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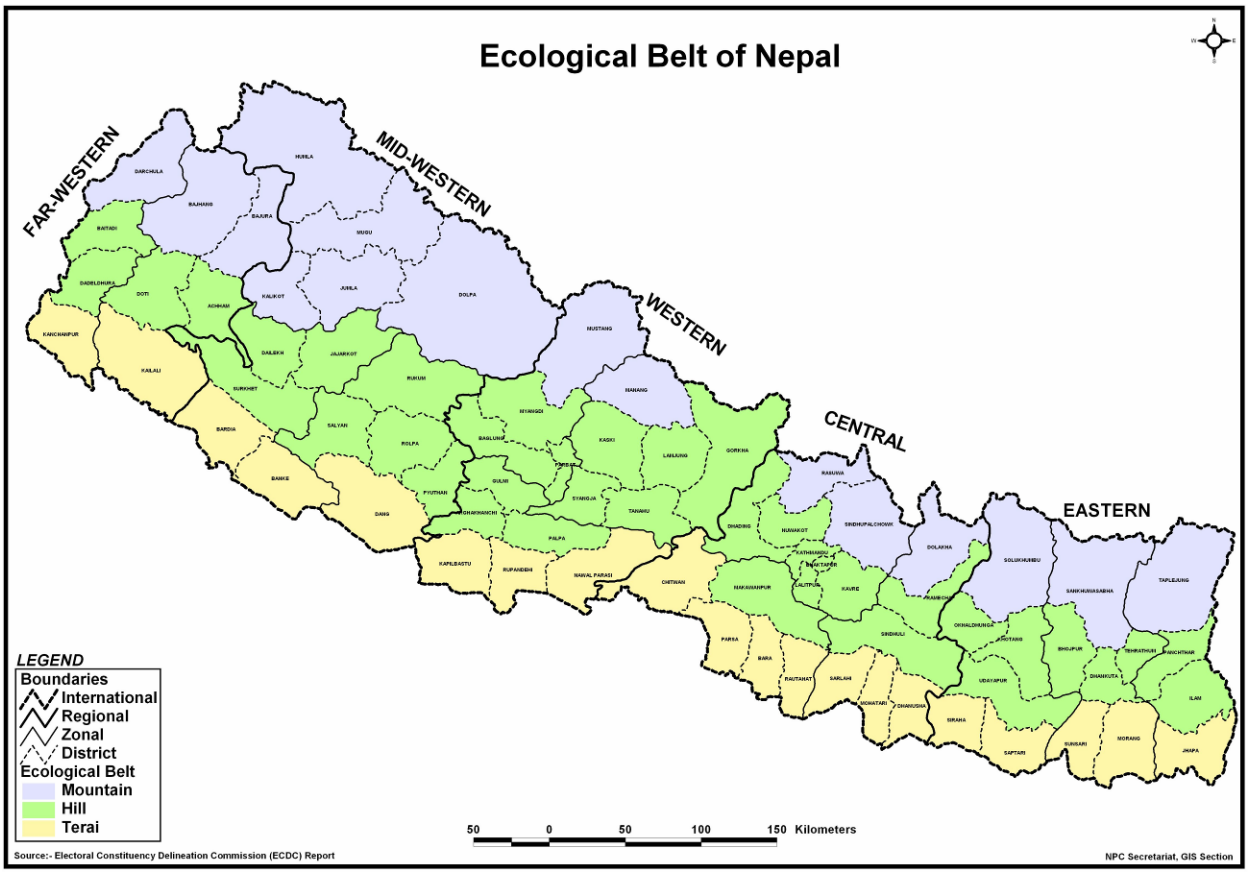
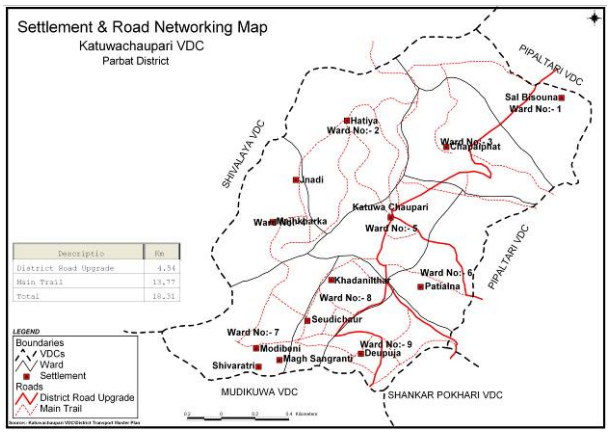
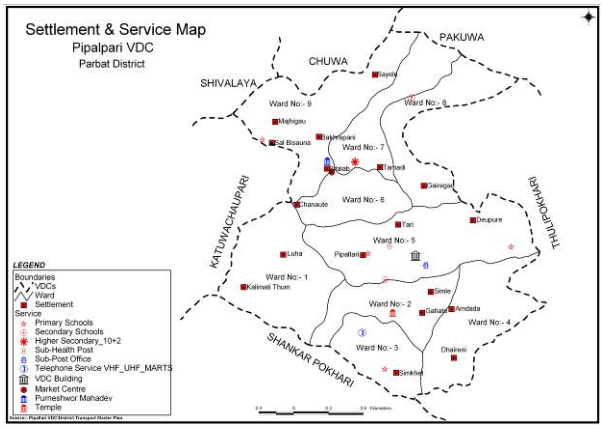


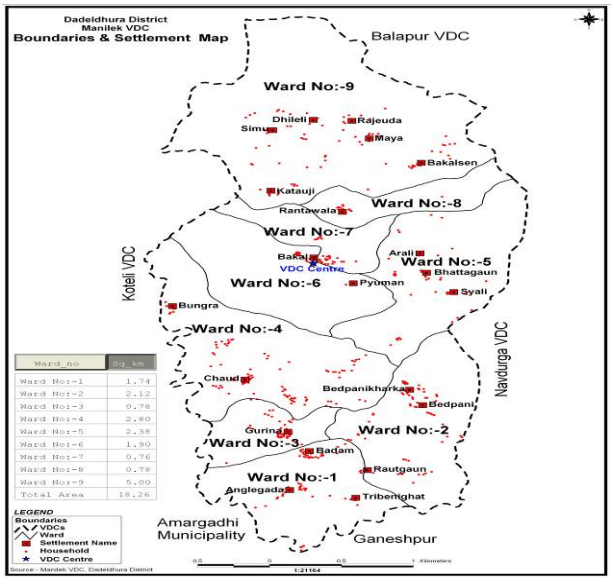
गाउँ विकास समितिको स्थलगत भू-तथ्याङ्क सङ्कलन

