

# **An innovative approach for under-resourced municipalities: A cost-effective geospatial information management system for local government in Nepal.**

**Gabriel ARANCIBIA, Canada and Bhushan SHRESTHA, Nepal**

**Key words:** Urban planning, e-governance, geospatial infrastructure, open source technology, municipal information systems, cadastre, land property taxes, street addressing, Nepal.

## **SUMMARY**

Local government in Nepal has important challenges related to manage the territory, and several approaches have been taken place from different levels of the Nepali government. The approach explained in this paper was defined as a solution to reduce some of the most critical barriers that are preventing newly empowered, but under-resourced municipalities, from carrying out their new responsibilities. For instance, some of the current obstacles found at Nepali's municipalities are: poor financial management systems, limited revenue raising capabilities, weak urban planning and management capacity (infrastructure planning, sector planning, project management, and infrastructure operation and management), insufficient quality urban planning data and related information management systems.

This paper describes the achievements of one of the three components of an ADB funded technical assistance project in Nepal between 2010 until the end of 2011, which is the development and implementation of a municipal geographic information management system (G-MIS) to three participating municipalities in Nepal (Butwal, Birgunj and Biratnagar - BBB). The Ministry of Physical Planning and Works was the Executive Agency of this technical assistance project, while the Ministry of Local Development was the organization responsible for overseeing the financial assistance component for the municipalities, while the Department for Urban Development and Building Construction (DUDBC) oversaw the urban planning and geospatial development of the contract. This work seeks to share the concept of the new approach for implementing a preliminary geospatial information management system and also the production of a geospatial database. The geospatial database consists of socio-economic survey datasets, house numbering and street addressing data, land parcel and mapping geo-database. The new approach of implementing a municipal GIS involved building a Web-based system with minimum financial resources to be used in day-to-day decision making for these three municipalities in Nepal.

## SOMMAIRE

Les municipalités au Népal ont des défis importants pour gérer leur territoire avec des sources financières restreintes, alors plusieurs approches ont été considérées dans divers niveaux du gouvernement népalais. L'approche décrite dans cet article a été développée comme une réponse innovatrice afin de réduire la contrainte la plus critique à laquelle doit faire face les gouvernements locaux et qui limite, surtout avec de faibles recettes, d'être responsable pleinement des nouveaux services du gouvernement central. Le but de l'approche dans ce projet est de chercher donc à établir des systèmes de gestion financières efficient, de chercher des nouveaux revenue, d'augmenter la capacité de planification et la gestion urbaine (planification d'infrastructure, gestion de projets et administration des infrastructures), et finalement d'améliorer la capacité de gestion de production et de mise-à-jour des données géo-spatiale.

Cet article décrit les résultats d'une composante du projet financé par ADB au Népal de 2010 à 2011, pour le développement et l'implantation d'un système de gestion de l'information municipal géo-spatiale des trois villes ; Butwal, Birgunj et Biratnagar (BBB). De plus, dans ce projet d'assistance technique le Ministère de planification et travaux publics a agi comme agence d'exécution, ainsi que le Ministère de développement municipal a été le responsable de la vérification de la composante financière, et finalement la Direction de développement urbain et construction (DUDBC) a participé comme partenaire pour surveiller ce projet. Cet article a comme objectif de partager l'approche pour le développement et l'implantation d'un système prototype de gestion de l'information géo-spatial, ainsi que la création des jeux données à référence spatiale qui tient compte des levés socio-économiques, le développement d'un système d'adresse et codification du réseau de rues, de l'intégration des lots avec le système des taxes foncières et finalement les outils de gestion urbaine. Malgré la complexité de ce projet, le défi majeur a été la mise au point du système G-MIS sur le Web avec un design extrêmement simple et avec un minimum de ressources financières, pour être utilisé jour-à-jour pour les agents et décideurs municipaux des trois villes en expansion, mais avec des budgets restreints afin de fournir des services essentiels.

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## **1. INTRODUCTION**

This document highlights the main achievements of an ADB funded project in Nepal in 2010 and 2011<sup>1</sup>, and seeks to address some of the most critical obstacles that are preventing newly empowered, but under-resourced municipalities, from carrying out their new responsibilities caused by: poor financial management systems, limited revenue raising capabilities, weak urban planning capacity (infrastructure planning, sector planning, project management and infrastructure operation and management) and insufficient data and related information management systems. The project was divided in three main components: (1) Financial management and revenue generation; (2) Urban service delivery (urban transport, solid waste management, water supply and sanitation systems and overall infrastructure planning); and (3) Development and Institutionalization of GIS-based municipal information system (G-MIS). This document intends to emphasize the critical issues and achievements of the third component of this project.

Implementing and institutionalization of a G-MIS was considered in this ambitious project as the solution to enhance and improve many municipal services, which is partly true, but the reality is that a GIS must be very well defined to be accepted as replacement of traditional and well establish paper-based practice by municipal officers. With this in mind, the approach to use GIS technology, as a mandatory component of this contract, was dramatically modified. In addition, other issues added on this mandate were the limited budget and the timeframe to address the barriers identified in these three municipalities. Furthermore, the lack of digital geospatial datasets and geo-reference databases created extra constraints to utilize traditional GIS solutions. The answer to tackle these issues was to use “Open Source” GIS/Database software adapted to run on local Web, with very simple work-flow tools. Data production capabilities were solve using innovative approaches, such as a mix of mapping concepts to organize and perform street addressing, house numbering and socio-economic survey at the same time. Municipalities were also advised that they must concentrate on providing services to the community, instead of building capacity on creating mapping and GIS information, which are not part of municipal functions.

The main achievements, in the component 3, are described hereafter , and can be summarized as: implementing and deploying a simple and user-friendly web-based G-MIS, simplifying data capture mechanisms within the daily activities of municipal officers, building capacity at the participating municipalities to handle house numbering integrated to land property taxes, strengthening e-governance capabilities by accessing data and information on all municipal

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<sup>1</sup> This ADB 7355 technical assistance project was executed by Cowater International Inc. with collaboration of the Ministry of Physical Planning and Works (Government of Nepal).

departments and finally creating a computer-friendly process embedded on the former traditional paper-based procedures.

