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GEOSPACE

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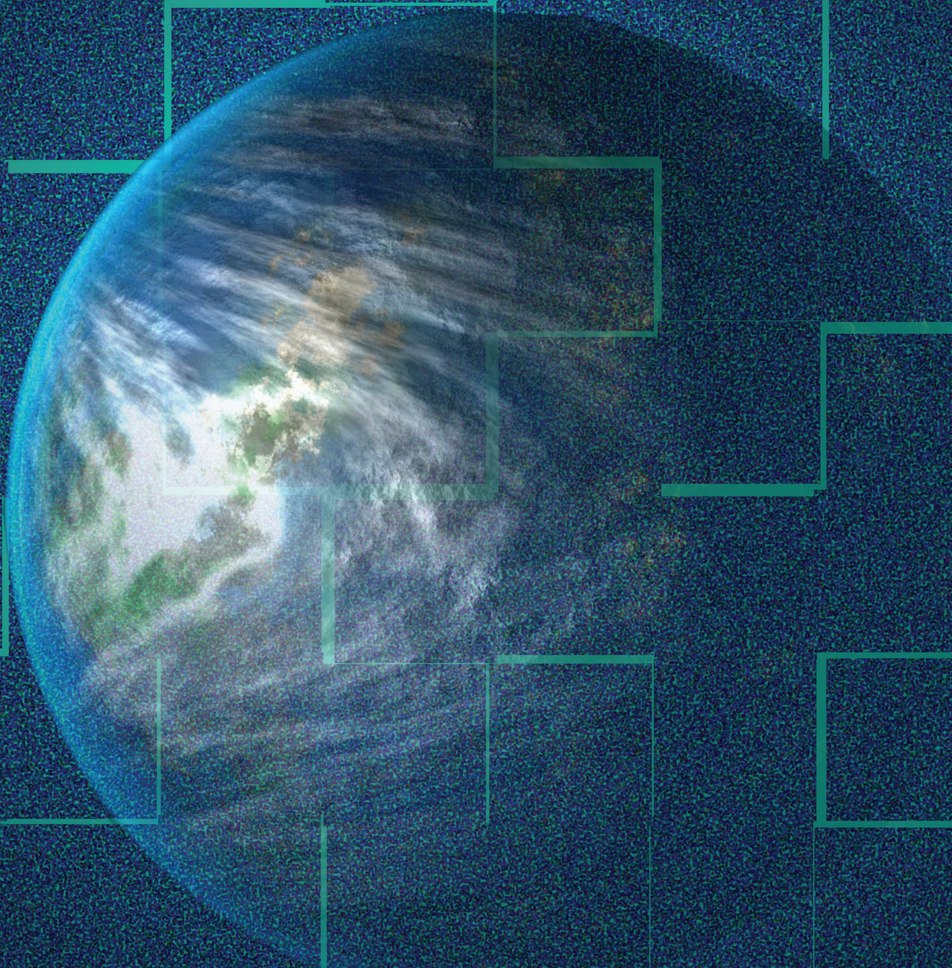

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Editorial

Nothing defines this Journal more eloquently than its title 'GeoSpace'. Every word written in it by the professional and students of Geo-information domain narrates their individual journey to research, aspirations, progress, and achievements. Within the pages of this magazine are the cherished collection of knowledge, wisdom and intelligence, hand-picked by a successful batch that commenced with a newborn hope of producing Geomatics engineers to solve the ongoing demand for spatial problems and solutions.

'Geomatics' is in its path from being 'brand-new' to a 'new' domain in the country. Full-fledged geo-problems are evolving and are also being addressed using corresponding techniques and scientific know-how. Geo-spatial industry is in its phase of expansion and as far as the academia is concerned, the fresh second batch of Geomatics Engineering is almost ready to test their potential in the market inside the border and abroad. Thus, realizing the need for documentation of our knowledge and experiences, we have created 'GeoSpace.'

Primarily, this journal shall serve two purposes: first, increase awareness about the 'Geo-Information' and scope of 'Geomatics Engineering'. Secondly, it shall act as knowledge sharing platform between the students, specialist and professionals related. We genuinely hope that GeoSpace bridges the existing gap between end users of geospatial data effectively.

