Surveying And Mapping In Nepalese Context

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Abstract

Surveying and mapping is indispensable for the development of any country. In our context, the history of the development of surveying and mapping is gradually marching with the pace of global technological development. This paper explores the various components of Surveying and mapping history and activities in Nepal e.g. Cadastral, Geodetic, Topographical, HRD, Land Use, NGIIP, DoLIA.

1. History of Survey and Mapping

People have developed several methods of recording and transmitting useful and necessary information from one person to other. Recording, capturing, speaking, transmitting, presenting may be in different form of media or ways. Spoken language, written documents, printed papers, electronic media like audio, video, data etc. are the different means of communications. In the surveying and mapping context, communicating real world to recipient or user is called land surveying and mapping. This surveying and mapping technology comprises of different methods of capturing field data and different methods of presenting to users or audiences. Both these technologies are sophisticated, challenging and complicated, because, to present a piece of land or earth on a piece of paper or in any other media in precise and accurate shape and size is not a simple job, it requires not only art and science but also highly skilled people, instrumentation, resources etc. It can be said that surveying and mapping are like a basic need of development, because every development activities depend upon the land. This fact can be proved by the history of the surveying and mapping. For example, one can take 3000 BC old land records of Babylon and Egypt. Another example is the nearly 5000 years old authentic map of Mesopotamia, where mountains, rivers and other geographical features are shown in a clay tablet. Similarly, some valleys of the Nile River were carefully mapped in ancient time in order to recover the property lands after the annual flood and also for taxation.

Paper, ink, instruments for measurements and technologies were discovered and developed during the thirteenth and fourteenth century. Accurate and precise surveying and mapping was started from Europe. The scientific surveying mapping started again from Europe in seventeenth century after the trigonometrical survey was discovered in France. Modern cadastral surveys and land records were also started in 1807 by the Napoleon in France. With the development of science and technology, surveying and mapping has also made a great stride and passed several milestones. For example, in those days, Theodolites, made of brass were big and heavy, had to be made part-wise, and the parts were carried separately to the trigonometrical station for the observation of higher order Trigonometrical surveys. Later on, portable optical Theodolites of 2-3 kilogram in weight were available at different precisions. Nowadays, Global Positioning System (GPS) receivers, weighing 1 to 1½ kilogram with millimeter accuracy are superseding Theodolites for precise control works. With the revolutionary development came in software, hardware, satellite and digital technology; surveying and mapping became simple, accurate, and precise. So, now in a short time, a large area of land can be surveyed and mapped with its all features even with 3D display. At present surveying and mapping has entered into the space technology and computer technology.

There are different means and ways to achieve the goal of surveying and mapping. For example, a large or a small map, either topographical map or land resource map or cadastral map or hazard map or any other type of map can be prepared directly by capturing data in the ground using total station with electronic recording system which can be plotted on a sheet directly. When the area of survey

is big, Photogrammetry or Digital Photogrammetry is suitable and when aerial photographs are not available satellite images with stereo images are used for mapping using Photogrammetry work station such as Intergraph, LPS or PCI software.

Remote Sensing with satellite images is widely used not only for new mapping but also for updating topographical land or forest map or agriculture map and land classification as well as for weather forecast or detection or changes in snow or glacier etc. There are innumerable applications of Remote Sensing, Geographical Information System, Land Information System, Global Positioning System, 3D Cadastral etc. as modern technologies of surveying and mapping.

2. Cadastral Survey in Nepal

In Nepal also surveying and mapping history is more or less same as in other countries of the world from the Lichhabi Era, land tax was a major source of income for the state, so land administration was necessary in those days also. Some improved form of first land administration was made by King Jay Sthiti Malla in the period of BS 1383 to BS 1450.

After unification of Nepal, some major changes in land administration took place in BS 1880 in which, the type of measurement, classification of land and area of land along-with its owner and tenure etc. were clearly specified. After this period land surveys were conducted in BS 1884 and there were number of land surveys conducted in between BS 1911 to BS 1930, traditionally done by an ethnic group called Dongol. They were experts in eye-estimating the land and classifying land to be used for land revenue purpose. In BS 1914 Kathmandu valley was surveyed. Terai and the Hill regions were surveyed by Dongol by eye-estimation around BS 1943.

