ORTHOPHOTO MAPPING: A FUNDAMENTAL DATA LAYER FOR URBAN GIS IN NGII IN NEPAL

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ABSTRACT:

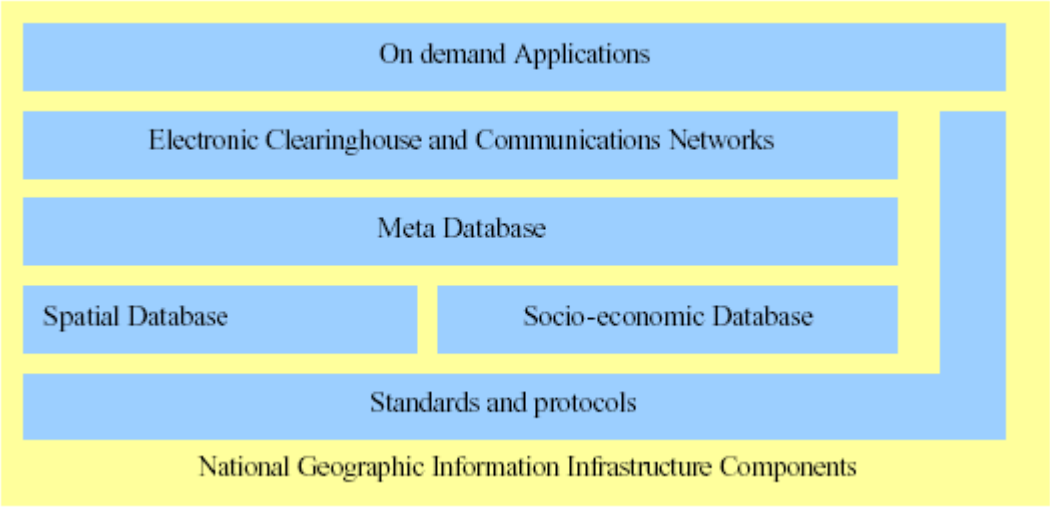
More recently, a national geographic information infrastructure programme to support spatial data need of different users has been initiated in Nepal. Quite often, urban planners need very detailed topographic details for their applications and more often they need a temporal coverage of data. Line map data layer having a clean topological vector database have very easy applications in a GIS, but they cannot fulfill many of the urban planning needs. To cater for these needs, an orthophoto map layer in the Nepalese NGII is under progress. The rationale and the coverage of the current orthophoto-mapping programme have been explained. A suggestion for a temporal coverage of orthorectified high resolution remote sensing imagery has been suggested.

1. NATIONAL GEOGRAPHIC INFORMATION INFRASTRUCTURE IN NEPAL

Geographic Information System (GIS) and Remote-sensing (RS) are very effective tools for the study, monitoring and management of spatial decision-making. GIS and RS become versatile, efficient and cost-effective due to the possibility for multifarious applications and usages of general framework spatial and attribute data. In Nepal, due to unavailability of such digital data, each GI Systems had to spend a lot of resources in its development as part of the GIS project. That meant a lot of duplication and loss of resources, which would eventually affect the time, budget and the efficiency of the system. The current national geographic information infrastructure (NGII) initiative undertaken by the Survey Department of His Majesty's Government of Nepal will help in the sharing of data in the country and thereby on the efficiency and cost/ time effectiveness of individual GI systems.

The National Geographic Information Infrastructure (NGII) in Nepal has a broader objective of strengthening planning and resource management through availing geo-spatial and thematic information to decision makers at all levels. This is proposed as a national spatial data infrastructure (NSDI) consisting of fundamental datasets, electronic clearinghouse, communication networks and on-demand applications. A schematic representation of the various components of the Nepalese NGII is shown in Fig 1.