'Strike a flint and it flashes out sparks of fire! Gentle stroking and there is nothing to admire.' Precious stones may sparkle and dazzle, yet it is the ubiquitous greystone covered with dust that ignited the human civilization. This is the similarity between the vain soul and a persevering mind. The attitude of the latter is prerequisite to succeed. To succeed, one does not require the qualities of a gemstone but rather the perseverance of a flint. By publishing this first issue, we have ignited the sparkles of fires, we have set on a journey that can only be defined by the pace and eminence of the travel, never by its destination. We shall reserve the future days for apprasing the efforts we have presently made. We thank our well-wishers, Seniors from batch 2007, writers and financial contributors for your assistance.

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Message

Dear Reader,

Geomatics Engineering is an interdisciplinary subject. This includes GIS, Survey, Remote Sensing, Photo-grammetry, Cartography, Computer Science and other relevant subjects. Its study allows for an integrated approach to acquire, anlyze and administer geo-informationfor sustainable develpment.

The field of Geomatics is still in its state of infancy in Nepal's context. To maximize the benefit of this field, there is a need to continue its activities. To promote these activites the students of Geomatics Engineering of Kathmandu University have been, from time to time, organizing programs through the Geomatics Engineering Society (GES) In addition to this GES is attempting to publish its first journal focused on the domain of Geo-information. I am happy to announce the publication of GeoSpace.

I am confident that by this very first issue, the GI community will be benefitted at large by the sharing of scientific and professional articles. I also look forward to future issues of the journal. I believe that this effort will boost networking among the students and professionals. I extend my hearty congratulations to GES for bringing the GeoSpace. I wish them all the best for continued endeavor.

SRSharma

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Government of Nepal

Ministry of Land Reform and Management
Land Management Tranining Centre

Dhulikhel Kavre

Date : 2069/01/22

Message

It has been very difficult to trace the dynamics of Geo-information (GI) technology. Partnership, Co-operation and sharing have been the mainstay for rapid development in the filed of GI science. Keeping this aspect in point of view, I would like to express my best wishes I believe, that this publication will assist to further boost up GI activities in Nepal. This journal, which has arisen from the pool of knowledge of GI veterans will ultimately help to enhance the sight of the readers who have keen interest on the GI discipline. I would like to express my sincere gratitude for the effort applied to materialize the publication work in terms of this journal.

Thank you,

Nagendra Jha
The Executive Director

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GIS In Age of Internet

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In year 1854 central London was hit by massive cholera outbreak which has killed more than 120 people in three days. The officials were unable to find out its cause, thus unable to control the epidemic. Then Dr. John Snow depicted its source, a contaminated water pump by plotting location of the death and water pump in map, thus helping to end the disease. Many believe this was earliest use of GIS analysis. However maps have been used for centuries for sharing geographic information and understanding pattern between human and nature. The development of the computer hardware and software technologies accounts for the development true Geographic Information System and now it has become an integral part of the information infrastructure in many organizations. The advent of web based GIS is major new trend in evolution of GIS. Developments of wired and wireless communication technologies and media in past few years have revolutionized the way our mapping and analysis activities function.