A training unit was established to train the Sarpat Napi to the Amin and Sarpat Napi (measurement by Chain) was started from BS 1952 in Hill and Terai regions. This crude method of Cadastral Survey was replaced by compass survey by *Compasse* from BS 1963. Later after the First world war Field survey team in Nepalese Army called *Fauji Napi* (Survey) surveyed using plane table and the chain from BS 1980 to BS 1996. Previously this office was called "General Survey Goshwora", later on the name changed into Survey Goshwora of Nepal Government. These surveys were conducted by Amin and checked by Inspector.

After the advent of democracy in the country in BS 2007, the nation started a number of development activities in all disciplines and a number of foreign aid poured in Nepal. One of them was for national topographical surveying and preparation of topographical maps. This project was under Colombo plan done by Indian Government and completed in 1952-56 AD. This map was at the scale of 1" to 1 mile covering the whole country. The Planning Commission was formed in BS 2013/14 and the first 5th year national plan was introduced in which surveying and mapping works was also included.

As per the programme made in the first Five-year plan of National Planning Commission the Cadastral Survey of the country was conducted by establishing Survey Department in BS 2014 Jestha 14, and under this Survey Department, some Survey Circles were made to conduct cadastral survey in the districts.

Again after the changes of political system in the nation in BS 2017, Land Reform Programme came in BS 2021 after the enactment of Survey Measurement Act BS 2019 and Survey Goshora's started conducting cadastral survey of the country. These cadastral surveys were done using plane table and graphical method. To conduct this programme UNDP deputed Mr. J. R. G. Herrop as Cadastral Survey Expert for a period of five years from BS 2022 to BS 2027 and he became the pioneer of cadastral survey as well as the planner of planned surveying activities in Nepal. Mr. Herrop made a number of circulars related to Survey Measurement Act BS 2019 and circulated it to all Survey Goshoras for implementing. These circulars and the Survey Measurement Act BS 2019 have been amended a number of times and are regarded as an instruction manual for cadastral survey. A collection of all these circulars were published twice in book form in BS 2041 and BS 2057 after 9th amendment and 10th amendment respectively.

3. Geodetic Survey in Nepal

In hilly areas, graphical trigonometric survey is not accurate enough to conduct accurate scientific cadastral survey; trigonometric survey for control points in the country was essential for this programme. Again UNDP provided Mr. Z.N. Wiedner as Geodetic Expert in BS 2026

who worked as the Director of the then newly established Trigonometrical Survey Branch. He started the establishment of National Geodetic frameworks along with some other volunteers from Switzerland, Sweden and Germany.

Trigonometrical Survey Branch extended its activities from BS 2031 by establishing Fundamental station, Fundamental base line and astronomical observatory at Nagarkot in BS 2032. From that year, Levelling Division also started its precise 1st order levelling network in the country. In BS 2037 the Branch also started gravity surveys. As the activities of the Branch expanded, its name also changed into Geodetic Survey Branch. All activities of Geodetic Survey Branch were assisted by volunteers from Switzerland, Germany and Sweden. The Branch prepared instruction books for Trigonometrical Surveys in 1976 AD, and two more books for Levelling survey and Astronomical survey in 1988 AD. A team of Czechoslovakian astronomical experts came in Nepal and they established 7 Laplace stations with 14 azimuth stations with the assistance of UNDP in BS 2032.

A team of British Army Survey established 14 Doppler Survey stations in different parts of the country in BS 2037 and in the following years the same army team established 68 first order triangulation points covering the whole country in east-west direction connecting communication microwave telephone tower in Tarai. They established some gravity stations and prepared gravity anomaly map of the country and with the help of gravity points, astronomical points and levelling points they established National Geodetic Network with defined positional accuracy.

