Spatial Data Base for Hydropower Projects in Nepal

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Key words: Hydropower Project, DGPS, Land Acquisition.

1. SUMMARY

Nepal is facing shortage of electric power and having load shedding up to 3-8 hours/day from many years. Although with the total capacity of generation of 84000 MW hydropower, it has only been able to produce around 800 MW hydropower at the moment and planning to generate 10,000MW in a decade for which detail topographical and other surveys are prerequisite for planning and construction of hydropower project.

Apart from topographical survey, geological, seismic, hydrological, environmental, land acquisition (cadastral) surveys are also necessary to be carried out for a hydropower project. These survey activities are conducted in feasibility and detail project design(DPR) or tender document preparation phases. The accuracy of such survey is much higher than in feasibility phase.

The topographical survey techniques usually involves acquisition of very high resolution imagery, extension of national network control points by DGPS, establishment of control points by precise traverse, leveling, detail survey by field or LiDAR survey method, bathymetric survey, demarking the land to be acquired and identification of land owners, land valuation. Geological, hydrological, environmental and seismic surveys spatial data are also linked to topographical survey data as spatial data base of the project.

This article briefly describes the method of preparation of spatial data base and their contents for hydro power project in Nepal.

2. BACKGROUND

Water resource is important natural resources for economic development of a country. Nepal has 2,27% of world resource, 8185Km2 of total water surface area, about 6000 rivers and streamsof total 45,000 km in length and is second richest country in inland water resources.

Availabity of aboundant water resource geophysical features provide opputunity for hydropower production in Nepal. Out of total hydropower generation capaciityof about 84,000 MW of power generation in the country about 42,000 MW of power generation is financially and tecnically fasible. Less tha 1% of total potential i,e 800 MW is developed till now. Government of Nepal has top priority on hydropower generation. The demand of electricity is projected for National Planning Commission; Nepal is shown in the following chart No.1.

The policy of Government of Nepal is expidite the generation electricity 10,000 MW in this decade through public and private efforts . In the couse of licensing hrdropower projects for survey or development for generation,transmission and distributionof electricity, the quality, volume and depth of study are needed to have same standard quality and fulfill the requirement, Department of Electricity Developmen has issued “Guidelines for Study of Hydropwer Projects” in 2003 which provides the formats and specific details for reconnaissance, prefeasibility and feasibility studies and detail project report(DPR)/ tender docunt preparation is also prepared for each specific project. They also include the detail topographical, geological and other surveys which are prerequisite for planning and construction of hydropower project.

