Survey Department at the Cross Roads

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Introduction

Survey Department was formally established in Jestha 2014 BS so the department celebrated its golden jubilee anniversary in 2064 BS with various programmes. During this period, the department had used the technology from sight rule to satellite based technologies and prepared major basic data and information for example, cadastral information including cadastral plans, coordinates of control points of geodetic network, topographical base maps, et cetera. One of the surprising achievements of the department is the open policy of dissemination of topographical base maps of Nepal even at the scale of 1: 25 000, accordingly, the maps are available to all the national and international map users. Because in some of the Asian countries, the topographical base maps are not open to all users.

Realizing the importance of Geospatial Information (GI), Survey Department in cooperation with European Union established National Geographic Information Infrastructure Programme for facilitating the availablity of spatial data and to access to the users and providers from different sectors for example governmental organizations, commercial sectors, academia and non-governmental organizations. At present, the programme is providing services to the GI community namely metadata clearinghouse facilities.

Survey Department is recognized as a National Mapping Organization (NMO) in national as well as in international community and the department supported the policy of globalization. So the department is affiliated with number of international professional organizations as their member. Being a member of the organizations, some of the responsibilities of the member organization are to participate in the events of these organizations and to organize some of the events of the organizations. The department succeeded to participate in the events as long as the resources permit but only a few international events had been able to organize in the past. For example, the department had organized the events First SAARC Technical Meeting on Cartography of SAARC Networking Arrangement on Cartography (SNAC) in 1995 and the 23rd Asian Conference on Remote Sensing (ACRS) of Asian Association on Remote Sensing (AARS) in 2002. These events have contributed to wider exposer of the activities of survey department in the international arena. Therefore, it is advisable that the department should organize more events of such kinds in the future aswell.

Based on these backgrounds, it can be observed that the department is now at the cross roads. So in order to go further, the department should plan the activities with new innovations for addressing the challenges and issues that are in the path of its development. Hence this paper tried to review its achievements from different perspectives, identify challenges and issues of survey profession within the department and recommend the actions to be taken to resolve them. Furthermore, each recommendation need detail study to prepare plan and implement for resolving the issue.

Review of the Technological Achievements

Survey Department succeeded to cross its major milestones mainly due to availability of financial and technical support from the donor countries and agencies and some of the other technological achievements are obtained through the investment of the resources from the government of Nepal itself. The major achievements so far made are briefly reviewed as follows:

Cadastral Surveying: Initially, cadastral survey was the only mandate for Survey Department when it was established. Basically, it was meant to prepare records of land ownership, classify the land parcel and determine its area for raising revenue. In 1964 AD, systematic cadastral surveying was started to support the Land Reform Programme announced by the Government of Nepal. The cadastral survey of the entire country was completed in 1997 AD. But still some of the dense areas named village blocks and government and public lands lying beyond the cultivated land are left behind the survey.

During the first round of cadastral survey, 38 districts were surveyed with local base as control and the maps thus prepared are termed as island maps whereas

remaining 37 districts were surveyed based on the national control network. Therefore, in 1994 AD, considering the incompleteness and networking reasons, cadastral resurveying was once again initiated in 13 districts of the country. Due to high transition of land parcels and considerable amount of land fragmentation in Kathmandu and Kaski districts, these two districts got priority to resurvey for keeping the land records and maps updated. The progress, so far, recorded that Kanchanpur district is the only district where the resurvey was completed.

Laplace Stations and Azimuth Stations: During the period of 1976-1977, a team of astronomical experts from Government of Czechoslovakia with the assistance from UNDP established seven Laplace stations and fourteen azimuth stations for the study of deflection of vertical. These Laplace stations are used as fundamental geodetic stations for establishment of higher order geodetic network.

Geodetic Network: In 1980-1984, a team from British army, financially supported by Government of United Kingdom established fourteen Doppler stations and sixty nine geodetic control points of First Order covering the area from east to west and from Tarai to high hill areas. These control points are used to extend the geodetic network of lower order control points for the consequent surveys.

