Nepalese Journal on Geoinformatics

Number : 11

Jestha 2069 BS

May/June 2012 AD

Annual publication of Survey Department, Government of Nepal

Published by:
Government of Nepal
Ministry of Land Reform and Management
Survey Department
Min Bhavan, Kathmandu
Nepal

No. of copies : 500

Nepalese Journal on GEOINFORMATICS

Jestha 2069, May-June 2012
Number 11

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Editorial

It is a matter of great pleasure for me to present the 11th issue of "Nepalese Journal on Geoinformatics", the annual publication of Survey Department. The journal aims to include research and informative articles in the sector of Geoinformatics, and regular features concerning annual activities of Survey Department. We are committed to fulfill its aims and offer a platform to share the knowledge and views of the professionals in the relevant field. We are continuingly making our efforts to improve the quality of the journal and standards of the articles to be published since past ten years of its publication. We always request distinguished authors to provide quality articles such that readers could be benefitted better. We are also exploring the ways how its usefulness could be enhanced. All the past issues are available online at www.dos.gov.np. Coming to this 11th issue, we have also been successful to find a place in Nepali Journal Online (NEPJOL: www.nepjol.info) to publish the journal online. This offer is under the 'Programme for the Enhancement of Research information (PERI)' with the cooperation of Central Library, Tribhuvan University. We sincerely acknowledge the offer and do hope this provision will benefit the readers from all around the world. We have expected feedback from its valued readers so that we can improve the future issues.

At last, I would like to express sincere appreciation to Mr. Krishna Raj B.C., the Director General and the chairperson of the Advisory Council for his invaluable guidance and kind forewords. Likewise, I would like to express my sincere thanks to all the authors, members of the Advisory Council, members of the Editorial Board, and to all who have contributed for the publication of the journal. I do hope to receive the similar cooperation in the future too.

June, 2012 — Jagat Raj Paudel

Kathmandu — Editor-in -chief

Forewords

It gives me immense pleasure to give my forewords on the eleventh issue of 'Nepalese Journal on Geoinformatics', the annual publication of Survey Department. The journal is continuously making its best efforts to provide a platform to its staff and related professionals to share their professional and research contributions, in a small scale though.

It has been a long journey for the department to contribute in nation building as the National Mapping Agency of the country. This issue of the journal is being published on the occasion of the completion of 55 years of its services to the country. At this moment, I would like to recall the proud history of the department. In 2064 B.S., we marked the Golden Jubilee year of the establishment of the department. In that year, we proudly announced the evolution of the department as 'from chain survey to satellite'. In the last five years, we have added in its technological evolution.

Recently, we have introduced policy of using digital technology for cadastral survey. Efforts are underway for the geoid determination of the country, measurement of the height of the Mt. Everest, updating of topographic maps, preparation of digital database among others. We have recently developed ten years' strategic plan, guidelines for improving the service delivery of the department, and currently working on the formulation of the Surveying and Mapping Master Plan. The department's regular activities are focused with priority in the rehabilitation of the maps and land records destroyed during the conflict, surveying and mapping of village block areas, and improving the efficiency and effectiveness of the service delivery from its district level offices. In view of the advancement of the Geoinformation and Communication Technology (Geo-ICT), and increasing societal need, the department has realized that the organization is lacking sufficient organizational capacity in terms of technological advancement to keep pace with time, and human capacity as well.

I would extend my heartiest thanks to the member of Advisory Council and Editorial Board for their persistent efforts to bring this issue publicized. The authors of the papers included in this journal deserve thankfulness for their contribution in making the journal a professional as well as informative to its readers. I would expect, their contributions in the days to come too.

Last but not the least, I would like to congratulate all the staff of Survey Department at the completion of 55 years of the department in serving the nation. At this moment, I pay tribute to those who have contributed to bring this department at this stage in a way or another.

Enjoy reading!

Thank you!

Krishna Raj B.C.

Director General

Survey Department

2069 Jestha,

A Prospect of Digital Airborne Photogrammetry Approach for Cadastral Mapping in Nepal

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Keywords
Digital Cadastral Survey, Photogrammetry, Aerial Photograph, Orthophoto

Abstract
Although the history of land recording system is very old in Nepal, systemic cadastral survey was commenced only after the promulgation of Land Measurement Acts in 1963 and the implementation of land reform programme in 1964. Cadastral survey of all 75 districts of Nepal was completed in 1995/96 using traditional graphical method with plane tables and telescopic/plane alidades. Derived information from the existing maps now are outdated and do not fulfill the needs of the general public. 27 out of the 83 district survey offices under Survey Department, Government of Nepal are presently involved in cadastral mapping of the village block areas which previously have been left out in the first phase of surveys (1964-1996). These offices as well are engaged in the preparation of new mapping series of the districts using the same traditional graphical survey method. The speed of this survey is relatively slow and the general public also is not very satisfied with this resurveying method. People now are soliciting for updated and reliable land information based on new cadastral maps due to greater demand for land market and higher land values. Now the time has come to adopt an appropriate innovative approach for resurveying in the country in order to meet the growing public demands on reliable land information system as well as to provide prompt services. Although various technologies in cadastral mapping are currently available, digital airborne photogrammetry using aerial photographs probably could be an appropriate technology for resurveying in Nepal, especially in the hilly districts for developing accurate and reliable land information system.

1. Introduction
Although the art of surveying and preparation of maps has been practiced from the ancient times, the methods for demarcating land boundaries have been evolved after the man has develop to sense the land property. The earliest surveys were carried out mainly for the purpose of recording the boundaries of land plots. The spatial component of land including accurate delineations of land boundaries was found to be important for administrators and rulers. This eventually has lead to evolve the cadastral survey. Cadastral survey along with its map is basically the parcel based land information showing the demarcation of every parcel boundaries. In addition, it includes land tenure, land use, land value and all other attributes of land which are needed for land administration. Many tools and techniques have been applied in the past in the field of cadastral survey from chain surveying to plane table surveying (with plain alidade/telescope alidade). For the last few decades various techniques have been evolved in the cadastral surveys such as digital cadastre using Total Stations and Global Positional Systems (GPS) instruments, digital aerial photography, and cadastral mapping using high resolution satellite images.

After the introduction of photogrammetry in the mapping processes, approaches in cadastral surveys as well have been changed dramatically. Photogrammetry was first invented in 1851 by Laussedat, and has continued to develop over the last 160 years. Over time, the development of photogrammetry has passed through the phases of plane table photogrammetry, analog photogrammetry, analytical photogrammetry, and has now entered the phase of digital photogrammetry (Konecny, 1994). After the development of aeroplanes in the early twentieth century, aerial photogrammetry technique has been applied in the field of mapping as well as in cadastral surveying. The first aerial photographs were taken over Italian territories in April 24, 1909 by William Wright. Likewise the first aerial camera was built by Oscar Messter in Germany in 1915 (Agor, 2011).

Cadastral survey of all 75 districts of Nepal was completed in 1995/96 using traditional graphical method with plane tables and telescopic/plane alidades. Derived information from the existing maps now are obsolete and do not fulfill the needs of the general public. An innovative survey technique must be adopted for the preparation of new series of cadastral maps for the country in order to create up-to-date land information database. The traditional graphical surveying methods are now very expensive and would take a long time. Analytical aerial photogrammetry technologies for cadastral mapping have been applied in many nations of the world (e.g. Zimbabwe, India, and Cyprus) for the last few decades. Digital photogrammetry technology, one of the latest technologies in the field of digital mapping, will provide accurate cadastral maps with relatively in short period of time and could be reasonably inexpensive. Prospective of digital aerial photogrammetry technique for the preparation of new series of cadastral maps in Nepal is briefly illustrated in this paper.

2. History of Cadastral Survey in Nepal

Although Systemic Cadastral Survey was commenced only after the promulgation of land reform programme in 1964, the history of land recording system is very old in Nepal. The land recording system has been organized for land taxation during the Lichhabi Era (about 1,300 years ago). In those days, land taxation was the prime source of revenue to run the state activities and cadastral survey was basically, in the form of description of land (such as Shresta & Lekhot). Likewise, during the period of Malla Era (14th to 18th Century), significant improvements including the classification of lands, specification for land measurements, provision measurement units (as hale, pate, kute, kodale etc.), development of special profession for land survey and measurement (Dangol), land adjudication and boundary description of land etc. were made. During the period of Rana Rules, the essence of the cadastral maps was realized as an indispensable component for land administration and the chain survey method then was introduced to prepare cadastral maps in 1923 (1980 B.S). Cadastral Survey, showing parcel boundary in the form of map, has been initiated and land records simply comprised of inventory of land parcels, land classification and landowners. This type of cadastral survey has been carried out in some major districts of Nepal but it was sporadic.

Several evolutions in the field of cadastral surveys, basically in techniques and tools for surveying, have been taken place since then. Major evolution however occurred after the establishment of Survey Department in the year of 1957 (2014 B.S). The Land Measurement Acts was introduced in 1963. With the implementation of this act, the cadastral maps became the legal documents defining the boundaries of all land properties and have provided the basic data for land administration including for land taxation. In addition, these maps became an integral part of the land registration process. Systematic cadastral surveys then were carried out on the priority basis of all the districts of Nepal in 1964. Major tools used in surveying basically were plane tables, plain alidades and chains. Later, plain alidades and chains were substituted by telescopic alidades and measuring tapes. The initial survey however was focused mainly for fulfilling the land reform programmes of 1964 and collecting land revenues, and fewer preferences have been given to the usual cadastral objectives. Moreover, National Geodetic Network Systems (NGNS) have not been established for cadastral mapping until 1969. Out of 75 districts of Nepal, cadastral maps of 38 districts were prepared without the national geodetic control points forming the island map sheets of cultivated land. After the establishment of Geodetic Survey Branch under Survey Department in 1969, cadastral surveying of remaining 37 districts was conducted on the basis of NGNS. Cadastral survey office was as well established in each district after the completion of the cadastral surveying of the district. Major responsibility of the district survey office is to maintain and update the cadastral maps and associated documents derived during the process of property transactions and parcel subdivisions.

Cadastral survey of all 75 districts of Nepal was completed in 1995/96 using traditional graphical method with plane tables and telescopic/plane alidades. However, nearly 20,000 hectares of conglomerated village block areas (so called Gaun Blocks) along with government lands were not mapped out due to the time constraint while conducting surveying works in the districts. After the accomplishment of the first phase (Eksoro Napi) of the cadastral mapping, the government has then decided to conduct surveys in the remaining village block areas scattered in many districts of the country, and Survey Department has so far completed surveying of more than fifty percent of these block areas (SD, 2011). These surveys are being conducted at the scale of 1:500 using graphical methods with plane tables, telescopic alidades and measuring tapes. Furthermore, resurveying of 38 districts that were not based on the national control network systems has been carrying out since 1996 with the preference given to the urban and suburban areas having high land values and transactions. Where control points are not enough, GPS technology is being introduced for the establishment of new control points in the village block areas as well as in the resurveying areas.

In 2006, a significant evolution in cadastral survey has taken place in Nepal after the Survey Department has introduced digital cadastral mapping in one of the municipalities of Kabhre district as a pilot project, using latest technology. The main objective of this mapping was to prepare digital cadastral database of the area to mitigate the land disputes, to secure land ownership rights and to develop parcel based land information system. A separate office called Banepa Survey Office was established in 2006 to carry out digital mapping of Banepa Municipality which has been accomplished in the year of 2010. Moreover, land ownership certificates of ward 7 of this municipality have been distributed, while ward 6 is implemented. Equipments such as Total Stations, computers, GIS softwares (Arc GIS and Survey Analyst) along with the other extension softwares (for example Parcel Editor) were used for the mapping. In the middle of 2010, this office has commenced to perform surveying of another municipality of Kabhre district (Dhulikhel Municipality) using the same technology (SD, 2011).

3. Need of New Cadastral Database in Nepal

Although the cadastral mapping of the entire country was completed in 1996 using graphical survey with plane table technique, derived information from the existing maps now are outdated and do not fulfill the needs of the general public. Moreover, existing cadastral maps are not accurate enough for the present planning and development of the country. Twenty-seven out of 83 district survey offices under Survey Department are presently involved in cadastral mapping of the village block areas which previously have been left out without mapping in the first phase of surveys (1964-1996). These offices are as well engaged in the preparation of new mapping series of the districts where cadastral surveys were not based on the NGNS. The scale of the new mapping series is generally at 1:500 and traditional graphical survey method with plane tables and telescopic alidades is being used. The speed of this survey however is relatively slow and the general public also is not very satisfied with this resurveying method. It is because of the fact that people are asking for updated and reliable land information based on new cadastral maps due to greater demand for land market and higher land values, especially in the urban and suburban areas. In addition, people are more aware of their ownership rights, areas and dimensions of land plots and values. Other reasons for the need of digital cadastral mapping in Nepal are land fragmentation resulting in small parcel size, problem of maintaining paper maps for the long period of time, scale factor in demarcation of plot boundary in the field, significant increase in property transactions etc. Considering all these facts Survey Department, Government of Nepal now has to adopt an appropriate innovative approach for cadastral mapping in the country in order to meet the growing public demands on reliable land information system and to provide speedy services. As cadastral data is an essential component upon which all the development activities as well as land administration is based on, an alternative solution must be solicited for providing accurate and reliable land information for effective planning and sustainable development of country.

4. Current Technologies for Digital Cadastral Mapping

A graphical ground surveying method using plane table and telescopic alidade for the purpose of cadastral mapping is no longer an appropriate solution for developing accurate and reliable land information system. A digital survey technique must be adopted for the preparation of cadastral maps in order to create up-to-date continuous digital cadastral database. These databases as well must support the thematic overlays and topographical data in seamless form and must replace the manual techniques associated with the creation and maintenance of the cadastral plans at various scales.

One of the widely used technologies currently in cadastral survey is a digital mapping using Total Station instruments, computers and softwares (for example in Bangladesh, India etc.). Survey Department has already performed digital cadastral mapping in one municipality of Kabhre district of Nepal, using this latest technology. Digital data of the study areas are acquired in the field using Total Station instruments. Ground Control Points (GCPs) are provided in the field using Total Station instruments. The data captured by Total Stations are directly transferred to a PC/Laptop computer. The raw data captured from field are managed as a separated layer. The acquired data are then processed in the computer using appropriate softwares such as Arc GIS/Arc Arc Map and Survey Analyst. Maps and associated attribute data are created as per required and digital cadastral database are then created after processing.

Another extensively used technology in cadastral survey these days is the use of optical remote sensing images such as high resolution satellite images IKONOS and Quick Bird. Photogrammetric techniques along with field verifications are used to produce digital cadastral maps. First of all, satellite images are geometrically corrected. Then vector data layers of land parcels and other detail like roads, building etc. are initially prepared from the geometrically corrected satellite images. Sufficient amount of control points are established in the field using GPS instruments. These details then are verified in the field as per required. Many countries in the world have adopted this technology for cadastral mapping (e.g. Turkey, Bhutan and Bulgaria). In most of the studies where satellite images were used for cadastral mapping have however indicated that they have faced problems in delineating land parcel boundaries correctly. This actually does not fulfill the objectives of the cadastral mapping where high accuracy of parcel boundary is required.

One of the other techniques for preparing digital cadastral maps is the use of analogue aerial photographs with application of digital photogrammetry method (Wijayawardana, 2002). Since 1940s, attempts have been made to use aerial photography for cadastral surveys. Digital photogrammetry emerged as the most efficient technology for mapping large areas for cadastral surveys. Many nations in the world have applied this technique for updating the existing cadastral maps (e.g. Bhutan, Srilanka, India and Cyprus). In this technique, first of all suitable scales of aerial photos of the project area are acquired. The acquired photos are scanned with a high resolution scanner and are then georeferenced using the control points. Orthophotos and mosaics from the georeferenced photos are also produced using the appropriate photogrammetric softwares. Then parcel boundary information is extracted by on screen digitizing using appropriate GIS softwares. Field verifications along with orthophotos, palmtop/laptop computers and GPS are conducted to correct unclear parcel boundaries as well as to solve boundary disputes between land owners in the fields. Although this surveying method may be cheaper and provide better land parcel boundaries compared to the photogrammetric technique with the use of high resolution satellite images, it may not be appropriate for the hilly areas due to relief displacement and shadowing effects. This surveying technique however may be suitable for the plain areas with latest aerial photographs.