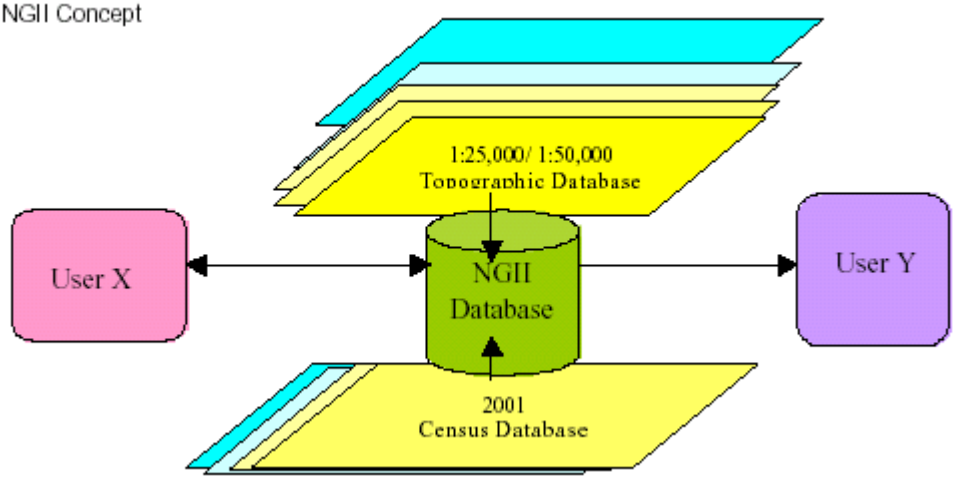
Figure 1; Schematic Representation of NGII Components



The fundamental spatial dataset in the NGII in Nepal are the National Topographic Database (NTDB) and the fundamental socio-economic dataset are the National Census Database (NCDB). The NTDB will have a horizontal coverage covering the whole country and vertical coverage at the scales of 1:25,000/ 1:50,000; 1:100,000; 1:250,000; 1:500,000 and 1:1M. The primary data input in the NTDB is the digitalization of the 1:25,000/ 1:50,000 topographic base maps produced by the Survey Department between 1992- 2001. The base data are generalized for the reduced resolutions and separate data layers are archived in the database.

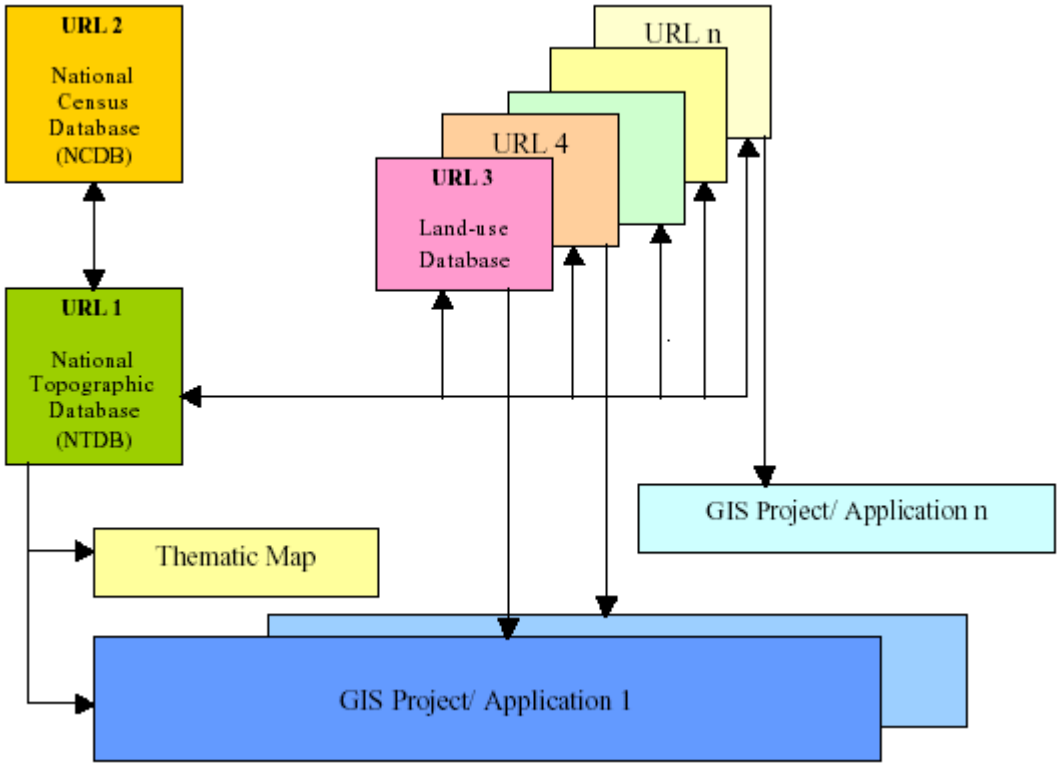
The NCDB is based on the results of the decennial national population and housing census. Therefore the NCDB will have a temporal coverage of decennial interval.