Land Resource Mapping: Under the cooperation of Government of Canada, Canadian International Development Agency (CIDA) supported to prepare land resources mapping of the country. The basis of the maps were the 1:50 000 topographic maps enlarged from existing one inch to a mile and the recently taken aerial photographs at the scale of 1:50 000. The coverage of the aerial photography was the area of Nepal below 15,000 feet altitude. The final products of the programme were aerial photographs covering the area mentioned above; Land Capability maps, Land System maps and Land Utilization maps at the scale of 1:50 000; Geological maps at the scale of 1: 125 000; Climatological maps at the scale of 1:250 000 and the corresponding reports.

Research Activity: From 1990-1993, Survey Department in collaboration with University of Colorado and Massachusetts Institute of Technology of United States of America conducted a research activity for the measurement of the Earth mass movement by establishment of GPS control points and tracking stations. Accordingly, 22 GPS points and 6 tracking stations were established and recorded the data continuously for the research period. Survey Department gave continuity for recording data at Nagarkot only after the termination of the project. But due to lack of proper human resources and related software, data processing could not be done.

Topographical Base Maps: In 50's, under the Colombo Plan of Government of India, Survey of India prepared and published one inch to a mile topographical base maps. In 1990 AD, Government of Nepal realized that the base maps were outdated and it was decided to compile a fresh topographical base maps. Accordingly, the new series of topographical base maps of the country were prepared in three phases. In the first phase, under the cooperation of Government of Japan, Japan International Cooperation Agency (JICA) prepared topographical base maps at the scale of 1:25 000 for Lumbini Zone only. In the second phase, under the cooperation of Government of Finland, Finnish International Development Agency (FINNIDA) supported to prepare topographical base maps at the scale of 1:25 000 for Tarai and middle mountains and 1:50 000 for high hills and Himalayan regions of Eastern and Central Development Regions of Nepal. In the last phase, the process was continued with the similar fashion as in the second phase to complete the rest of the areas of Nepal. The major products of the projects are the aerial photographs covering entire areas of Nepal at the scale of 1:50 000 and the topographical base maps at the scales mentioned above.

Leveling Network: Geodetic Survey has established precise leveling network along the major highways of Nepal based on the precise bench marks provided by Survey of India to Survey Department whose datum is the mean sea level adopted by Survey of India.

National Spatial Data Infrastructure Development: In the development of National Spatial Data Infrastructure, FINNIDA of Government of Finland and DANIDA of Government of Denmark supported the department from 1996-2001 for the preparation of enumeration maps of Municipalities and Village Development Committees for population census of 2001. Then, FINNIDA continued their support for the preparation of digital orthophoto of urban and semi-urban areas of Nepal till 2002 AD. With this project, the department established the digital database of topographical maps which is one of the milestones of the department. Then based on this database, Survey Department prepared the database at the resolution of smaller scale of 1:100 000 and in process to prepare the database in even smaller scale resolution.

Then from 2002-2005, European Commission supported the department for providing Geographic Information Infrastructure services to the user community. The major achievements were on demand census and topographic information access via internet, publication of population and socio-economic atlas, metadata clearinghouse services and technical infrastructure for Geographic Information services.

Participation in International Forum: In the present context of globalization, Survey Department is following the footsteps of international forum for its exposure by affiliation with some of the international professional

organizations like, Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP), SAARC Networking Arrangement on Cartography (SNAC), International Steering Committee for Global Mapping (ISCGM), Asian Association on Remote Sensing (AARS), Asia Pacific Regional Space Agency Forum (APRSAF), International Federation of Surveyors (FIG), Group on Earth Observations (GEO), Sentinel Asia Joint Project Team (SA JPT) and Global Spatial Data Infrastructure Association (GSDIA). The staff of the department frequently participated in the activities of these organizations and the staff, in general, presented the paper either in a form of country report or to share some of their innovations and technological approaches of the field, in the events.