## 2. THE WEB-BASED GEOSPATIAL MANAGEMENT INFORMATION SYSTEM

The approach employed to address the creation of GIS capabilities at the three participating municipalities (BBB) was defined based on the preliminary institutional assessment at the early stage of the project. The following are the main criteria taken in consideration for the changes from a traditional GIS solution to Web-based G-MIS presented in this paper:

**Organizational Structures:** The three municipalities have traditional organization structures to support paper work-flow processes, but are flexible enough to embrace technological changes to enhance their capabilities to better serve their communities.

**Human Resource Capability:** Overall it was found that the majority of technical staff in BBB is familiar with computers and basic software. Some senior and junior staff members have received commercial GIS software training, and several have gone through more than one training program. Furthermore, senior staffs in all three municipalities know about the importance of land use mapping and its potential benefits in planning and decision making.

Despite this respectable grounding in computer operation and basic software, it was found that current municipal staffs do not have sufficient skills or knowledge to utilize, produce, interpret and analyze outputs to support decision making, updating maps and disseminating updated GIS based information to the public.

**GIS/IT Software and Hardware:** Existing GIS/IT infrastructure in BBB was analyzed in order to understand equipment procurement needs for these municipalities. In general, nearly all key municipal staffs have high-end laptop for their personal use. Every technical unit has sufficient high and middle range computers, but they are currently in use for general word processing purposes only.

All three municipalities have local area network, but only Butwal has network in working condition. Although, they do have wireless internet that connects a limited number of offices. A wireless system allowing access to the Internet from anywhere within the municipal compound in Butwal.

**Software:** ESRI's Arc GIS is one of the most commonly used GIS software in Nepal. It is currently being used by Kathmandu Metropolitan City, other municipalities supported by UEIP<sup>2</sup>, and by other government and non-government organizations in the country. Nevertheless, BBB do not have any software that enables them to produce maps or to use spatial data for municipal purposes. Software costs and lack of priority status for such items

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<sup>2</sup> Urban Environment Improvement Project

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by senior management are seen as the primary reasons behind this situation according to municipal staff.

**GIS Databases:** BBB all have GIS based digital databases comprising most of the key data layers such as building footprints, road network, water bodies. Biratnagar and Butwal have also created a GIS layer with simple land use classifications such as built-up, agriculture, water body and forest area. However, none of these databases or associated maps have been used for planning purposes and there is no systematic mechanism for collecting, updating or maintaining existing spatial data (either digital or hardcopy).

**Digital Maps:** Biratnagar and Birgunj already have GIS based digital maps (in shape file) in the scale of 1:2500. These are available also in AutoCAD (dxf) format. Butwal also has GIS based digital maps in shape file but lacks some of the important topographic data layers such as contour.

**Socio-economic information:** All BBB have of some kind of socio-economic data sets but there is no any integration with the spatial data they already have. It was identified that different divisions / sections tend to build (outsource) their own datasets on an ad hoc basis without first verifying the availability of data in other units of the municipality. These data sets are often project specific and thus difficult to adapt and integrate into planning and management activities (e.g. social survey in Biratnagar Municipality).

**Ability of developing cadastral (land parcel) management application:** In addition to BBB, a very rapid assessment was done at the District Survey and District Land Revenue (part of the Ministry of Land Administration and Reform), responsible in Nepal for producing cadastral maps and land ownership databases. However, it was found that there is no appropriate flow of cadastral information from District Survey Office (DSO) and Land Revenue Office (LRO) to the municipalities. Cadastral maps are updated as need be in connection to the parcel sub-division for land ownership transactions. But the other changes in land use (e.g. buildings, newly constructed and expanded roads, changes of river courses etc.) are not updated on a regular basis.

**Street Addressing Systems:** During the commencement of the project, it was found that the current status of street addressing and house numbering systems in BBB are very precarious. The main exception is Butwal, which undertook a house numbering initiative with support from UDLE<sup>3</sup>. Almost all streets have been named as a result. The same cannot be said for Biratnagar and Birgunj, where only a small number of streets have names. If any of the municipalities undertook house numbering programs in the past, none have been successful to date.

**Potential for Linking GIS-based MIS with Taxation Systems:** This assignment found that the integrated property tax is the trend on all municipalities in Nepal instead of separate taxes

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<sup>3</sup> Urban Development through Local Efforts Project

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for house and land. These integrated property taxes are currently managed using software from a Kathmandu-based firm (Shangrila MicroSystem). This system allows participating municipalities to register and collect land taxes on a regular basis and manage all property tax accounts. The current system is based on parcel records for each municipality being copied from the Registration Book of the Land Revenue Department.

Analyzing the results of this comprehensive assessment and also the lessons learnt from other similar projects, the conclusion was obvious, and the team strongly recommended to develop an “open source” G-MIS with Web capabilities to be able to share information and using some tools on a work-flow process. From a data point of view, the choice was to reduce the number of data for the socio-economic survey by using property instead of household units. This was done using mapping technology, the purchase of satellite geo-reference images to create a topographic digital map with few selected features, define a simple strategy to create a street address and house numbering datasets at the same time as topographic maps were developed. Finally, land parcel database was prepared by private firm using scanned hard-copy cadastral map and BBB were advised that this type of business is not part of municipal services.

