TOPOGRAPHICAL SURVEY BRANCH WITH REMOTE SENSING

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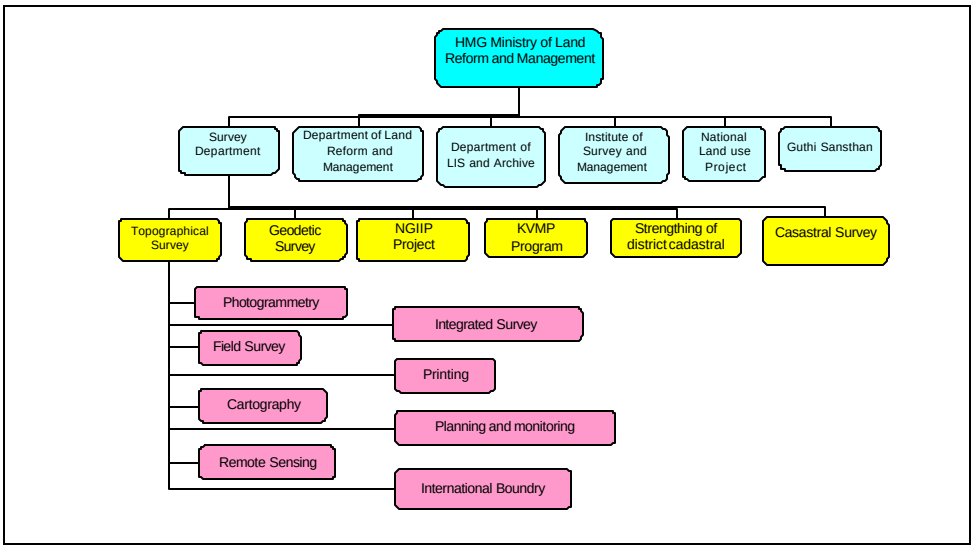
Abstract.

This paper is made for institutional development and it is oriented towards the study of past, present and future of Topographical Survey Branch. All existing (Topographical, Land Resource, Thematic, Derived etc) maps of HMG Topographical Survey Branch prepared on different dates by different donor agencies, has become outdated, so regular and systematic updating of these maps are very important. This has become a big problem because of constraints of finance and human resources. When we adopt modern technology, like Remote Sensing with GIS, there are problems in lack of specialists and finance. If we adopt conventional method we have financial constraints and it is very time consuming also. Remote Sensing with GIS is the only optimal methodology for updating all these maps. Other than that, the Satellite Space image data used for updating of existing maps can be further used for various other programs, projects, studies and research of other users also.

1. Back-ground of the Branch:

Topographical Survey Branch, under the Survey Department, Ministry of Land Reform and Management, His Majesty's Government of Nepal is the Central Organization to provide topographical mapping services, land resource mapping, derived mapping and other mapping services to all concerned. Our organization structure as its names stand is given below.



With the following responsibilities and aims, this branch was established in 1972, since its birth the branch is struggling to develop its activities in the field of Surveying and Mapping.

- To produce topographic, administrative, political and thematic maps.
- To produce large scale topographical maps for urban and rural areas as required.
- To provide Land Resources maps and information.
- To publish National Atlas, reports and data relating to the topography and land resources of Nepal.
- To provide aerial photographic services for various mapping projects.
- To participate in regional and international mapping programs.
- To provide cartographic, photogrammetric and map printing services to the Government agencies in Nepal.
- To provide mapping services for land use planning and other decision making purposes for the users.
- To conduct Surveying and Mapping in delineating International boundaries of Nepal.
- To up-date all above maps, reports and to adopt new technology and methodology of Surveying and Mapping of the branches as and when required.

For planning, execution, evaluation of above programmes this Topographical Survey Branch was established.