Wikipedia has defined Web GIS as the process of designing, implementing, generating and delivering map on the World Wide Web. In this chapter WebGIS, web mapping, distributed GIS and cloud computing are used synonymously to define server based mapping and analysis technique though there actual meaning is not exactly same. The basic idea of this system is data is stored in database server. The data is processed and converted to desired information in mapserver which are then accessed by the clients. These heterogeneous and distributed systems are connected by communication technology such as Internet, Intranet,WAN or LAN. Different commercial and open source technology are developing in WebGIS field. Open source web mapping technologies such are Geoserver, Mapserver, Openlayer, Scalable Vector Graphics etc are developed by communities and can be used for free. It is being developed rapidly with the involvement of large number of people. But they have poor documentation. Commercial vendors are also focusing more on developing web based technologies. Erdas Apollo servers, ArcGIS server, Smart Client, Geomedia etc are few examples of commercial technologies. Commercial technologies have more functionality, easy to use, have less bugs and more documentation but the price for them is high. Databases are also becoming more GIS friendly these days. Postgresql/Postgis and Oracle not only support spatial data but also provide basic GIS functionalities. Public API of Google maps, Yahoo maps, Bing maps and MapQuest have also made web mapping piece of a cake. Development of additional complex GIS function in addition to data dissemination is also possible in recent days with development of technology like AJAX. Web GIS has demonstrated stellar performance ever since its inception. The user and application have grown at incredibly rapid rate. Web map has increased public demand and awareness for the map. The evolution leads GIS away from data browsing, analyzing and managing for individual decision making, more towards group participation and communicating on social decision issues. Its capability to combine data from different source and create, query, update and delete data has made it a robust system. It opens the possibility of real time mapping, more frequent map update and cheaper data sharing. Since we do not need sophisticated hardware and software also cost of the GIS is dramatically reduced in web based system. Web mapping also enables collaborative mapping. Since data can be acquired from distributed users data update is very efficient. Open street map and google earth, Ushahidi project of Africa are its examples. Excellent application can be made by integrating Management Information System (MIS) and GIS which enable better decision making. National Informatics Center India is very good example where this technology is well functioning. Google earth and World Wind developed by NASA are virtual globe and provide high interaction. They are good source of data and can be used to study our environment.

In Nepal few organizations including ICIMOD, Land Use Mapping Project, Survey Department etc t already using web mapping. In Nepal it can be further applied on real estate business, for emergency management, security agencies, environment department, meteorology and hydrology department, Tourism department, Forest Deprtment, Central Bureau of Statistics, Department of Land Information and Archive (DOLIA) among others. For instance DOLIA can develop LIS to manage its spatial and aspatial data. DOLIA has generated large volume of Cadastre and Land registration data. Now DOLIA need to manage, update and disseminate this data. The only solution is developing a distributed GIS network. They can store the data securely in central server. The data can be accessed and updated by survey office and land revenue office but only of their jurisdiction. Technology is available which allow transaction to take place offline also and database on central server is updated whenever the connection is available. This functionality has special benefit in countries like Nepal where steady connection are not available. View only access of the data can also be easily given to unlimited number of users. This will make the system more transparent.

While WebGIS is gaining popularity some important issues such as Interoperability, Speed and Data security should be considered. Sharing and interoperability of heterogeneous spatial data on complex web based system become a challenge. The emergence of Web Services provides a new WebGIS framework for dealing with this issue. Web Services can package data, message and behavior based on unified standards, without considering the specific application environment. The Open GIS Consortium (OGC) defines the standard services aimed to solve the problem of heterogeneity at the spatial data modeling level. OGC is an association looking to define a set of requirements, standards and specifications that will support GIS interoperability. The objective is technology that will enable an application developer to use any geodata and any geoprocessing function or process available on 'the net' within a single environment and a single workflow. OGC is also successful to facilitate data sharing and increase interoperability among automated geospatial information systems. The disadvantages like long transmission times and non-uniform user interfaces can be overcome by more efficient code and a better bandwidth of the Net. Map Tiling and Image pyramid strategies are also solution of the slow response of web based mapping technology. ECWP protocol developed by Intergraph provides the fastest image delivery on web. Image seeding is even faster than many desktop based systems using this protocol. Some organizations are reluctant to use this system because of lack of policy and data security issues which needs to be solved.

The development of the internet technology is redefining the collection management and dissemination of spatial information. Making GIS applications available through the World Wide Web will lead to an enormous increase of the usage and accessibility of spatial data. This new internet computing environment is bringing GIS out of special niche into broader information technology market and thus this technology has enormous potentials and possibilities. The demand for web based GI system is going to increase worldwide in near future. Nepal need to develop clear data sharing policy, good communication network and sound manpower to take advantage of this technology.