## 2.1 The geospatial architecture and Web-based information system

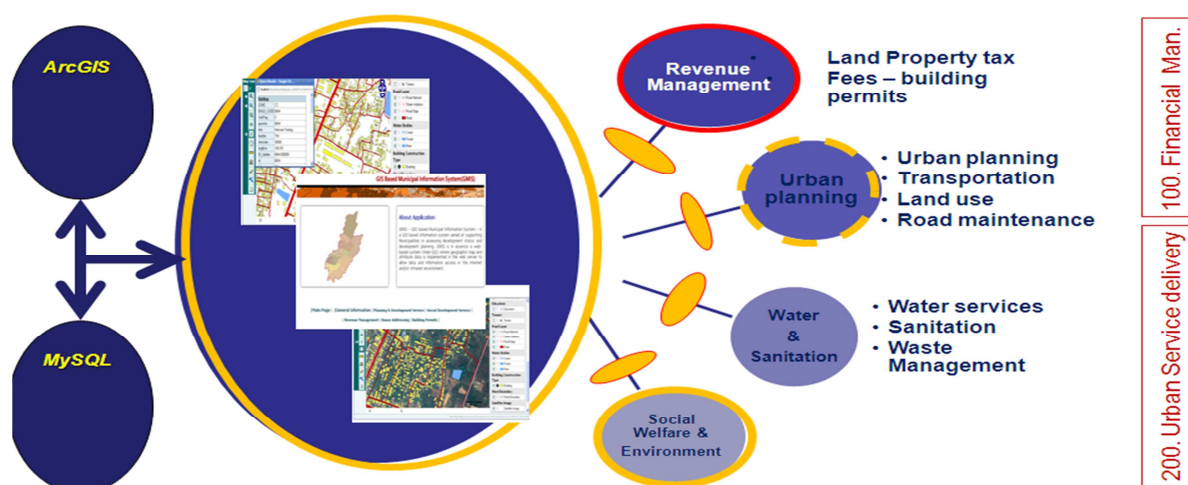
The G-MIS system has been developed on “open sources” software *MapServer* to be able to have an infrastructure capable of being used by most of the end-users at the municipality, without having the need of purchasing commercial off-the-shelf expensive software license. The conceptual model for this system is based on the needs and requirements set by the project team at the inception report stage and adjusted after during the development process in coordination with the municipal officers.

The main requirements set for the Web-based G-MIS are the following:

1. Interface for displaying and query geographic information (GIS maps);
2. Database tools integrated with GIS functions to manage socio-economic information;
3. Information management tools to maintain edit and display street addressing and house numbering database;
4. Mechanisms to maintain, edit and display building permits datasets;
5. Tools to link with the Taxation system and display land taxation information;
6. Application to manage land parcel information.

All the above functionalities of the system have been added using a modular approach and with the concept of reducing the manipulation using menu driving tools. The latter provides end user to easy navigate on the system without having formal GIS or computer knowledge.

The following figure illustrates the system capabilities and conceptual design.



Each circle has a color ring (yellow, red or yellow dash-line), which represent a database for specific sector or division inside the municipality. For instance, the color blue indicates datasets that will be created and filled for this project, such as the mapping geospatial database that will be maintained and supported at the GIS Unit of each participating municipality (biggest blue circle). This is the main change in this approach, because this municipal Unit will be on charge of maintaining geographic datasets as well as street address vector and attributes using ArcGIS (GIS commercial software). The other yellow ring represents datasets including in the *MySQL* database, which would be maintained by municipal officers, such as the socio-economic database that will be updated by the Social Welfare or/and Environment division. The yellow dash-line circle indicates that the project will design the database structure, but the urban planning division must be on charge of collecting and filling the fields in this database.

The red ring represents the land taxation and building permits (fees) databases, which are already in Oracle/MS SQL a fully operational at the Finance Division (Department) of each municipality. The small yellow ellipsoids between the connections from one circle to another represent the interface to link and interact between the G-MIS database with other municipal databases.

The project team defined and selected the features to be developed in *MapServer* in conjunction with the municipal officers. A summary of the main G-MIS features are listed below:

## 1. Mapping Component

- a. Renders maps stored on a server in the shape file format.

- b. Supports tools for zoom in/out/full extent, pan, feature identification, distance measuring tool, area measuring tool, print map display tool, query tool, etc.
  - c. Shows the current scale of the map display.
- 2. Table of Contents to control the map layers**
- a. Provides layer information of the layers currently configured on the map control.
  - b. Provides options to move layers up and down.
  - c. Provides on/off options to set the visibility of the individual layers.
- 3. Search/Query facility**
- a. Search facility enables users to find the locations on the map.
  - b. Users would select a category (e.g. Schools, Banks, offices, hotels, markets, gas stations, dumping sites, etc.), the system bring the queried feature in the center of screen.
  - c. User can point and zoom the specific feature on the map by clicking the desired feature from the list.
- 4. Updating/Editing capabilities**
- a. Ability to update/edit tabular data from a popup screen linked with *MySQL* database.
  - b. Search/Query *MySQL* database to edit table.
  - c. Add new tabular data associated to an object, i.e. GIS Unit add new object in *ArcGIS* (polygon of a new building) with a key to link with database and other Division will input tabular data in *MapServer*.
- 5. Administrator**
- a. Interface for administrator for loading and configuring layers.
  - b. Administrator capabilities to classify the users by their right to access the information.
  - c. Capabilities to manage user name and password to access the system.

## 2.2 Building the geospatial database

A very brief description of the concept to build a robust, useful and inexpensive data production process is explained in this section, as well as the repository mechanism to populate the geospatial database and also other type of datasets. The datasets which integrate the main database are:

- 1. GIS-based urban maps.
  - 2. Socio-economic Surveys data.
  - 3. Land parcel inventory and integration with land taxes.
  - 4. House Numbering and Street Addressing codification.
1. **GIS-based urban maps** have been prepared for all three municipalities and are integrated in *ArcGIS* geo-database as well as in *MapServer* database. The following table lists the main products developed on this contract concerning hard copy maps.

A digital database of the base maps has been prepared alongside extensive field work for verification and updating. The database includes administrative and physical



features, social infrastructure and urban environment features, physical infrastructure and utility, building and urban service infrastructure (building foot prints with indication of their functional use).

2. **Socio-economic Surveys** -The main objective of this survey work was to carry out socio economic surveys of 100% of the buildings in all three municipalities. To meet this ambitious objective, the location of each and every house of the municipality was identified and its construction type and uses were as recorded. The socio-economic data collected through the surveys has been used to populate the GIS-based MIS. This information data will help for future municipal planning.

34,100 buildings in Biratnagar, 20,300 in Birgunj and over 21,400 in Butwal were identified to be surveyed. Each building/house (not household) was surveyed and coded specifically so that socio-economic information of corresponding house could be easily integrated into spatial data layer of buildings. The output product of this task helped to establish and create GIS-based information base for efficient and sustainable urban development ultimately.

3. **Land Parcel Inventory (Cadastral Information)** - A consulting team was nominated to create land parcel inventory. The main objective of the proposed task was to create a GIS-based land parcel database covering at least 25% of total cadastral map sheets of each of the three municipalities using cadastral maps and land parcel information.