5. Digital Airborne Photogrammetry Technique in Nepal

5.1 Justification of New Approach

Cadastral mapping of the entire country was completed in Nepal in 1996 AD using graphical survey with plane table technique. Information derived from the existing maps now are outdated and do not fulfill the needs of the general public. An appropriate innovative approach for resurveying is needed in order to meet the growing public demands on reliable land information. Apart from that, the new approach should increase the speed of mapping and reduce costs & time, particularly where a large area have to be resurveyed. One of the widely used technologies in updating existing cadastral maps is the use of digital aerial photographs with the application of digital photogrammetry. In this technology, digital photographs captured directly from the digital camera are stored and processed on a workstation setup; and many photogrammetric tasks are highly automated (e.g. automatic Digital Elevation Model (DEM) extraction and digital orthophoto generation). The output products are in digital form, such as digital maps, DEMs, and digital orthophotos saved on computer storage media. Therefore, they can be easily stored, managed, and applied as per required.

In comparison to analogue photographs, digital photography has several advantages which include stereo matching, edge response, noise estimation and classification. In addition, there are no requirements of films, photo labs, scanning, noise from film grains and cost of duplication (Perko, 2005). An important novel feature of the digital systems, in comparison to analog systems, is their high radiometric potential, which was empirically proven by Honkavaara and Markelin et al. (2008). This could significantly improve the automation potential processes during the production of orthophotos.

Although the legal boundaries of parcels cannot be determined from the photographs without extensive verifications/adjudications on the ground, this technique can be as accurate as and significantly faster than ground surveys. A study of digital photogrammetry technique conducted by Agrawal and Kumar (2008) in Nizamabad district of Hyderabad, India show that for rural and urban areas, accuracy of the linear measurements up to 0.25 metres with a confidence level of 90% for distances within 1,000 metres was achieved. This accuracy level is good enough for resurveying of hilly districts of Nepal where most of the existing cadastral maps were prepared at the scale of 1:2,500 with accuracy level less than 0.50 metres for linear measurements. This technology probably is an appropriate technology for resurveying in Nepal, especially in the hilly districts such as Achham and Arghakanchi, in order to develop accurate and reliable land information system for effective planning and sustainable development of country as well as to meet public's satisfaction.

5.2 General Processes in Digital Aerial Photography Technique

5.2.1 Acquisition of Digital Aerial Photographs

At first, new digital aerial photographs are acquired for the project area at a suitable scale. A proper flight planning is performed based on the parameters which include flying height, ground resolution, the focal length and the pixel size of the sensors etc. These-days commercial softwares are available for the flight planning processes.

Frame based cameras such as UltraCams from Vexcel Imaging Austria and DMC (Digital Mapping Camera) from Intergraph, designed especially for precision photogrammetric applications are generally used for the acquiring digital aerial photography. Direct georeferencing is increasingly applied in connection to the photogrammetric film/frame cameras. For the geocoding of orthophotos and their tone-matched mosaics new in-flight determinations of the coordinates of the exposure stations and the sensor orientation have been made possible by in-flight differential GPS and by Inertial Measuring Units (IMU)/ Inertial Navigation System (INS). The prerequisite for the use of this technique is an airborne system calibration of camera. Appropriate numbers of GPS Stations and Tracking Stations are commonly linked to the in-flight GPS. Additional GCPs are established in the field using GPS instruments where necessary. As in the analogue photography, side overlaps and forward overlaps for stereo coverage are needed and they follow the same principles. For True orthophoto generation, especially in urban areas, higher overlaps like 80%-90 % are required (Newmann, 2003).

One of the studies carried out in Andra Pradesh Province of India has recommended that aerial photos at 1:10,000 scale are appropriate for the rural areas and 1:4,000 for the urban areas in order to maintain the accuracy of the outcome maps (Agrawal and Kumar, 2000).

Once the digital raw data are acquired from the flight, they require post processing to create the final output images which will be used for subsequent digital mapping.

5.2.2 Generation of DEM and Orthophotos

One of the major processes in digital photogrammetry using aerial photography for cadastral mapping is to create DEM. The principle method of generating DEMs from digital photographs is now automatic stereo matching using the GCP data and additional control data derived from aerial triangulation. Existing digital database, where necessary, may be supplemented while creating DEMs. If airborne GPS and IMU/INS data (which can be referred to as exterior orientation) is available for each photo, GCPs may not be required while processing for DEM creation. Various softwares have been developed over many years and packages such as L P Suite sold by Leica Geosystems, and Match-T are now widely used. These softwares can process hundreds of images or photographs with very few GCPs, while at the same time eliminating the misalignment problem associated with creating photo mosaics. Editing software as well comes with the package and this has significant use, especially at large scales. Major factors affecting the accuracy of DEM during the processes are accuracy of the source data/derived elevation, terrain characteristics, sampling method and interpolation method (Dowman, 2002).

Orthophotos are valuable means in digital mapping process in order to obtain accurate planimetric features with an efficient and speedy manner. In the digital photogrammetry, orthophotos are generally created from the digital photos through orthorectification processes using DEMs and triangulation results. Scale variation and relief displacement in the original photography are removed in the orthophotos. The orthophotos has the geometric characteristics of a map and the image qualities of a photograph. The objects on an orthophoto are in their true orthographic positions. Hence, it is possible to measure true distances, angles and areas directly from them. For the hilly regions, where the elevation differences are very high, true orthophotos may be appropriate. True orthophotos can be generally obtained from three line digital scanners using algorithms that use information from all three looks. Matching algorithms using only two images may be able to produce true orthophotos if breaklines can be utilized (Dowman, 2002).

5.2.3 Digitization of the Known Parcels

For the digital cadastral mapping, parcel boundaries of the details can be extracted by using a computer and appropriate GIS softwares. Orthophotos, with their continuous tone imagery of the ground, provide large number of details which are identified and extracted. Then vector data layers of land parcels and other details like roads, building etc. are initially prepared from the orthophotos. Other ground features as well can be collected and subsequently attributed to reflect the spatial and non-spatial characteristics associated with a feature. However, the major problem is to collect information of the terrains which are covered by obstacles such as trees, high buildings, etc. Unclear details are subsequently verified in the field.

5.2.4 Verification/Adjudication in the Field

In cadastral mapping undertaken by photogrammetry technique, there is a need for follow-up ground surveys to verify the actual location of legal boundaries that may not be visible on the photography or may have been wrongly identified. To overcome this, survey team with GPS and related orthophotos if needed Total Stations instruments, should go to the field to check the parcel boundaries. For efficiency and accuracy in surveying, it is worth to use large scale orthophotos for field adjudication process as well as for land registration. Land owners could trust more on images and models rather than on maps as they could visually interpret their parcel boundary. This will also expedite in identification of ownerships on the ground in the presence of owners.

5.2.5 Final Production of Digital Cadastral Database

After the completion of field verification/adjudication processes, final digital cadastral database along with the attribute data are prepared. These databases can be readily updated as per the changes in land parcel information. Updated, accurate and reliable land information will then be utilized for effective planning and sustainable development of the country.

6. Conclusions

Cadastral mapping of the entire country was completed in 1996 AD using graphical survey with plane table technique. Derived information from the existing cadastral maps now are outdated and do not fulfill the needs of the general public. Furthermore, it is not accurate enough for the present planning and development of the country effectively. Now the time has come to adopt an appropriate innovative approach for resurveying in the country in order to meet the growing public demands on reliable land information system and to provide prompt services. A digital survey technique must be adopted for the preparation of cadastral maps to create up-to-date continuous digital database. Although various technologies in cadastral mapping are currently available, digital aerial photogrammetry probably could be a suitable technology for resurveying in Nepal, especially in the hilly districts for developing accurate and reliable land information system. It should be borne in mind that for performing cadastral mapping through digital aerial photogrammetry technique, sophisticated infrastructural set up such as workstation and appropriate photogrammetry softwares is mandatory. Apart from that skilled manpower is needed in the implementing institution.

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Detection of Building in Airborne Laser Scanner Data and Aerial Images

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Key words:

nDSM, planar segmentation, feature extraction, mean height of nDSM, NDVI, standard deviation of nDSM.

Abstract

The automatic extraction of the objects from airborne laser scanner data and aerial images has been a topic of research for decades. Airborne laser scanner data are very efficient source for the detection of the buildings. Half of the world population lives in urban/suburban areas, so detailed, accurate and up-to-date building information is of great importance to every resident, government agencies, and private companies.

The main objective of this paper is to extract the features for the detection of building using airborne laser scanner data and aerial images. To achieve this objective, a method of integration both LiDAR and aerial images has been explored: thus the advantages of both data sets are utilized to derive the buildings with high accuracy. Airborne laser scanner data contains accurate elevation information in high resolution which is very important feature to detect the elevated objects like buildings and the aerial image has spectral information and this spectral information is an appropriate feature to separate buildings from the trees. Planner region growing segmentation of LiDAR point cloud has been performed and normalized digital surface model (nDSM) is obtained by subtracting DTM from the DSM. Integration of the nDSM, aerial images and the segmented polygon features from the LiDAR point cloud has been carried out. The optimal features for the building detection have been extracted from the integration result. Mean height value of the nDSM, Normalized difference vegetation index (NDVI) and the standard deviation of the nDSM are the effective features. The accuracy assessment of the classification results obtained using the calculated attributes was done. Assessment result yielded an accuracy of almost 92 % explaining the features which are extracted by integrating the two data sets was large extent, effective for the automatic detection of the buildings.

Background

Airborne laser (Light Amplification by Stimulated Emission of Radiation) scanning (ALS) also known as LIDAR (Light Detection and Ranging), is an active remote sensing technique. A helicopter or an airplane mounted sensor sends laser pulses towards ground and records the elapsed time between beam launch and return signal registration. The accurate reflection point location can be calculated using time taken by a beam to return to the sensor, the beam shooting direction, the position and altitude of the sensor recorded with a Global Navigation Satellite System receiver (GNSS) and inertial measurement unit (IMU).

Airborne laser scanner data has proven to be a very suitable technique for the determination of the digital surface models and is more and more being used for mapping and GIS data acquisition purposes, including the detection and modeling of manmade objects or vegetation (Elberink & Mass, 2000).For map updating, city modeling, urban growth analysis and monitoring of informal settlements, there is need for accurate information regarding the buildings which is traditionally collected by an operator. For large volume of work, this process is very tedious and takes a long period of time and eventually increased the cost of the project. In most of the cases only small percentages of the changes have taken place but the operator has to inspect whole of the area carefully in order to locate the building that have changed. Automated approaches are of great importance in such applications, as they can reduce the amount of manual work, and consequently lead to a reduction of the time and cost of the process (Khoshelham et al., 2010). Airborne laser scanning technique plays a vital role in the acquisition of the 3-dimensional point clouds of high density and irregular spacing data in the field of surveying and mapping. The airborne laser scanning technique represents a recent technology based on fast acquisition of dense 3D data and allowing the automation of data processing. In the recent years its use has been increased day by day. One of the most prominent application areas of this technique is extraction and modeling to create 3D city models. By measuring point clouds defined in the three dimensional coordinates, this technique provides automatically Digital Surface Models. But for 3D city modeling, the discrimination between terrain and elevated objects based on this surface model is still a challenging task, since fully automatic extractions are not operational(Tarsha-Kurdi et al., 2006)III symposium,photogrammetrc computer vision ,Bonn</secondary-title></titles><dates><year>2006</year></dates><pub-location>Bonn, Germany</pub-location><urls></urls></record></Cite></EndNote>. Many researchers have shown the capacity of LiDAR data in detection and extraction of the buildings (Maas & Vosselman, 1999).The automatic building extraction in the urban area from data acquired by airborne laser sensors has been an important topic of research in photogrammetry for at least two decades. Earlier, the automatic building detection approaches mostly depend on a monocular aerial or satellite image. These approaches faced a lot of difficulties with occlusion complex buildings and presence of vegetation. These difficulties are due to the lack of information in a single image for the algorithms (Khoshelham et al., 2010). Mainly buildings detection methods are based on classification of the data to eliminate other objects rather than buildings.

Objective

This study is aimed in exploring the techniques for the extraction of the features required for the detection of the building using laser scanner data and aerial images.

The main objective of the project is:
To detect the building from the airborne laser scanner data and aerial images for various purposes

Moreover, the specific objectives are

- To determine the set of features which can uniquely describe the buildings in the airborne laser scanner data and aerial images
- To find the appropriate entity for the classification of the buildings
- To assess the ability of nearest neighbour classification and rule based classification approaches in detection of buildings.
- To test effect of different attributes of segment in the classification process.

Study area and data used

The study area is Vaihingen city, which is situated close to the Stuttgart, Baden-Wurttemberg, Germany; its geographical coordinates are 48° 56' 0" North, 8° 58' 0" East. The test area is situated in the centre of the city Vaihingen. It is characterized by the dense development consisting of historic buildings having some trees, high

Figure: 1 Study area

rising residential buildings that are surrounded by trees and purely residential area with small detached house. The data used for the implementation of this study was captured over Vaihingen in Germany. This data set was captured and provided by the German Society for Photogrammetry, Remote Sensing and Geoinformation (DGPF)[Cramer,2010]:http://www.ifp.unistuttgart.de/dgpf/DKEP-Allg.html (in German) for the test of digital aerial camera. These data set are for the test data from the ISPRS and used for the research purposes.

Figure: 2 Left: Laser scanner point clouds. Middle: digital aerial image. Right: Laser scanner DSM.

The digital aerial images are a part of the high-resolution DMC block of the DGPF test with 8 cm ground resolution. DSM was interpolated from the ALS point cloud with a grid width of 25 cm, using only the points corresponding to the last pulse.

Feature extraction procedure

The features extraction procedures give an overview of the set of the course of action, algorithms and the technique implemented to accomplish the required objective. This section of the study report endeavor bit by bit impending into the concrete process to meet the objective.

For the successful completion of any project it needs a clear plan and conception that will delineate the undertaking flow from one step to the next in order to complete the pre defined objective. A conceptual workflow diagram was outlined and used as strategy during the performance of the procedure.

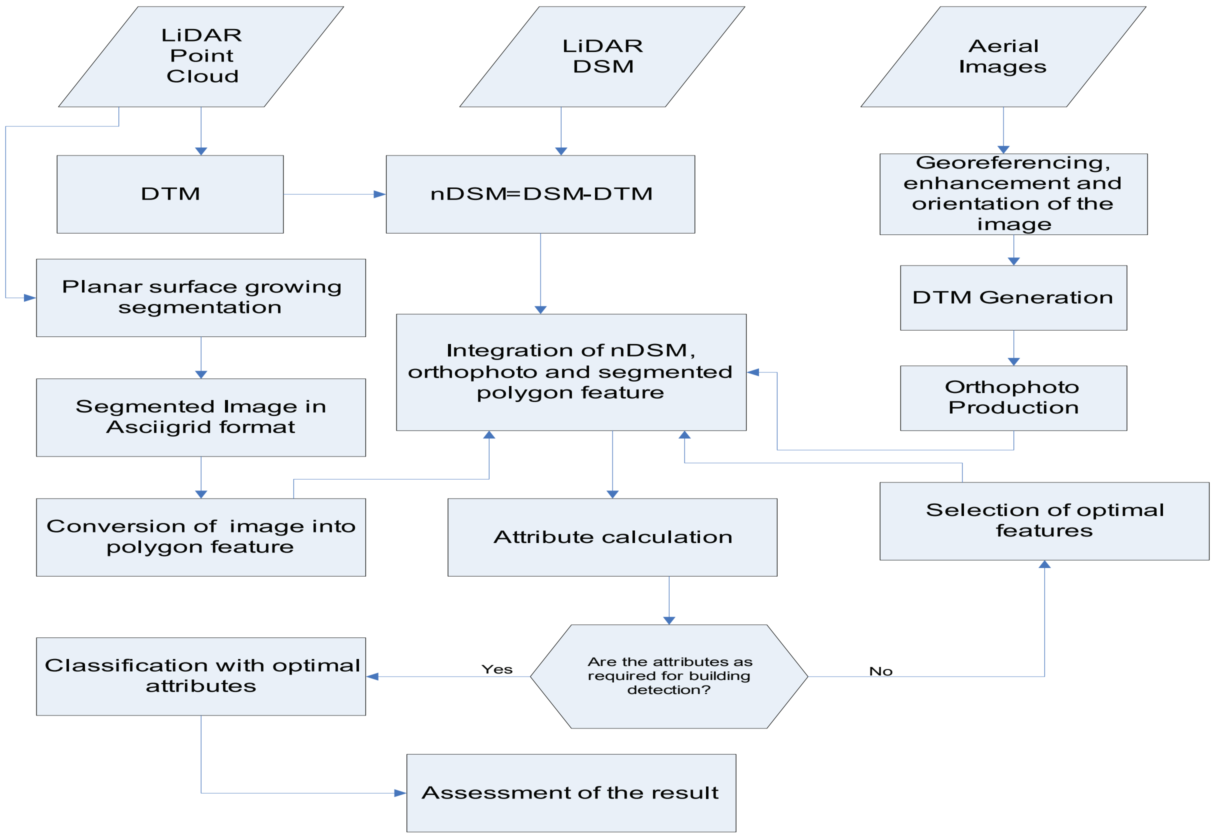

Figure: 3 Conceptual work flow diagrams.