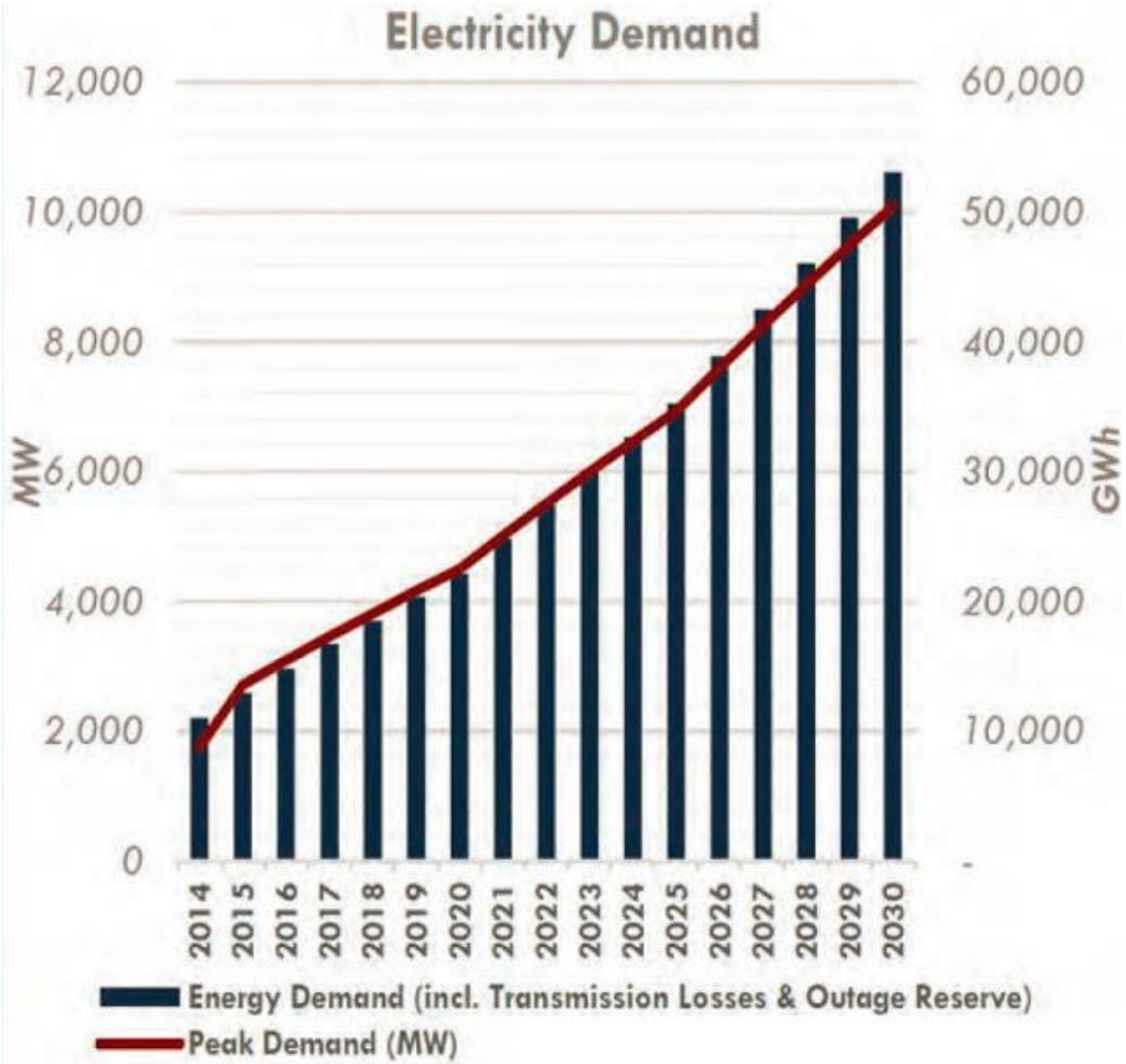

Chart No.1: Electricity demand forcaste

3. STATUS OF MAPPING IN NEPAL

Topographical map coverage of Nepal is available at the scale of 1:25,000-1:50,000 with the assistace of Government of Finland. The 3rd order trigonometrical control points at about 5km interval and precise level at an interval of 2km along the main highways are also exist. Cadastral survey of private land was carried out at the scale of 1:500- 1: 4800 of the country was carried out from 1964 to 1998 and is updated daily by local offices as and when trasanction and mutation of parcels occour. Land resources maps – Land utilisation, land system and land cability maps were produced at the scale of 1:50,000 and geology maps were produced at the scale of 1:125,000 and climatic maps were produced at the scale of 1:250,000 -1:2000,000 with the assistace of Government of canada.

Land resources maps are being compiled at the scale of 1:10,000. It is expected the tarai area about about 25% of Nepal will be completed in this year 2017. The large scale topographical mapping of urban areas is taking place at the scale of 1:5, 000 with very slow rate and most of the new town are without maps. Re cadastral survey is progressing slowly.

4. SURVEY AND MAPPING REQUIREMENT FOR FEASIBILITY AND DPR

The hydropower project area of dam site, reservoir and power house areas are surveyed at the scale of 1:500 -1:2000 and Tunnel axis at the scale of 1:2,500-1:5,000. Bathymetric survey/ cross section survey is carried out using total station at 20-50m interval using rope across the river/stream. The accuracy of establishment of ground control points atfeasibility stage is better than 1: 10,000 and DPR stage is about 1: 100,000 and positions of details and spot heights are also more accurately surveyed at DDPR stage. Elevation control points are established by levelling. Generally detail survey is done using total station over the station established on ground control stations opposite side of bank and some time using recflectorless method. However, reflectorless gives poorer result in heighting.

Geological survey is divided into regional, specific areas and engineering geological maps. General geological maps prepared at the scale of 1:25,000 of entire area, geological maps of sites are prepared at the scale of 1:500 -1:2,000 of damsite and power house areas, and engineering geological maps prepared at the scale of 1:5,000 of the area. Sciesmic refraction survey is carried out to locate the position of sciesmic points/ phones accurately and referenced to the topographical survey. The recent sattellite imagery and stereo photography are also used for interprtation of geological features in regional scale.

Water volume is calculated from the levelling survey data at least three cross sections on straight sections of river.

Evironmental study is carried out at about1;5,000- 1:10,000 scale using existing topographical base maps and with help of recent sattellite imagery.

Existing cadastral maps and ownership data are used as available in the local offices and project area is transfered to cadastral maps for land aquisition and resettlement purposes by GIS technique.

Transmission line survey is carried out by strip mapping of 100m either side of transmission line with establishment of positions of angle towers by DGPS survey and the maps of strip is usually prepared by total station and supprted by satellite imagery. Geological and environmental feafures are also studied from satellite imagery supported with field visits.

"Guidelines for Study of Hydropwer Projects" Department of Electricity Development 2003 which provides the formats and specific details for reconnaissance, prefeasibility and feasibility studies. Spepecfication for detail project report(DPR)/ tender docunt preparation is also prepared for each specific project, are used as a guidelines.

5. METHODOLOGY OF TOPOGRAPHICAL SURVEY

Topographical base map are prepared on the basis of the points by extending 2nd or 3rd order geodetic networks to the project sites with pair of intervisible ground control points at power house, dam site and reservoir areas by DGPS method. They are further extended by precise traverses for detail mapping as well as future relocation of constructions. Detail mapping is carried out by total station observations and digital base map are produced at required detail and accuracy. Every steps of survey and sample details are checked automatically by observation procedures.