The land ownership data of related parcels from District Land Revenue Office was collected and added to a land ownership database of land parcels for all three municipalities. This database contains 312 map sheets. As soon as digitization of land parcel data was completed the next process was data cleaning, quality control and data integration. The land ownership database was then integrated with the land parcel GIS-Database.

4. **House Numbering and Street Addressing Systems** - The GIS based street addressing system was set to be compatible with the current addressing system trend (e.g. Metric System) in Nepal. The metric addressing system is an easy method to identify houses. This involved analyzing the streets in each municipality in coordination with municipal staff and come up with a GIS based street map. A small GIS application would then be developed to maintain the street address and distribute house numbers in the municipality.

The socio-economic survey teams were also responsible for the house addressing work. As a result, the total numbers of houses with new addresses are the same as of number of houses that were surveyed (12,000 houses in Biratnagar, 12,000 in Birgunj and 8000 in Butwal). However, these house numbers will be verified before distributing house number to the house owner formally. Furthermore, orientation programs were conducted

for implementing the house addressing system in Butwal, Biratnagar and Birgunj. Policymakers including political entities of the municipalities were briefed on basic policy requirements and the technical staff was trained on implementation.

### 2.3 The Web-based information system

A very important achievement in this project was the development of a Web-based G-MIS using “open source” platform based on the conceptual design defined and showed on section 2.1 of this paper. Several reasons forced our team to select this platform: Before describing the result of this system, it is important to bear in mind that G-MIS has been developed from the following considerations, which allowed having a customize solution for the BBB. These considerations are:

1. Acquiring GIS-based data, Computer Hardware and Software and creating municipal maps and database is very expensive and time a consuming endeavor.
2. Procuring commercial GIS such as ArcGIS for each individual user is practically not possible due to the huge investment cost.
3. Success rate of institutionalizing GIS is very low mainly due to limited people in the organization with good GIS knowledge.
4. Only the privileged few who understand the workings of GIS could use it, thus it has limited beneficiaries.
5. G-MIS was developed for BBB as hybrid system, one license of commercial off-the-shelf GIS per municipality, a customized open-source GIS server system and database (MySQL).
6. There are four major components of this system - (i) Spatial Data Maintenance; (ii) High level spatial data analysis and map preparation; (iii) Attribute Data Maintenance; (iv) General Query and analysis using Web-GIS.
7. This TA came up with an approach of implementing Web-GIS System that will avail the ordinary (non-GIS skill) user the opportunity to be able to carry out basic GIS functionalities.
8. The significance of this is that as long as one can use any kind of web browser such as Internet explorer, Mozilla-Firefox, Google chrome, etc. will be able to have access to interactive maps and perform basic mapping operations like pan, zoom in/out, identify features, search for features, print map display, etc.
9. Since the application is deployed in network environment, different departments, sections and units in the municipality can access the GIS-based maps with above mentioned GIS functionalities.
10. This system can be easily migrated to Internet environment through which more persons beyond the municipality can also get benefit of the system.

From the above-mentioned considerations, municipalities must bear in mind to really value the Web-based G-MIS in place for their own use. Furthermore, an information system is successful only when end-users are capable to take advantage of it and this can

facilitate the day-to-day work.

The following screen-shot shows the principal features of this Web-based G-MIS.

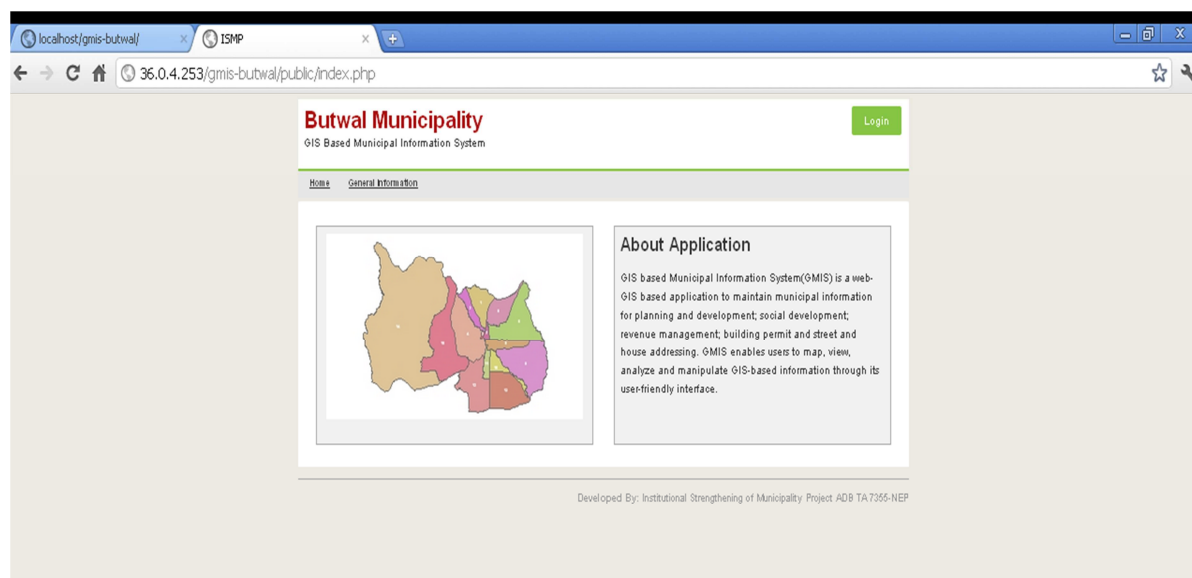


Figure 1. G-MIS main menu

This is the main screen of the system. However, by clicking “General Information” end-users do not require to login with username and password. This “General Information” function allows end-users to query, search, and display municipal information in the digital map of the municipality as well as allows to show the satellite image along with geographic data (see figure 2).