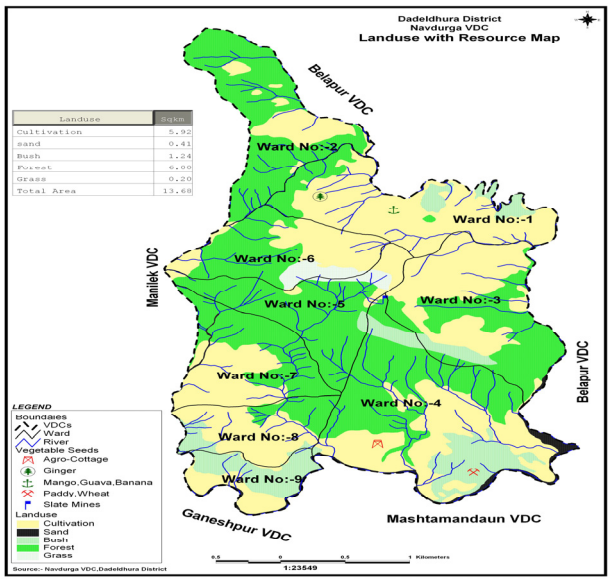
केही छानिएका गाउँ विकास समितिहरूको आधारभूत तथ्याङ्क सङ्कलन गर्ने सिलसिलामा राष्ट्रिय योजना आयोगको सचिवालय, भौगोलिक सूचना प्रणाली शाखा (GIS) को आ.व. २०६७/६८ का लागि निर्धारित वार्षिक कार्यक्रम अन्तर्गत गाउँ विकास समितिको स्थलगत भू-तथ्याङ्क सङ्कलन गर्ने निर्धारित कार्य योजना अनुसार २०६८ बैशाख महिनामा सुदुर पश्चिमान्चल विकास क्षेत्रको महाकाली अञ्चल, डडेलधुरा जिल्लाको निर्वाचन क्षेत्र नं १, मा पर्ने मनिलेख गा.वि.स. र नवदुर्गा गा.वि.स. हरूको तथा पश्चिमान्चल विकास क्षेत्रको धवलागिरी अञ्चल, पर्बत जिल्लाको निर्वाचन क्षेत्र नं १, मा पर्ने पिपलपारी गा.वि.स. र कटुवा चौपारी गा.वि.स. हरूको स्थलगत भ्रमण गरी भू-तथ्याङ्क सङ्कलन गर्ने कार्य सम्पन्न गरिएको थियो ।

उक्त कार्य अन्तर्गत स्थलगत रूपमा Topo-sheet लाई आधारमानि GPS बाट स्थानीय स्तरमा उपलब्ध सडक, शिक्षा, स्वास्थ, संचार, स्थानीय बजार, भू उपयोग सम्वन्धी सेवा सुविधाको अवस्था बारे GIS Data सङ्कलन गरी Thematic नक्साहरू तयार गर्ने कार्य सम्पन्न गरिएको थियो । उक्त कार्यमा सम्बन्धीत गा.वि.स. कार्यालयहरू एवं स्थानीय बासिन्दाहरूबाट पूर्ण सहयोग प्राप्त भएको थियो ।









Health Facility Mapping Survey - An Initiative to Institutionalize HealthGIS in Nepal

The Health Management Information System (HMIS) section in the Department of Health Service (DoHS) of the Ministry of Health and Population (MoHP) has initiated integration of GIS technology into its current health management information system for providing new paradigm of spatial-enabled planning, monitoring and evaluation programmes. In this regard, the new concept healthGIS – the integration between two sciences geoscience and health science, had been materialized as "Health Facility Mapping Survey (HFMS)" with the help of World Health Organization (WHO)/ Emergency Humanitarian Action (EHA) in 2009. The key approach of HFMS has been adopted as Service Availability Mapping (SAM) to support decision making by providing planners with skills and tools required to map and monitor services and resource availability on a regular basis. The conducting of SAM was two phased approach as: District SAM and Facility SAM. The facility SAM was carried with the self-administrated questionnaire (or tools) having key information as: (a) facility identification, (b) available services in health facility, (c) health facility infrastructure, and (d) health workforce.

The HMIS section, in the first phase had completed the survey in 27 districts in last FY 2066/67. Likewise, in this FY 2067/68, survey has been conducted in more 30 districts. Furthermore, remaining 18 districts are planning to conduct survey in coming FY 2068/69. This survey covers all the state-run and non-state-run health facilities along with health workforce. While carrying out the survey, the central HMIS team and regional Statistical personnel were trained on tools, technology and methodology of the survey. District statistical and computer personnel were trained to collect the necessary information from health facilities. The result from 27 districts has been disseminated in hard-copy and digital form. The CSPro software has been used for data entry of survey questionnaire. The STATA software has been used to process the datasets, and analysis has been carried out in ArcGIS software. For the general public, Keyhole Markup Language (KML) file has been created to visualize in freely available GoogleEarth software environment.

NEWS from the Nepal GIS Society

GIS Lab construction within the NEGISS premises

Nepal GIS Society has recently built a GIS Training Hall at the rented room of Women Development Training Center, Jawalakhel, Lalitpur. Ten personal computers with visual aids and power back-up are within the training hall. Twenty participants can easily accommodate in the training hall. Society has now planning regular GIS and RS training to disseminate the knowledge as well as enhance the capacity of the youths and professionals.