2. Past and Present Projects of Surveying and Mapping in the Branch:

Before and after the establishment of the Branch a number of projects and programmes has been launched and completed. Some of the major projects are as follows:

a) **Survey of India-**
The first topographical base map of the country was 1" = 1 mile. It was completed during 1950-60 with the co-operation of the Government of India. A total of 266 maps sheets covering the whole country were prepared. These maps are now outdated and too small in scale. Moreover, the units of measurements were not metric, and the projection systems and parameters used are different from the present system. However these first topographical maps have been support for a long period of time in all development and administrative activities of Nepal. In many cases demand for more detailed, up-dated and larger scale maps were seeking.

b) **UNDP** –
In the initial stages, with the UNDP assistance, infrastructure of the branch was established. This branch was able to procure major surveying and mapping instruments and equipments. It also assists on manpower development through training at home and abroad as well as technical assistance by different types of technical exports. Today this branch has more than 150 employees working in various posts in different technical sections. Under the head of the Deputy Director General, there are photogrammetry, remote sensing, field, cartography and GIS, map reproduction, integrated survey and border sections. This project was started from January 1979 and ended on June 1982. During this period various programs were launched and completed, for example numerous derived maps, thematic maps were prepared under the supervision of foreign experts and volunteers.

c) **Government of Canada**: -
In 1977, with the assistance of Canadian Government, Land Resource Mapping Project was launched from this project we got land capability maps, land System maps, Land Utility maps, Geological map, Climatological maps of Nepal based on existing 1"= 1 mile maps and aerial photographs taken in 1978. They prepared these maps in the scale of 1:50 000 in regions below15000feet altitude.

d) **JICA** –
In 1989, with the assistance of Japanese Government Topographical base maps of Lumbini Zone was prepared and it was 81 map sheets in the scale of 1:25 000 and was completed in 1992.

e) **Government of Finland** –

Topographical mapping of other zones was also necessary and due to financial constrain branch could not prepare the new series of topographical maps, so proposal was sent to donor agencies, ultimately thanks goes to the Government of Finland that the Finnish Government has accepted the proposal.

With this grant assistance, Topographical mapping of two development regions of Nepal viz. Eastern and Central Development Regions was started in 1991. Accordingly a new series of topographical base maps at 1:25 000 scale for Terai plains and mid- mountain regions and 1:50 000 for the rest area was completed in 2002.

In the first phase of the project a total of 294 map sheets was completed in 1996 and in the second phase of the project a total of 255 sheets at a scale of 1:25 000 was completed in 1999 and in the third phase a total of 76 map sheets in the scale of 1:50 000 was completed in 2001. Including 81 maps sheets of Lumbini zone, a total of 706 topographical map sheets are available and in use and sale.

f) **Census Mapping** –

With the assistance of Finland, Denmark and European Commission, Census Mapping Project was started from 1999. This project's main aim was to prepare a digital data of all hard copy made so far. Within given time period most of topographical maps sheets of the whole country except mountain regions where population is very low, digitization and preparation of census mapping are completed. At present the mountain area maps also digitizing and secondly ortho photomaps of the urban area are preparing. Third program of this project is at presently known as National Geographic Information Infrastructure Project is preparing derived maps of different scales and preparing national date base.

g) **Other activities** –

Before establishment of this Survey Branch, there were only cadastral maps, 1:1 mile topographic maps and geographical maps of the country prepared by foreign countries only. With the help of existing 1"= 1 mile topographical maps first Nepal map, Development Region maps, Zonal maps, District maps were prepared in different scales by HMG resources only. Different types of maps prepared under this program were revised and reprinted whenever necessary. Apart from these different derived maps, there are some municipality maps and engineering or other project maps prepared on the users request. There are Village Development Committee maps prepared by HMG resources for census purposes in 1990 and they are a total of 3997 map sheets in different sector.

The branch has prepared wall maps in the scale of 1: 75 0000 and School Atlas prepared for schools and general users. There are other small-scale maps prepared, printed and published by HMG resources. Apart from these maps there are some reports, Land resources, manuals of technical works. The branch also provides topographical mapping services to government and non-government agencies. One of the main activities of the branch is to maintain the record of administrative boundaries and International boundaries. In international boundaries, all works like delineation of boundaries Surveying and mapping of boundaries, pillar construction & maintenance, boundary delineation, boundary maintenance, periodic inspection etc is also responsibilities of this branch.