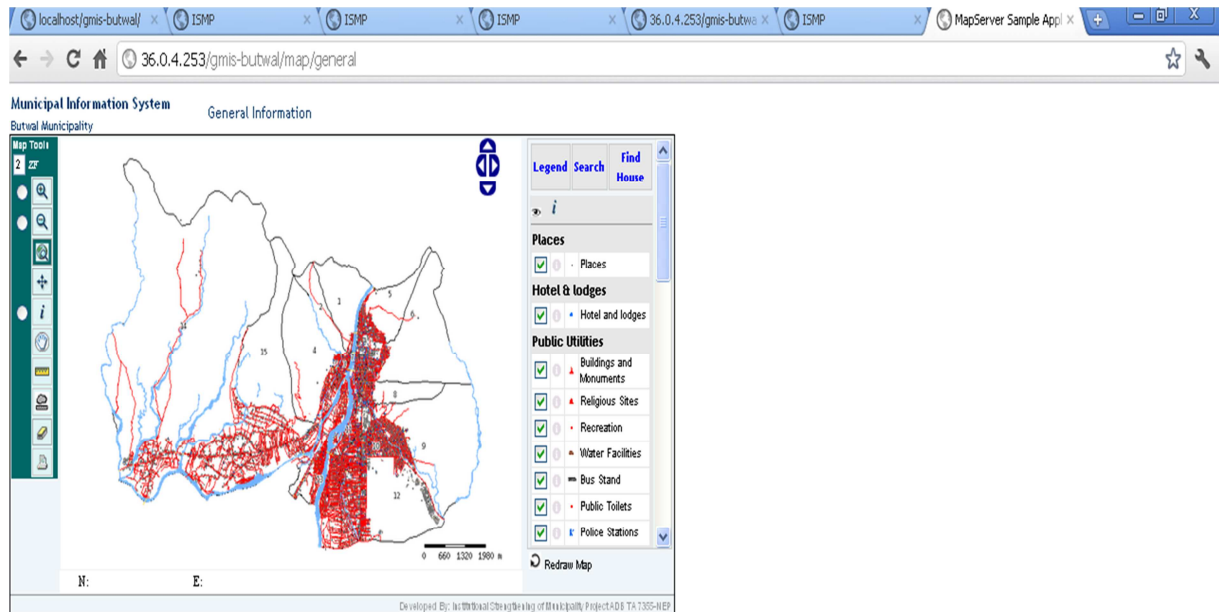


Figure 2. General Information tools (not restriction - allows query and display for all users)



Figure 3. General Information tools (combine display digital topographic map and satellite image)

The General Information application is the main tool developed in this GIS component. However, this GIS system allows also to be operated by multiple users, because the software can handle several datasets from the server using Web-based technology. As a result, the participating municipalities not only have GIS capabilities, but also database management system for non-knowledgeable computer users.

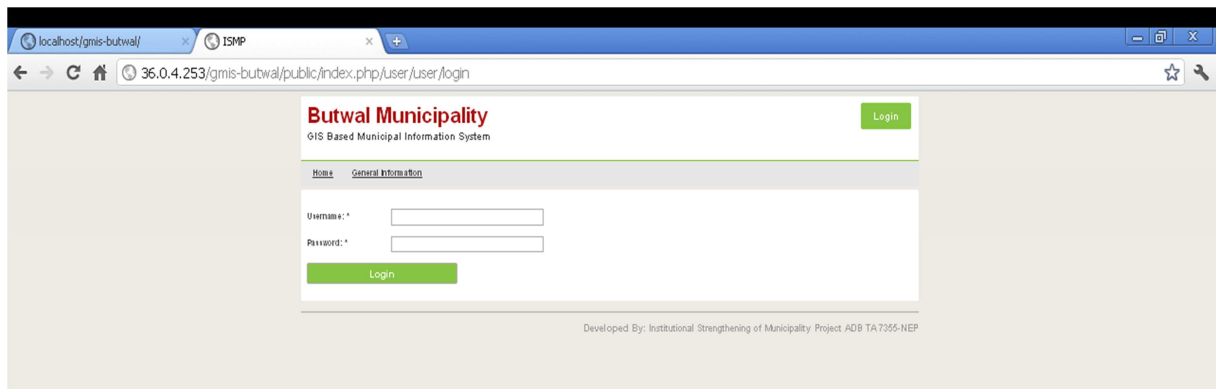


Figure 4. Login - only for municipal officers with special authorization.

Other municipal officers can use other tools from the G-MIS system to assist them on day-to-day services. The whole point of having restricted access to G-MIS is because at this stage end-users can add, delete, update and query municipal data or information in all databases integrated in the G-MIS system.