GIS Training conducted from May 29 to June 03, 2011

Nepal GIS Society has organized a week (42 working hours) long training course on 'Geographic Information System and Global Positioning System' from May 29 to June 03, 2011. The training was held at the recently build GIS Training Hall of Nepal GIS Society. The training was conducted in ArcGIS 9. X software. The training had covered introduction to GIS, Geo referencing, Data management, Projection, Analysis and Output design including GPS field survey and GPS data transformation into GIS. Twenty-three participants from different organizations including, students and individuals were participated. The coverage of participants was one each from Bhutanees Refugee Camp Jhapa, DDC Rautahat, and Upper Tamakoshi

Hydropower Dolakha, three from District Forest Office Dolakha, four from Department of Forest, Babarmahal Kathmandu, and the rest were individual professionals and students from Kathmandu, Lalitpur and Bhaktapur.

GIS Training Participants Group Photo Organized by Nepal GIS Society.

GIS Training Class Room

Geo-Information Technologies in Nepal

- **Dr. Krishna Poudel**[1]

The application of space technology in the developed country started since 1900. However, its commercial development began only after 1960s. Earth Observation technology was the first of its kind to detect surface resources. In 1970s and 1980s it came into the commercial realm in a substantial way thereby expanding access to these technologies. In the new millennium this technology has been enjoying great potentiality as more and more practical applications evolved. The merging of spatial technologies with the flexibility and resourcefulness of internet and wireless communications devices is opening of new vistas of meaningful applications and having great impact on the way information is generated, presented and analyzed thereby it a lot easier to factor in special considerations in policy and decision making.

The National Remote Sensing Center was the pioneer organization to establish the history of digital spatial database of Nepal which was established with the financial and technical support of USAID in 1979. Government of Nepal has released its forest coverage map of Nepal based on Multi Spectral Scanner (MSS) data of American Remote Sensing Satellite (LANDSAT) in early 1980s. At the National Remote Sensing Center more focus had been given to the satellite based forest coverage mapping with image processing and raster database analysis with the help of ERDAS Imagine software. The concept of vector database handling GIS system has been started after the establishment of Mountain Environmental and Natural Resources Information System (MENRIS) in ICIMOD in late 1980s.

The application of spatial technologies has gradually expanded to cover other areas of environmental management. More noteworthy development in this regard has been initiated by United Nations Environment Programme (UNEP) during first half of 1990s when systematic efforts were launched to create digital database with diverse thematic orientations. Since then number of government organizations and universities have acquired spatial technology. Many students and professionals have been receiving their degree in courses having Geographic Information System (GIS) Remote Sensing (RS) and Global Positioning System (GPS) and numbers of students graduating from foreign universities were also in rise. Enterprises based on offering Spatial Decision Support Services (SDSS) were on increasing. A number of government departments had been included provision for creating digital database in their annual programme.

The Ninth Five Year Plan (1995-2002) has made clear stipulations on the use of GIS and RS technology for the preparation of the land use map of the country as a key planning aid. It has also stipulated the need to prepare resources inventory of the country in digital forms. Similarly the Local Self Governance Act (LSGA) 1999 has also recommended preparing the local level resources inventory in the forms of digital database of areas under jurisdiction of each local government outfit.

The Tenth Five Year Plan (2002-2007) has accorded high priority on poverty alleviation strategy and also highlighted the importance of poverty mapping of spatial units of local governments like VDCs, Municipalities, and DDCs as a key element of strategies aimed at poverty reduction. The need to factor in spatial dimensions and leverage available technological means, for example GIS and RS technologies to achieve this end has been amply articulated in government directives and policy pronouncements. The Three Year Interim Plan (2008-2010) has also been proposed to prepare the GIS database of the country. The first Democratic Republic Government has also

[1] Associate Professor of Tribhuvan University and President of Nepal GIS Society

[2] Few excerpts of the text cited from the book ' Geographic Information Science and Technology: Building concepts in Nepalese perspectives' published by Nepal GIS Society, Kathmandu written by the author in 2010 '

been envisaged the spatial database based planning in its Minimum Common Agendas for operating multiparty joint government. Beyond the barrier of local level planning several current issues like monitoring climate change, disaster reduction, forest resource survey, land use and land cover mapping, infrastructure mapping are some of the potential sectors where the spatial technologies are commonly applied. Vertical integration of location specific data captured and acquired through the space technologies and analysis by maintaining specific accuracy level in GIS provide high potentiality of data linkages as well as merging of voluminous information in a single platform.

The GIS laboratory within the country was established in the National Planning Commission Secretariat with a view to strengthening the decentralized planning activities with the support of UNDP in 1992. The capability of the laboratory and its resourcefulness in terms of being able to contribute to up-stream policy supporter has remained more or less static. Furthermore, one of the UNDP supported programmes has established a GIS Center at the Ministry of Local Development as well to support the Local Governance related activities. Those laboratories still have faced problems of human resources and depending on consultants supported by the donor agencies. It has a serious problem of capability enhancing of the local staffs.

Some of the key government agencies like Department of Survey, Department of Irrigation, Department of Mines and Geology, Department of Roads, Department of Urban Housing and Building Construction, Department of Water Supply and Sanitation, Nepal Telecom, Nepal Electricity Authority, Ministry of Defense, Ministry of Agriculture and Cooperatives and National Agriculture Research Center, Central Bureau of Statistics have established some form of GIS and RS laboratory and information systems – a process that started prior to 1995. With some exceptions these laboratories are in function, however, their work has yet to transcend departmental boundaries to be able to serve larger goals. On the front of human resources development and training all the universities in the country (i.e Tribhuvan, Kathmandu, Pokhara and Purvanchal) have been introduced GIS and RS curricula during the early days of 1990s more as complementary courses of respective degree programme, but no one has developed the specialized courses so far.

The rapid pace at which globalization is taking hold in increasingly requiring nations and societies to enhance efficiency and productivity across socio-economic landscape and strength their competitive positioning. This will be achieved not through maintaining the status-quo but by leveraging benefits offered by recent advances in technological domain. Since the importance of spatial consideration cannot be neglected in dealing with a host of development challenges, conditions must be created for putting to use the potentialities offered by GIS and RS technologies.