Border Maps: Survey Department is supporting to prepare Nepal-India and Nepal-China border maps in favour of Ministry of Foreign Affairs from the very beginning of the projects. As per the international norms of border between two nations, the strip maps of both areas are prepared jointly with their corresponding counterparts Survey of India and National Surveying and Mapping of China respectively. The maps were prepared in digital environment and the establishment of digital database of the border maps is in progress using GIS technology. After completion of the delineation of border line on the maps, the protocols of the maps will be prepared with the corresponding governments.

Geoid Model: In 2010, Government of Denmark supported to carryout Airborne Gravity survey for determination of geoid model. At this stage, data acquisition has been completed and data processing is in progress. So after the determination of geoid model, difference between the geoid and ellipsoid of any points in the country can be computed so that the ellipsoidal height can be converted to orthometric elevation for practical uses.

Infrastructure Development

Infrastructure development in Survey Department can be summarized as follows:

Technical Assistance: When the support programme from UNDP was in progress, there were foreign expert services and United Nations Volunteers services for supervising activities of different disciplines of surveying and mapping as a technical assistance. Furthermore, under Japanese International Cooperation Agency (JICA), some Japanese Overseas Cooperation Volunteers (JOCV) services were made available. Under these assistance programmes, the experts and volunteers prepared some instructional manuals and trained some of the technicians in the corresponding disciplines of surveying and mapping.

Physical Infrastructure: Some of the physical infrastructure developments are as follows:

- **Building:** Survey Department has its own building in a complex at Kathmandu. As the department has eighty three survey offices spreading all over the districts but only twenty offices has its own building and the rest of the offices in the district are established in rented houses.
- **Equipment:** From 1972-1985, United Nations Development Programme (UNDP) supported for strengthening Geodetic Survey and Topographical Survey by supplying major surveying equipment such as Theodolites, Stereo Plotters, Rectifier, Reproduction Camera, Printing Press, et cetera.

  In 2008 AD, Government of Japan assisted to provide hundred Total Stations for carrying out cadastral survey numerically.
- **IT Infrastructure:** Survey Department had established remote sensing lab, digital cartography lab and cadastral lab in corresponding buildings. The systems are supported by the software like Arcview, Arcinfo, ERDAS, et cetera.

  During the period of technical support from European Commission in 2002-2005, infrastructure for running the system of web based technology was established in National Geographic Information Infrastructure Programme of the department.

Human Resources Development

Human resources development is a key component of the department. Initially, the department has to face some problems to manage proper human resources for carrying out different activities and had to compromise in the qualification of the staff. For example, for carrying out cadastral survey, candidates having class eight of secondary school levels were given training of Amin course of eight month duration and recruit as Amin who has got very high responsibility. Similarly, for the jobs of topographical survey, fresh candidates having qualification of School Leaving Certificate (SLC) and Intermediate Science (I. Sc.) were recruited temporarily and given on the job training in the corresponding jobs. Gradually, the department managed human resources with the following options:

Scholarships: Initially, the then government of Nepal provided scholarships from the programmes of several donor agencies such as Colombo plan, UNDP scholarship, et cetera to the eligible candidates from the fresh graduates to study at institutions in the corresponding countries India, United Kingdom, Russia, et cetera. When they came back to Nepal, they competed for the government

service through Public Service Commission and got appointment to work at Survey Department. Then from 1978 AD, Government of Nepal provided scholarships to some of the eligible staff through donor agencies and countries like UNDP, government of The Netherlands, government of Japan, et cetera for further training and academic qualification in the institutions abroad. Some of the institutions where the staff studied for their corresponding trainings and academic qualifications are Survey of India, ITC of The Netherlands, Swiss School of Geomatics of Switzerland, Geographical Survey Institute of Japan, Polytechnic Institute of London of UK, Geodetic Department of Ohio State University of USA, et cetera. This process is still continuing but limited to the support from the government of The Netherlands.