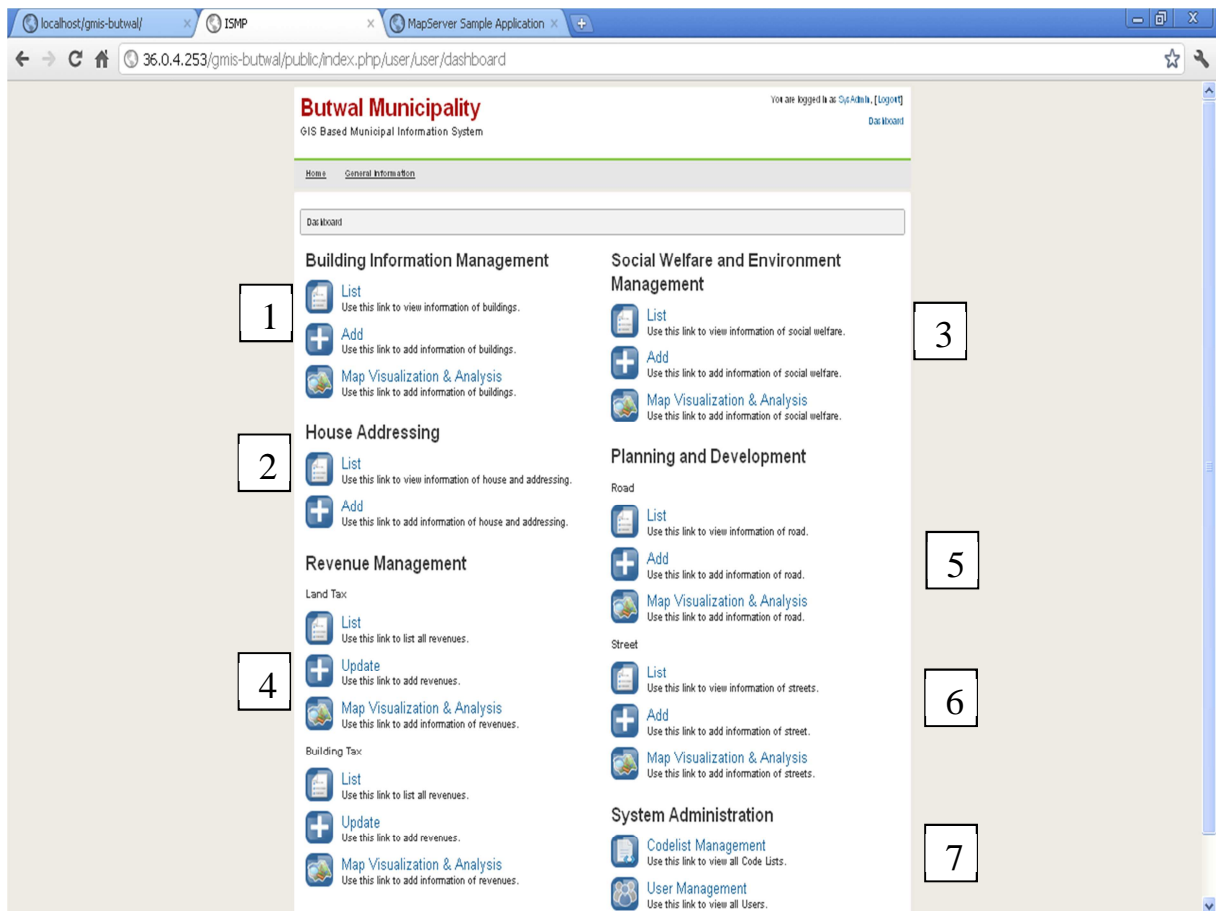


Figure 5. Main Menu - The above screen shows G-MIS system's main menu.

The menu displayed at Figure 5 shows seven applications integrated in G-MIS. The first three applications are additional tools developed during this project to help municipality to deal with new services and also to enhance other tasks. The following table summarized the application capabilities.

Box number	Feature description
1	<b>Building information Management:</b> This tool allows end-user to geographically display all building with or without permits. In addition, this application has tools to edit and update the building database, as well as link this current information with the current paper-based database. An important tool is to link this database with the GIS software to digitize the new building in the map and add comments about the building permit process.
2	<b>House addressing:</b> This is a new tool develop exclusively to promote and add the new street name into the road network database, as well as define the house number in the database. Currently, only Butwal has some street names and house number, but doesn't cover the whole city. Birgunj and Biratnagar require setting and completing the street address and house number database.
3	<b>Social Welfare Management:</b> This is another extra tool, which allows end-user to display and query on the map current social issues from the SES database. Also, municipal-officers can add, edit and QC the socio-economic survey (SES) database to develop social welfare initiatives.
4	The other applications integrated in the G-MIS system are mentioned as potential capabilities to add in the GIS component. However, the project team believed that without these tools, it would be difficult to manage all datasets created during this TA project. As a result, at the last stage of the project these tools were finalized.
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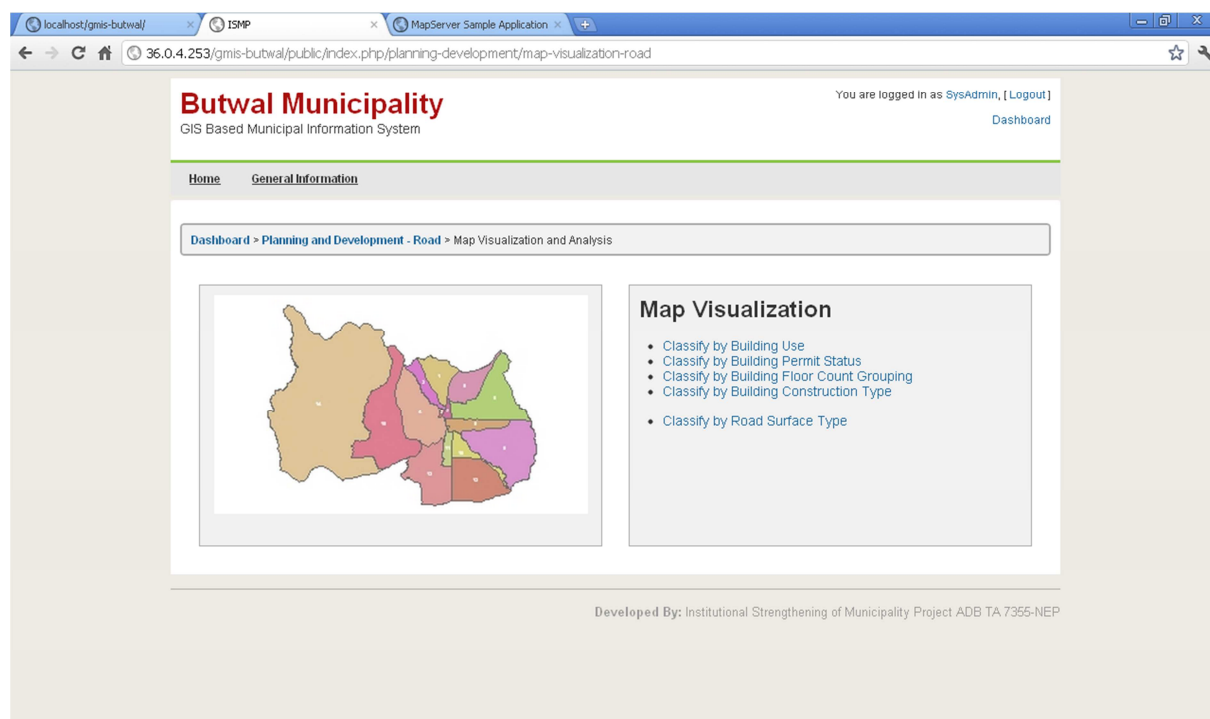


Figure 6. Building Information Management Menu - Map visualization options (by building features)