In conclusion, the challenges of technical inadequacy, managerial constraints, legal barriers and policy lacking are observed in the field of spatial technologies in the country. By and large the lack of standard curricula and organized academic degree the human resources of different academic background and disciplinary diversity database prepared, analyzed and applied in the field of GIS and RS have several inconsistencies. Data standardization, interoperability, and common sharing have technical lacking and inadequacies. By its nature data should be within the common property regime. The Right to Information is a fundamental part of the democratic governance. However, the management constraints, policy lacking and legal barriers data become the single organizational property rather common property. Common access control, costing and value added taxing, source of revenue and security provisions are often come as an agenda of debate on spatial technology based digital database management system.

For addressing the challenges it has to take some steps towards the space technologies based database acquisition, management, application and dissemination policies, action plan and implementation guidelines. Building national spatial database infrastructure (NSDI) is among the priority list. The concept of NSDI had been perceived long back and the Department of Survey had established a section of National Geographic Information Infrastructure (NGII). But its official structure is confined as a section of the Department of Survey and the lesson learnt practices shows that it has a problem to flow its decisive ideas and orders to other sectorial Ministries and Departments. The practice to build data warehouse, publication of metadata of all digital data acquired and prepared in different governmental, non-governmental, corporate level are not in organized form. Therefore, a national level autonomous body to maintain, manage and organize GIS and RS technologies is highly essential. The action has to carry on by the National Planning Commission Secretariat.

Grass-root Reality: Beyond the Attention of Concerned Authorities

- **Shanker Raj Pathak**

In the context of Nepal, almost exact location of existing settlements (small/large), ward boundaries based on location of settlements (and in reference of other geographic features such as road, river, hill, peak, etc.) and VDC boundary without conflict with boundaries of neighbouring VDCs, together form what is known as grass-root level. Based on experiences of mapping of grass-root level in 12 VDCs of Morang district, it has been attempted through this article to draw an urgent attention of concerned authorizes such as Ministry of Local Development (MLD), Department of Survey (DOS), Election Commission of Nepal (ECN) and Central Bureau of Statistics (CBS), etc. to realize how important it is to map grass-root level of remaining VDCs of the country in order to update the existing VDC level maps of Nepal, improve census database, enhance electoral system and improve service delivery at VDC level. Since this work is inevitable for the Federal Nepal (of near future), the concerned authorities are strongly urged to start the work jointly as soon as possible.

1. Background

The boundaries of 3,915 Village Development Committees (VDCs), 58 municipalities, 75 districts and 5 development/administrative regions of Nepal are based on the topographic map of scale 1:25,000/50,000 published by Department of Survey (DOS), Government of Nepal (GON). The topographic maps of the whole country were published in different dates and time. However, the information contained in the maps was based on the aerial survey carried out in 1992 under Finnida Project, funded by the Government of Finland.

It has been reported by various agencies in time to time that there is serious problem in the boundaries of most of the VDCs. Many settlements existing in the field do not appear in the map. Settlements that actually belong to one VDC do appear within the boundary of another neighbouring VDC. The area of one VDC happens to fall within the boundary of another VDC. A large settlement is extended in two-three wards of a VDC without a clear demarcation of the part of the settlements (number of houses) falling in different wards.

Because of such problems existing in the ground level, the fundamental data of a VDC (such as number of houses, households, population, male and female) prepared by Central Bureau of Statistics (CBS) through census does not match with the existing reality. These problems together have made census data dubious. The whole electoral process adopted by Election Commission of Nepal (ECN) is not yet able to register all those citizens qualified to cast their vote in national/local level election.

Many questions were raised during various seminars and the presentation about the problem in the VDC boundaries and location of settlements as per the existing topographic map. Department of Survey (DOS) was found pointing the finger to Ministry of Local Development (MLD) claiming that it was the duty of MLD to provide the location of settlements and correct VDC boundaries (through DDCs & VDCs) to the DOS. Central Bureau of Statistics (CBS) which has its offices in 33 districts of Nepal also pointed the finger [1] towards MLD contending that it was the duty of VDCs to verify the basic data of the VDC. Election Commission (EC) of Nepal which has its branches in all 75 districts also confirmed that it verifies voters list with the help of VDCs and thus MLD is to be blamed for any shortcomings. In reality, what is lacking is the coordination between concerned agencies and combined effort among all of them.

2. Methodology

Considering various statements made by different agencies/experts, it was decided to examine the local reality in 12 VDCs of Morang districts namely Warangi, Ramite Khola, Dainiya, Siswani Jahada, Jhapa Baijanathpur, Siswani Badahara, Hattimuda, Thalaha, Bhaudaha, Budhnagar, Bhattigachha and Majhare anticipating the Village Profiling (VP) work in 12 project VDCs under Nepal Government Citizen Partnership Project (NGCPP) funded by USAID, Nepal, and implemented by ARD Inc., Burlington, USA.

Numbers of A3 sized colored maps such as settlement location within VDC boundary, river system within VDC boundary, road network within VDC boundary, spot height and contour network within VDC boundary, landuse/landcover within VDC boundary, etc. of each of 12 VDCs were prepared by using digital data extracted from 1:25,000 topographic maps published by DOS.

A High Resolution Satellite Imagery (0.5 meter resolution) from GeoEye satellite, USA, of each of 12 VDCs were used in order to identify and locate the exact position/location of various settlements in each VDC, delineate the ward boundary and verify the existing VDC boundary.

An extensive field visits along with the local people were made to observe the location of settlements appeared as per GeoEye Satellite Imagery, delineation of possible ward boundaries as per the location of settlements (and other geographic features) and position of existing VDC boundaries.

Each house and every household within each house of each settlement were visited. Baseline database[2] at grass-root level was prepared based on the interview with the household heads of each house.

Based strictly on the baseline database at grass-root level, socioeconomic database (containing about 300 socioeconomic parameters) as per the three different forms (household level, settlement level and VDC level) recommended by MLD was collected, and computer entry was made by designing a data entry/output software based on Microsoft Access and Visual Basics (VP) Programming.

[2] Mr. Shanker Raj Pathak is GIS Expert, NEAT, a project implemented by Chemonics International, Washington DC, USA, and funded by USAID, Nepal.