Generation of the Normalised Digital Surface Model

Normalized digital Surface Model (nDSM) is a category of raster layer that correspond to a regular arrangement of locations and each cell has a value corresponding to its elevation. nDSM is the digital representation of the absolute elevation of the features above the surface of the earth. It is generated by subtracting the digital terrain model from the digital surface model i.e. nDSM = DSM - DTM. Hence it is the digital representation of the absolute height of the objects above the DTM. Here the Digital Terrain Model has been prepared from the LiDAR point cloud by using the smooth surface growing technique. A Digital Terrain Model is the elevation model of the landscape which does not have the object above the surface of the earth. Thus, the DTM correspond to only the bare earth surface. On the other hands Digital Surface Model takes account of topography as well as the features with their respective height above the surface of the earth. Thus the generated nDSM provides only the objects above the surface of the earth.

Information extraction from the aerial images and laser scanner data can be done from the smallest processing unit of the image with its features applied for the processing such as classification. The smallest processing unit can be determined as a pixel or an object in the image. In the past and now a days, the single pixel based characteristics by the measurement of reflectance value from the surface of the earth have been used for the most of the methods in information extraction from the images. The traditional pixel based methods are not fully effective to extract information from the high resolution images because of the spectral complexity i.e. similar reflectance from more than one class and different spectral reflectance from one class without paying attention to spatial relationship among the neighbor. The object oriented analysis can overcome the limitation of the pixel based analysis. The initiative of object-oriented analysis is that images are broken down into spectrally homogenous segments or objects. Large number of parameters can be automatically calculated for these created segments like segment's spectral characteristics, texture, shape, orientation, proximity or adjacency to other objects etc. All or some of those characteristics can then is utilized to make rules that are in turn used to classify the segments.

Segmentation

Segmentation is an important step for the feature extraction from the available data by applying an appropriate segmentation algorithm and outlining parameters that could provide a most favorable segmentation pattern. A segmentation algorithm groups points that belong together according to some criterion. The most common segmentation of point clouds are those that group points that fit to the same plane or smooth surface. Segmentation is then equivalent to the recognition of simple shapes in a point cloud (Vosselman et al., 2004). The appropriate segmentation algorithm for the detection of the building is planner segmentation as the geometry of the manmade objects can often be described by a set of planar surfaces. The most suitable algorithm for the detection of the building are surface growing which can be regarded as an extension to three dimension of the well-known region growing algorithm. For processing point clouds surface growing can be formulated as a method of grouping nearby points based on some homogeneity criterion, such as planarity or smoothness of the surface defined by the grouped points (Vosselman, et al., 2004).Surface growing consists of two steps: seed detection and growing. In the first step of the seed detection, a small set of the close at hand points is singled out that forms a planar surface. All points within a number of radiuses around a randomly preferred point are analyzed to determine whether some proportion of the point set fits to a plane. If this is not the case, another point is selected randomly and the neighborhood of this point is analyzed. One time a set of coplanar points has been established, this set represents the seed surface that will be extended in the growing phase. In the region growing step, all points of the seed surface are set onto a heap. Points on the heap are processed one by one. For each of these points, the neighboring points are determined using a data structure. If a neighboring point has not yet been allocated to a surface, it is tested to settle on if the point can be used to enlarge the surface. If the point is within the some distance of the plane fitted to the surface points, the surface label is allocated to the point and the point is situate onto the heap. In this fashion all points on the heap are processed and the surface is full-grown until no more neighboring points robust to the surface plane.

Normalized difference vegetation index:

The Normalized difference vegetation Index is a numerical indicator that uses the visible and near infrared bands of the electromagnetic spectrum and is adopted to analyze the laser scanner data and aerial images for the detection of the buildings. It has found a wide application in separation of the buildings from the vegetation. The vegetation has a significant spectral difference to buildings. Roofs of the buildings usually not covered by the vegetation; therefore we can find a features that represents vegetation in a stable way to separate the buildings. The bigger the difference therefore between the infrared and the red reflectance, the more vegetation has to be. The NDVI algorithms subtract the red reflectance values from the near-infrared and divide by the sum of the red and near-infrared bands.

$$\text{NDVI} = \frac{\text{NIR - RED}}{\text{NIR + RED}}$$

Where NIR = Near infrared band and RED = Red band

Mean height value of normalised digital surface model:

Building objects are always elevated. Thus Buildings are higher than a certain level. It can be used the height information from the nDSM for the recognition of the buildings. Difference of the height between the digital surface models and digital terrain model could be a good indicator to detect the buildings from the airborne laser scanner data and aerial images. The height of the objects depends upon the height of the point inside the segment. The elevation information is a very consistent source of information for the detection of the buildings. Most stabile information for the detection of the buildings is their different elevation compared to their surroundings.

$$\text{Mean height value of nDSM} = \frac{\text{Sum of point heights}}{\text{Total number of points in segments}},$$

$$\text{Mean height value of nDSM} = \frac{\Sigma X}{n}$$

Where X is layer elevation value of the point. n is the number of the point forming a segment.

Standard deviation of the height of the normalised digital surface model

Standard deviation attribute gives the nature of the distribution of the height value deviated from the mean value. It is widely used measurement of the variability or diversity of the height of the objects. It gives an idea about how much the variation or dispersion of the height of an object from the mean value or the expected value. Standard deviation of the height is normally a very key attribute in building detection assessment as it is sharp indicator of the nature shape of the structure.To separate buildings and trees both are elevated object, standard deviation of nDSM has been an important feature to separate buildings from the trees as trees have very high elevation values close to very low elevation values due to the leaf off tree branches. Standard deviation of nDSM alone is not sufficient to separate building from the tree because some of the coniferous trees are not leaf off and give back a quite homogeneous elevation. It may be problematic for those building having gable roofs as they have height variation.

Standard deviation of the nDSM height

$$(\sigma) = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n}}$$

Where n is the number of the point forming a segment, x_i is the layer elevation values of all n points forming segment and $\bar{x}$ is the layer mean value.

Relational boarder to building neighbor object

All objects have neighborhood relationships which could helpful for the extraction of the features. Thus, the attributes relational boarder to building neighbor object is based on the contextual information or the surrounding neighbor objects information on the classes of neighboring segments. This attribute is useful to separate the small segment which inside of the other segments. It is independent of the area of the segment so it is not useful to separate the bigger segments.

The area of segment features

Area of the segments is one of the important features for the extraction of the building. This attributes measures the area of the segments. It is calculated by multiplying the number of pixels formed the segment by the size of the pixel as Area = [Number of pixels]*(0.25*0.25)

Results

Figure 4 underneath exhibit the graphical depiction of the NDVI values by means of histogram. Here the value of the NDVI ranges from -0.2 to absolute value of unity.

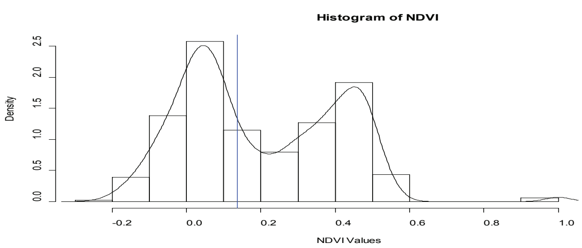

Figure: 4 Histogram of NDVI

The vertical line screening in the graph correspond to the threshold value something like 0.14, the value below of that threshold value represents the buildings segment and beyond of the threshold value represents the other objects like vegetation. Thus the buildings represent the portion in the graph having NDVI value less than 0.14. It is also clear from figure 4 that most of the buildings have NDVI value ranges from 0 to 0.1 having a peak density. Two peaks can be seen in the graph meaning two objects have more concentrated NDVI values. However, we can also perceive from figure that either the perfect vegetation has NDVI value of unity or the outlier values in the NDVI and some water bodies having negative values of NDVI.

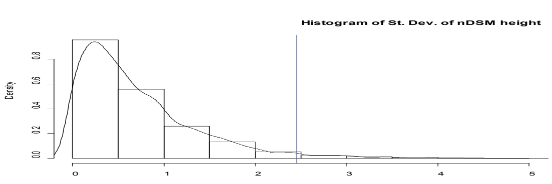

Figure: 5 Histogram of standard deviation of nDSM height

Figure 5 above demonstrates the graphical representation of the standard deviation of nDSM height value. The vertical line in the graph represents the threshold value something like 2.5, the portion in the graph below of that value represents the buildings and the portion in the graph beyond of that value represents the other objects like trees. Figure shows that small numbers of objects have high variation of the height. Most of the objects concentrated towards the lower value of the standard deviation showing the lower variation of the height. From the figure it is clear that the buildings have lower value of the standard deviation indicating the small variation or fluctuation in the height value and the trees exhibit the higher value of the standard deviation indicating the higher variation or fluctuation in the height values. From the figure, it can also be seen that the data exhibit the positive skewed as the left most side has the peaks of the histogram. The positive skew means that more objects obtained are in the lower values of standard deviation.

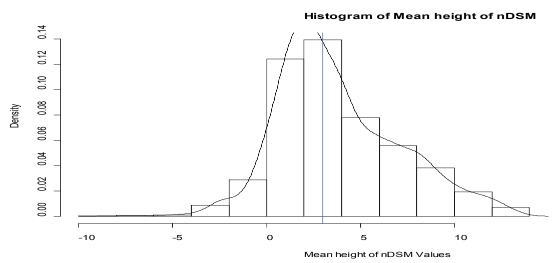

Figure: 6 Histogram of mean height of nDSM

Figure 6 above demonstrates the presentation of the mean value of nDSM height values using histogram. The vertical line in the graph represents the threshold value 3m which was set as the less than 3m object cannot suppose to be a building, below of that value represents the other object having low elevation and beyond of that value represents the elevated objects like buildings and the other objects trees.

Classification Result based on the nearest neighbour method:

Figure7 mentioned below represents the classification result obtained by means of the nearest neighbor classification technique using the three attributes normalized difference vegetation index, mean height of the nDSM and the standard deviation of the height of the nDSM. The relative legend shows the classification represents.

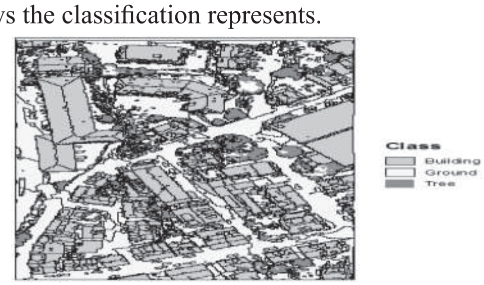

Figure: 7 Classification result based on the nearest neighbour classification method

Classification results based on the rule based classification method:

Figure8 mentioned below represents the classification result obtained by means of the rule based classification technique using the three attributes normalized difference vegetation index, mean height of the nDSM and the standard deviation of the height of the nDSM. The relative legend shows the classification represents:

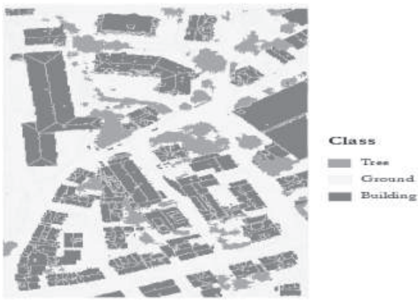

Figure: 8 Classification result based on the rule based classification method

Accuracy assessment of the classification result:

For the assessment of the results obtained from the Nearest Neighbor (NN) classification, the technique employed to evaluate the result is divided into four phases according as the attributes used for the classification in nearest neighbor classification method. In the NN phase 1, the attributes used were mean height value of the nDSM, standard deviation of nDSM height and NDVI. NN phase 2 refers to the attributes used were mean height value of the nDSM and standard deviation of height of nDSM. Similarly in the phase 3 the attributes used were mean height value of the nDSM and NDVI and finally in the phase 4 the attributes used were standard deviation of height of nDSM and NDVI. In the rule based classification (RB) all the attributes were used for the classification and the RB phase refers to the rule based classification. The assessment result obtained is presented in the following table 1.

Phases	Metric (%)		
	DR	R	OA
NN Phase 1	77.3	92.9	92.3
NN Phase 2	61.7	86.0	87.0
NN Phase 3	75.4	95.2	92.6
NN Phase 4	93.3	67.6	88.6
RB Phase	86.0	84.1	91.8

Table: 1 Assessment results

From the analysis of the results presented in the table1, it can be seen that the overall accuracy (classification of building area as buildings and the other object as not buildings), the user's accuracy (classified building is actually a building according to the reference data) as well as the producer's accuracy (building area classified as building) for NN Phase1, Phase 3 and RB phase are greater as comparison to the other phases in which the attributes either used all three or only mean height of nDSM and NDVI. If standard deviation is used with other two attributes separately the accuracy slightly lowers. The overall accuracy of the two technique of classification namely nearest neighbor and rule based using three attributes is almost same 92 %.

Conclusion and Recommendations

Automatic move towards to building detection in airborne laser scanner data and the aerial images are extremely important in many applications like 3D city modeling, urban growth analysis, monitoring of informal settlements and map updating processes as it could diminish the amount of the labor-intensive work and consequently lead to a lessening of the time and the cost of the course. In general, in order to overcome the boundaries of image-based and Lidar-based system, it is of benefit to use a combination of these techniques. Investigating the best possible features for the detection of the building using airborne laser scanner data and the aerial images is the main goal of this paper. Thus, an integration technique of the LiDAR data and the aerial images to extract the features for the automatic detection of the buildings has been explored. Height information from the LiDAR is most important feature to detect the elevated object and the spectral information from the aerial images is an added important feature to separate buildings from the vegetation. Features namely mean height value of the nDSM; NDVI and the standard deviation of the height of the nDSM were extracted from the integration results of both the data set. Classification results obtained using these features are quite impressive. From the accuracy assessment result, it has been found that the overall accuracy of the detection of the buildings using the extracted features is 92 %. Thus, ninety two percentages of the buildings were automatically detected using extracted features. From the classification analysis result and the accuracy assessment of the result it is possible to conclude that the features which are extracted have been successful for the automatic detection of the buildings. Features extraction done in this study is based on the nDSM generated from the DSM which was interpolated from the ALS point cloud with a grid width of 25 cm using only the points corresponding to the last pulse. Other study and experiment can be done using multiple echoes and intensity for further research. Other studies and experiment need to be done for study area having complex scene and undulating terrain. It is recommended to move forward to explore the other features than the features extracted in this study to detect building using both the data set. In this study feature extraction for the buildings detection is premeditated using laser scanner data and the aerial images. It is recommended to move forward to detect other objects like roads, trees etc. When buildings are covered by trees, either they cannot be detected or they can only be detected partially. In addition, multi-return LiDAR data can be applied to effectively differentiate trees from buildings in those cases.