The University of Colorado and Massachusetts Institute of Technology (USA) has established 29 GPS control points from east to west covering the whole country by precise Global Positioning System (GPS). Geodetic Branch initiated GPS survey during 1994 AD and started providing GPS control points of 3rd order based on 1st and 2nd order control points of geodetic network. From those 3rd order GPS points, theodolite traversing/ triangulation are being done to provide further extension of 4th order control required for cadastral survey.

Similarly, Geodetic Survey Branch has established precise levelling networks and gravity points of different order, which are spread in the whole country. The Eastern Nepal Topographical Mapping Project and Western Nepal Topographical Mapping Project aided by the Government of Finland have established a total of 101 GPS stations in which 29 points were primary stations and 72 points were secondary stations. These point were used for topographical mapping of the country.

4. Land Management Training Centre in Nepal

To fulfill the demand of human resource for land surveying personnel, a Survey Training Center was established as the government institution under the assistance of Colombo plan in BS 2024. The first Principal of the centre was Mr. V. Rongong of India, who was assisted by some other Indian Instructors. They started this training center to train Amins and Junior level surveyors. Later Mr. B.R. Jain worked as Principal from BS 2028 to BS 2032. Initially the training was only for Amins and Junior surveyors. Later the center started Senior Surveyors course and special courses like Geodetic, Photogrammetry, and Cartography etc. After Mr. B. R. Jain, Nepalese Principal and Nepalese instructors took over all the works of the center.

Survey Training Centre has started training in land management also. Previously it was under the Survey Department. Now its name has been changed into Land Management Training Centre under the Ministry of Land Reform and Management and started training of land management along with surveying and mapping.

5. Topographical Survey in Nepal

Topographical survey was established as a unit in BS 2031. Later UN expert Mr. H. E. Callaway came as Project Manager for this Survey Unit and shortly it was converted into Topographical Survey Branch in BS 2032. Topographical Survey Project of US$ 700 million was granted by UNDP. Project Manager Mr. Callaway and his Nepalese counter part Mr. P.P.Oli jointly made programme and activities of this and also managed necessary scholarships in-house and abroad in the field of Photogrammetry, Cartography, Reproduction etc. With UNDP assistance Topographical Survey Branch became well equipped with trained manpower and the building was built at the then HMG's own cost. In this period, with the help of available 1"=1 mile Topographical Maps,

Administrative maps etc were prepared and printed, for example District map, Zonal map, Development Regional map and the map of Nepal etc.

Land resources maps of land utilization, land capability, land system at the scale of 1:50,000 and geological maps at the scale of 1:125,000 and Climatological maps at the scale of 1:250,000 were prepared using 1:50,000 scale aerial photographs with the assistance of Government of Canada in 1980 AD.

In 1989-91, the Government of Japan assisted to prepare 81 topographical map sheets of Lumbini Zone at the scale of 1:25,000. Similarly, the Government of Finland assisted to prepare topographical maps of eastern and middle development region of the country from 1991 to 1995 at the scale of 1:25,000 in Tarai and hills and 1:50,000 in mountainous area by a project called Eastern Nepal Topographical Mapping Project. Similarly in 1995-2001 again the Government of Finland extended its aid to prepare remaining topographical maps sheets of the country through Western Nepal Topographical Mapping Project.

6. Land Information System in Nepal

In the meeting of the 13th and 14th United Nations Regional Cartographic Conference for Asia and Pacific held on May 9-18, 1994 in Beijing, China and February 3-7, 1997 Bangkok, Thailand respectively and the 1st Cartographic Conference of South Asian Association for Regional Cooperation (SAARC) countries held during 14-15 March, 1995 in Kathmandu, commitment was made for the application of land information system by the member countries. The government executives and the bureaucracy in Nepal have realized the potential of LIS as a tool for development and to attain the goals of the Five Year plans of the nation. So the government proposed in the 8th plan (1992-1997) to establish LIS in Nepal.