3. Results

Upon completion of grass-root level mapping[2] in all 12 VDCs of Morang district, following results were obtained in favor of the negative statements made by different development agencies and experts working at VDC level. The results from 12 VDCs pointed out even worse scenarios than the statements made during various seminars and presentation. Following were the realities found out at grass-root level:[1]

3.1. Number of additional settlements[3] Identified & located: Upon completion of grass-root level mapping, more than 50 % additional settlements were discovered which were not mentioned in any earlier map published by DOS. The additional settlements identified and located were ranging from 7 to 42 numbers in 12 VDCs. The old as well as newly discovered settlements are presented in table 3.1:

Table 3.1: Number of settlements in 12 VDCs, Morang district.

SN	VDC	Nos. of Settlement (before Grass-root Level Mapping)	Nos. of Settlement (after Grass-root Level Mapping)	Additional Settlements (newly discovered)
1.	Budhnagar	16	23	7
2.	Thalaha	20	28	8
3.	Majhare	16	31	15
4.	Sisbani Jahada	12	28	16
5.	Dainiya	18	36	18
6.	Bhaudaha	11	32	21
7.	Hattimuda	19	41	22
8.	Jhapa Baijanathpur	10	33	23
9.	Bhattigachha	21	45	24
10.	Ramitekhola	29	54	25
11.	Warangi	32	64	32
12.	Sisbani Badahara	11	53	42
TOT	**12**	**215**	**468**	**253**

3.2. Ward boundaries delineated: Based on the location of settlements (old or newly discovered) and with reference of various other geographic features (such as river, road, jungle, etc.) ward boundaries of all nine wards of each VDC delineated. The ward boundaries of VDCs were not available before, even if available of some VDCs, they were not field verified.

3.3. VDC boundaries verified: All 12 VDCs had some kind of problem in their boundary. However, 9 of 12 VDCs (75 %) had some serious problems such as partly an area of one VDC falling into other, settlements of one VDC falling into the boundary of other VDC and even 2 wards of one VDC (Ramitekhola) falling into the boundary of other VDC. The existing boundary of a VDC, not following the existing road and river course was common problem in all 12 VDCs.

[3] Pathak, Shanker Raj: **Local Reality through Grass-root Level Information:** SWASHASAN (The Journal of Self-Governance & Rural Development), Vol. 30, Ministry of Local Development (MLD), Government of Nepal (Mar 2008).

3.4. House identification plate placed in each house: A number plate of size 12" X 9" with basic information of that particular house was placed in the front side of each house. The number plate provided the name of household head (if there are more than one household living in the house, the name of the head of all household head appears in the plate separated by a slash), house number, settlement name, ward number and VDC name.

3.5. Baseline database[4] prepared and installed at VDC office: The baseline database at grass-root level such as the house number, number of households in each house, name of each household head, population in each household, male and female in each household in each settlement (and thus ward and VDC) was prepared and a digital copy of the same was installed at the respective VDC office.[1]

3.6. Socioeconomic Database at ward level prepared and installed at VDC office: The socioeconomic database based only on the baseline database at grass-root level was prepared and installed at the respective VDC office.

4. Conclusion

For the first time in Nepal, 12 VDC authorities of Morang district got acquainted with the boundaries of their respective VDC, boundaries of nine wards within a VDC and location of all settlements within each ward of a VDC. In addition, the VDC authorities also had the correct information on the individual house, number of families (households) in each house, number of male, number of female and total population in each household within a settlement (thus ward and VDC) through which they could establish house/household to house/household relation with the people through house identification plate.

The baseline database of the respective VDCs which were installed in VDC office was able to establish linkage between the community people (within VDC boundary) and the local government. They are very supportive to VDC authority in effectively delivering the services to community people and maintaining the transparency as well.

The baseline database are supporting to CBS particularly during census. If the census is carried out based on the baseline database of a VDC, nobody can question on the database generated by CBS through census. The officials responsible in carrying out the census in any VDC should know how many households they have to visit in order to carry out the census. In fact, if all 3,915 VDCs and 58 municipalities are able to produce baseline database and socioeconomic database based on baseline database, there is no need to carry out census. The resources allocated for census can be diverted to socioeconomic research.

The DOS can incorporate the updated grass-root level information of VDCs in the next edition of maps and all those maps exhibiting the grass-root level information become plausible to the users.

The EC of Nepal can have the correct list of voters from each settlement (thus ward and VDC) and almost nobody will be barred from casting the vote in any election due to absence of name in the voters list. With the database maintained by each VDC, EC can plan for better re-location of polling booths thereby the percentage of pooling will be increased. Even, the reasons for low

[4]Pathak, Shanker Raj: **Settlement: A Foundation for Local Governance:** SWASHASAN (The Journal of Self-Governance & Rural Development), Vol. 25, Ministry of Local Development (MLD), HMG of Nepal (March 2005).

pooling in some VDCs, if any, can be found out, and the remedial measure can be applied thereafter. [1] With the help of the database maintained at VDC office, quick recommendations can be given to the community people seeking for citizenship, passport, voter's identification card with photographs, relationship certificate, etc. from VDC office so that VDC people feel satisfaction from the service delivery system of VDC.

With the help of the database maintained at VDC office, the number and location of women, Dalit, Janjati, marginalized people, senior citizens, differently able people, etc. can be found out and something can be plan for their welfare.

Above all, the database maintained at VDC office will be helpful in planning, decision making and policy making exercises in all sectors at VDC level.

5. Recommendation

In the context of more than 75 % VDCs having problem in VDC boundary, ward boundary and identification/ location of more than 50 % settlements (particularly in VDCs of Terai district), it is highly recommended to go for grass-root level mapping in the remaining VDCs of Nepal as well. However, the mapping work should be done in joint effort of MLD, DOS, CBS and the EC of Nepal through their respective offices operating in the concerned districts.

Till date, no plausible socioeconomic data available at VDC level, and even the available baseline data of VDC is not able to reflect the local reality, there is no other option but to collect the baseline data upon grass-root level mapping in each remaining VDCs. All collected baseline data should be based on settlement, and socioeconomic data should be based on baseline data. Settlement should be considered as a prime spatial unit at the VDC level based on which ward boundary must be delineated.