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Looking Back 2011-2012

Change of leadership in Survey Department

Government of Nepal appointed Mr. Krishna Raj B.C., then Joint Secretary of the Ministry of Land Reform and Management, as the Director General of Survey Department. After taking the charge of the Director General on 2068/4/30, Mr. B.C. addressed the staff in the meeting hall of the department. He stressed on the fact that the cooperation from all the colleagues would be the strength for him. He also mentioned that he would always put his efforts in strengthening the department to make it more efficient and effective. Before his address, Mr. Madhu Sudan Adhikary, the Deputy Director General of the Department delivered the welcome speech. He also wished for the successful tenure of the Director General.

Digital Cadastral Training Program

Cadastral Survey Branch conducted Digital Cadastral Training Program at Banepa from 2068/6/29 to 2068/7/8. The participants were from Survey Department, Cadastral Survey Branch, Survey office Dillibazar, Survey office Chabahil, Survey office Kalanki, Survey office Lalitpur and Survey office Bhaktapur. The number of participants was 31.The training program was divided into three parts namely theoretical classes, field works and lab exercises. On completion of the training, Deputy Director General Mr. Narayan Chaudhary distributed the certificate to the participants on 2068/7/8 amid a closing function. Similarly similar training was conducted in Pokhara from 2068/7/21 to 2068/8/8.The participants were from Survey office Dhangadhi, Survey office Banke, Survey office Rupandehi, Survey office Kaski and Survey office Kapilbastu. On completion of the training, Director General Mr. Krishna Raj B.C. distributed the certificate to the participants on 2068/8/8 amid a closing function.

Annual Discussion Programme on Cadastral Survey

Cadastral Survey Branch organized an annual discussion programme from 25 - 27 September 2011 to review the progress of the previous fisical year and to discuss the programme of current fisical year.

Distribution of Land Ownership Certificate

The then Minister of state of Mininstry Land Reform and Management Ms. Jwala Kumari Shah distributed land ownership certificates of Banapa Municipaliy ward no. 7 on 5th December 2011 amid a function. Secretory of Ministry of Land Reform and Management, Mr. Lal Mani Joshi, Director General of Survey Department Mr. Krishna Raj B.C., Deputy Director General Narayan Chaudhary, Chief District Officer of Kavre District Mr. Rudra Nath Basyal addressed the function.

Similarly land ownership certificates of the following Municipalities/VDCs were distributed by the concerning Survey offices.

Dillibazar	-	Tokha Saraswoti VDC,
Kalanki	-	Village block area of Shatungal VDC ward no. 6, 7, 8
Nawalparishi	-	Village block area of Sunwal VDC
Rupandehi	-	Butwal Municipality ward no. 11 and Kerabani, Motipur VDCs
Parsha	-	Birganj Municipality ward no. 19
Kaski	-	Pokhara sub-metropolish ward no. 13
Makawanpur	-	Village block area of Palung, Daman, Markhu, Phakhel VDCs
Chitawan	-	Village block area of Ratnanagar Municipality ward no 5, Patihani, Pithuwa, Bachhauli, Sharadanagar, Shucranagar, Bhandara VDCs
Morang	-	Biratnagar sub-metropolis ward no 15 and Dianiya, Kadmaha, Amahi Bariyati VDCs
Sarlahi	-	Malanwa Municipality ward no. 9, village block area of Parsha and Dhankaula VDCs
Bhaktapur	-	Thimi Municipality ward no. 12
Achham	-	Baijanath VDC

Survey office building under construction

Survey office buildings of Bhaktapur, Dhading, Dhanusha, Kalanki, Makawanpur, Biratnagar, Chitawan and Rautahat are under construction as per the annual program of the fiscal year 2068/069. After the completion of these buildings 26 survey offices out of 83 will operate from their own buildings.

Geoid of Nepal from airborne gravity survey

An airborne gravity survey covering the entire country was carried out from 10^{th} to 17^{th} December 2010 with the cooperation between the Department and Technical University of Denmark (DTU-Space Denmark). Currently the data processing is under progress at DTU-Space Denmark.

Visit of consultant of FAO

Mr. Neil Puller, consultant of FAO visited Survey Department on 10^{th} November 2011. He presented the software concerning Solution on open land administration (SOLA).

Talk program on redetermination of height of Mt. Everest

The Geodetic Survey Branch of Survey Department organized a talk programme on the 14th February 2012. Professor Giorgio Poretti of university of Trieste was the Chief Guest. He has been Professor of Mathematics at the University of Trieste since 1969. A Researcher in Topography, applied Geophysics and Geodesy since 1975, he has carried out several projects in the Karakorum and in the Nepali Himalayas as a member of the EV-K2-CNR Committee for high altitude research. In 1992 he led the Italian scientific team and performed the first GPS measurement of the summit of Mt Everest. In 1996 he carried out the measurement of Mt. K2 also. He had remeasured the elevation of Mt Everest in 2004 too.

Mr. Niraj Manandhar, Chief Survey Officer of Geodetic Survey Branch delivered a presentation on the topic "Redetermination of the elevation of the Mt. Everest". Similarly, Prof. Poretti delivered his presentation on "Gravity Anomalies in Central and Eastern Nepal" and "Experience of the Everest height measurement in 1992 and 2004". Discussion was followed by the presentation.

Joint Secretary Mr. Tej Raj Pandey at the Ministry of Land Reform and Management chaired the programme. Director General Krishna Raj B.C. and Deputy Director General Kalyan Gopal Shrestha of Survey Department delivered brief accounts on the possibility of Survey Department's collaborative approach to remeasure the Everest elevation with Evk2Cnr Project of Italy. Representative of National Planning Commission and EvK2Cnr Projects, and officials of Survey Departments participated in the Programme.

Establishment of Special Survey Office

The maps, field book and other related documents of Arghakhanchi district were destroyed during conflict period. As per the decision of Goverment of Nepal (Minister Level), on 16^{th} November 2011 Special Survey Office Arghakhanchi was established.

The Survey office was inagurated on 23 November 2011 by the Director General of Survey Department Mr. Krishna Raj B.C. amid a function. Deputy Director General of Cadastral Survey Branch Mr. Narayan Chaudhary, the chiefs of the district level offices, representatives of local political parties, representatives of civil society and media persons were present in the function.

Evolution of Land Use Policy in Nepal

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Keywords

Land Use, Policy, Five years Plan, Land Use Policy Drafting Committee

Abstract

Land use is one of the priority sectors of Government of Nepal which can be visualized from the different official documents of the Government. In each of these documents, short term policy is introduced and most of the times it succeeded with partial implementation of the said policy. Therefore, this paper tried to review how the land use policies have been evolved from the period of eighth five year plan to date. Recently the council of ministers, Government of Nepal approved the Land Use Policy. The progress so far made in the preparation of land use data and maps have been briefly mentioned. Some of the key issues have been identified for not achieving the targeted goals of land use policy and proposed some suggestions to overcome the shortcomings. After the adoption of land use policy, it will effectively support in execution of land use implementation plan.

1. Introduction

Land use has been an integral part of human existence and lively hood from the early period of civilization as human need water, shelter and food for which they depend on land. So, knowingly or unknowingly, human have been making the best use of the land for their survival. For instance, despite of not having the land use plan in early days, human select relatively safe area (from hazards and environment) for the settlement, agriculture land closer to the settlement and forest land at appropriate places. While developing settlement area also, people have allocated land to preserve water, open land for recreation, and so on. In Nepalese context as well, old settlement areas have open spaces such as bahal, chowk, market areas, et cetera within their surroundings. Such systematic layout of the settlements can be considered as land use plan and were influenced by the local tradition, environment factors, social structure, terrain and physiography of the area and livelihood such as agriculture, animal, trade and craft et cetera. However, due to increase in population attributing to the increased demand of land resources, the traditional practices of land use simply cannot sustain the demand. This has resulted in over exploitation of land resources causing severe environmental deterioration and decrease in productivity of lands. The impact of such over exploitation is evidently seen and felt in the forms of increasing frequency and scale of hazards (including floods, erosion, land slide, et cetera), loss of productive agriculture land as a result of urbanization and desertification, loss of forest cover due to deforestation, loss of water resources and other negative environmental impacts. All these factors have resulted in food insecurity, insecurity of land tenure, loss of habitat and biodiversity and impacting the livelihoods of people.

Therefore, we are in the stage that we need a better and scientific land use plan and that must be implemented for sustainability of our land which supports our livelihood. Furthermore, the global context of sustainable land use and to meet UN MDG (United Nations Millennium Development Goals) 7: Ensuring Environmental Sustainability by 2015, Nepal should now have a Land Use Policy and land use plans for implementation in order to ensure sustainable use of our land to conserve environment and biodiversity, eradicate poverty, promote economic growth and preserve cultural and national harmony. Fortunately on Baishak 4, 2069 the council of ministers Government of Nepal approved the Land Use Policy. So based on this policy a sustainable land use plan need to be design and implement for uplifting the life of the people.

If we analaze the situation scientifically, we can clearly present the picture of the current situation in the country. In the context of agriculture sector, only 27% of the total land of the country is potentially arable and less than 20% is actually being cultivated (LRMP, 1986) and almost 66% of the active population are employed in the agriculture sector (DOA, 2011) and it contributes to about 32% of GDP (UNIDO, 2009). Furthermore, it is most evident that there will be extension of urban area in the suburbs of municipalities across the country because of high tendency of migration from rural areas and availability of different facilities in urban areas. So, the arable land will be highly utilised to build housings and to expand urban areas which is happening in the country. Due to which the food production is falling. So, if this trend is not addressed in time, the nation will face a great economical and social disaster in near future.

The next important sector is the forest land. Because the forest plays an important role in the lives of Nepalese people as they collect fuel wood for energy, leafy material for fodder, harvest timber for construction of furniture and house, et cetera. According to the land utilization report (LRMP, 1986; DFRS, 2002), about 40% of land of Nepal is covered by the forest but it is estimated that about 1.7% forest and 0.5% of shrub land get encroached every year (MoFSC, 2002). Furthermore, the forest land being used in one hand to distribute to Sukumbasis (landless people) and Kamaiyas (bonded labours). Secondly, forest land encroachment by the local people in recent days is increasing for their personal uses such as agricultural, housing or small scale industry purposes. So the forest is claimed to be shrinking.

The overall scenario from the existing issues such as increasing size of population, low investment, improper land utilization, depending on water intensive crops, changing land utilization by expanding settlements in the agricultural land shows that Nepal has turned into the food-importing country and at the same time larger group of the Nepalese fell under the poverty line. The report of the Third Nepal Standards Survey (NLSS-III) released by Central Bureau of Statistics in 2011 shows that almost 25% of Nepalese are still living below the absolute poverty line. The reason is evident that in one hand a larger group of population is dependent on the land resources and on the other hand there is a lack of proper planning on land resource management.

In order to optimize the uses of land resources, efficient land use planning and land utilization is essential. Land use plan should be prepared by considering environmental perspective to maintain its ecological balance and to focus on economic perspectives to fulfill the basic needs of the people. A comprehensive land use plan can only be prepared when an up-to-date information system of the land resources is available and the plan can be implemented systematically when there exist appropriate law and policy of land use. So if the past history is reviewed, Government of Nepal always tried to formulate policies on land use and attempted to create a land resource information system. This paper tries to study the evolution of land use policy in Nepal.

2. Review on Policy Related with Land Use

Government of Nepal realized the necessity of land use policy for making best use of land resources for the upliftment of the people in Nepal. Therefore, the document related with policy matters always includes short term policy related with land use. In the following paragraphs, such policies are reviewed:

2.1 Eighth Five Year Plan (049-053 BS)

The eighth five year plan (049-053 BS) identified the land use plan as a long term basis programme so in order to address this sector, the policy adopted for the plan was as follows:

- To give priority to increase employment using land resources
- To connect agriculture research with environment based on the differences of land form and climate
- To preserve environment, control landslides and control river inundation
- To implement land use for extension of urbanization
- To formulate land use policy for local level and to increase coordination
- To attempt to prepare master plan for establishment of coordination between land, forest, environment and development
- To create awareness of land use in district and central level
- To amend the existing land use policy and to formulate new act and regulations and to implement

2.2 Ninth Five Year Plan(054-058 BS)

The ninth five year plan (054-058 BS) was focused for sustainable development for preservation and extension of ecological sectors of Himal, Mountain and Tarai using land and other natural resources. The policy adopted for addressing this aspect is as follows:

- To formulate land use plan and to implement by establishment of relationship and coordination amongst the land use related organizations which exist in district level and central level
- To create public awareness on importance and role of land use plan based on the land form, climate, soil et cetera as well as in agricultural production, environment preservation and other sectoral development
- To develop technical and institutional capability for identification of national problems like landslides and land erosion
- To implement the land use plan based on the maps prepared at national and district level by identifying and classifying the land of entire country for agriculture, forest, grazing, settlement, urbanization, industrialization purpose
- To increase land productivity by discouraging the intention of keeping the arable land in non productive state

2.3 Tenth Five Year Plan (059-063 BS)

The objective of land use sector for the tenth five year plan (059-063 BS) was to create land administration work as service oriented and informative by development of sustainable land use management for increasing land productivity. The policy adopted to support the objective is as follows:

- In order to address all land related activities, a national land policy will be formulated and will be implemented. Furthermore, an integrated land related act will be formulated and implemented.
- In order to discourage the use of arable land to other non-agricultural purposes, a land use working policy will be formulated and activated.
- Land resources maps and data will be updated by studying changes in land use. National Geographic Information System will be developed for disseminating the geographical information in an effective manner.

2.4 Three Year Interim Plan (064-066 BS)

Due to unavailability of appropriate land use policy and at the same time there is an increasing trend in fragmentation of plot, the three year interim plan (064-066) prioritize to concentrate for preparation of land use plan and to implement by including development of proper land management and settlement management. In order to address the issues, the policy adopted for this period is as follows:

- Land ownership, land use and land resource data system will be strengthened through Geographical Information Infrastructure.
- Among the areas where land use data are available, land use plan will be implemented through local or user's community in certain areas.

2.5 Fiscal Year Budget 2067-68 BS

The policies adopted in connection to land use by the Government of Nepal for the fiscal year 2067-68 BS are as follows:

- From this fiscal year, it is proposed to change land management system for balancing economic growth, industrial system and environment, by abolishing inter-conflict and weakness in our traditional land management.
- Now onwards, the existing land classification system will be amended. Accordingly, the land system will be classified into six classes namely: agriculture, industrial, forest, commercial, housing and public land. On this basis, the land ownership certificates will be issued.
- An individual or a company who wishes to develop housing plan in a plot, has to fulfill all the formalities and the construction work should be completed and should sold the houses within five years of time.

Again on Chaitra 29, 2067, Deputy Prime Minister and Minister of Finance made public a white paper of Government of Nepal on Economic Status and Policy Concept. In the document, the related policy for the land use sector is as follows:

"An appropriate act will be formulated to discourage to use potentially arable land for real estate and other unproductive activities by promoting to use arable land for increasing agro based products."

2.6 Fiscal Year Budget 2068-69 BS

The policies adopted in connection to land use by the Government of Nepal for the fiscal year 2068-69 BS are as follows:

- Land classification will be done on the basis of its utilization and scientific land reform program will be carried out for increasing productivity of land. The recommendations made by previous land reform commission will be gradually implemented.
- Land use policy will be formulated within mid-October of 2011. Cadastral mapping master plan will be prepared to carry forward the cadastral work in a planned way. The draft of new land reform bill will be formulated to introduce fundamental changes in the land management and to complete the current reforms.