In line with this policy, the Department of Land Revenue of Ministry of Land Reform and Management (MoLRM) initiated infrastructure development and computerization of non-spatial parts of the cadastral parcels by establishing a central office in the Department. In 1995, it was realized that the spatial part of land parcel is of equal importance and the Council of Ministers set up a new project ILIS directly under MoLRM. Various studies and piloting was done to develop a system during this period. The SIDA provided technical assistance in this matter. In the 9th Plan (1997-2002), the Government gave priority for LIS development. In 2000 AD, the Council of Ministers decided to form a new dedicated separate Department called the Department of Land Information and Archive (DoLIA). It is continuing it's piloting for development of District Land Information System (DLIS) software in three offices. In the current 10th Plan (2002-2007) also, the emphasis has been given to establish land information system in three districts Kathmandu, Bhaktapur and Kaski and provide services through computer technology. Now DoLIA is working on this line.

In 1995, when Microsoft introduced Windows 95 in PC, LIS project made programme in Windows 95 because it was easier to handle than Bhu-Laxmi software previously made by the then National Computer Centre which was complicated and not user friendly. All the data captured previously could not come to use, so DOLIA started data capture again using DLIS software for both the attribute data and spatial data. The department prepared the SAEx software to handle the land parcel.

7. Land Records and Archive in Nepal

Previously, maps and other documents concerning land were not kept in orderly manner, so Survey Department started archiving them in BS 2050, in which, copying of district cadastral maps and field books were made and records kept. Later, in BS 2056, when Department of Land Information and Archive was established all the land records with the Survey Department had been transferred to Department of Land Information and Archive (DOLIA). At present the department has almost all copies of district cadastral maps and field book. Copying and scanning works of cadastral map and field book is still going on. Other important old land documents of Land Reform and Management Departments are also scanned and being kept them in archive. All records and the documents thus archived should be kept in different places in different media like hard copy and soft copy to safeguard them from fire or other possible catastrophe.

8. National Land use in Nepal

Nepal has diverse land features and has altitude ranging from 58 m. in Terai to 8848m, Mt. Everest (Top of World) in height. It was realized very early that proper

land use must be adopted in Nepal as the country is economically based on agriculture. The development of agriculture and land use pattern according to soil, location or altitude is important, so land use project is an important project.

Provision for this was there in the Land Use Act in BS 2025 but it was never implemented in the field. Considering the importance of land resource maps and land use the Government of Canada launched a project in Nepal in 1985-86 AD. In this project, land capability maps, land utility maps, land system maps of Nepal at the scale of 1:50,000using 1:50,000 aerial photographs were prepared, along with geological maps and climatology maps. There are many reports on the findings from this project and according to the report the following land data were published.

Description	Area in sq. km.	Percentage
Forest	55,180	37.4
Agriculture	30,520	20.7
Snow-mountain	22,460	15.2
Grazing	17,450	11.8
Bush and low forest	7,060	4.8
Barren land	9,980	6.8
River and riverside	4,000	2.7
Other	830	0.6
Total	1,47,181	100

Considering the importance of land use the Ministry of Land Reform and Management initiated National Land Use Project in BS 2057. This project published some land zoning maps of the districts along with the reports. These land zoning maps on the scale 1:25,000 were prepared by using satellite images and topographical maps sheets and land resource maps. For implementation of land zoning, large scale land zoning maps, detail study of the land parcels are required.

9. National Geographical Information Infrastructure System in Nepal

For the census of 2001, EU assisted in preparing a digital database of all the topographical maps, a total of 706. Later, EU also extended its help to establish National Geographical Information Infrastructure Project (NGIIP).

NGIIP, together with census 2001 data, has prepared "The Population and Social- Economic Atlas of Nepal". The project has been generating database and different derived maps from National Topographical Database (NTDB). At present the project has been generalising NTDB for the production of derived maps at the scale of 1:100,000 and 1:250,000. The main aim of NGIIP is to work as clearinghouse of the country. For this NGIIP will integrate existing and other data to be generated in future from various sources and disseminate the same to the user through NTDB.

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