3. Existing Maps and Data of the Branch

Since, main objective of Topographical Survey Branch is to provide services concerning facts and figures of land by means of maps, data, photographs images etc. Within its thirty years of period the branch is providing following products for the users:

Derived maps

Administrative Map	Scale	No. of Sheets	Remarks
Nepal	1:1,000,000	1	Various version
Nepal	1:2,000,000	1	Various version
Regional Maps	1:500,000	5	Nepali version
Regional Maps	1:500,000	3	English version
Zonal Maps	1:250,000	15	Nepali
District Maps	1:125,000	76	Nepali
Municipality Maps	1:10,000 to 1:50,000	39	Map manuscript 1990
Village Development	1:10,000 to 1:50,000	3997	Map manuscript 1990

Thematic Maps

Map	Scale	Number of sheets	Remarks
Land Utilization	1:50,000	266	
Land System Map	1:50,000	266	
Land Capability Map	1:50,000	266	
Climatological Map	1:250,000	7(Western Nepal)	
Climatological Map	1:1,000,000	1	
Geological Map	1:125,000	82	

Topographical Maps

Name	Scale	No. of sheet
Lumbini Zone	1:25,000	81
Eastern Nepal Topographical Project	1:25,000	255
Eastern Nepal Topographical Project	1:50,000	37
Western Nepal Topographical Project	1:25,000	254
Western Nepal Topographical Project	1:50,000	79
Total		706

Aerial Photographs

i. Aerial Photographs of the country below 15,000 feet taken in 1978-79 at the scale of 1:50,000.
ii. Aerial Photograph of Lumbini zone taken in 1990 at the scale of 1:50 000
iii. Aerial Photograph of Eastern Nepal (Eastern and Central Development region) taken in 1992 at the scale of 1:50,000.
iv. Aerial Photograph of western Nepal (Western, Mid Western, Far Eastern Development region) except Lumbini zone taken in 1995-96 at the scale of 1:50,000.
v. Aerial Photograph taken for different projects in different dates in different scales. .
vi. Aerial Photographs of metro political area taken by Census Mapping Projects in 1998 at the scale of 1:15,000.

Digital Data of topographical maps

All above Topographical maps of scale 1:25 000 and 1:50 000 (total 706sheets) has been digitized and are published for users, but some map sheets are common on above projects, so digital sheet data of total 678 sheets are available.

4. Realization of Remote Sensing in the Branch

Since, establishment of Survey Department, Topographical Survey Branch is the Central organization under the Government of Nepal responsible for National Surveying and mapping activities within the country, it is therefore responsible for the accomplishment of Land Surveys, mapping production and distributions. Thus, the responsibility is to give the updated geo-information in the country to support multi-sector development activities by publishing the data/information in the format as per the demand of the users communities, modern and efficient geo information can be obtain from the data/remote sensing technology.

Updating geo-information is very important because reproduction is not a problem but correct, accurate and up-to-date as well as in the users' required format is important. After perceiving these activities the branch is looking forward to the appropriate opportunity to formulate a procedure or a project for the updating of database of topography or land resource or any other types of geo-information. For this purpose we select the Remote Sensing technology. Satellite image data will be efficient and good geo -information requires for multi sector development activities and can be achieved by scientific spatial information technology called Remote Sensing. There are very good range of Remote Sensing applications, but one of the main applications of Remote Sensing is mapping or geo-information collection of data required for geo-information.

Since, information is power and remote sensing is spatial information, therefore spatial information is also a power. This power plays a vital role in the national building but also use as monitoring and evaluation of any scientific and technical studies. At present its main field of applications are topographical, forestry, agriculture, geological and mining, meteorological, land resources system, soil and water resources management, environment and pollution, wetland mapping, vegetation classification and plantation, oceanography, land use and land classification, soil erosion etc.