2.7 Policy Formulation

All of these efforts mentioned above could not materialize to formulate land use policy so on Magh 14, 2066, one of the Committees of Legislative Parliament, Committee on Natural Resource and Means gave directive to Ministry of Land Reform and Management to prepare a draft on Land Use Policy within three months of time by coordinating the Ministry of Land Reform and Management, Ministry of Agriculture and Cooperatives and Ministry of Physical Planning and Works. In order to accomplish the assignment, Ministry of Land Reform and Management formulated a draft policy working committee whose composition is as follows:

1. Joint Secretary, Ministry of Land Reform and Management: Co-ordinator
2. Representative, Under Secretary: Ministry of Agriculture and Cooperatives: Member
3. Representative, Under Secretary: Ministry of Forest and Soil Conservation: Member
4. Representative, Under Secretary: Ministry of Physical Planning and Works: Member
5. Representative, Under Secretary: Ministry of Land Reform and Management: Member
6. Representative, Under Secretary: Survey Department: Member

7. Under Secretary, Law Section, Ministry of Land Reform and Management: Member
8. Project Chief, National Land Use Project: Member Secretary

The committee collected relevant information for drafting land use policy through series of discussion with individuals and experts from the concern organizations by organizing workshops. The workshops were organized in different parts of Nepal to represent all the districts. They also collected information from individuals at local level by development of a questionnaire. The present status prevails that the draft policy working committee had prepared a draft of land use policy. So, on Magh 4, 2068, Ministry of Land Reform and Management organized a workshop to give final shape of Land Use Policy in Kathmandu for validation and collecting final suggestions and comments on the draft. Based on the deliberations on the draft policy, the drafting committe incorporated the relevent recomendations and submitted the final draft to Ministry of Land Reform and Mangement. The final draft was forwarded to council of ministers Goverment of Nepal through proper channel and the policy was approved by the cabinet on Baishak 4, 2069. The complete document of Land Use Policy can be downloaded from the website www.molrm.gov.np

3. Progress in Land Use Sector

The progress so far made in land use sector can be reviewed as follows:

3.1 Land Resources Mapping Project (LRMP)

Realizing the importance of proper land use, Land Resources Mapping Project was commenced in 1977 AD to prepare land resources maps of the country which is a basis for the preparation of land use plan. The project was funded by Government of Canada and the project was jointly implemented by Survey Department, Nepal and Canadian International Development Agency (CIDA), Canada. The project successfully terminated in 2034 B.S with the publication of the following products:

1. Aerial Photographs at the scale of 1:20 000 covering areas of Mid western and Far western Development Regions below 15 000 feet altitude
2. Aerial Photographs at the scale of 1:50 000 covering areas of entire Nepal below 15 000 feet altitude
3. Land System Maps at the scale of 1:50 000
4. Land Utilization Maps at the scale of 1:50 000
5. Land Capability Maps at the scale of 1:50 000
6. Geological Maps at the scale of 1:125 000
7. Climatological Maps at the scale of 1:250 000
8. Related Project Reports

These products were extensively used by the user's community and are still in use.

3.2 National Land Use Project (NLUP)

Then in 2058 B.S, Ministry of Land Reform and Management established National Land Use Project. A Land Use council was also formed to guide and identify the programme for the project and to monitor and evaluate the work progress of the project.The constitution of the Land use Council as per the Land Related Act 2021 is as follows:

1. Vice Chairman, National Planning commission: Chairman
2. Secretary, Ministry of Defence: Member
3. Secretary, Ministry of Forest and Soil Conservation: Member
4. Secretary, Ministry of Agriculture and Cooperatives: Member
5. Secretary, Ministry of Physical Planning and Works: Member
6. Three Experts from Land Use Sector nominated by the Government of Nepal: Member
7. Secretary, Ministry of Land Reform and Management: Member Secretary

On Falgun 13, 2064, the Sixth Meeting of Land Use Council decided to constitute a Land Use Technical Committee for supporting the works of Land Use Council with the composition of the following officials:

1. Project Chief, National Land Use Project: Co-ordinator
2. Representative, Ministry of Land Reform and Management: Member
3. Representative, Ministry of Forest and Soil Conservation: Member
4. Representative, Ministry of Agriculture and Cooperatives: Member
5. Representative, Ministry of Physical Planning and Works: Member
6. Representative, Central Bureau of Statistics: Member
7. Representative, Survey Department: Member Secretary

Again, on Kartic 29, 2067, in the Ninth meeting of the Land Use Council, the Committee is expanded with the additional members of representative of at least Under Secretary level from Ministry of Irrigation, Ministry of Environment and Ministry of Local Development.

The scope of work for the project is to update the Land Use maps of Land Resources Mapping Project (1986 AD) and to prepare Land Use data for the municipalities and Village Development Committees of Nepal. But, in the sixth meeting of Land Use Council, the preparation of land use data for Municipalities was assigned to Ministry of Physical Planning and Works. The project started the updating the land use maps using outsourcing option to implement the jobs.The data prepared are based on the soil classification and mapping standards of US System of Soil Taxanomy (USDA, 2003). Furthermore, each category of soil types is also compared with FAO System (FAO, 1998). This system was adopted to establish linkage with the universal soil classification system.The achievements of the project so far are as follows:

1. Completed updating of Land Use maps of District level data which is at the scale of 1:50 000
2. Prepared Land Use data including Land Capability Data, Soil Data, Land Use Zoning and Profile for Lekhnath Municipality of Kaski District and Kirtipur, Bhaktapur and Madhyapur Thimi municipalities of Kathmandu Valley at the scale of 1:10 000
3. Prepared Land Use data including Land Capability Data, Soil Data, Land Use Zoning and Profile for few Village Development Committees at the scale of 1:10 000

Land resources data and information are collected, integrated, analyzed and extracted under digital environment using Geographical Information System (GIS) and Remote Sensing (RS) technology with the help of appropriate Satellite Image Data.

3.3 Other Activities

As per the prevailing Local Self Governance Act 2055, the Municipalities and Village Development Committees has authority to prepare Land use map to allocate land for commercial, settlement, agriculture, entertainment sites, et cetera. In spite of having such authority, the Municipalities and Village Development Committees did not activate the act. However, Ministry of Physical Planning and Works is undertaking the preparation of present and proposed land use plans of some of the municipalities through Department of Urban Development and Housing Construction and concerned municipalities. Some municipalities are doing the similar jobs under the directives of Ministry of Local Development as well.

There exists some other Acts related with Land Use sector in the domain of Agriculture, Forest, Irrigation, Environment, Industry, et cetera which are being exercised by the corresponding ministries.

4. Issues in Land Use Sector

If we review the progress of the policies mentioned in the above paragraphs, it is not fully materialized but partially implemented. The reasons could be due to existence of certain issues related with land use sector which can be listed as follows:

- Lack of an appropriate organizational and institutional framework
- Lack of national level coordination for uniformity and compatibility
- Lack of systematization of GIS-based land resources information systems
- Insufficient human resources
- Insufficient financial and technical resources to develop the system

Land use programme is a multi-disciplinary approach so if there is a lack of appropriate organizational structure and lack of specifications; it is obvious that there will be lack of coordination, uniformity and compatibility in the preparation of data. Due to availability of insufficient financial and technical resources it will be difficult to produce proper and sufficient human resources and will be rather difficult to develop an efficient system.

5. Actions Need to be Taken

In order to address the issues mentioned in the aforementioned paragraph, the following actions need to be taken:

- Strengthening organizational and instuitional set-ups
- Implementation of Land Use policy and related Act
- Preparation of specifications and standards for the land use data
- Preparation of Human resources development plan
- Develop mechanism to update the land use data and to disseminate
- Seek for technological and financial support from bilateral and/or multilateral aid agencies

Ministry of Land Reform and Management should take initiatives to conduct Organization and Management (O/M) Survey for the establishment of a separate organization for carrying out the land use programmes and also should seek for the donor agency for supporting the activities related to land use. In the mean time, National Land Use Project should finalize the standards, norms and the specifications for the preparation of land use database and should identify the necessary human resources and prepare a human resource development plan. However the project has taken the initiation to prepare national level land use specification and expect to finalized before the end of fiscal year 2068-69. Since the land use policy is realesed, the formulation of related land use act should also be initiated as soon as possible

6. Conclusion

From the study it prevails that every document related with land use clearly stated its intention for the betterment of the Nepalese people but every attempt seems to be partially succeeded to implement the plan. Because there are some deficiencies such as lack of proper institution, resources, coordination between related organizations, et etera. However, Land resources data and information are prepared which will help for supporting the planning of land resources management. Efficient utilization of these data and information is necessary to achieve sustainable and rational use of land which will definitely leads to alleviate existing poverty of the Nepalese people. Recently Government of Nepal released the land use policy, so immediate action need to be taken to formulate related act. This will support to develop efficient land use plan and to implement the plan effectively. The land use act should address issues related to updating mechanism data sharing policy and data disseminate process. In order to materialize the plan, it is necessary to establish a separate organization with necessary infrastructures including proper and appropriate human resources.

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Participation in the International Events by the Officials of Survey Department

- Raja Ram Chhatkuli
  The then Director General
  2011 Cambridge Conference
  26 June - 1 July, 2011Southampton, U.K.

- Professional Education
  1 year from September 2011
  Shanjib Kumar Saha, Survey Officer
  ITC the Netherlands

- Krishna Raj B.C., Director General
  Capacity Building for Survey and Mapping Agencies
  UN - GGIM Forum
  PCGIAP Ad-hoc Meeting
  13-28 October, 2011
  South Korea

- Kalyan Gopal Shrestha
  Deputy Director General
  Niraj Manandhar
  Chief Survey Officer
  Finalization of Nepal Geiod Project
  16-22 October, 2011, Denmark

- Suresh Man Shrestha
  Project Chief, NGIIP
  Role of National Statistical and Mapping Agencies in Disaster
  Response and Response Preparedness
  14-18 November, 2011, Thailand

- Niraj Manandhar Chief Survey officer
  IUGG conference
  28 June to 7 July, 2011
  Melbourne, Austrila

- Niraj Manandhar, Chief Survey officer
  Workshop on the use of Multi-GNSS for Sustainable Development
  21 - 22 March, 2012
  Bangkok, Thailand

- Kalyan Gopal Shrestha
  Deputy Director General
  Niraj Manandhar, Chief Survey officer
  FIG workshop on "International Terrestrial Reference Frame" 04-05 May 2012
  Rome, Italy

- Sijan Kumar Dhakal
  Chief Survey Officer
  Damodar Dhakal, Survey Officer
  Global Mapping for Sustainable Development
  14 May - 02 August 2012
  Japan

- Krishna Raj B.C, Directior General
  UN-GGIM conference
  20-26 May, 2012
  Beijing, China

LIS Activities in Nepal : An Overview in prospect of DoLIA

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Keywords
GIS, LIS, SAEx, Digitization, Geodatabase, DLIS, PRMS, IRMS, CILIS.

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 affored 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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Obituary

All the officials of Survey Department pray to the Almighty for eternal peace to the departed soul of the following officials of the department and remembered them for their contribution towards the achievement of the goal of the department.

1. Late Mr. Raju Thapa	-	Surveyor
2. Late Mr. Bhutai Chaudhary	-	Amin
3. Late Mr. Ram Dev Mandal Dhanuk	-	Helper
4. Late Mr. Dhruba Bharati	-	Helper

Price of some of the publications of Survey Department

1. List of Geographical Names volume I to V - NRs 600/- for each volume.
2. Nepalese Journal on Geoinformatices - NRs. 100/-
3. The Population and Socio-economic Atlas of Nepal (Hard Copy) NRs. 2,500 (In Nepal), € 200 (Out side Nepal)
4. The Population and Socio-economic Atlas of Nepal (CD Version) NRs. 250/-

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Price of Maps

S.No.	Description	Coverage	No. of sheets	Price per sheet (NRs)
1	1:25,000 Topo Maps	Terai and mid mountain region of Nepal	590	150.00
2.	1:50 000 Topo Maps	HIgh Mountain and Himalayan region of Nepal	116	150.00
3.	1:50 000 Land Utilization maps	Whole Nepal	266	40.00
4.	1:50 000 Land Capibility maps	Whole Nepal	266	40.00
5.	1:50 000 Land System maps	Whole Nepal	266	40.00
6.	1:125 000 Geological maps	Whole Nepal	82	40.00
7.	1:250 000 Climatological maps	Whole Nepal	17	40.00
8.	1:125 000 Districts maps Nepali	Whole Nepal	76	50.00
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10.	1:500 000 Region maps (Nepali)	Whole Nepal	5	50.00
11.	1:500 000 Region maps (English)	Whole Nepal	5	50.00
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13.	1:1 million Nepal Map	Nepal	1	50.00
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22.	Administrative Map	Nepal	1	5.00

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Gravity Point	-	Rs 1 000.00

Role of Survey Department In Disaster Management In Nepal

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Keywords

Disaster, Hazard, Vulnerability, Earthquake, Disaster management, Survey Department.

Abstract

The Himalayan Range is a young mountain system of the world and about 83% of the total area of Nepal is covered by high hills and mountains. Major river systems of Nepal originate from the glaciers and are perennial in nature. According to the preliminary results of the Census 2011, more than 50% of total population live in Terai and are vulnerable to flood. Since Nepal falls under the seismically active zone earthquake has been one of the major disasters experienced in the country. Fire, Glacier Lake Outburst Flood, lightening, hailstorm are some other natural disaster claiming lives of Nepalese people.

It is not possible to stop disasters, but the consolidated effort of different organization may make us better prepared to overcome the negative impacts of such disasters. This article tries to explore the role of Survey Department in this context.

Introduction

Nepal lies in between the latitudes of 26°22' N. to 30°27' N. and the longitudes 80°04' E. to 88°12' E. Nepal is a landlocked country lying in between People's Republic of China in the north and Republic of India in the west, south and east. In May, 2008 Nepal has been declared as the Federal Democratic Republic. Nepal covers an area of 1,47,181 square kilometers. The Constituent Assembly of Nepal is busy in forming the constitution of the country. Recently, State Restructuring Commission has submitted its report to the government of Nepal on transforming the country into a federal system. Currently Nepal has been administratively divided into five development regions, fourteen zones, seventy-five districts, fifty-eight municipalities and 3915 Village Development Committees (VDCs). Each VDC and municipality is further divided into at least nine wards. Each district is headed by a chief district officer (CDO) responsible for maintaining law and order and coordinating the work of field agencies of the various government ministries.

Topography

Nepal can be divided into three main regions – Terai, hills and mountains. The plain area in the south, called Terai, occupies about 17%, hills 68% and mountains 15% of the total area of the country. More than 80% of the land is comprised of hills and mountains. On an average it extends to 885 kilometers in the east-west and 193 kilometers in the north-south directions. The elevation difference within this small area ranges from about 60 meters to 8848 meters (Mt. Everest).

Rivers

Most of the rivers and streams of Nepal flow from north to south. Basically, rivers originate from Himalayas, Mahabharat range and Chure hills. Rivers originating from Himalayas are perennial in nature.

The three main river systems of the country Koshi, Gandaki and Karnali originating from glaciers and snow-fed lakes constitute the rivers of the first category. Rivers like the Mechi, Bagmati, Kamala, Rapti, etc. originating from the Mahabharat range, constitute the rivers of the second category. Streams and rivulets originating mostly from the Chure hills make up the third category; these rivers rely on monsoon rains and are otherwise dry.

Climate And Rainfall

Nepal has very pleasant climate. Nepal has four distinct seasons. Spring, from March to May is warm and dusty with rain showers. Summer, from June to August, is the monsoon season when the hills turn lush and green. Autumn, from September to November, is cool with clear skies. In winter from December to February, it is cold at night and can be foggy in the early morning but afternoons are usually clear and pleasant, though there is occasional snow in the mountains.

Weather climate conditions in Nepal vary from region to region. Summer and late spring temperatures range from more than 40 Degrees Celsius in the Terai to about 28 Degrees Celsius in the hilly region of the country. In winter, average maximum and minimum temperatures in the Terai range from a mild 23 Degrees Celsius to a brisk 7 Degrees Celsius while the valleys experience a chilly 12 Degrees Celsius maximum temperature and a minimum temperature falling below freezing point. Much colder temperatures prevail at higher elevations.

The mean annual precipitation ranges from more than 6000mm along the southern slopes of the Annapurna range in central Nepal to less than the 250mm in the north central portion near the Tibetan plateau. Precipitation varying between 1500mm and 2500mm predominate over most part of the country. On an average, about 80% of the precipitation is confined to the monsoon period (June-September).