Shaping the Future Geospatial Information Through Geomatics Engineers

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Introduction

Nepal is in dire need of infrastructure development for sustainable socio-economic and environmental development. This obligation must be guided by national policies well backed by accurate & reliable geo-spatial information which solely depends on Geomatics. In Nepal, the sensible use of geo-spatial information in development processes has not been emerged. Therefore this is the opportunity to persuade geomatics engineers to make comprehend the state, business communities, producers and users in shaping future geo-information towards sustainable development perspective. And for it, concerning all geo-communities including geo-spatial world forum, universities and UN communities have to take lively initiation. This is the age of information, so numbers of technologies are evolving day by day. Among them, geo-spatial information technology holds the potentiality of depicting significant contribution on policy-making, formulating plans, infrastructure development, resource management and others. Though Nepal has difficult terrain, it has great geographical diversity, plenty of natural resource and large potentiality for economic development which are neither explored nor envisioned. Nepal has already experienced its more than five decades of structured planning history, the country is still facing the major challenges on basic services, safe drinking water, road access, health facilities, education, electricity, emergency service, income opportunity etc connecting with the vicious circle of poverty. This is because of the lack of quality geo-spatial data, the techniques and methods used in structured planning process or designing programs and decision making.

Geomatics development in Nepal is noteworthy. Land surveys were done by Dangol caste in Malla era (1324). Military compass school called “compase” after first great world war and later, Amin (surveyor) training school was established under army. In 1964, land reform program was announced and surveying training had conducted under UNDP’s assistance and Colombo plan. In February 1965, Mr. J. R.G. Harrop, became the Director of Survey Department and Survey Training Center, at the moment, Land Management Training center (LMTC) was established in 1967. In the changing context, the center’s single efforts could not be sufficient to cop up growing academic needs. As a result, a private institution 'School of Geomatics' has emerged in 2000 to produce basic surveyors and diploma in geomatics engineering. Similarly in the challenging environment, the government institution LMTC and Kathmandu University have started Bachelor in Geomatics Engineering in a partnership model since 2007. Indeed, this is a milestone for the fulfillment of academic human resources on geomatics

Rationale of the Paper

Geomatics science is an ever-evolving technology and its application is spreading rapidly to offer the great functionality for using and disseminating geo-spatial information. As an interdisciplinary nature, Geomatics has become so far a platform for all kind of disciplines. Also, geo-information as the serving discipline needs to explore and evaluate applications for sustainable development. Otherwise, it will be valueless and nowhere. Therefore, the young geomatics engineers have to make generous uphill struggle and promise efficient performance, cost benefits, efficiency gains, resources allocation and efficient management of geo-spatial services. They must focus on spatially enabling systems to cater present and future challenges of planning and decision making processes of sustainable socio-economic and environmental developments. The writer focuses his view for encompassing the quality services and move with hand in hand for shaping future geo-spatial information within nation building perspective. The paper also highlights to deliver message for planners, decision makers and business communities on the potentiality to work together for the advancement of geo-spatial industry in Nepal. Finally, it concludes with its necessity and potential areas to shape and reinforce geo-spatial services through quality geomatics engineers. In turn, it may incorporate serving the South Asian region as a potential geo-market.

Geomatics

Geomatics, the mathematics of the earth, the science of the collection, analysis and interpretation of data, especially instrumental data, relating to the earth's surface (Oxford English Dictionary).

Geomatics Engineering is a modern discipline, which integrates acquisition, modeling, analysis, and management of spatially referenced data, i.e. data identified according to their locations. Based on the scientific framework of geodesy, it uses terrestrial, marine, airborne, and satellite-based sensors to acquire spatial and other data.

Geomatics science includes the process of transforming spatially referenced data from different sources into common information systems with well-defined accuracy characteristics. A Geomatics Engineer uses knowledge coming from several disciplines, such as:

- Geodesy (terrestrial, celestial, and orbital coordinate systems measurements)
- Positioning and Navigation (e.g. with GPS, GNSS), Engineering surveys (e.g. planning, design, construction)
- Digital Imaging (how to extract useful information from images according to the application, e.g. environmental studies or agricultural studies) and Mapping (how to make the maps of tomorrow) using Photogrammetry (airborne photographs) or Remote Sensing (images taken by satellite sensors)
- Geographical Information Systems (computer systems capable of assembling, storing, manipulating, and displaying geographically referenced information)
- Land Tenure Systems (land information managing, land surveying, land right, land use and land value).