MLD has already spent a huge amount of resources in vital events registration. Still the up to date vital events are difficult to maintain. If a small mechanism is set up at VDC level upon grass-root level mapping and baseline data collection, monthly up to date vital events can be collected. For this, a mechanism was suggested in all 12 VDCs so that one person from each ward can report the cases of vital events (birth, death, marriage, divorce, in- migration and out-migration) to VDC office at the end of each month and the VDC Secretary of respective VDCs can update the baseline data at the first week of each month based on the vital events reported and arrange to send vital events as well as updated baseline data to the District Information and Documentation Center (DIDC), District Development Committee (DDC). DDC then can arrange to send the information to MLD and other organizations.

[5] Pathak, Shanker Raj, **Baseline Database at Grass-root Level:** SWASHASAN (The Journal of Self-Governance & Rural Development), Vol. 27, Ministry of Local Development (MLD), HMG of Nepal (Jun. 2006).

Potential Scope of GIS Based License Management System (GBLMS) Development plan in Department of Electricity Development

- Ram Gopal Kharbuja[1]

Abstract:

Department of Electricity Development (DoED) is Nepal government organization having regulatory mandate in the electricity sector. Electricity acts 1992 and its regulation 1993 made obligatory to have authorized license from Government o Nepal to study and develop electricity projects and its utilities. After promulgation of liberal hydropower development policy 2001, there is an increasing interest for developing hydropower schemes and it has becoming necessary of GIS based Licensee Management System (GBLMS) for removal of duplication as well as for efficient transparent and logical decision making process in issuance of licensee to the developer. Beside this GBLMS will also help to formulate effective plan in electricity and its utilities development plan to achieve the national goal of sustainable economic development through hydro-electricity production in Nepal.

1 Background

Nepal is second richest country in the world for water resources. It has more than 6000 rivers having potential power production of about 83000 MW out of which about 43000 MW hydropower generations is techno-economically feasible. Although the hydropower development in Nepal had initiated in 1911 a century ago, the pace of development is not as it was expected due to various reasons like lack of finance, trained manpower, unstable government etc.

Department of Electricity Development (DoED) is a regulatory organization according to the Electricity Act 1992 and its Regulation 1993 for implementing policies and programs for electricity development from its water resources. Government of Nepal has endorsed private public partnership (PPP) concept in both hydropower development policy 1992 and 2001 aiming to encourage and promote private sectors in hydropower development in Nepal for generation of clean energy hydro-electricity at affordable cost in environment friendly sustainable manner.

The increasing number of applications for feasibility and environmental studies of hydropower projects from private companies since 2001 showed that the private companies are more interested in development of hydropower projects in Nepal under the Build Operate Own and Transfer (BOOT) system. Several hydropower projects had been developed and operated by the private sector successfully during the last decade. Government of Nepal has also actively involved in development of hydropower projects through the DoED and Nepal Electricity Authority (NEA).

3 Necessity of GIS Based License Management System (GBLMS)

The development of Hydro-electricity projects and its construction needs some land resources having suitable terrain with steep rivers with perennial flow of water even in dry season. Hence each hydropower project needs certain land resources for laying out its structures of essential components like headwork (dam, barrage, weir, intake, gravel trap, under sluice, settling basins etc), water conveyance structures (head race canal/tunnel, forebay/surge tank, penstock pipes and tailrace canal/tunnel), powerhouse structures (turbines, generators, switchyards) and power evacuation and distribution structures (towers, poles, wires, transformers etc). These land

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resources are occupied permanently through out the design periods of the projects which may greater than fifty years for simple run-off rivers and hundred years for reservoir projects. Beside this the information about the access roads and project roads within the project area are important not only for development phase but also for sustainable operation and maintenance as well as rehabilitation works in future.

The information about the project components and its other essential infrastructures should be depicted clearly in systematic and scientific manner for removal of the duplication work, resolution of the conflict and planning for future.

Geographical Information System (GIS) is widely accepted science based Geo-informatics tools used for storing, retrieving and analyses of information related to land resources. GIS can handle unlimited number of information in user friendly environment and can produce visual graphics charts and maps at any desirable scale for presentation in reports and documents. It had been used as a decision making tools for planning and executions of infrastructure development projects in world wide. The Survey department of Nepal had already developed digital data base of river networks, contour, spot height, land use, road networks and other land related information of Nepal. These digital data base are compatible with the GIS and already had been used several institutions like Department of hydrology and Meteorology (DHM), Department of Building (DoB), Department of Water Supply and Sanitation (DWSS), Department of Local Infrastructure Development and Agriculture Road (DOLIDAR) and others for decision making and planning process of the relevant development activities. Beside this, several other spatial data base developed based on satellite images and radar observations are available in Internets. Some of these resources are available freely in Internet and valuable for timely appropriate decisions.

At present, DoED has not GIS facilities and the data related to the licensees has been stored in excel spreadsheets in different computers by different users of the license section. DoED has experienced difficulties to update and handle the data including the authenticity and visualization of the information on graphical forms like charts and maps. Present data base is not much more scientific and the visual analyses for over lapping of the project areas are almost impossible. This has created duplications raising conflicts among the developers. The sorting and searching facilities of particular information among the licensee on charts and standard tabular form for report and document production is not available as well.

Hence DoED has realized the need of GIS Based License Management System (GBLMS) for effective storage, retrieving and visual analyses of the information about the Licensee issued to both the private and public developer of hydropower projects to overcome the difficulties and problems described above. GBLMS not only enhance efficiency of DoED but it also provides backbone key information for development of energy sector infrastructure plans in future. This will ultimately helps to fulfill the national goal “Increase hydro-electricity production to sell at affordable cost for domestic use and export excess energy supporting economic growth of Nepal in sustainable manner”.

4 Initiation

World Bank (WB) has agreed to support for establishment of GBLMS and strengthen the capacity of DoED professionals through the Power Development Fund (PDF) under the capacity Building project of DoED. Conceptualization of GBLMS has been developed in DoED as a program of the project component and it is under the phase of discussion and approval.

The main objective of this project component is to develop and establish GBLMS in DoED and train the DoED personnel for sustainable operation and management of GBLMS as a decision

making tool for timely and transparent decisions based on logical reasons on licensee applications. GBLMS will also help for efficient management of licensee that issued and going to be issued in future by the DoED.