LiDAR survey are also used for multipurpose or large projects. Through, it shows the accuracy of 6-10 cm and reliability of heighting or position may required to check by ground survey methods during implementation.

6. AVAILABLE TECHNOLOGY

The technology of GNSS and total station are available and used extensively in Nepal. Digital mapping with data base is also used and needed to standarized. LiDAR Survey is also used in some projects. However, lack of required instruments and sufficient manpower at local survey companies or survey offices, this technology is not fully utilsed.

7. ACCURACY

Accuracy of ground control points at reconnaissance, prefeasibility and feasibility is better than 1:10,000 and detail project report(DPR)/ tender docunt preparation is better than 1:100,000 or 3rd order. Accuracy and density of details are also checked and be within the standards governed by the map scale although digital survey are scale free.

8. DATABASE

The data base topographical maps are prepared accordingly and data base of geological, land resources and other data are also prepared and superimposed with topographical database. Details about existing data base for urban mapping and land resouces maps were pesented in the articles as references 2 and 3. There is no clear standards or guideline for data base for study of hydropower project at DPR level is exsiting in Nepal. The following Figure 4 will show the working methodology.

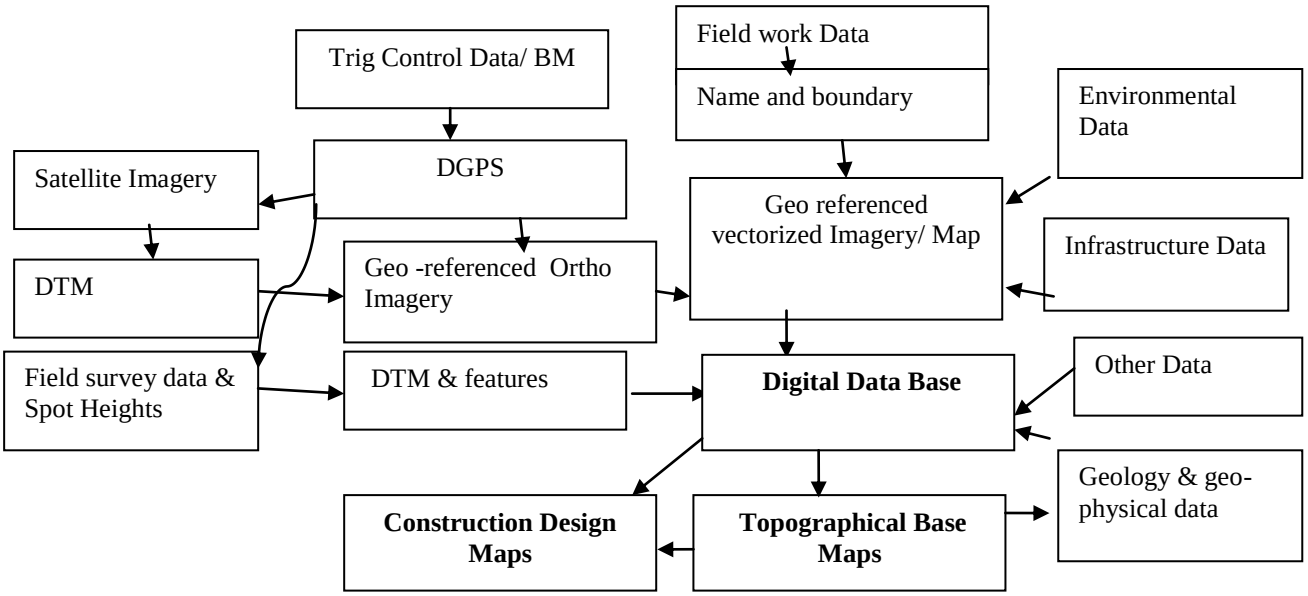

Figure 4: General Methodology

9. CONCLUSION AND RECCOMENDATION

Many hydropower development projects are in various stages of developmentin Nepal. The scale of maps, contents and standard symbols or terminology are not uniform. The soil and geological classification are based on the locality names. It will be difficult corelate to international standards. Therefore, standard classification system of non topographical features are also needed to be developped as international standard level as well as guidelines for spatial data base and requirement studies for DPR/ tender docunt preparation are also in urgent need.

REFERENCES

1. Guidelines for Study of Hydropwer Projects" Department of Electricity Development, Government of Nepal, 2003
2. Land Use Zoning Database in Nepal,,Punya P OLI and Ms. Manisha THAPA, 15th GSDI conference in Taipei, Taiwan, 2 December 2016
3. Preparation of database for Urban Development, P. OLI,FIG Congress 2014, Kuala Lumpur, Malaysia, 18 June 2014
4. Engineering and design,Control and topographical surveying, Manual, No 1110-1 -1005, US Army Corsp Engineers, 1January 2007.
5. Hydroppwer Status Report, 2016, International Hydropower Association (IHA)
6. Electricity Demand Forcast 2030, A MAED Based Approach, Envestment Board, Government of Nepal,

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