Geomatics as a science of visualization or expression of all kind of information provide and maintains the triangular relation between geospatial data to its producer and end users. In many engineering works, ignorance of spatial information, various projects are hanging or unsuccessful which were made feasible but technically failed. The examples can be taken as, there is a canal but no irrigation; there is a pipeline but no water; there is a land in a map but not in a ground; there is a bridge but not across the flow of water; there is urban and regional planning but traffic jam, slums, solid waste and pollution etc. are mounting. Similarly, geography and earth sciences rely more and more on spatial data. Geomatics application helps to acquire, manage and interpret such data by providing digital maps and images of resources and infrastructures from different technologies; field surveys, GPS, remotely sensed images which are analyzed and visualized on different formats and styles through geographic information system (GIS). Moreover, the blending of ICT with Geomatics is providing new insights into global issues such as the patterns and degradation of forests, monitoring of crops, home land security and prevention of cultural heritages, war strategies and conflict management activities. At present, various applications of space technology are used in the country. The highly developed Internet mapping and the wireless based geospatial data dissemination to the vast array of users accelerate the space technology as seamless disciplines. In real life, there are many multi-disciplinary or potential cross-disciplinary applications and usefulness with other disciplines. One must be aware on the integration and holistic orientation of such applications through a separate academic discipline. That is not anything else, except geomatics. In this context,

According to the Rio Conference in 1992, sustainability has been the central principle of international development. Also, the World Summit on Sustainable Development (WSSD) 2002, in Johannesburg had unconditionally recognized "Geomatics" as a significant part of the world sustainability. It focuses on place, people and information as the key elements of the development.

Potential Intervention Areas

Geomatics engineers are likely to move towards nation building making socio-economic and environmental developments sustainable. Therefore, the following potential intervention areas, among others are put together:

1. Establish the role of measurement science or geomatics or geo-spatial information discipline, and rigidity to maintain professional integrity, code of conduct and responsibilities of geomatics engineers in the society as a whole.

2. Develop geomatics and geo-spatial professional societies, consortium and relevant forum to advocate the importance of geomatics and spatial knowledge. Encourage the government, especially the decision makers about the enormous value of geospatial data from planning to implementation stage of the development programs such as in road construction, housing and settlements, traffic management, pollution reduction, disaster management, land use planning, monitoring natural resources and environment protection etc.

3. Widen strong base on Geodesy because it serves society by providing reference frame for the navigation on land, sea and in the building of infrastructure and determination of reliable boundaries for real estate properties or even maritime zones. Geodesy has become more concerned with the changes in 'geometry' and 'gravimetry' of features on, beneath or above the surface of the solid Earth and ocean than it was previously. It also serves all geosciences including geophysical, oceanographic, atmospheric, hydrological and environmental science communities. Geodetic products serve disaster prevention and mitigation, prevention of the biosphere and the environment, security, a better use of natural resources for sustainable development. It serves for:

- Monitoring the solid earth, variations in the earth's rotation, the atmosphere with satellite geodetic techniques and the temporal variations in the earth's gravity field.
- Determining the satellite orbits, and positions

4. Make understanding on land rights, land use and land value to the professionals, users, producers and general public. Create immense awareness towards the development of cadastre and geo-spatial data infrastructure because the value of a cadastre cannot be limited to human rights and legal certainty. Also, convince people that cadastre gathers, manages and share information that defines and reinforces property rights. In turn, the property rights translate directly into economic development, social stability, good governance, physical well being and value of life. Drive geo-spatial technology to leap towards the modernization of cadastre as a milestone to support sustainable development.

- Enhance adjudication process in cadastre as simple and transparent.
- Adapt fixed boundary principle (coordinated) for accurate parcel measurements.
- Compel existing land administration system towards the title registration systems.
- Initiate and make substantial efforts to establish scientific land valuation systems.
- Initiate and create massive efforts to integrate land registration and survey office, and to devolve the land services to the local administrative unit e.g VDC level.
- Convince decision makers to adapt geomatics education to all cadastre professionals.
- Make generous efforts to change the existing mismanagement situation on land into desired land management process.
- Identify the attributes of some 'best practices' in land administration from the world where sustainable economic development concerned to Nepal.