The expected outcomes from execution of this proposed program are preparation of GBLMS with all complete infrastructures for operation of Geo-informatics tools for efficient decisions and effective planning of electricity projects and its utilities in future.

5 Scope of works

The scope of works for the development of GBLMS can be broadly classified in to following four parts:

- Procurement of Softwares and necessary Hardwares
- Development of data layers related to energy sectors focusing on hydropower projects
- Capacity buildings of DoED professionals
- Study to recommend institutional setup and its requirements

5.1 Procurement of Softwares, digital data and necessary Hardwares

DoED has planned to procure GIS software including the extension or add on programs like ARC-Info, ARC-Map with 3D and Spatial Analyst , Arc-HYDRO and other relevant water resources management and modeling programs. The GIS software needed to be network version of 9.2 and newer than that having a capability to work on the software by six or more different users concurrently at a time.

Beside the software, DoED also needs the digital data layers including river network, road network, contours, settlements, and land-use land-cover, administrative and physiographic and other digital layers prepared by the survey department. These data layer will be used as base data for development of the GBLMS with digital database of electricity generating projects with electricity relevant utilities/infrastructures that had been developed so far. These data layers will provide important information for effective planning of infrastructures related to development of clean energy within Nepal. DoED has also planned to buy a complete set of topographic maps of Nepal published by the survey Department as backup system in hard copy. Set of the topographic maps will be used for checking consistency and updating of information given in digital data layers.

Beside the software, digital data and topographic maps, the powerful computers for database server and work stations are essential and planned to purchase in this program. DoED has planned to buy ten branded latest computers, one digitizer board of A_0 size and three sets of plotters of A1 size under this project to enhance institutional capacity to provide required infrastructure for operation of GBLMS.

5.2 Development of data layers related to energy sectors focusing on hydropower project

The scope of works in this part can be further sub divided in two parts a) digital data update and customization b) Development of digital data layers of energy sector focusing on hydropower projects c) Development of GBLMS

5.2.1 Digital data update and customization

The digital data layer purchased from survey department is to be updated and refined it if necessary with information in attribute table providing suitable fields like name of the river, its tributaries, order of the river, river slope and length etc. The information of the rivers up to fifth order or more than that from the major rivers are essential and needed to be updated from topographic maps published by the survey department. The demographic data based on latest published census data is to be appended on the attribute table of the settlement data layer as there are important for preliminary assessment of social-economic impacts due to hydropower project. The information should be at least up to VDC level and more down scale (ward level) is preferable if possible. Similarly the information about the road networks, their operations conditions and others are important for assessment of access to the projects and hence updated road network digital data layer will be prepared from this study program. The information is to be updated based on latest published data from relevant institutions. Beside this, the land use and land cover data are important in planning of hydropower project. Updated digital data base of the land use and land cover is to be prepared based on the latest available information in proper fields of attribute tables.

Since, some of the Nepalese rivers are originated in Tibet China, the information related to drainage area, river networks, length and slopes are also important and required to be complied based on the published map or GIS analyses from the Digital Elevation Model (DEM) data. The consultant needs to prepare seamless hydrological correct DEM data of at least 100 m resolution or less than that for all the areas covering drainage basins of Nepalese river. The information about the tributaries of boundary and trans-boundaries River like the Mahakali and Mechi rivers needs to be included in possible extent. Customized spatial data base is to be prepared to get information about the drainage area of river at any desired point of interest using geo-informatics tools and the DEM data. The customized spatial database is to in the commonly used geographic projection systems MUTM and WGS.

5.2.2 Digital data layers related to electricity energy sector infrastructures

Information about existing infrastructures and their operations conditions are important for future planning to avoid the duplication works as well as to strengthen or upgrading of the infrastructures for efficient utilization in sustainable manner. Hence DoED has planned to prepare digital data layers of existing as well as the planning infrastructures related to electricity specially focusing on hydropower projects. The electricity related infrastructures can be broadly classified in to three groups as below. The GIS data layers of all three groups need to be developed in details comprising the information as described below.

- Generation/production utility

  The generation or production utility can be broadly classified in to thermal, hydro solar, wind, biogas and others. Hydro-electricity production system generally consists of headworks, water conveyance and powerhouse components.

  The headworks generally consist of Dam/weir/barrage with spillway, intake, under sluices, settling basins etc. The geographic location of the head works with their associated information is to be prepared to the possible extent. The minimum information of headworks that needed to be included is as follows but not limited to the following:

  Name of the project, Owner/Developer of the Project, Project capacity

Weir crest elevation, type, length, design flood discharge, design head over the crest,

Under sluice shape, size, elevation, design discharge

Intake type, channel numbers, size, design discharge, sill level, trash rack size and type,

Gravel trap size and flushing channel size, slope, design discharge,

Approach channel length, slope, size, design discharge, canal escape length

Settling basin type, size and shape, numbers, length of settling zone, elevation of operation level, spillway sill level, length, flushing system type, size, length

Stilling basin type, size, downstream sill level and water level at the design discharge

Water conveyance components are mainly designed for transfer of water from head work to the powerhouse site and then to the tail race site. The information of water conveyance component needed to be included in the GIS layers is as follows but not limited to the points:

Project name, owner or developer of the projects, project capacity

Head race canal/tunnel, Design discharge, shape and size, length, slope, elevations at end and significantly important points, number of crossings and their length, types, number of escape,

Forebay/surge tank shape, size, length, Operation levels,

Penstock pipe length, diameter, thickness, material, number of anchor blocks and saddle support, elevation at ends and significantly important points, number of crossings and their length, types, number of expansion joints, gates valve etc.