Geology

The Himalayan Range is a young mountain system of the world. It is a broad continuous arc along the northern fringes of the Indian subcontinent, from the bend of the Indus River in the northwest to the Brahmaputra River in the east. The Himalayan mountain chain extends in an east-west direction between the wide plains of the Indus and Bramhaputra in the south and the vast expanse of the high Tibetan Plateau in the north. The limit of the Himalayas in the east and west is marked by the eastern and western arc of Himalayan bends.

Himalaya was formed by the collision of the Indian Plate with Tibetan (Eurasian) Plate around 55 million years ago. Many scientists believe that at that time the northward moving Indian plate first touched the southern edge of Tibetan (Eurasian) plate.

The Himalayan mountain system developed in a series of stages 30 to 50 million years ago and they are still active and continue to rise today. Himalaya is considered as a tectonically very active and vulnerable mountain system of world.

Population

According to the preliminary results of the Census 2011, the population of Nepal is 26,620,809 which is 14.99 % more than the population of Census 2001. 50.15% of total population live in Terai, 43.11% of total population live in Hills and 6.74% of total population live in Mountains. 21.9% of total population live in Eastern, 36.5% of total population live in Central, 18.6% of total population live in Western, 13.5% of total population live in Mid-Western and 9.6% of total population live in Far-Western development regions. 83.0% of total population of Nepal lives in urban and 13.0% of total population of Nepal live in rural areas of Nepal. Among the municipalities, Kathmandu Metropolitan City has highest (1,006,656) and Dhulikhel Municipality has lowest (16,406) population. Kathmandu district has highest (1,740,977) and Manang has lowest (6,527) population. The highly populated districts are Kathmandu (1,740,977), Morang (964,709), Rupandehi (886,706), Jhapa (810,636) and Kailali (770,279). Least populated districts are Manang (6,527), Mustang (13,799), Dolpa (36,701), Rasuwa (43,798) and Humla (51,008). The population density has increased from 157 per square kilometers in 2001 to 181 per square kilometers in 2011. Terai has highest population density of 392 per square kilometers and Mountain has 35 per square kilometers. Population density in urban areas is 1,381 per square kilometers while it is 154 per square kilometers in rural areas.

What Is Disaster?

According to the United Nations International Strategy for Disaster reduction (UNISDR):

Hazard - A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Hazards arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination.

Vulnerability - The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures, and disregard for wise environmental management.

Disaster - A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

Disasters are often described as a result of the combination of the exposure to a hazard, the conditions of vulnerability that are present, and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation.

The Major Kinds Of Disaster In Nepal

Flood and Landslide - The topographical feature of Nepal is mainly responsible for flood and landslide. Flood is caused by heavy precipitation which may occur at any place except high Himalayan region during the monsoon season. In general Terai, southern belt, are prone to floods and flash floods. The causes of landslide in Nepal are natural as well as man-made. Geomorphology of Nepal is very fragile and most of the parts of country fall under seismically active zone. In general the middle hills are prone to landslides. The natural phenomena like heavy rainfall, active geotectonic movements, deforestation and disturbance of hill slopes are also the major causes for occurring landslides.

In July 1993 A.D. Nepal experienced a devastating flood in the Tarai region of Nepal which took the life of 1336 people and affected 487,534 people. Flood and landslide of 1998 A.D. was severe which affected various parts of the country, mainly the Tarai and the middle Hill region. This disaster claimed 273 human lives, injured 80 people and killed 982 cattle heads. Besides, 33,549 families were affected, 13,990 houses and 1244 cattle sheds were destroyed and 45 thousand hectares of land and agricultural crops were ruined. Flood and landslide in 1999 A.D. killed 193 people while the corpse of 47 people could not be found and 91 people were seriously injured. In this disaster 8,844 families were affected, 3,507 houses and cattle sheds were destroyed and 177.32 hectors of land and agricultural crops were ruined.

On August 18, 2008 the Saptakoshi River broke through a retaining wall following heavy monsoon rains, resulting in floods in Sunsari District in southeastern Nepal. Flooding affected eight village development committees and displaced between 35,000 and 50,000 people, according to the U.N. Office for the Coordination of Humanitarian Affairs (OCHA) and local media. Flood waters blocked Nepal's East-West Highway and disrupted communications systems.

Earthquake - Nepal falls under the seismically active zone mainly due to the subduction of Indian plate under Tibetian plate. The seismic record of Nepal is available since 1255 AD. After that, a series of earthquake occurred in Nepal. Major are in 1408, 1681, 1810, 1833, 1866, 1934, 1980, 1988 and 2011 AD.

Earthquake in 1934 A.D. with a tremor of 8.4 Richter scale magnitude claimed the life of 16,875 people and destroyed 3,18,139 houses. Nepal experienced two other major earthquakes one in 1980 A.D. and another in 1988 A.D. The earthquake of 1980 A.D. had a tremor of 6.5 Richter scale magnitude and claimed life of 178 people and about 40 thousand houses were destroyed. The earthquake of 1988 A.D. had a tremor of 6.6 Richter scale and killed 721 people, 1566 cattle heads and destroyed about 64,467 houses. Recently the earthquake of September 18, 2011 A.D. had a tremor of 6.8 Richter scale and killed 6 people and completely destroyed 68 houses in Nepal.

Fire - About 86% of the population of the country inhabit in the rural areas mainly in thatched houses closely clustered where fire hazards are likely to be common. The forest fire usually outbreaks during dry season. In 1999 A.D. fire disaster claimed the life of 39 people injuring 10. The number of affected families by this disaster reached up to 1,065 destroying 1,035 houses.

Glacier Lake Outburst Flood (GLOF) - The impact of climate change has caused GLOF as a major threat in Nepal. GLOF affects high Himalayan region as well as down-stream by extreme damages of lives and properties. Major events shown in past were Tamor Koshi (1980), Sun Kosi (1935, 1981), Dudh Kosi (1977, 1985), Arun (1968, 1969, 1970) etc. Now Tsho Rolpa and Emji Glacier Lake are in most vulnerable stage according to researchers.

Others - The epidemic of diarrhea, encephalitis, meningitis is common during hot and rainy season. The lightening, hailstorm are other natural disaster. The sudden avalanche and heavy snow fall in winter season sometimes cause heavy loss of human lives and properties. Haphazard storage of inflammable substances in cities and urban houses may pose serious threat to the lives of thousands of people.

On the basis of the facts presented above, we can conclude that Nepal is a disaster prone country, most devastating disasters being earthquake, flood and landslide.

Disaster Management In Nepal

Ministry of Home Affairs works as the apex body in relation to disaster management in Nepal. Formulation of national policies and their implementation, preparedness and mitigation of disaster, immediate rescue and relief works, data collection and dissemination, collection and distribution of funds and resources are the vital functions of the Ministry. It has its network throughout the country to cope with the natural disasters. There are 75 administrative districts in the country and each district there is the Chief District Officer as the district administrator who acts as the crisis manager at the time of natural disasters.

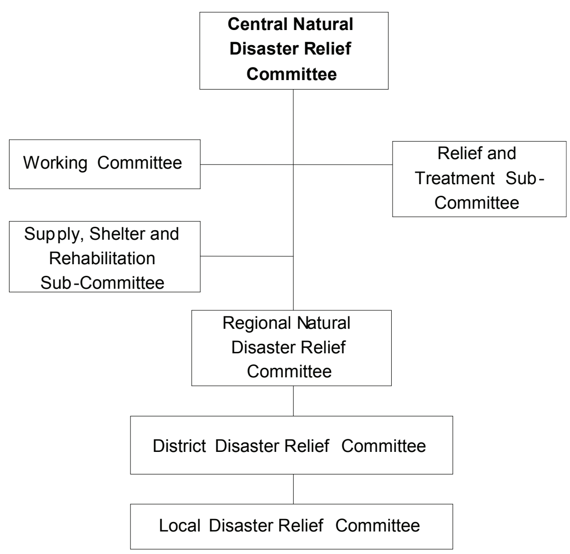

Figure 1: Disaster Management in Nepal

Thus, the Ministry of Home Affairs is the key agency for immediate response during disasters and has to play a leading role in managing the natural disasters in the country.

Role Of Different Institutions

According to the Natural Disaster Relief Act 1982 (NDRA) Central Natural Disaster Relief Committee (CNDRC) has been constituted under the chairmanship of the Home Minister in order to formulate and implement the policies and programs relating to the natural disaster relief work and to undertake other necessary measures related thereof. Secretaries from different ministries are members in this committee. Surprisingly, Survey Department, Ministry of Land Reform and Management has no official representation in this CNDRC.

The Department of Mines and Geology (DOMG) is preparing a landslide inventory. Department of Water Induced Disaster Prevention (DWIDP) is carrying out different activities related to water induced disasters. The Department of Soil Conservation (DOSC) is doing some protection works in different districts. The Department of Roads (DOR) is carrying out some bio-engineering works in cooperation with the Tribhuvan University (TU), in order to stabilize the slope and road cut sides. The Department of Hydrology and Meteorology and International Centre for Integrated Mountain Development (ICIMOD) are preparing the map of flood prone areas. The Department of Hydrology and Meteorology (DOHM) is involved in generating data on earthquakes and weather forecasts in the country.

Disaster Management

Simply speaking, "disaster management can be defined as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters." [International Federation of Red Cross and Red Crescent Societies].

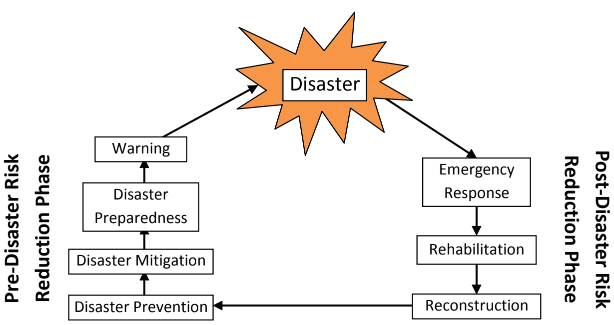

Figure 2: Disaster Management Cycle

Disaster Risk Reduction (DRR) aims to reduce the damage caused by natural hazards like earthquakes, floods, droughts and cyclones, through an ethic of prevention. There are basically two phases in this regard – Pre-Disaster Risk Reduction Phase and Post-Disaster Risk Reduction Phase.

Role Of Survey Department

We do not know when a disaster may break upon us and hence, it is important that we take necessary preparatory measures in case anything unforeseen happens. Natural disasters do not knock on our door before they came and most of the times it is the unexpectedness that harms the most. Although, our preparedness may not stop the disaster from happening, we can definitely control the amount of loss caused by a disaster.

1. The current trend of Survey Department focusing mainly on cadastral mapping should be radically changed to widen its services to a broader range of sustainable development partners. Being a National Mapping Agency, Survey Department should reach out to different development sectors to assist them in the field of mapping and geo-spatial information production and proper use of such information for the overall sustainable national development. One of such development partners is the one leading disaster management in the country.
2. Disaster preparedness, emergency response and rehabilitation are some major phages where Survey Department can provide important information. Existing geo-spatial data in digital or hard copy map form may serve as a tool to predict, manage and mitigate the effects of disasters.
3. Geo-spatial information generated after a disaster can greatly assist in impact assessment and rehabilitation works. Accurate geo-spatial information at hand can greatly ease the overall disaster management process.
4. Generally a few days after a disaster occurs, geo-spatial information may come from a variety of sources. These data are generally in different forms and standards making the use of such information a very difficult task. In this context SD must take appropriate actions to formulate and implement the standards for geo-spatial data/information.
5. Disaster preparedness and rehabilitation works are humanitarian efforts to mitigate and rescue the affected people. Survey Department should take necessary actions to develop a policy to avail baseline geo-spatial data to the concerned organizations free of cost.
6. Geo-spatial data generation and map making is becoming easy day by day. Cheap and sometimes free technology (software, internet etcetera) is becoming available. Survey Department should develop a team of experts and skilled operators to undertake the task of geo-spatial data generation (especially on the basis of satellite images), map making and data sharing especially devoted to the field of disaster management.

7. Efforts of Survey Department alone may not be sufficient to generate required geo-spatial data and information required for disaster management. Survey Department should explore the possibilities of working with different national, regional and international partners working in the field of geo-spatial data and information for disaster management.

Conclusion

Nepal has witnessed a variety of disasters in the past. Due to its topography and geological structure it is a disaster prone country. Disaster management involves a huge amount of resources – both financial and material as well as man power. It is not possible to stop disasters from happening. A consolidated effort of various organizations is a must to cope with the ruthless effects of disasters. Survey Department has a great role to play in the humanitarian efforts to prevent and mitigate the effects of disasters by providing timely, up-to-date, standard, affordable geo-spatial information.

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Calendar of International Events

FIG Working week and general assembly 2012
6-10 May 2012
Rome, Italy
E: fig@fig.net
W: www.fig.net/fig2012

Global Geospatial Conference 2012
14-17 May 2012
Quebec City, Canada
W: www.gsdi.org/gsdiconf/gsdi13

The 8th International Digital Earth Symposium
14-18 May 2012
Taipei
E:derc@mail.pccu.edu.tw
W: www.deconf.pccu.edu.tw/2012TIDES/

2nd International conference and exhibition on Mapping and spatial information 2012
15-17 may 2012
Tehran, Iran
E: icmsi2012@ncc.org.ir
W: www.conf.ncc.org.ir

19th Meeting of ISCGM
12 august 2012
New York, U.S.A.
E: sec@iscgm.org
W: www.iscgm.org/

The XXII Congress of ISPRS
25 August-1 September 2012
Melbourne, Australia
E: director@isprs2012.org
W: www.isprs2012.org

9th United Nation Regional Cartographic
Conference for Asia and the Pacific
29 October- 2 November 2012
Bangkok, Thailand
E: statistics@un.org
W: www.unstats.un.org

33rd Asian Conference on Remote Sensing
26-30 November 2012
Pattaya, Thailand
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W: www.acrs2012.gistda.or.th

Asian Geospatial forum
17-19 September 2012
Hanoi, Vietnam
E: info@asiageospatialforum.org
W:www. asiageospatialforum.org

19th APRSAF
11-14 December 2012
Kuala Lumpur, Malaysia
E: aprsaf 19@aprsaf.org
W: www.aprsaf.org

Transliteration System For Nepali Language

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Keywords

Geographical names, Romanization, Transliteration, Barhakhari, Vowels, Consonants.

Abstract:

Maps are one of the most popular and comprehensive documents in which people can see geographical names and are one of the most effective means to convey accurate place names. In absence of these names it would be very hard to relate the map with the ground. It is very important to standardize these names to get rid of confusion, inconsistency, uncertainty and misunderstanding the names presented in a map. It is rational to develop a Romanization (Transliteration) System for Nepali, not only to support the initiatives of United Nations Group of Experts on Geographical Names (UNGEGN) but also to standardize the way the Nepali geographical names are written especially in maps.

INTRODUCTION

As the Surveyors and Photogrammetrists wrap up their data capturing works, it is time for Cartographers to roll up their sleeves to present the captured data in a meaningful way in a form of map. The world we live on is full of different kinds of man-made and natural features like settlements, parks, transportation network, administrative units, hydrographic features, mountain range, peaks, forests etcetera. Most of the data are presented using traditional symbols. For example, blue lines for streams, rivers, canals; brown lines for contour lines; green color for features related to vegetation and so on.

Apart from the symbols assigned for different features, most of the features shown in a map have their own names viz. names of rivers, settlements, highways, country and administrative divisions and so on. Each of these features is identified by its name to make it distinct from others. It would have been wonderful to have unique and standard name for each and every geographical entities. But in practice we can see different names for one and same object, one name given for different objects lying in different geographical locations, same name written and spelled differently. It is very important to standardize these identifying names to get rid of confusion, inconsistency, uncertainty and misunderstanding of these features. It is more so when people from a different community or nation use these feature names.