5. Role of geospatial data is dynamically increasing, so convince business communities that geo-spatial data can generate significant improvements in their business.

- Define the interrelation of geospatial industry and economy. Link geospatial techniques, to location based services (LBS), contingency planning, preserving historic or cultural heritage and structures, urban and regional planning, rural-urban linkages, food security, monitoring of big constructions (such as dams, high-rise buildings) seismic acquisition, early warning and alarm functions, disaster management and security etc.
- Persuade vivid technology geo-ICT as a public good for good governance, the rules, process and structures for decision making in land and its resources.
- Initiate to bridge the gap between the public and private entities who are key stakeholders of PPP model for spatial data infrastructure. Also identify steps with benefits to invite or encourage private sector participation.
- Identify energy sector using geo-spatial technology for asset management and grid analysis, power market assessments, tools for assessing renewable energy potential, monitoring big hydro-dams, planning and management of right-of-way activities, property appraisal and property acquisition etc.
- Make extensive use of geo-spatial technologies (RS, GPS & GIS) for watershed management, water supply, drainage systems, modeling of recharge zones and water quality monitoring, hydrologic & hydraulic analysis and vulnerability analysis.
- Keep up fine knowledge in area selection, fieldwork planning, project designing, subsurface investigation and spatial modeling in mining and exploration.
- Build trust upon surveyors and emphasize sustainability of geo-spatial systems.

6. In the context of the complexity of infrastructure and value of buildings, move towards 3D RRRs registration (rights, restrictions and responsibilities) not only for cadastre but also for planning, crisis management, taxation, environmental impact assessment and many other land and resources management activities.

7. Encourage mastery in engineering surveys and learn to carryout large scale integration of advanced survey-sensor raw data and data processing results. This process it is very difficult due to complexity of data format standardization. In big projects, project itself, corporate IT groups and vender technology experts like ESRI, Leica, Trimble etc. accomplish the tasks. Therefore, essentially educate surveyors and field engineers to fulfill knowledge gap between surveyors and construction managers (Joseph Betit, Bechtel Corporation, USA).

8. Make understanding on the wider use of Earth observation technology and develop consortium and forums of various stakeholders Earth observation community.

- Capacity development for utilization and deployment of Earth observation projects and programs.
- Advocacy for maximizing benefits of Earth observation in nation building. Elucidate the role of photogrammetry and imaging for application in car navigation, disaster management and monitoring of fast growing urban centers by GIS ready geo-information.
- Make realization on the needs and benefits of real-time geo-informatics and Telegeoinformatics.
- Keep up, up-to-date knowledge on the development of latest sensors technologies, positioning and tracking technologies, CCD

cameras, GPS/INS systems/map matching algorithms. Also, integrating GNSS positioning data to detect rapid motion and long-term movement trends.

- Develop awareness on mobile mapping with UAV (unmanned aerial vehicle) technology, integrated mobile mapping systems, mobile 3D laser mapping, mobile multi-sensor systems, mobile mapping applications and on-line mobile mapping services.
- Initiate on the principle of 5D modeling, full integration of 3D space, time and scale. Also the applications in practical situation of 5D models.
- Prepare yourself to keep up with modeling spatial geometry, making observations and estimating spatial positions, and their uncertainty, as a key component of the Geomatics Engineering education.

9. Calculate the current limitations and prospects of future developments by identify the need of human resources in geomatics and geospatial industry.

- Identify the constraints on capacity building and continuing professional development (CPD) in the geo-industry.
- Introduce Geomatics education in schools and side-by-side, including Geomatics science as an extensive academic degree program in university level as a collective discipline applied to independent fields of study such as cartography, photogrammetry, remote sensing, geodesy, GIS and other mapping sciences. Also, conduct awareness program to geo-information stakeholders; engineers, real estate brokers, geo-consultants, notary public, IT institutions and others.
- Make exchange of ideas between industry and institutions leading to relevance and marketability of the trained human resources. And foster the importance and usefulness of the spatial information to the end users in their daily activities.
- Make efforts to establish sister relation with the foreign institutions for the expansion of geospatial technology and collaboration between organizations through education exchange programs. Take initiation to expand RICS professional in the country.