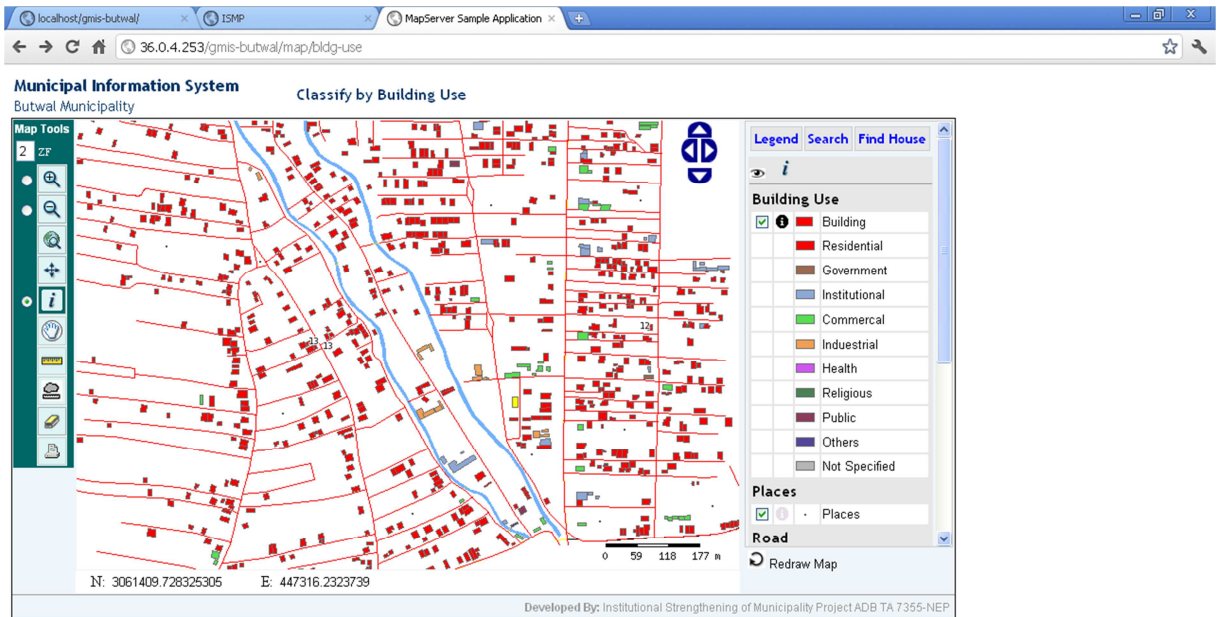


Figure 7. Building Information Management Menu - Map query and visualization by building usage.

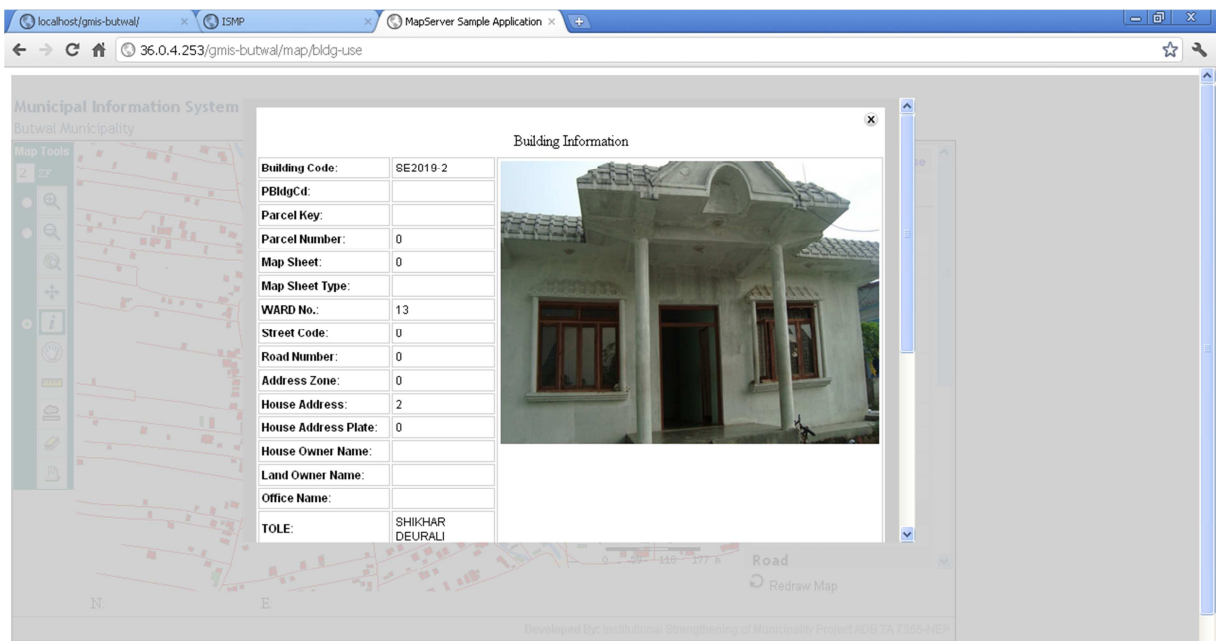


Figure 8. Building Information Management Menu - Results from database by clicking one building in the map (building information).