Geographical information system today is one of the major decision making tools in the areas of resources planning and management. Integration of Remote Sensing technology with GIS technology has widened the potential of both technologies so another major benefit of this technology is that they can be integrated and a number of national level or local level projects of natural resources or other studies can be implemented successfully. Some beneficial points on Topographical Survey Branch with Remote Sensing are as follows:

- Digitization of whole topographical maps series is completed.
- GIS and RS can be integrated.
- As centre for satellite images, data can be used for other purposes and projects.
- Low cost compared to aerial photographs.
- Remote Sensing with aerial photographs can create digital photogrammetry for large-scale mapping.
- Mapping with point by point digitization is not required.
- It does not require stereo viewing or measurement.

Space Imaging as a visual information and visible resource has numerous application viz. Environment, Utilities, Exploration and Mining, Media, Entertainment and consumer, Transportation, Agriculture, Property insurance and Crisis management, Real estate and Development, Forestry, Telecommunication etc.
Thus selection of technique of remote sensing for topographical survey branch is feasible.

5. Status of Remote Sensing in the Branch.

Present status of Remote Sensing in Topographical survey Branch is in initial stage only. At present we realize that remote sensing technology is important, necessary and appropriate for our mapping activities. There are many things to be done for full operation of remote sensing in the branch. At present following works has been done by the branch.

- The branch established remote sensing lab with few computers and procured ERDAS Imagine Professional software version 8.4 and 8.5, high resolution IKONOS image (1 meter resolution, the product of merging of 1m black & white e and 4 m multi-spectral image) of Kathmandu Valley and IRS data of Lumbini zone.
- The branch prepared project proposal and sent it to different donor agencies.
- After establishment of Remote Sensing Lab and some local training with the IKONOS image of Kathmandu Metropolitan area, our staff has prepared a image map.

The following steps have been taken for the image map preparation.

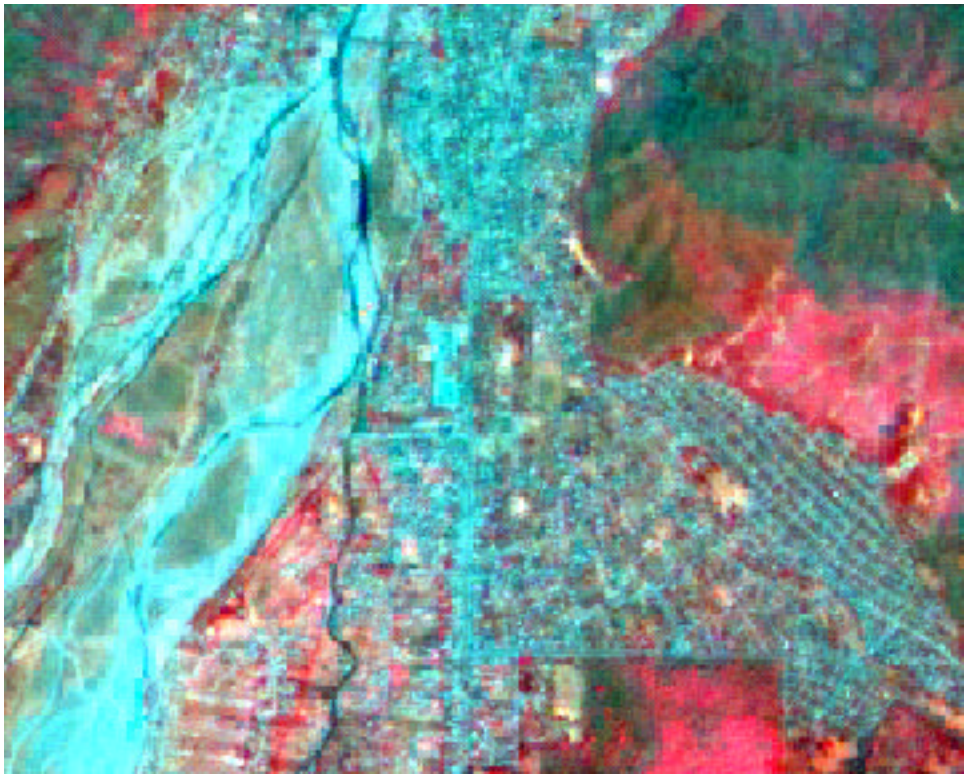
- The image was procured in two parts; therefore they were geo-corrected with the help of toposheets and mosaics.
- Enhancement - To improve the sharpness of the image enhancement was done.
- There was a problem in enhancement of image only in the core area due to fogs, which we suppose to be due to air pollution. Therefore the images were enhanced for atmospheric correction, which reduced the effect of atmospheric pollution and gave sharp image to some extent. The sample of this product is given below.

