase Creation of 32 survey offices (including few partially remaining survey offices) are in process and will be completed in the near future. It is very essential to maintain the Geodatabase highly qualitative and accurate. DoLIA is always conscious on qualitative matters as the digitization of cadastral maps is a very sensitive and serious matter concerning precise geometric aspects. Scanned Image check, georeference check , on screen raster vector overlay check, attribute check and print overlay check are some of the major steps of checking for maintaining accuracy on the Digitization and Geodatabase Creation.

Constraints affecting Quality:

Due to following constraints quality of Digitization and Geodatabase Creation may not be achieved as per expectation always.

- Some source cadastral maps are very fragile and are not conditioned well. There are a lot of shrinkage and warp so that error can't be eliminated.
- Some source cadastral maps have hole inside the body of the sheet so that parcel can't be identified.
- Some source cadastral maps have blurred and faint lines so that digitization can't be done perfectly .
- In some survey offices there are multiple trace copies of the same cadastral sheets in use at a same time. Some parcels are splitted in one other parcel in

another haphazardly . They are not integrated so that there arises problem in scanning and digitization.

- In some survey offices there are no any complete information of the total numbers of cadastral sheets. Some may have already lost and torn without having any option.
- Some file maps are prepared in a very careless manner. Parent parcel and prepared file maps mismatched in shape and orientation in many cases and area of the filemaps have been remarkably vary.
- In some cases tracing of map sheets have been carried out incorrectly so that the trace copy will not be more reliable and creates problem in linear dimension, area and also in edge matching with the adjoining sheets.
- Sometimes it has been found that the grid of the cadastral map sheet is different from its exact dimension 50cm × 50cm.
- Sometimes due to some human nature such as high excitement, excessive pressure, time constraint, tediousness after working for long time, bad intension, wrong eye judgment , inadequate knowledge and skill, lack of coordination may affect the quality of the job.

Operational Status

Definitely, there is a necessity of update of the geodatabase after digitization and preparation of geodatabase as per the daily transaction in the survey offices. DoLIA has been providing the necessary IT equipments, required training for manpowers for the update of the geodatabase on such survey offices for providing the computer based cadastral services such as Kittakat (parcel split) and Kitta Akikaran (parcel merge) and map prints through SAEx application in a very accurate and reliable way. The parcel history about the parent parcel, parcel owner, splitted parcel, owner after parcel split are also maintained in geodatabase. Update of geodatabase is in progress in almost all the survey offices where digitization and geodatabase preparation have already completed. Moreover, model survey offices Lalitpur and Dillibazaar are taking steps for using SAEx application for computer based service delivery.

Limitations for operation

Full fledged computer based services using computer application in an uninterruptable way can't be in practice in survey offices as per expectation due to some following limitations.

- Majority of surveyors are familiar only in traditional manual methods and they have no more keen interest to shift towards modern technology.
- Due to change resistive behavior and hesitations to work in computer applications.
- Due to lack of interest to learn and gain computer skills
- Due to inadequate computer knowledge most of the surveyors have no confidence to work in computer environment.
- Inadequate infrastructures eg. server, computers, printers power backups etc
- There is fearful load-shedding problem in the country so that backup or UPS also can't be in full charge. Using generator is very costly and difficult to afford.
- Lack of motivation to the concerned surveyors. They desire some incentive and motivation as it increases some work and they need to work parallel in both system (manually and digitally) until there will be a full fledged digital environment in survey offices.
- Lack of clear and strict direction from the concerned department and ministry.
- Lack of clear legislation addressing digital service delivery.
- Difficult to afforded paroprietary softwares for centeral and all district level offices

Besides, there are some technical issues too. Some are as follows:

- **Area difference:**

Naturally after digitization there is difference in area between the digitized area and recorded area. This is a common and definite problem as the means of area calculation is different. The recorded area is carried out using computing scale and grid whereas digitized area is computetd by on screen digitization, and automatic calculation from the application itself.

- **Edge matching:**

Sometimes in grid sheets, the parcels lying in more than one sheet don't exactly coincide between the adjoining sheets. That may results of appearing the different parcels for the same parcel and the shape also appears to be changed. Such problem may occur mostly due to the errors on the source maps during the time of mapping or due to the error accumulation on tracing the maps.

- **Adjustment of file maps:**

File maps are prepared when the parcel is too small and cause difficulties to split and difficult to write the parcel number within it. File maps are prepared in larger scale by enlarging proportionally without change in area. But in practice in many cases the file maps vary in orientation and area from the parent parcel. Theoretically such file maps should be exactly fitted to the parent parcel while making Geodatabase of cadastral maps. This type problem may arise due to lack of sincerity while making file maps.

- **Inaccurate split of parcel:**

Sometimes it is also found that the parcel is splitted inaccurately at the time of parcel split (kitta kat). The parcel is splitted with area larger or smaller then, what it required to be. This type of problem is easily noticed after digitization. This type of problem may arise due to performance in haste having maximum work pressure in survey office or lack of sincerity during parcel split.

These types of technical issues are briefly incorporated in standard operation Procedure (SOP) prepared by Joint

technical team of DoLIA and Survey Department and are provided to concerned survey offices . Deep, thorough and more detail technical discussions can be made on these abovementioned technical issues.