Tailrace channel/tunnel type length, size and slope, end elevations etc

Powerhouse components specially produce electricity from hydraulic energy of flowing water. Powerhouse has more electromechanical mechanical equipments in addition to hydraulic machines to control flow in the machines. The information about potential power production and electromechanical equipments are important for strategic planning and royalty/revenue calculations. The information needed to include in powerhouse components is as follows but not limited to:

Powerhouse type, size, number of units, potential power and monthly energy production (PPA energy table)

Turbines/Runners types, pitch/number of blades and size, rated capacity, head, efficiency, workable ranges of flow

Generator types, rated capacity, Governor,

Switch yards type, size, and transformer specification

- Transmission utility

The main functions of the transmission utilities are to evacuate power from generation unit to the substation near to the load centre. The information about the transmission utilities are important for planning strengthening of the utilities in future and the information needed to include in the data layers should include as follows but not limited to:

Transmission line length, type, wires size shape and material, transmission voltage, number of towers, types and size, tower spacing, range of clear distance of wires and ground, owner, feeding places/substations

Substations type, size, connecting hubs, feeding from and to, feeding and supply voltage, power and monthly energy table supplied from feeder and discharged, number of transformers and their specifications

- Distribution utility

The main function of distribution utilities is to distribute electricity to the end users. The reliable, regular and standard supply of electricity in efficient manner to the end users is achievable only when the distribution utilities are planned properly as well as operated and maintained in systematic manner. The information to be included in this data layers are as follows but not limited to:

Distributions stations feeder length/capacity/voltage, number of household served, power and monthly energy table supplied and discharged numbers of poles and types, wire length/type, number of transformers and their location. Digital data layer of distribution utilities is desired up to 11 KV and higher than that.

5.2.3 Development of GBLMS

For General Licensee management purpose, the detail of information as described above are not required and may be difficult to post the information on web pages due to bulky information. Hence it is required to develop customized GIS data layers for GBLMS of all Generation/production, Transmission and Distribution utilities. The GBLMS customized digital layers needs to be developed based on the detail information of the projects/utilities prepared as described above with additional information if any necessary. The following are the specific requirements of the GIS digital data layers especially for GBLMS.

- Generation/production utility

The generation or production utility can be represented in project wise bounded by a rectangular polygon depicted to the projects based on the co-ordinate data given to the developer for the case of issued licensee or its desires coordinate for the case of application for licensee. The details of the generation components need to be appeared while it is required to look up by just a click at desired project. The following information is essentially to be included but not necessarily limited to listed points below:

Project: Name, River, Name of developer/company and its partners, project type, capacity, project coordinate in Degree Minute and Second system, Name of VDC, Districts

License: type, first application date, issued date, Validity date, Remarks

Renewal process: application date, issued date, validity date major work done, satisfactory level (repeat it up to five times)

Project particulars weir (elevation), water conveyance (end point elevations), powerhouse (units, turbine type, and capacity) and tailrace outlet level,

Work completed/progress: Topographical, Hydrological, Geological, Optimization, Environmental, PPA, Financial closure, construction, Commissioned

- Transmission utility

The transmission utilities are generally represented by the line diagram with point data for connecting substations showing their locations. The following information is essentially to be included but not necessarily limited to listed points below:

Project: Name, Name of developer/company and its partners, transmission voltage and capacity, length, type, Name of connecting substations, Name of VDC, Districts

Project specific particulars: Substations, no, name, size area, no of connecting hubs total, free, connected, no. of towers types, size and elevation range, wire size, materials etc

License: type, first application date, issued date, Validity date, Remarks

Renewal process: application date, issued date, validity date major work done, satisfactory level (repeat it up to five times)

Work completed/progress: Topographical, Geological, Environmental, Financial closure, construction, Commissioned

- Distribution utility

The distribution utilities are generally represented by the line and point diagrams showing their connectivity. The following information is essentially to be included but not necessarily limited to listed points below:

Project: Name, Name of developer/company and its partners, transmission voltage and capacity, length, type, Name of connecting substations, Name of VDC, Districts

Project specific particulars: Substations and distribution centre, no, name, size area, no of customer that served, etc

License: type, first application date, issued date, Validity date, Remarks

Renewal process: application date, issued date, validity date major work done, satisfactory level (repeat it up to five times)

Work completed/progress: feasibility study, construction, Commissioned

5.3 Capacity buildings of DoED professionals

DoED has realized need of refresher trainings to its professionals for enhancing their knowledge and hands on experience and feelings on working in GBLMS. Under this capacity building programs four different types of training has been proposed. Basic GIS training of GIS and GBLMS of 30 working days will provide to about fifty numbers of professional working in DoED for familiarization of working in GIS environment and GBLMS. The advanced level of GIS training of 15 working days will train about twenty professionals of DoED to enhance their capacity for applying GIS and GBLMS to formulate strategic plans and with modeling facilities for optimization of hydropower potential and energy of hydropower projects and its utilities in basin scale. The basic GIS training will be in domestic while the advanced GIS training is planned to conduct in abroad within South East Asian countries.

5.4 Study for institutional setup and its requirements in DoED

DoED has realized the necessity of an efficient institutional set up for effective implementation of GBLMS in daily works so that DoED can update the information of licensee independently and efficiently with necessary confidential that need to be maintain in beaurocratic system of Nepal. DoED has planned to conduct a study through a consultant for recommendation of an effective institutional setup within the DoED to make sustainable use of the GBLMS and GIS. Study for institutional set up will assess required institutional setup in DoED organization with resources like human, logistic facilities and budgetary resources including both capital investment and recurrent expenditures. The legal provisions for authenticity and updating mechanisms will be included with detail job description of individuals in the unit. Input from institutional specialist, concerned stake holder's consultation and workshop are the proposed means for finalizing the recommendation of institutional setup for achieving the targeted output of this program.

6 Conclusions and Recommendations

Development of GBLMS will prepare basic infrastructures for application of Geo-informatics tools in decision making process to formulate strategic energy sector plans and its mentoring and evaluations. Use of GBLMS will enhance the efficiency, transparency and logical reasoning to settle down conflicts that may arise in licensing of hydropower projects and its utilities. This will ultimately support to achieve the national goal "sustainable economic development through exploitation of hydropower potential available in Nepal".

Government and its development partners need to support continuously for creating conducive environment for the use of modern geo-informatics tools in decision making process. The stake holders of this project component have to accelerate their activities in an efficient manner for timely completion of service, hardware and software procurement with prevailing public procurement act 2063 BS and its regulation 2064 BS in addition to the WB procedures.

7 References:

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5. List of Licenses issued, cancelled and applications information downloaded from website of Department of Electricity Development (DoED): http://doed.gov.np/

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