10. Maintain Surveyor's role as Geo-data Manager and encourage innovations for good land governance. Make efforts to cop up with global geo-industrial market covering the vast gamut of technology for foreseeable future which is on the horizon.

11. Initiate to adapt Seoul Declaration on Global Geo-spatial Information Management (GGIM), 24-26 October 2011 as; Geo-information to address global challenges.

12. Others

- Lead to make appropriate legal arrangements in geomatics and geo-spatial industry.
- Initiate open source legal, technical and business perspectives.
- Fostering natural and real estate property through rule of law.
- Initiate for Cyber infrastructure and social networking.
- Geomatics world is constantly evolving, so essentially keep up with the rapid growth of the know-how, methods and tools of this multi, cross and interdisciplinary field.

Conclusion

Spatial information, which has its base on Geomatics science, provides essential and adequate grounds for planning overall development activities. Geomatics offers great functionality as a science of visualization for the geo-spatial information related to almost all of the disciplines. It has numerous applications even in government activities from regulatory functions such as law and order maintaining, crime control and conflict management to various development functions. So, the sector of applied Geomatics science plays a pivotal role in the development process of a country, and, therefore, offers a significant role to the geomatics engineer for shaping and spreading quality geo-spatial applications as a key element in sustainable economic development.

Choose favorite adventure and shape your future

References

- Initiatives for Geomatics Education in Nepal, FIG Working Week 2007, Hong Kong SAR, China, 13-17 May, 2007, Mr.Baburam Acharya & Mr. Keshav Sharma.
- Burrough, Peter A. & McDonnell, Rachael – Principles of Geographic Information Systems, Oxford University Press, 1998.
- Dowman Ian, Geomatics education needs attention, Coordinate, issue-1, Jan 2007.
- Kraak, M. J – exploratory cartography: map as tools for discovery, 2003.
  LMTC Booklet, Land Management Training Centre, 2004.
- Molenaar, M. - Geo Information System, ITC, 2003.
- GIM International January 2012 and December 2011
- Programme for Geospatial World Forum 23-27 April, 2011

Need for Land Information System in Nepal

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The cadastral and land information system in Nepal has started going in the digital form just a few years back. Previously as well as till now the land and parcel records used to be limited in the papers and large chunks of the files and folders. When the government of Nepal started using the software especially built to solve specific problems in the specific offices. As a result of the constant research and dedication they came out with some pretty good software such as Parcel Editor for the Digital cadastre record keeping and printing out the land record and ownership information, Spatial Analyst Extension (SAEX) developed for Department of Land Information and Archive(DOLIA) to serve the purpose of digitizing the previous land records and hard copy maps and DLIS developed by for land Revenue offices to make them able to keep the land and parcel's ownership and transaction information in the digital form. As the times passed those software started functioning, the managerial personnel who were in the development phase of these software were shocked by their shortsightedness. The problem here was that these software were good at what they were made for but they had created the technological islands because those software could in none of the way interact with each other. This meant that the information that they kept and maintained were not compatible and usable by the others. Thus there lacks a single information system that could acts as a warehouse of the cadastral and land ownership information. We just have to go to two different offices physically in order to get the information about a certain parcel its ownership and taxes.

Food and Agriculture Organization (FAO) has started its works in implementation of the free and open source land administration in Nepal. The Solution on Open Land Administration (SOLA) project of FAO has been previously implemented in Ghana and Samoa and now they are implementing this in Nepal. SOLA is primarily the desktop solutions that need to be setup in the each of the offices but function with either one central server or the distributed ones. The major problem that lies here is that it has not been customized to be able to serve the land information system in Nepal. Also the need for setup of SOLA admin in each machine the task has to be done puts a significant amount of memory overhead. The works are undergoing in the customization of the SOLA. Although they are building the application for web solution, they currently are not much interested in bringing that in Nepal.