Figure 2: NGII Concept



The NTDB database maintained at the Survey Department (SD) and the NCDB database maintained at the Central Bureau of Statistics (CBS). They will be fully integrated and available as fundamental NGII dataset for different applications.

Figure 3: Generalized Schema of NGII



2. FUNDAMENTAL SPATIAL DATA LAYERS IN THE NEPALESE NGII

The spatial database of NGII has the following major fundamental datasets:

- Control points,
- Administrative Boundary,
- Designated Areas,
- Transportation network,
- Buildings,
- Landcovers,
- Hydrography,
- Topography,
- Utilities,
- Toponymy.

The above become essential framework data for all GIS applications, but they become insufficient for many applications. The urban growth in Nepal has been very rapid and in most of the cases unplanned and haphazard. Therefore for monitoring of urban phenomena and carrying out rational urban planning activities, it is felt that topologically clean vector database alone will not be enough to give a very clear picture of the existing situation. The urban planners at one time or
other find it useful to have a pictorial view of the situation as an additional data layer.

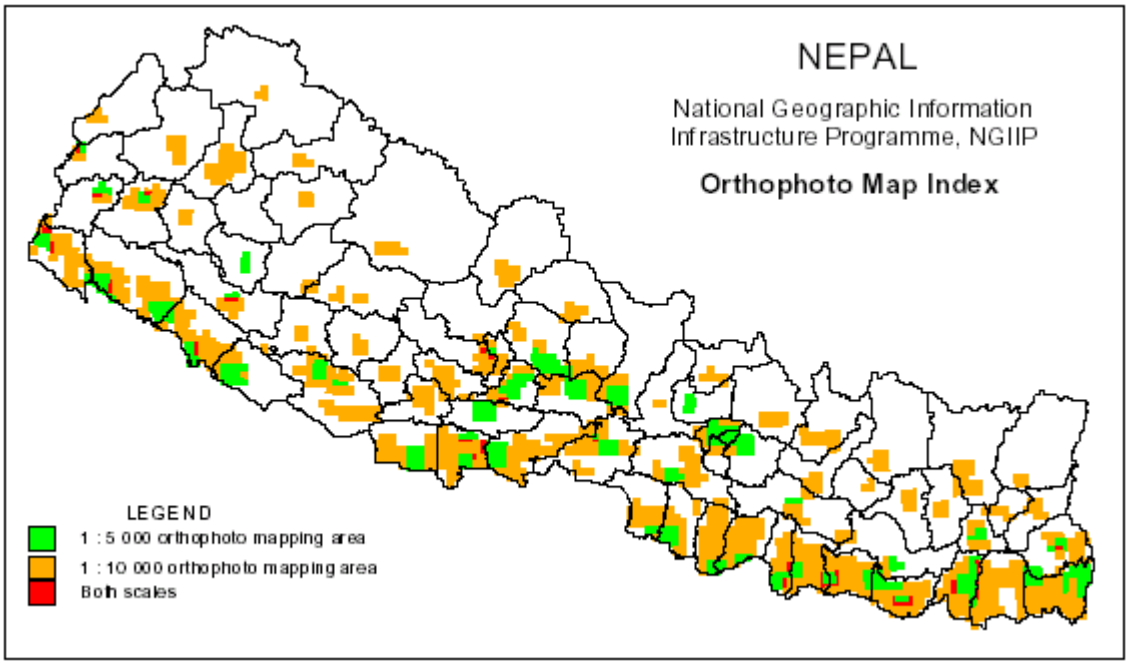
Orthorectified image layer of necessary resolution is proposed as the answer to this demand. This should form one of the important data layers in urban GIS.

