Preparation of Database for Urban Development

By Punya P OLI,
1. Chairman, ERMC (P) Ltd.,
   Kathmandu, Nepal.
   Email: punyaoli@ermcnepal.com
2. Coordinator,
   Himalayan College of Geomatic Engineering and Land Resources Management;
   Web site: www.geomaticcollegenepal.edu.np

Contents

• Definition
• Status of Urbanization in Nepal
• Status of Urban Mapping in Nepal
• Historical Development
• Method of data creation
• Data requirements
• Data Model
• Description of data base and design
• Data description
• Land suitability Decision
• Problems encountered
• Recommendation
Definition

• Municipal Geographical Information System is data base including topography, infrastructures, socio economic situation, metric house addressing system, cadastral situation and link these data to tax system of the municipality.
• Infrastructures are data like transport, electricity, water supply, waste management.
• Metric house addressing system is naming of street and assigning house number in metre.
• Cadastre data superimposition is superimposition of cadastral data on data base.

Status of Urbanization in Nepal

• Urban Population of Nepal
  The urban population is 17.07%
  Annual increment rate of 3.38% and
  Population with own houses 85.25%

  (Population Census 2011)
• Recently planned 72 municipalities
• Present Urban Population 25.16%
• Present Urban area 6.9%
• Whole Kathmandu Valley will be municipal area
Status of Urban Mapping

• Department of Urban Development and Building Construction (DUDBC) conducted the creation of required data base of selected 45 municipalities and available to public of 20 municipalities,

• Data base is at the scale of 1:2,500- 1:5,000 and at the scale of 1:10,000 for the remote forested area.

• Cadastral Maps available of all private land parcels of Nepal at the scale of 1:500- 1:4,800 and general scale is 1:2,500
Historical Development

- Large scale topographical mapping of urban area in 1972 at the scale of 1:2000
- Ortho photo mapping of municipalities in 2001
- Data base of 45 municipalities and 10 new towns are available.
- Some kinds of geo database is available of all municipalities.

Legislations
- The Urban Development Act, 2045 (1988)
- Specification for Urban Geographic Information Service in Nepal in 1999 by Survey Department
- Colour Codes for Digital Base Maps and Planning Norms and Standards 2013 by DUDBC.

Objectives of preparation of urban map

- Preparation of digital maps of the urban area at scale of 1:2500 based on high regulation (0.5m) satellite imageries, aerial photographs, available topographical maps and field survey data.
- Collection and development of municipal geographical information system incorporating the cadastral information, existing infrastructures, demography and socio-economy of each household, environment, administrative units etc.
- Development and establishment of effective house numbering and street addressing system
- Development of the GIS system to link tax system software being used by the municipality.
General Methodology

Location of DGPS

<table>
<thead>
<tr>
<th>S. No</th>
<th>Description</th>
<th>WGS84/GRS80</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Easting</td>
<td>Northing</td>
</tr>
<tr>
<td>1</td>
<td>TRIG 207</td>
<td>566405.234</td>
<td>3121293.540</td>
</tr>
</tbody>
</table>
DIGITAL BASE MAP OF KHURKOT NEW TOWN

Legend

Administrative

- VDC Boundary

TDC Boundary

Ward Boundary

Ward Number

Location Name

Land Cover

- Cultivation

- Builtup Area

- Forest

- R barren Land

- Bush/Shrub

- Grass

- Tree Cluster

- Sand

- Swamp Area

- Trees / Tree

- Orchard

- Plantation

- River / Stream

- Pond

- Canal

- Land Slide

- Characteristic Land

Topographic Feature

- Spot Height

- Contour

Transportation Infrastructure

- Black Topped Road with Bridge

- PCC Road

- Gravel Road

- Stone Pavement Road

- Brick Pavement Road

- Earthen Road

- Tracks

- Airport Runway

National Geodetic Control Point

National Bench Mark

GPS Points/Control Points

Building

- Temple

- Stupa

- Monastery

- Church

- Mosque

- Crematorium(Ghat)

- School/College

- Bank/Cooperative

- Health Service

- Police Station

- Fire Station

Check Post

- Post Office

- Telephonic Office

- Water Supply Office

- Electricity Office

- Hotel

- Drinking water Source

- Factory/Industry

- Water Supply Pipe

- Public Tap

- Well

- Electricity Pylon

- High Tension Line

- Electric Transformer

- Telecom Tower

XXV International Federation of Surveyors Congress, Kuala Lumpur, Malaysia, 16 – 21 June 2014
Validating the geometrical accuracy against the cadastral data
## Confusion Matrix