Benefits:

A lot of benefits can be achieved after having digitization and geodatabase preparation. Some are summarized below:

- Prompt, transparent, reliable qualitative cadastral services can be provided to the general public in a digital environment.
- Parcel split, parcel merge can be done very accurately and precisely through SAEx application
- Cadastral maps can be stored, managed, retrieved, analyzed and disseminated in GIS environment.
- Survey offices will be free from tension of retracing of cadastral maps time to time due to over use.
- There will be no problem of misplacement, lost, torn, shrinkage and expansion of cadastral maps.
- Survey offices can get rid of the dependency on good weather for ammonia map print. Prints of cadastral maps can be provided at any weather in any scale and paper size.
- Different kinds of queries can be easily done from Geodatabase. E.g. how may parcels are less than 100 sq.meter in a specified area?, how many parcels have attachment with roads?, how many government parcels are there in certain sheet?etc.
- Such geodatabase will be highly essential and useful for various development projects related to road, irrigation, transmission line, canal, drinking water etc.
- Area of every parcel and dimension of each segment of a parcel can be obtained very accurately and precisely. There will be no variation in result in every measurement which is a very remarkable benefit over the traditional method.
- Area and other information of a parcel can be obtained on a single click.
- With the help of unique parcel key linkage between spatial data and attribute data of land revenue office can be established so that we can have the information of parcel ownership too.
- A systematic and scientific Cadastral Geodatabase has been prepared and maintained.
- A small space is sufficient to store, update, retrieve, query and to disseminate the cadastral information.

IRMS (Image Reference Management System) :

The IRMS is a MS-SQL based software for the reference entry and management of the pages of fieldbooks images. The fieldbooks images collected from the different survey offices are reference entry in IRMS giving District Code, VDC Code, Ward number, fieldbook page number, parcel number so that image can be retrieved on database concepts without one by one opening of the fieldbooks pages. With the information of District code, VDC code, ward number and parcel number we can easily retrieve the required fieldbook pages that can be provided to general public in printed forms. Finally after reference entry of all the fieldbooks images of all survey offices we can merge individual database of each survey office and make a single database so that information of fieldbooks of all over the country can be obtained from a single computer.

Status:

Image Referance Entry (IRM) of fieldbook Images of 16 survey offices has been almost completed and IRM referance Entry of 25 survey offices is in process and will be completed in coming few months.

PRMS (Plot Register Management Software) :

PRMS is also a MS-SQL based application designed and developed to capture the information of plot register of survey offices. After data entry and update of PRMS we can have the information of the history of any parcel; what is the origin parcel?, how many parcels are formed after parcel split (kittakat)? , what are the original parcels of the merged parcel (Before kitta Akikaran)? through PRMS. We can easily have information of all the intermediate parcels, origin parcel and present parcel (kayam kitta) through this application. It will maintain all the parcel history after transactions. SAEx will maintain the parcel history only after operation or update on this application. It will be more useful for origin parcel information and until parcel history is maintained through the operation of SAEx application.

Status

Data entry of plot register detail of Lalitpur survey office has been almost completed in PRMS Software and data capture (data entry with preparation of image) of plot register of 11 survey offices is in process and will be completed in the near future.

Shortcomings of the system developed and challenging issues:

DoLIA has developed different softwares for handling the spatial and attribute data of cadastre. Those software are based on different platforms. For example ArcGIS is required for SAEx application. Similarly MS-SQL, . net framework, Crystal report is required for DLIS, PRMS, IEMS software. SAEx application interfaces is totally in english so that sometimes it may create complication. It would be easy and user friendly if all those softwares have the common platform. It would be more effective and useful if all the spatial and attribute data could be handled by a single integrated system. Some codes used in different system were not uniform, Now Code standardization is being done for making the codes intact

and uniform on all systems. DoLIA has changed back end database used in DLIS. Previously it was in MS-Access now MS-SQL is being used as database due to some limitations of MS-Access. Previously prepared MS-Access database of some Land Revenue Offices had been migrated to MS-SQL. During migration some data could be lost: time and effort should be given again for the same database. Softwares adoptaion is also another challenging issues for DoLIA. Platforms used by softwares will not be available in market in pace of time as softwares developed by DoLIA are based on proprietary software. Such type of proprietary software are upgraded to newer versions time to time and it is very difficult to adopt with them. Purchasing proprietary software for all central and district level offices for each user is very difficult to afford for developing country like ours.

Conclusions:

Thus using these various softwares DoLIA is vigorously working on modernizing land administration and approaching towards paper and pencil free land administration and establishing Land Information System (LIS) in Nepal with full effort and dedication with limited manpower and resources. As spatial data and attribute data are the fundamental components of LIS, DoLIA has been focusing on capturing , storing, processing, and bringing them in operations or transactions for computer based service delivery to general public till these days from the date of establishment. Now DoLIA is also taking steps towards Central Integrated Land Information System (CILIS) maintaining a central server with network connection so that live or updated information from the district land revenue offices and survey offices can be obtained from the central server of DoLIA. Initially land revenue offices of Kathmandu valley are connected to the central server. Gradually other land revenue offices will also be connected to the central server. A study is being done for maintaining single database of the cadastral geodatabase with the network connection of district survey office and central server located at DoLIA and integrating with the DLIS database.

With this integration we can have Central Integrated Land Information System (CILIS), we can disseminate the data to various stakeholders e.g. local bodies (municipalities\VDC), financial institutions, real estate agencies and other stake holders and can have good revenue generation through data dissemination. DoLIA is on the way. It is not a easy job. It is a huge task that may takes some more time and investment. To achieve this goal; support, co-operation, co-ordination, positive feedbacks from the concerned departments and ministers are highly essential.

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