Names of the geographical features should be unique as far as possible for consistent use and it is an essential element of communication worldwide and supports socio-economic development of the concerned area. Due to script differences it has always been a problem to write proper feature names in a different language. For example, the name Kathmandu can be found written differently in different maps published by Survey Department. In topographic map at scale 1:25 000, it is written as "KĀṬHMĀṆḌAU", in English version of map of Nepal at scale 1:1000 000, it is written as "KĀṬHMĀNḌU". The same name is written differently in Nepali version of map of Nepal at scale 1:1000 000 as "काठमाडौं" and "काठमाण्डौ". Following the pronunciation guide in map of Nepal at scale 1:1000 000, the name "KĀṬHMĀNḌU" should be written as "काठमान्डु" in Nepali script. Now the question arises whether all these three places "काठमाडौं", "काठमाण्डौ" and "काठमान्डु" the name for same place or names of three different places? This shows how important it is how to write names in maps? Will it not be possible for Survey Department to standardize those names at least in its own publications? Being a National Mapping Authority, Survey Department should find a way out for standardization of geographical names in Nepal. It is not an easy task. The gravity of this problem is so big that United Nations Organization has formed "Working Group on Romanization System" under "United Nations Group of Experts on Geographical Names (UNGEGN)".

The aim of this article is to raise awareness among the users of Nepali geographical names on how to write these names using roman alphabets and to get feedback from the readers of this article to develop/reorganize/standardize Romanization (Transliteration) System for Nepali alphabets, especially to write geographical names.

MAP AND GEOGRAPHICAL NAMES

Maps are one of the most popular and comprehensive documents in which people can see geographical names and are one of the most effective means to convey accurate place names. For general map users it is next to impossible to relate the map with the ground in absence of these names. In a map one can see a variety of geographical names viz. names of country and its administrative divisions, names of different places, roads, streets, rivers, mountain ranges, peaks and names of other natural and man-made features. The volume of these names in a map depends upon its type and map scale.

With the help of standard geographical names we can correctly and unanimously identify the reference location which plays a vital role in writing laws, regulations, legal notices postal addresses and other official documents. Standard geographical names are equally important in the field of education, tourism, administration, management, industry, commerce. Similarly, the role of standard geographical names is invaluable in the field of rescue operation, postal and transportation services. In the field of Geographical Information System (GIS), standard geographical names can be used as reference to which other attribute information can be linked.

Collecting all geographical names of a country and standardize them is not an easy task. There are many issues in standardizing geographical names. To collect, process, formalize and enforce the geographical names a "Geographical Names Authority" must be established. This will be the national authority in the field of geographical names. One of the biggest problems of standardization of place-names is the representation of geographical names in different alphabets and scripts. Since there is rarely a one-to-one relationship between the symbols of different alphabets, the risk of misrepresentation of geographical names from unsystematic conversion systems is imminent.

To coordinate the efforts of different countries in the field of geographical names, in 1959, the Economic and Social Council (ECOSOC) paved the way for a small group of experts to meet and provide technical recommendations on standardizing geographical names at the national and international levels. This meeting gave rise to the United Nations Conferences on the Standardization of Geographical Names (UNCSGN) and to the United Nations Group of Experts on Geographical Names (UNGEGN).

One of the general aims of UNGEGN has been to arrive at an agreement on a single, scientifically based, Romanization system from each non-Roman alphabet or script for international application. To aid the process, a special working group under the responsibility of the United Nations Permanent Committee of Experts on Geographical Names was set up – "Working Group on Romanization Systems".

TRANSLITERATION

According to Wikipedia Transliteration may be understood as a mapping from one system of writing into another, word by word, or ideally letter by letter. Transliteration attempts to use a one-to-one correspondence and be exact, so that an informed reader should be able to reconstruct the original spelling of unknown transliterated words.

The Roman writing system has 26 letters (a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z) as its core alphabet. These 26 letters are not sufficient to represent different letters and/or sounds from other languages. Diacritical marks, appearing above or below a letter, or in some other position such as within the letter or between two letters, are used to change the way these letters are pronounced. In this way letters/sounds from different languages can be represented in Roman system.

NEPALI LANGUAGE

Nepali is the official language of Nepal. It is an Indo-Aryan language spoken in Nepal, Bhutan, Burma and India. It is written in the Devanagari script. In Nepalese context it consists of 12 vowels, 36 consonants and some especial characters.

Nepali vowels: Practically 12 vowels are in common use as listed below:

अ आ इ ई उ ऊ ए ऐ ओ औ अं अः

Apart from the above list of vowels, frequently the following vowels are also used in Nepali:

ऋ ॠ ऌ ॡ

Nepali consonants:

In Nepali language there are 36 consonants. Each consonant is pronounced with a vowel sound अ (a) and are written as shown in the table below.

क ख ग घ ङ च छ ज झ ञ
ट ठ ड ढ ण त थ द ध न
प फ ब भ म य र ल व
श ष स ह क्ष त्र ज्ञ

Each consonant can also be pronounced without a vowel sound अ (a) and are written as shown below.

क् ख् ग् घ् ङ् च् छ् ज् झ् ञ्
ट् ठ् ड् ढ् ण् त् थ् द् ध् न्
प् फ् ब् भ् म् य् र् ल् व्
श् ष् स् ह् क्ष् त्र् ज्ञ्

Extra letters – There are some especial letters in Nepali language as shown below.

श्र हृ ॐ अँ

Nepali numbers – The numeric digits from 0 to 9 are written in Nepali as follows.

० १ २ ३ ४ ५ ६ ७ ८ ९

Combination of consonants and vowels creates different sounds in Nepali and are called *Barhakhari*. The following table illustrates the *Barhakhari*:

क का कि की कु कू के कै को कौ कं क:
ख खा खि खी खु खू खे खै खो खौ खं ख:
ग गा गि गी गु गू गे गै गो गौ गं ग:
घ घा घि घी घु घू घे घै घो घौ घं घ:
and so on.

TRANSLITERATION OF NEPALI LANGUAGE

Over the past several decades several methods have been devised to convert Devanagari script to the Roman alphabetic script. The United Nations recommended system was approved in 1972 based on a report prepared by D. N. Sharma. United States Board on Geographic Names (BGN) and the Permanent Committee on Geographical Names for British Official Use (PCGN) have developed a Romanization system for Nepali in 1964 – "The BGN/PCGN 1964 System". During the preparation of topographical maps of Lumbini Zone during 1980s and recent topographical maps during 1990s, Survey Department has developed Transliteration System for Nepali.

It is not possible to represent all Nepali letters with the help of just 26 Roman alphabets. Finding appropriate letters to represent Nepali vowels and consonants is the main task of developing a Transliteration (Romanization) system for Nepali. To represent different Nepali letters by Roman alphabets, we have to use combination of two or more Roman letters. Similarly we can use diacritic (a special mark added to a letter to indicate a different pronunciation, stress, tone, or meaning) marks as well. The following tables show the Roman letter (or letters) representing Nepali vowels and consonants:

Transliteration (Romanization) of Nepali vowels:

अ	आ	इ	ई	उ	ऊ	ए	ऐ	ओ	औ	अं	अ:
a	ā	i	ī	u	ū	e	ai	o	au	ṁ	ḥ

Transliteration (Romanization) of additional Nepali vowels:

ऋ	ॠ	ऌ	ॡ
ṛi	ṛī	ḷi	ḷī

Transliteration (Romanization) of Nepali consonants:

क	ख	ग	घ	ङ	च	छ	ज	झ	ञ
ka	kha	ga	gha	ṅa	cha	chha	ja	jha	ña
ट	ठ	ड	ढ	ण	त	थ	द	ध	न
ṭa	ṭha	ḍa	ḍha	ṇa	ta	tha	da	dha	na
प	फ	ब	भ	म	य	र	ल	व	
pa	pha	ba	bha	ma	ya	ra	la	wa	
श	ष	स	ह	क्ष	त्र	ज्ञ			
sha	ṣha	sa	ha	kṣha	tra	gña			

Transliteration (Romanization) of Nepali consonants - half form:

क्	ख्	ग्	घ्	ङ्	च्	छ्	ज्	झ्	ञ्
k	kh	g	gh	ṅ	ch	chh	j	jh	ñ
ट्	ठ्	ड्	ढ्	ण्	त्	थ्	द्	ध्	न्
ṭ	ṭh	ḍ	ḍh	ṇ	t	th	d	dh	n
प्	फ्	ब्	भ्	म्	य्	र्	ल्	व्	
p	ph	b	bh	m	y	r	l	w	
श्	ष्	स्	ह्	क्ष्	त्र्	ज्ञ्			
sh	ṣh	s	h	kṣh	tr	gñ			

Apart from letters presented above, there are some more letters in Nepali as presented below:

श्र	हृ	ॐ	अँ
shra	hṛi	om	ā̆

Transliteration (Romanization) of Nepali numbers:

०	१	२	३	४	५	६	७	८	९
0	1	2	3	4	5	6	7	8	9

Transliteration (Romanization) of Nepali *Barhakhari* (example):

क	का	कि	की	कु	कू
ka	kā	ki	kī	ku	kū
के	कै	को	कौ	कं	क:
ke	kai	ko	kau	kaṅ	kaḥ
ख	खा	खि	खी	खु	खू
kha	khā	khi	khī	khu	khū
खे	खै	खो	खौ	खं	ख:
khe	khai	kho	khau	khaṅ	khaḥ
ग	गा	गि	गी	गु	गू
ga	gā	gi	gī	gu	gū
गे	गै	गो	गौ	गं	ग:
ge	gai	go	gau	gaṅ	gaḥ
घ	घा	घि	घी	घु	घू
gha	ghā	ghi	ghī	ghu	ghū
घे	घै	घो	घौ	घं	घ:
ghe	ghai	gho	ghau	ghaṅ	ghaḥ

and so on.

REMARKS

Nepali is not a simple language. Apart from vowels and consonants, it also has a few symbols applied with its letters to make a distinct sound. They are:

1. The dot (*shirbindu*) above the given alphabet is pronounced differently depending upon the consonant following it:

Following consonant	Shirbindu pronounced as
Ka, Kha, Ga, Gha	ṅ
Cha, Chha, Ja, Jha	ñ
Ṭa, Ṭha, Ḍa, Ḍha	ṇ
Ta, Tha, Da, Dha	n
Others	ṁ

2. The sign " ृ " written below a given consonant is pronounced as the sound of given consonant suffixed by 'ri' sound. Example कृ (Kṛi), पृ (Pṛi).
3. The sign " ्र " written with a given consonant is pronounced as the sound of given consonant suffixed by 'ra' sound. Example क्र (Kra), प्र (Pra).
4. The sign " ँ " called *chandrabindu* – a diacritic used in Devanagari script indicating that the previous vowel is nasalized.
5. In Nepali combined letters are formed by joining the half form of the consonants with the full form of consonants. The way these combined letters are written differs slightly in different cases.
6. Many names in Nepali are composed of two words. It is rational to separate these words. For example, Biratnagar should be written as Birat Nagar Lalitpur as Lalit Pur, Makawanpur as Makawan Pur. The last words in these names show some quality of the given place. The way we write the names must be standardize by the proposed "Geographical Names Authority".

EXAMPLES:

The following table shows some examples of Transliteration of Nepali names.

S.N.	NAME IN DEVANAGARI	NAME IN ENGLISH	ROMANIZED
1	काठमाडौं	Kathmadau	KĀṬHAMĀḌAUṆ
2	काठमाण्डौ	Kathmandau	KĀṬHAMĀṆḌAU
3	काठमाण्डू	Kathmandu	KĀṬHAMĀṆḌŪ
4	ललित पुर	Lalit Pur	LALITA PURA
5	बिराट नगर	Birat Nagar	BIRĀṬA NAGARA
6	पोखरा	Pokhara	POKHARĀ
7	वीर गञ्ज	Birganj	WĪRA GAÑJA
8	भक्त पुर	Bhakta Pur	BHAKTA PURA
9	नेपाल गञ्ज	Nepal Ganj	NEPĀLA GAÑJA
10	लुम्बिनी	Lumbini	LUMBINĪ
11	कपिलवस्तु	Kapilwastu	KAPILAWASTU
12	नवल परासी	Nawal Parasi	NAWALA PARĀSĪ
13	भैरहवा	Bhairahawa	BHAIRAHAWĀ
14	धनकुटा	Dhankuta	DHANAKUṬA
15	नारायण घाट	Narayan Ghat	NĀRĀYAṆA GHĀṬA
16	कैलाली	Kailali	KAILĀLĪ
17	बैतडी	Baitadi	BAITAḌĪ
18	ज्ञानेश्वर	Gyaneshwar	GÑĀNESHWARA
19	वानेश्वर	Baneshwar	WANESHWARA
20	धनगढी	Dhangadhi	DHANAGAḌHĪ
21	रौतहट	Rautahat	RAUTAHAṬA

RECOMMENDATIONS:

We are used to write, especially the geographical names, the way we like it. In general we can recognize a name without serious confusion. So far nobody has raised the question why we write a name this or that way? But before it is too late we should develop a unique system of writing geographical names to avoid confusion, inconsistency, uncertainty and misunderstanding of these features among us and more importantly among international communities. We should not forget that most of the geographical names carry some historical and/or socio-cultural importance with them and it matters a lot.

National Planning Commission, Survey Department, Ministry of Local Development, General Post office, Election Commission etc are more concerned with geographical names in their day-to-day work. These organizations should therefore robustly work hand-in-hand to create, support and promote the idea of establishing a "Geographical Names Authority" in Nepal.

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References: References should be listed in alphabetical order at the end of paper in following sequence and punctuation. Author's last name, Author's initials, Year of publication, title of references article, name of book of journal, volume number, country or city, name of publisher etc.

Headings: Major heading should be flushed with the left margin in Times New Roman "10" bold font and with Upper casings.
Minor heading should be flushed with the left margin in Times New Roman "10" Bold font and with Upper and Lower Casing.

Bullet Point: Use only (•)

Placement: Photographs or tables should be pasted in place of manuscript pages with caption in their positions in Times new Roman "10" with Upper and lower casing.

Review: The First High Level Forum on Global Geospatial Information Management (GGIM), a United Nations Initiative

Krishna Raj B.C.*
Director General
Survey Department

Location referenced databases are increasingly important to societies all over the world. Geospatial data and associated policies at regional and global levels are important tools for addressing current cross-border problems across a wide range of disciplines and sectors. In response to these challenges, and following several years of preparatory activities on regional and global geospatial information management issues, the United Nations (UN) officially launched Global Geospatial Information Management (GGIM) initiative (www.ggim.un.org) with Resolution 2011/24 of the UN Economic and Social Council (ECOSOC) in July 2011. The Resolution created a formal mechanism for discussing key issues and potential action relating to SDI developments at national, regional and global levels, involving UN member states as the key players. The Council also adopted a resolution to form a UN Committee of Experts for Global Geospatial Information Management (UN GGIM). The GGIM initiative aims at playing a leading role in setting the agenda for the development of global geospatial information and to promote its use to address key global challenges. It provides a forum to liaise and coordinate among the UN member states, and between UN member states and international organizations.

As an effort of furthering GGIM initiatives, the First High Level Forum on GGIM, was held in Seoul from 24 to 26 October 2011, which was jointly organized by the United Nations and Korean National Geographic Information Institute (NGII Korea). The forum was supported by the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP), the Permanent Committee for Geospatial Data Infrastructure of the Americas (PC-IDEA) and the Committee on Development Information, Science and Technology (CODIST) for Africa. About 350 participants from 90 countries, 22 UN representatives, and 37 representatives from international organizations and the private sector attended the forum. The inaugural session was addressed by the Prime Minister of the Republic of Korea Mr. Kim Hwang-Sik, United Nations' Under-Secretary-General Mr. Sha Zukang, and Prof. William Cartwright, President of the Joint Board of Geospatial Information Societies. In the opening address, the Prime Minister stressed that geospatial information is the most fundamental and essential tool to support the joint efforts in resolving global issues. By interconnecting information on natural disasters, poverty and the environment through location data, global issues such as sustainable development and poverty eradication can be systematically and effectively managed. He pointed out that, as a consequence of rapid technological advances, geospatial information have become increasingly important in our daily lives.