Formal Training: In order to carry out cadastral survey to fulfill the objectives of the land reform programme announced by the government, Survey Training Centre as one of the wings of Survey Department was established to impart formal training course to produce Amins of eight months duration and later the duration of the course was increased to twelve months and the name of the course has been changed to Basic Surveyor course. Gradually, the scope of the training was widened to impart Junior Surveyor course and Senior Surveyor course of twelve months each and later the duration for the Senior Surveyors course has been changed to sixteen months. In 2056 BS, Ministry of Land Reform and Management restructured its organizational structure in which the training centre was upgraded to a departmental level organization, which means the training centre became one of the wings of the ministry, by adding further to conduct training programmes for land administrators and the name of the centre has been changed to Land Management Training Centre (LMTC). In 2007 AD, the training centre made agreement with Kathmandu University (KU) to conduct Bachelor of Engineering (BE) in Geomatics Engineering of four years duration and KU in association with LMTC started the BE in Geomatics Engineering in which twenty four students got scholarship from government of Nepal to cover seventy five percent of the fees of KU. This scholarship programme of the government will continue for four batches of the course. So far, the training centre had produced more than 5000 technicians of different level of surveyors.

On the job training: On the job training is a very popular and inexpensive system for mass production of human resources. Therefore the department gave priority to follow this system to train semi-skilled technicians. In this system, the staff could acquire knowledge only in one the following subjects: stereo operator, Cartography drafting, leveling survey, Theodolite surveys, Total Station operation, et cetera. This system became very effective as the majority of the activities were accomplished successfully through the staff that were trained under this approach.

Challenges and issues

Every organization has to face challenges and deal with several issues so the department is not an exceptional. The following are some of the challenges and issues that exist in the department:

Technological Development: Technological development in the domain of surveying and mapping is so rapid that it is very difficult to keep pace with the recent systems mainly due to lack of proper hardware, latest software and skilled human resources.

Data Management: Survey Department has lots of data and information which are very sensitive and important for supporting the work of building the nation. So which data to store, how to store, where to store, how to retrieve when necessary, who is responsible for security of the data; these are some of main issues that are unanswered yet with respect to data.

Human Resources: One of the major challenges facing by the department is to manage skilled human resources for conducting its activities. Because, in one hand, majority of the staff are with inadequate training and in the second hand, the majority of the trained staff have attitude of going abroad. So, the department is facing the problem of brain drain of the potential staff. One more problem is difficult to retain the trained staff in the working area of her/his expertise due to the provision of transfer system of staff from one organization to next. For example, if a staff has been experienced as a stereo plotter operator and all of a sudden transfer to work in survey office where the nature of the work she/he has to carryout is quite different than she/he was performing. The transfer of such staff is a great loss for the organization because it takes quite a bit of time to produce an experienced operator. In reality, such transfer is very normal in government service but the Survey Department has to bear negative impact because the staff for performing most of the activities need a certain expertise or need some additional training which is not easy to develop such staff.

Provision of License: In the prevailing Survey Measurement Act, 2019, (Eighth Amendment 2056), there is a provision to issue license to the individuals from a particular group who should have the qualification and experiences as mentioned in the concerned paragraph of the Act. So there is a demand from the surveyors who are not eligible for the license that there should be different category so that majority of the surveyors can accommodate in the group of license holders. Furthermore, due to lack of proper instructions for using license, the license holders have not been able to materialize the license for carrying out survey works. Therefore, the department needs to address these issues as soon as possible.

Service Delivery: Customer's satisfaction is one of the key components of the department which can be achieved

by effective service delivery. Promptness, transparency and loyalty to the profession are important pre-requisite for effective service delivery. So, to address this very important issue is a challenging task to the department.