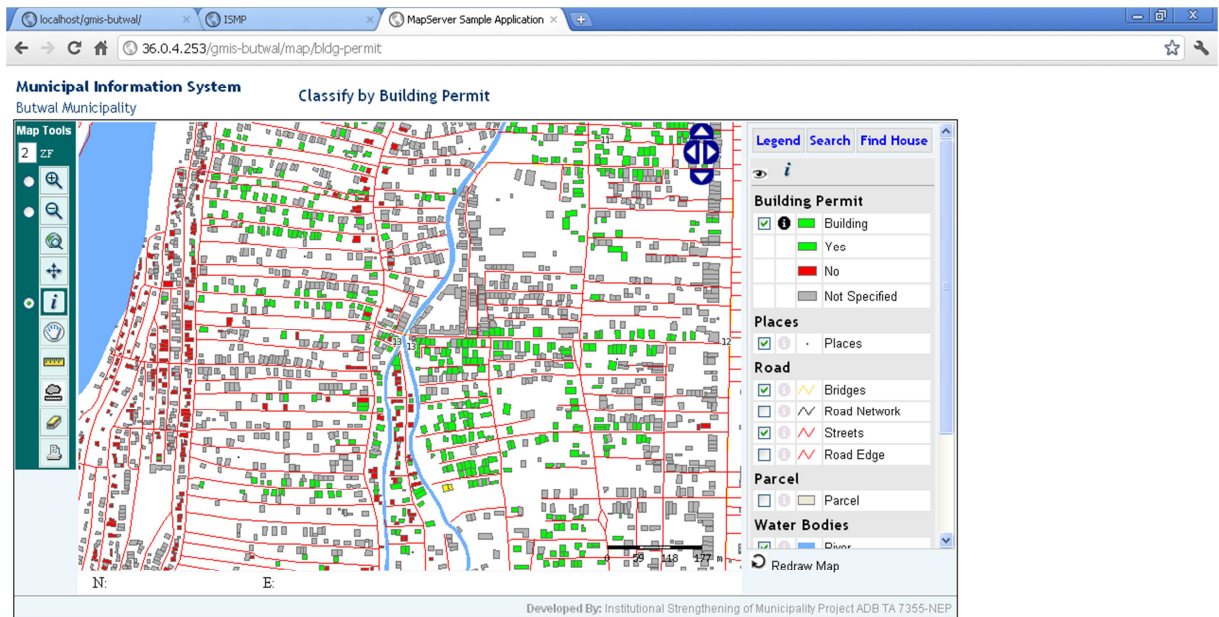


Figure 9. Building Information Management Menu - Results from query by building permit.

### 3. RESULTS

This briefly explains the achievement of one component of a technical assistance project in Nepal, which is considered by ADB as a real success story. Recently the same firm was awarded the continuation of the implementation of this work in four municipalities in Nepal.

For the component three of this ADB contract, the most important accomplishments of the implementation and institutionalization of the G-MIS are:

1. A successful and on-time implementation and deployment of an extremely simple and user-friendly and inexpensive web-based G-MIS;
2. A simplify data capture mechanisms implemented for daily activities of municipal officers;
3. The effective building capacity at the participating municipalities to handle house numbering and street addressing integrated to land property taxes,
4. Setting and strengthening e-governance capabilities by accessing data and information on all municipal departments;
5. The creation of a computer-friendly process embedded on the former traditional paper-based procedures;



6. The efficient mechanism to build the socio-economic survey database;
7. The creation of GIS mapping to the three participating municipalities and GIS tools to update and maintain the integrity of the geo-database.

## REFERENCES

Cowater International. Reports and documentation from ADB AT 7355 NEP project (2010-2011).

Jeff Thurston (2011). "How Do Geo-technologies and Spatial Data connect with urban planning". V1Magazine, Berlin, Germany.

Lee, L. M.(1997). "Creating large digital maps for municipal planning applications using desktop GIS- The Penang Experience.", 6th ESRI South Asia Users Conference,8-10 Sep. Penang, Malaysia.

Schutzberg, Adena (2005). "MapServer Community, Autodesk Announce MapServer Foundation" [http://www.directionsmag.com/article.php?article\\_id=2037&trv=1](http://www.directionsmag.com/article.php?article_id=2037&trv=1)

## BIOGRAPHICAL NOTES

**Gabriel Arancibia** is a Quebec Land Surveyor, Professional Surveyor of Canada and Survey Engineer. He detains a B.Sc. in Survey Engineering from Universidad de Santiago (Chile), a B.Sc. in Geomatics and M.Sc. in Geodesy both from Université Laval (Quebec, Canada).

Mr. Arancibia is a senior project manager with more than 26 years of experience in international land administration, land tenure, mapping and Geographic Information Systems (GIS). Presently, he is Senior Project Manager for Cadastre and Land Titling at Thomson Reuters and currently on mission in Afghanistan as Senior Project Manager of component 1 for the Land Reform in Afghanistan (LARA) project. He was formerly Project Director for the Mapping and Legal Surveying Services at AECOM in Canada and CEO of InterGis, a geomatics, land administration and land surveying service firm serving the Ottawa region and abroad. Mr. Arancibia also has been involved in an IMF consulting mission in Mali to review mapping, land registry and cadastre processes. He worked in Nepal for an ADB municipality government strengthening assignment with the Canadian firm Cowater International, and in Ecuador on cadastre process re-engineering project implementation. Since 2009, Mr.

Arancibia has been in charge of contracts in Canada and abroad, including the integration of Cree/Naskapi Registry System for the Ministry of Indian and Northern Affairs Canada.

Mr. Arancibia has extensive international experience and since 1992 has been actively involved in IT/GIS business development, identifying and participating on initiatives in North America, Latin America, Asia and Africa. More recently, he has participated in consulting assignments in Ecuador, Nepal, Mali, Colombia, Costa Rica, Pakistan, Peru, Indonesia, Maldives, Bolivia, El Salvador, Argentina and the Philippines.

**Dr. Bhushan Raj Shrestha** is the residence of Kathmandu born in 1960. He has Masters in Statistics from Nepal, MS in Computer Science from Philippines and PhD in Environmental Information System from Austria. He has started his carrier in Information Technology more than 25 years ago. After completing MS Computer Science in 1995 from Philippines, he started working in the field of Information Technology focusing on GIS. He has more than 15 years of working experience in GIS and Spatial Information together with Information Technology.

He has experience of working with different organizations in establishing IT and GIS infrastructure that include establishing ICT and GIS infrastructure for Environment Management in Ministry of Population and Environment as an System Analyst / System Administrator, Kathmandu Metropolitan City as an Advisor of Mayor and Member of City Planning Commission, as a National Co-Director for EU funded project of “Kathmandu Valley Mapping Program”; As a Director and IT/GIS Specialist and Advisor in different renown GIS service providers in Nepal; Board Director / IT Faculty of an IT/Management College; Board Director and IT/GIS Specialist of a NGO working in Urban Development.

Dr. Shrestha has experience of working in creating Spatial Infrastructure for Urban Management for more than 12 cities in Nepal including three largest cities of the country. He has also experience of implementing GIS in groundwater resource mapping, utilities mapping, disaster management, water supply management, poverty mapping, knowledge base for protecting riverside land encroachment and developing Action Plans for River catchment management, etc. He was the key expert in this ADB AT 7355 NEP initiative and on charge of creating GIS-based digital database, maps and GIS-based Municipal Information System in three Nepali Municipalities Birgunj, Biratnagar and Butwal with implementation of Open Source Map Server and ESRI's ArcGIS.

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