The Forum began with a Ministerial Segment followed by the opening session. Ministers from eight countries (Korea, Chile, Finland, India, Malaysia, Mongolia, Namibia, and Niger) participated the session and delivered their statements. Dr. Vanessa V. Lawrence CB, Director General and Chief Executive, of Ordnance Survey, United Kingdom moderated the session**.** The sessions began with keynote speech followed by panel discussions. The session mainly focused on exchanging views on the role of geospatial-information in national development. The Ministers strongly supported the GGIM initiatives and praised the role of geospatial information in policy formulation and evidence-based decision making for national development. Several policy challenges like climate change, disaster management, population growth and food security, tourism, urban planning and sustainable development were discussed. Ministers pointed out that demand for the geospatial information is not only the concern of political level but also the increasing concern of civil society in the context of efficient public service delivery. Most importantly, the Ministers stressed the importance of working together across borders, through research and development (R&D) activities, sharing good practices and technology transfer, in order to meet national, regional and global demand for geospatial information, such that Member States with less capacity could also be benefited by providing access to additional capabilities and capacities. The delegates appreciated the attention that

*Mr. Krishna Raj B.C. is the Director General of Survey Department. Mr. B.C. attended the reviewed Forum.

was given at the highest political level regarding the issue of geospatial information management. Such an attention from the political level was considered as an important precondition to successfully tackle the institutional and policy challenges related to geospatial information management.

The Ministerial Segment was followed by four thematic sessions focusing on “Challenges in Geospatial Policy Formulation and Institutional Arrangement”, “Developing Common Frameworks and Methodologies”, “International Coordination and Cooperation in Meeting Global Needs” and “Capacity Building and Knowledge Transfer”. Each session began with Keynote speech followed by panel discussions.

The Forum was preceded on Sunday 23 October by an Exchange Forum attended by representatives from the geospatial industry and the government. The geospatial communities affirmed their commitment, and together with the academia, pledged to use their collective professional expertise, research and development capacities to help realize the vision and goal of UN_GGIM of building sustainable geospatial information infrastructure at national, regional, and global levels and of enhanced cooperation in the generation, dissemination and sharing of geospatial information.

The other key issues identified and discussed in the forum can be summarized as follows:

- Common frameworks and methodologies are useful to increase accessibility and sharing of data. The concept of global geodetic reference system and a global consultation mechanism on the adoption of technical standards are appreciable. Further exploration is needed for common framework, which is expected through appropriate work groups under UN_GGIM. Collaboration among the Member States in developing common framework, tools and procedures is important. Adoption of common frameworks and methodologies is also useful to share best practices on impact and usefulness of well implemented national spatial data infrastructures.
- International geospatial information societies and standard setting organizations deserve important role in GGIM initiatives. UN_GGIM could play an important role to act as a coordinating body providing overall guidance and direction.
- The geospatial industry can be a key partner of global geospatial information community. The dialogue between the governments and industry partners should be continued under the umbrella of UN_GGIM.
- The accessibility and sharing of geospatial data at the national level should possible at minimum cost and it should be one of the information policy issues. Open data (and metadata) platforms could be of great support for effective integration of geospatial data with other thematic data. Privacy and national security considerations need to be taken seriously and restrictions on the release of geospatial data should be minimal.
- UN_GGIM could develop and elaborate some guidelines for countries, describing existing models of institutional arrangements and their strengths and shortcomings.
- There is urgent need of developing a roadmap based on international best practices to assist countries in the development of a National Spatial Data Infrastructure which would form the basis for integrating data with other sources and for data-sharing at all levels (local, national, regional and global).
- Effective strategies for building and strengthening capacity of Member states are needed to manage geospatial information. A holistic capacity building effort is needed that includes capacity assessment and capacity enhancement in all dimensions: building of knowledge and institutions, education research and outreach.
- UN_GGIM Mechanism can be a coordinating body for facilitating regional cooperation, and exploiting and utilizing the strength of the international professional communities as well as geospatial industry.
- Effective regional cooperation is required with greater efforts for building effective spatial data infrastructure and capacity development in the developing countries.

At the closing ceremony, held on the final day of the event, the Forum adopted the Seoul Declaration.

Seoul Declaration on Global Geospatial Information Management (GGIM)

(Issued on 26 Oct, 2011)

We, the participants of the First High Level Forum on Global Geospatial Information Management held in Seoul, Korea, on October 24 to 26, 2011, having met in the context of United Nations initiatives to enhance global cooperation in the field of geospatial information management in order to help overcome global challenges, hereby issue this Seoul Declaration on Global Geospatial Information Management (GGIM).

Recalling Resolution 2011/24 of the United Nations Economic and Social Council, which recognized the need to promote international cooperation in the field of global geospatial information;

Recalling further the United Nations Secretary-General's Report E/2011/89, which encouraged the strengthening of cooperation among Member States and International Organizations and emphasized the urgency in establishing concrete actions for the further development of global geospatial information in order to adequately respond to global challenges;

Recognizing the need for full interoperability of multi-dimensional geospatial information and integration with other data sources at national, regional, and global level, in order to provide an effective information base for the resolution of global and local issues, and the need for establishing national, regional and global mechanisms for effective management and utilization of such information;

Sharing a global vision and conviction that reliable and timely geospatial information is an important basis for policy decision making, especially in the context of humanitarian assistance and sustainable development;

We, therefore resolve,

- to express our support for the initiative of the United Nations to foster geospatial information management among UN Member States, international organizations, and the private sector; and in this regard:
- to take actions to foster and strengthen national, regional and global cooperation with the aim of developing an interconnected global community of practice on geospatial information under the umbrella of the United Nations;
- to devise effective processes for jointly and collaboratively promoting common frameworks and standards, as well as harmonized definitions and methods for the treatment of national geospatial data in order to enhance geospatial information management at the national, regional and global level;
- to share experiences in policy-making, supporting legislation, and funding strategies, to encourage and develop best practices in geospatial information management (i.e. collection, storage, maintenance and dissemination) at all levels, including integration of spatial data with thematic data from other sources, and to facilitate and promote capacity development in the developing countries.

References:

1. *Seoul Declaration on GGIM (http://ggim.un.org/docs/meetings/High%20level%20forum/Seoul%20Declaration%20on%20GGIM-25%20Oct.pdf)*
2. *Summary of the UN_GGIM Meeting (http://ggim.un.org/docs/meetings/High%20level%20forum/GGIM-chairman%20summary%20HLF-26.pdf)*

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20th Anniversary Program of NRSPS

The 20th Anniversary Program of Nepal Remote Sensing and Photogrammetric Society (NRSPS) was organized on April 29, 2011. The programme was initiated by Mr. Rabin K. Sharma, President, NRSPS. After opening of the programme, Mr. Buddhi Narayan Shrestha, former President of NRSPS released Earth Observation Volume III; Annual Newsletter of NRSPS in which two articles: "Use of Airborne Gravity System for Determining Geoid by Rabin K. Sharma, President, NRSPS and "Free Image Data for Remote Sensing Practices" by Madhusudan Adhikari, President, Nepal Surveyor's Association were included. The most attractive part of the program was the presentation on "Sensitization of LiDAR and its Application" by Anish Joshi, Secretary, NRSPS and "Application of LiDAR in Forest Resources Assessment" by Hari Prasad Pokharel, Member, NRSPS.

Workshop on Application of Space Science

B.P. Koirala Memorial Planetarium, Observatory and Science Museum Development Board of Ministry of Science and Technology, Nepal in collaboration with Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), India jointly organized a Workshop on Application of Space Science from July 08-10, 2011 in Kathmandu. The main objective of the workshop is to facilitate a full pledged national initiative on space science. This will entail a comprehensive policy framing from research, development and application of space science. The workshop was attended by about 80 participants from different organizations. Seven papers including the paper entitled Resource Mobilization in Applications of Space Technology in Nepal which was jointly prepared by Madhusudan Adhikari, President, Nepal Surveyor's Association (NESA) and Rabin K. Sharma, President, Nepal Remote Sensing and Photogrammetric Society (NRSPS). The paper was presented by Mr. Sharma in one of the technical sessions.

Interactive Programme on Application of GIS in Context of Nepal

Geomatics Engineering Society (GES) of Kathmandu University organized an "Interactive Talk Programme on Application of GIS in context of Nepal" with the theme "Discovering the World via GIS" on the occasion of GIS Day 2011 on November 17, 2011 at Dhulikhel. The programme was attended by the selected GIS experts, staff of Department of Civil and Geomatics Engineering of the University and the the students of Bachelors Engineering of Geomatics Engineering (BE GE). The main highlights of the programme were the welcome speech by Ms. Reshma Shrestha, Coordinator of BE GE, presentation of Nava Raj Subedi, Director, Land Management Training Centre and a presentation of Nabin Paudel, a student from 3rd year BE GE. Finally, Rabin K. Sharma, President, Nepal Remote Sensing and Photogrammetric Society gave a speech on application of GIS as a Chief Guest of the programme. The initiatives taken by the young group of students was highly appreciated for organizing the programme.

Highlights of the Programme for the Year 2012

The Society planned for carrying out the following programmes for the year 2012:

1. Commemorate Anniversary Program
2. Dissemination of Information on Space Technology Application
3. Networking with Related Agencies and Institutions
4. Amendments of the Statutes of NRSPS
5. Presentation Program on some relevant themes
6. Launching Membership Driven Program

Nepal GIS Society

Advisory Committee Members

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Dr. Binayak Bhadra

Mr. Buddhi Narayan Shrestha

Director General, Department of Survey

HoD Central Department of Geography, TU

HoD MENRIS, ICIMOD

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Member	-	*Mr. Madan Kumar Khadka*
Member	–	*Mr. Bipin Kumar Acharya*

Activities of Nepal GIS Society in the year 2011/12

Nepal GIS Society General Body Meeting (GBM)

General Body (GB) meeting of the Society held on February 23, 2011 at Women's Development Training Centre, Jawalakhel, Lalitpur. Mr. Govinda Joshi, General Secretary briefed progress report of the Society. Similarly Mr. Madhav Adhikari, Treasurer presented financial report. Open discussion was followed after the presentation. President of the Society Dr. Krishna Poudel highlighted some activities of Society and answered questions raised by the members. An eleven member executive body with Dr. Krishna Paudel as President was elected unanimously by the general body meeting.

GIS Lab construction within the NEGISS premises

Nepal GIS Society has recently built a GIS Training Laboratory at the rented room of Women Development Training Center, Jawalakhel, Lalitpur. Twelve personal computers with visual aids and power back-up are within the training lab.

Celebration of 18th anniversary of the Society and International GIS Day

On the auspicious occasion of the 18th Anniversary of the Society on 22nd July 2011, Society arranged a meeting with the Advisors and honorable GIS experts at the GIS Lab of the Society. Current activities and future programmes of the Society had been shared during the meeting.

On November 16, 2011 Society had celebrated International GIS Day by organizing a half-day GIS seminar.

Project completion

Nepal GIS Society has successfully completed GIS Users Survey 2011. This task was financially supported by High Level Commission for Information Technology (HLCIT).

The outcome of the survey has been uploaded in the webpage of the Society http://www.negiss.org.np. *report.*

Book published

Nepal GIS Society published a book 'Geographic Information System in Local Development' in Nepali language, written by Dr. Krishna Prasad Poudel. The book is targeted for the local level development authorities and officials working at Districts and VDCs.

Nepal Surveyors' Association (NESA)

NESA CEC
Secretariat

Mr. Madhusudan Adhikari
President
Mr. Ambadatta Bhatta
Chief Vice President
Mr. Saroj Chalise
General Secretary
Mr. Prakash Dulal
Secretary
Mr. Durga Phuyal
Secretary
Mr. Sahadev Ghimire
Treasurer
Mr. Dadhiram Bhattarai
Co-treasurer
Mr Hari Prasad Parajuli
Member
Ms. Jyoti Dhakal
Member

NESA CEC
Other members

Mr. Ram Sworup Sinha
Vice President
Eastern Development Region
Mr. Tanka Prasad Dahal
Vice President
Central Development Region
Mr. Gopinath Dayalu
Vice President
Western Development Region
Mr. Ramkrishna jaisi
Vice President
Midwestern Development Region
Mr. Karansingh Rawal
Vice President
Farwestern Development Region
Mr. Premgopal Shrestha
Member
Ms. Geeta Neupane
Member
Mr. Laxmi Chaudhari
Member
Mr. Kamal Bdr. Khatri
Member
Mr. Bijubhakta Shrestha
Member
Mr. Sahadev Subedi
Member
Mr. Balam Kumar Basnet
Member
Mr. Nawal kishor Raya
Member
Mr. Santosh Kumar Jha
Member
Mr. Khim Lal Gautam
Member

Background

Utilizing the opportunity opened for establishing social and professional organizations in the country with the restoration of democracy in Nepal as a result of peoples movement in 1990, Survey professionals working in different sectors decided to launch a common platform named Nepal Surveyors' Association (NESA) in 1991, as the first government registered Surveyors' Organization in Nepal.

Objectives

The foremost objective of the association is to institutionalize itself as a full fledged operational common platform of the survey professionals in Nepal and the rest go as follows

- *To make the people and the government aware of handling the survey profession with better care and to protect adverse effects from it's mishandling.*
- *To upgrade the quality of service to the people suggesting the government line agencies to use modern technical tools developed in the field of surveying.*
- *To upgrade the quality of survey professionals by informing and providing them the opportunity of participation in different trainings, seminars, workshops and interaction with experts in the field of surveying and mapping within and outside the country*
- *To upgrade the quality of life of survey professionals seeking proper job opportunities and the job security in governmental and non governmental organizations*
- *To work for protecting the professional rights of surveyors in order to give and get equal opportunity to all professionals with out discrimination so that one could promote his/her knowledge skill and quality of services.*
- *To advocate for the betterment of the quality of education and trainings in the field of surveying and mapping via seminars, interactions, workshops etc*
- *To wipe out the misconceptions and ill image of survey profession and to uplift the professional prestige in society by conducting awareness programs among the professionals and stakeholders*
- *To persuade the professional practitioners to obey professional ethics and code of conduct and to maintain high moral and integrity*
- *To advocate for the ratification of Survey Council Act and Integrated Land Act for the better regulation of the profession and surveying and mapping activities in the country.*

Organizational Structure

The Organization is nationwide expanded and it has the following structure
14 Zonal Assemblies ZA, 14 Zonal Executive Committees ZEC
5 Regional Assemblies RA, 5 Regional Executive Committees RAC
Central General Assembly CGA, Central Executive committee CEC

Membership Criteria

Any survey professional obeying professional ethics and code of conduct, with at least one year survey training can be the member of the Association. There are three types of members namely Life Member, General Member and Honorary Member. At present there are 2031 members in total.

Activities

On 18th Bhadra 2068, the Surveyor's day was celebrated organizing different sport events and quiz contest.

Price of Aerial Photograph and Map Transparency

Prduct	Price per sheet
a) Contact Print (25cmx25cm)	Rs 150.00
b) Dia-Positive Print (25cmx25cm)	Rs 500.00
c) Enlargements (2x)	Rs 600.00
d) Enlargements (3x)	Rs 1200.00
e) Enlargements (4x)	Rs 2000.00
Map Transparency	
a) 25cm * 25cm	Rs 310.00
b) 50cm * 50cm	Rs 550.00
c) 75cm * 75cm	Rs 800.00
d) 100cm * 100cm	Rs 1250.00
Diazo/Blue Prints	Rs 40.00
Photo copy	Rs 50.00
Photo lab facilities	US$ 200/day

In case the materials provided by the clients, the office will charge only 40% of the marked price as service charge.

Price of Digital Topographic Data Layers

LAYER	Rs/Sheet
Administrative	100.00
Transportation	200.00
Building	60.00
Landcover	300.00
Hydrographic	240.00
Contour	240.00
Utility	20.00
Designated Area	20.00
Full Sheet	1000.00

Image Data:

Digital orthophoto image data of sub urban and core urban areas mintained in tiles conforming to map layout at scales 1:10 000 and 1:5 000, produced using aerial potography of 1:50 000 and 1:15 000 scales respectively are also available. Each orthophoto image data at scale 1:5 000 (couering 6.25 Km^2 of core urban areas) costs Rs. 3,125. 00 . Similarly, each orthophoto image data at scale 1:10 000 (covering 25 Km^2 of sub urban areas costs Rs 5,000.00.

Price of SOTER Data	Whole Nepal	NRs : 2000.00