Actions Need to be taken

Survey Department is, at present, at the cross roads of technological development and advancement because the department had already completed its prime jobs such as establishment of primary geodetic network, completion of first round of cadastral survey of entire country, publication of topographical base maps of the country, publication of land resources maps and establishment of digital topographic database. Now the actions needed to be taken by the department could be listed as follows:

- After successful completion of Geoid determination for Nepal, Geodetic Survey should have its follow up programme for transforming crude leveling height to orthometric height for the application of consequent surveys.
- Maintenance of the higher order geodetic points
- Updating Topographical Base Maps properly and should be in a regular basis.
- Upgrade the Remote Sensing and GIS Lab for effective implementation of the concerned activities with proper software, adequate hardware and skilled/trained human resources
- Management of the equipment which are no more in use
- Development of Parcel based Cadastral Information System to support Land Information System
- Preparation and implementation of cadastral surveys of the areas which were left behind in the first round of the survey as soon as possible
- Preparation of plan for either geo-referencing the cadastral maps which are in the form of island or resurvey these areas
- Development of 3D cadastre system and implementation of the system
- Development of a mechanism to control land fragmentation and design a system for operation of land consolidation programme
- Development of mechanism for providing effective service delivery to its clients
- Prepare plan to build office buildings in all Survey Offices of the districts within a very short period of time. Without having its own building, effective service delivery will be difficult because the office setup and client approach to the officials will be very haphazard.
- Implement the Survey office strengthening programme effectively for supporting effective service delivery and maintaining the cadastral document properly
- Implement National Geographic Information Infrastructure programme (NGIIP) effectively and attract more stakeholders to accommodate in the platform of NGIIP
- Advocate decision makers for regular entry of human resources of all levels of the hierarchy of the organization and provision of giving them opportunity for further training and/or academic qualification
- Upgrade the status of Amin from Non-gazetted class II to Non-gazetted class I for making them more responsible in their profession
- Initiate to revise the existing Survey Measurement Act 2019 to address all the issues in surveying and mapping including that of license
- Since the department is member of so many international organizations, so one of the responsibilities of the department is to conduct a few activities of some of these organizations. After organizing the First SAARC Meeting on Cartography of SAARC Networking Arrangement on Cartography (SNAC) in 1995 and the 23rd Asian Conference on Remote Sensing (ACRS) of Asian Association on Remote Sensing (AARS) in 2002, the department has not organized any of the international events. Therefore the present time is very proper to organize at least one international event in near future.
- Take immediate action to replace the existing out dated Global Mapping data of Nepal for International Steering Committee of Global Mapping (ISCGM) with recent data.
- Take immediate action for preparation of updated version of Cadastral information to update Cadastral Template 2003 of Permanent Committee for GIS Infrastructure for Asia and the Pacific (PCGIAP)

Conclusion

Survey Department is really at the cross roads of its development path as the department had already acquired basic data and information of surveying and mapping.

Therefore, the achievements are reviewed from the different perspectives such as technological development, human resource development and infrastructure development. Based on the identification of the current challenges and issues, actions needed to be taken are recommended for further development of the department. Therefore, this paper could be a guideline for planning its future programmes.

References:

1. *Arjun Bahadur Basnyat, Cartographic Activities in Nepal; presented in 10th UN Regional Cartographic Conference for Asia and the Pacific, Bangkok Thailand, January 17- February 8, 1983.*
2. *Dev Raj Paudyal and Rabin K. Sharma, Analysis of 3D Cadastre Situation in Nepal; published in Nepalese Journal on Geoinformatics, Number 5, 2006*
3. *Ganesh Prasad Bhatta, NSDI Initiatives in Nepal: an Overview; published in Nepalese Journal on Geoinformatics, Number 6, 2007*
4. *Rabin K. Sharma and Babu Ram Acharya, Human Resource Development Policy in the Sector of Space Technology in Nepal; presented in the 11th Asia Pacific Region Space Agency Forum, Canberra, Australia, November 3-5, 2005*
5. *Rabin K. Sharma, Survey Profession and Professional Organizations in Nepalese Context; presented in the XXIth ISPRS Congress 2008; Beijing, China, July 3-11, 2008.*
6. *Survey Department at a Glance; a publication of Survey Department, 2009*