<table>
<thead>
<tr>
<th></th>
<th>Agriculture</th>
<th>Forest</th>
<th>Residential</th>
<th>Commercial</th>
<th>Industrial</th>
<th>Public Services</th>
<th>Other</th>
<th>Total</th>
<th>user Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>85</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>94.4444444444</td>
</tr>
<tr>
<td>Forest</td>
<td>1</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>31</td>
<td>96.77419355</td>
</tr>
<tr>
<td>Residential</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>53</td>
<td>94.33962264</td>
</tr>
<tr>
<td>Commercial</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>95</td>
</tr>
<tr>
<td>Industrial</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>80</td>
</tr>
<tr>
<td>Public Services</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>19</td>
<td>1</td>
<td>21</td>
<td>90.47619048</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>10</td>
<td>90</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>87</td>
<td>32</td>
<td>52</td>
<td>23</td>
<td>4</td>
<td>20</td>
<td>12</td>
<td>230</td>
<td></td>
</tr>
<tr>
<td><strong>producer Accuracy</strong></td>
<td>97.7011494</td>
<td>93.75</td>
<td>96.15385</td>
<td>82.60869565</td>
<td>100</td>
<td>95</td>
<td>75</td>
<td>216</td>
<td></td>
</tr>
<tr>
<td><strong>omission error</strong></td>
<td>2.29885057</td>
<td>6.25</td>
<td>3.846154</td>
<td>17.39130435</td>
<td>0</td>
<td>5</td>
<td>25</td>
<td></td>
<td>93.91304348</td>
</tr>
</tbody>
</table>

Kappa Statistics: (KIA): 0.92

Overall accuracy : 93.9%
DESCRIPTION OF DATABASE

Data base is designed for thematic layers, entities (types, categories, components) and topological relationships between feature classes.

Thematic layers of base Map

- Control points-
- Administrative boundary-
- Topographical and hypsographic features-
- Transport- Road-; airport-; bridge- ; railway
- Hydrography-
- Land Use
- Infrastructures- Water Supply; Sewerage-; Electricity-; Communication
- Buildings-
- Environment- watershed, hazards, flora and fauna,
- Cadastre-
- Street names and house number-
- Socio-economic data-
- Linkage of data with Tax System-
LAND SUITABILITY DECISION FOR URBAN DEVELOPMENT

• Land suitability analysis by
  – SLEUTH Model - SLEUTH stands for Slope, Land cover, Exclusion, Urbanization, Transportation and Hill shade and
  – Multi Criteria Analysis (MCA) Model is used for development which is influenced by both natural and social-economic conditions.
  – It is difficult to find enough land in hill area as per these model.
CONTRIBUTION OF BASE MAPS FOR SUSTAINABLE URBAN DEVELOPMENT

• National planning commission collects from lower level to national planning commission and decides the programmes on the basis of resources available and the resources allocated on the basis of database.
• Lack of detail geo-database, will delay the development programmes 2-3 years and accordingly cost of project will increase.
• The detail digital base maps/data will provide above data of the situation of the area.
• Database will be useful for future urban development and conservation of nature and culture.
• Data base will be sufficient to carry out technical, social and financial feasibilities.

PROBLEMS ENCOUNTER

The main problems are :
• Technological- updated with the technological changes like software, imagery, aerial camera, photogrammetric instrumentation and ortho photo or DTM generation facilities,
• Land form is either too steep or too flat. The steep land form is prone to land slide and expensive to develop infrastructure and flat land are flooded in rainy season every year
• Climatic- Rainy season, fog- cold wave, extreme altitude/slope and temperature situation are main physical problems in the field and
• Maintenance (updating and upgrading ) of existing GIS database is essential.
Recommendation

- The urban population will increase with greater rate annually and urban development will necessitate take place at greater speed to provide housing and infrastructure to the urban people whether the city is planned or not. Hence, database required to prepare of all municipalities.
- It is also required to update existing topographical maps and creation of new ortho photo, and start preparation of large scale maps of the whole country at the resolution of 0.5m - 1m.
- It is also required to maintain existing geodetic control net work.

Thanks

- 25th FIG congress
- Session Chairperson, Rapporteur, and participants
- Host & PEJUTA (Association of Authorised Land Surveyors Malaysia)