3. ORTHOPHOTO- MAPPING STATUS IN NEPAL TO SUPPORT URBAN GIS

Traditionally, Nepal had an experience of photo mapping to cater for specific needs of the users. Quite often semi-controlled photo-mosaics or rectified photo mapping were conducted in the last 25 years to support specific user applications. With the advent of digital techniques, it has now become possible to digitally ortho-rectify photo imagery with more ease and accuracy. Survey Department recently launched an ortho-photo mapping project under its NGII programme to support general applications among which the urban planners and managers are the major target group.

Nepal has 58 municipalities the so assumed densely populated urban areas and many other areas, which are semi-densely populated. The densely populated urban areas are estimated at 7500 km2 and the semi-densely populated urban areas are estimated about 25000 km2. The orthophoto-mapping for the densely populated urban areas are based on 1:15,000 scale aerial photography of 1998-99 and that of semi-densely populated urban areas is based on the 1:40,000 - 1:50,000 aerial photography of 1996. The area of ortho-photo mapping is shown in figure 4.

Figure 4: Index of Orthophoto- mapping in Nepal



The orthophoto-mapping are conducted under the following procedure. The original film negatives or diapositives as appropriate are scanned using precise photogrammetic scanner with scanning resolution of 20 microns. Digital ortho-rectification is carried out using the GCP data and further control data derived from aerial triangulation. Digital Elevation Models are derived using the method of autocorrelation. Additional support is taken from the existing digital database based on 1:25000 scale/ 20m interval contour map digitization, where necessary. The accuracy of orthorectification for dense areas and semi-dense areas are expected as 2m and 5m respectively. Based on the resolution of imagery and the accuracy, the assumed mapping scale of the ortho-photo mapping are assumed as 1:5,000 and 1:10,000 respectively.

4. PROBLEMS OF ORTHO-PHOTO MAPPING IN NGII

- The orthophoto-mapping based on aerial photography being a complex process involves various expensive and sensitive hardware and software. It is felt that a non-commercial organization will severely under-utilize them, and is considered un-economic to install the full orthophoto-mapping system. Therefore, not all hardware and software are available in-house.

- There is a large time-lag between aerial photography and the orthophoto image production.

- It will not be too easy and economic to have temporal data layers of orthophoto- images in the database.

- Suitable data dissemination policy needs to be in place to correspond with the aerial photo distribution policy of the country.

5. CONCLUSIONS AND RECOMMENDATIONS

The ortho-photo mapping project is in the progressing phases and the results are not yet ready for dissemination. The conclusion from the experience so far is that it is expensive and high-tech project. The full conclusion on the economy and suitability of the project can be adjudged after the results have been tested by the users. The Urban Planning and Building Construction Department has already been looking forward to them for their forthcoming urban mapping and urban GIS application.

It is felt that the use of high-resolution satellite imagery could be more economic and efficient in many respects compared to ortho-photo mapping from based on traditional aerial photography. It is expected that most of the problems outlined in section 4 could be overcome using such highresolution satellite imagery for ortho-photo mapping.

However, this conclusion is based on theory alone. We do not have the experience of using highresolution imagery for ortho-photo mapping for a project of similar size. A pilot project is recommended for being undertaken.

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