IKONOS Image of a part of Kathmandu Valley in scale of 1 : 4000

- These enhanced images were cut and composed in our mapping layout system in 1:5000 scale.

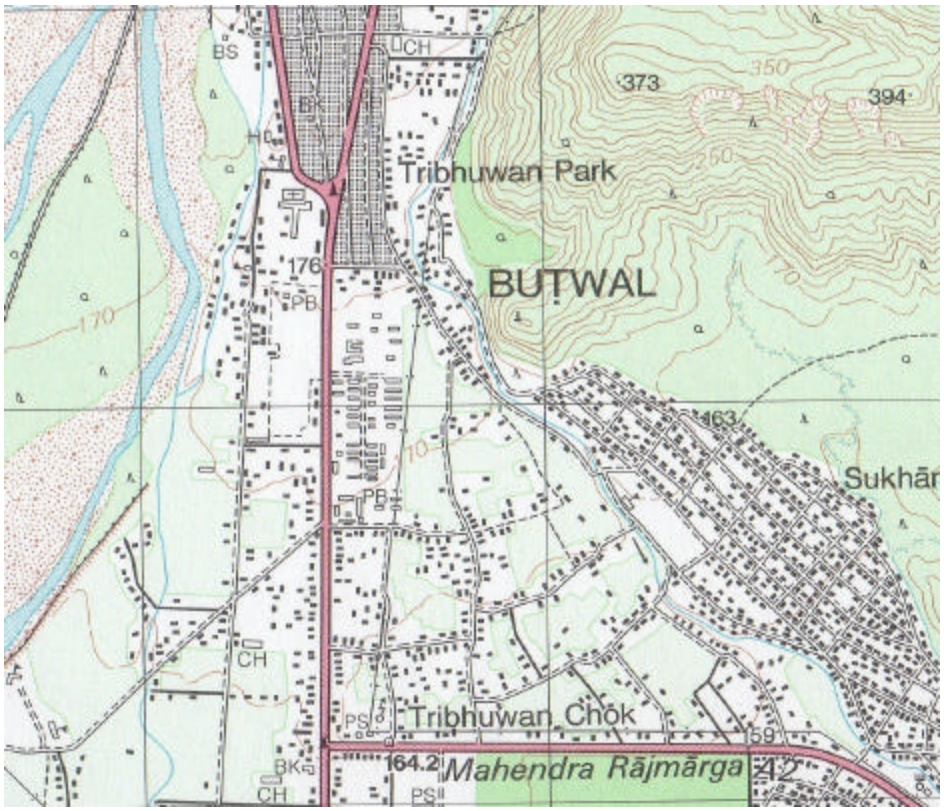
Secondly, the branch has worked for up-dating topographical maps and following steps has been taken for up-dating in brief.

- Topographical map of Lumbini Zone of scale 1:25,000 was selected for updating.
- For this purpose IRS data, which we procured in two parts (1C/1D LISS-24 m and 1C/1D PAN-6 m) were geo-referenced separately with the help of existing toposheets.
- These geo-referenced images were mosaiced and merged together. We got the image map after some enhancement.

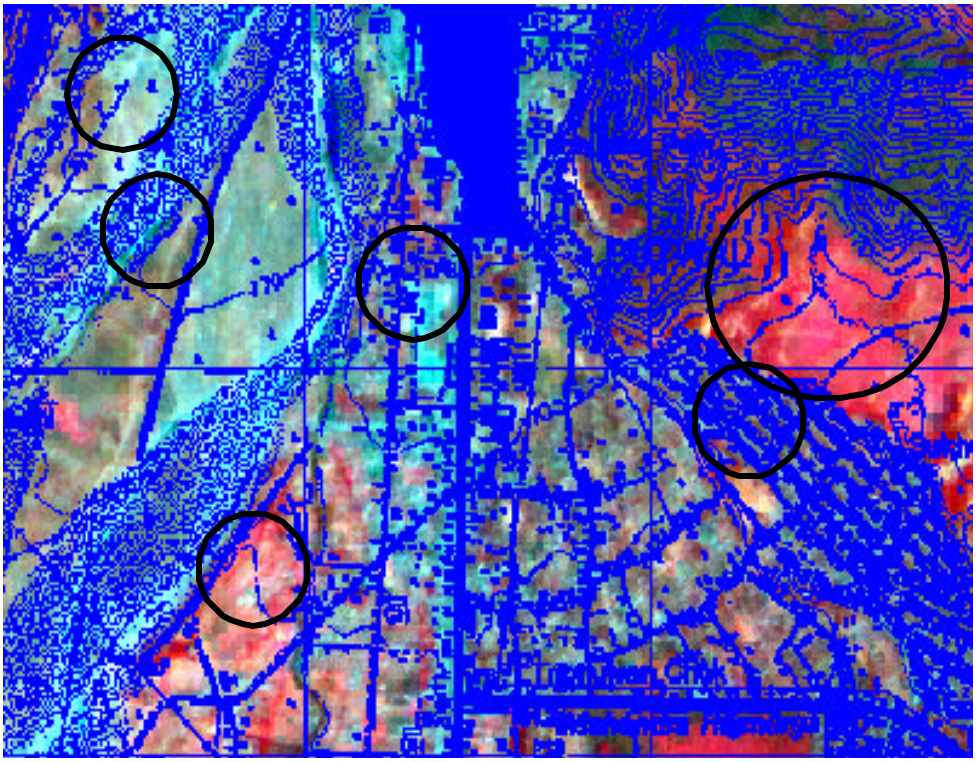


IRS Rectified Merged 24 m/6 m Image (1:25000)

- Recent rectified IRS multi-spectral Image (24-m) of 2002 and Topographical map of 1991 of Lumbini, JICA were compared and many changes were noted within these two image and toposheets.
- These changes were updated accordingly in the digitized vector layer.
- This new vector database will be used for printing of topographical maps after completion of symbolization and color separation. Sample of satellite image map prepared base on IRS data is given below.
- Changes in features are indicated by circles.



Scanned Topo 1:25000



Overlay of Toposheet on top of image for the comparison (1:25000)

6. Problem of Remote Sensing for implementation in the Branch.

The main problems in the implementation of remote sensing technology are as follows.

- It is the new technology in context of Survey Department.
- Our branch has limited budget and no skilled human resources.
- There are some institutions, which give GIS training but there is no opportunity to get Remote sensing training/courses in Nepal.
- Since this is research and cost oriented technology, this problem is more in developing countries compared to developed countries.
- Government and some non-government organization have already realized the usefulness of these technologies but due to lack of specialists, development in this field are very low
- Some other problem is about satellite image data and proper software itself because we do not acquire any satellite and we have to order it and to buy it from concerned agencies it takes time.

7. Conclusion

In this paper there are explanations of Topographical Survey Branch and its necessities of Remote Sensing Technology. The branch has selected this technology for their further programs, but this is not all for them they should implement this program for resource mapping and updating of the new series of topographical maps with the help of aerial photographs and GIS data. It will be worth to prepare new land resource maps rather than updating of old land resource maps. In the second phase while updating new series of topographical maps they should prepare all topographical maps of the country in one scale (1:25000) in one system with same accuracy.