Although questioned by many of the management and decision level personnel there is a true potential for making all these tasks a systematic and much simple. Actually there could be made a geospatial web-portal that provides the users (or the authorized persons) the ability to query the current status of the selected parcel of the selected person in the certain location and display the results in the tabular as well as in map format. In addition to the query ability it could be extended to support the transaction and record updating and deletion. Other stakeholders such as the VDC or Municipality could as well be served by providing them with the ability to administer the property construction and land/property taxes. The major ability of this solution will be that it will be accessible via all the ordinary computers and even mobile devices that have access to internet. The problem of personal privacy will be dealt by segregating the ordinary citizens from the managers via the use of the user authentication and clearance levels according to which their access rights are defined.

Technically the servers will be established at Land Revenue office and District Cadastral offices. The servers must be able to run Apache on the backend. The basic strategy is to maintain the information in both the land revenue office and the cadastral office using a spatially enabled database program such as PostgreSQL. Then the maps will be served via any servers such as Geoserver or Mapserver that uses the information in the database. Finally the results will be displayed in the user's browser through some server side includes such as PHP, ASP or via the use of the java applets.

Geomatics engineers will be the guiding personnel in this whole task as they know cadastral information needs of nation and the programming techniques along with the database and GIS knowledge that needs to be deployed for solving this problem. The field experience aided by the strong theoretical base of the geomatics engineers could be a major help. This complete information system if made will be a major help in the standardization and in the increment of the efficiency of the tasks done at the land related offices.

Impact of GIS on Organizational Performance

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1. Introduction

Pervasive use of GIS indicates a high degree of expectation for bringing positive changes in organizations broadly in terms of productivity, efficiency and ultimately organizational behavior. Although evaluation framework of information system is a multidimensional construct and peering merely from organizational perspective does not end up in completeness in the measurement of impact of GIS, the paper only attempts to focus on the advancement made so far on the organizational impact by GIS. The method followed in this study is the review of the literatures used to review by Nedovic-Budic (1998) on the aspect of organizational impact brought about by GIS technology. In the base paper of Nedovic-Budic (1998), there are fifteen cited pre-1998 papers in the context of organizational impact, (out of 22 citations in the context, some are repeating). Papers reviewed are Campbell and Masser (1992); Campbel (1994); Worrall (1994); Tveitdal and Hesjedal (1991); Gillespie (1992); Smith and Tomlinson (1992); Antenucci et al (1991); Brown (1997); French and Wiggins (1990); Johnson (1995); Hitt and Brynjolfsson (1996); Landauer (1995); and two post-1998 literatures, namely Nedovic-Budic (1999) and Gonzalez (2007). All these papers have been reviewed focusing on the organizational impact issues. Discussion has been made regarding the generation of additional insights, method applied and justification for the choice of method.

2. The Context

Organizational impact of GIS has been one of the dimension of measurement of success of IS success model (Delone & Mclean, 1992). Since organizational efficiency and effectiveness caused by the implementation of GIS depends on the other dimension of the IS success model such as user satisfaction, dependency relationship exists among these dimensions (Miles, 1980). However, this paper does not drift to model the 'ecology' caused by these elements of success model. It mainly focuses on the original findings on the paper referred by Nedovic-Budic (1998) in the context of organizational impact and the same on post-1998 literatures. I classified these papers based on the emphasis given by the respective authors in their research vis-à-vis organizational impact. Generally they are focused on productivity, benefits, effectiveness, efficiencies, cost reduction brought about by GIS.

3. GIS Less Capable in Saving and better Quality Decision

Campbell and Masser (1992) carried out study to find the impact of GIS in local government authorities in Great Britain. The method applied was a combination of detailed case studies as well as a comprehensive telephone based survey of all 514 local authorities. The authors justify that the collection of response through the postal questionnaires from all 514 authorities could be an intensive task considering the size of the response. At the same time, possibility of non-response to the postal surveys exits which renders difficulties to draw precise conclusions on the overall study. On the other hand, the previous descriptive case studies in the topic are failed to provide comparability between studies and therefore it is difficult to identify the general trend in the use of GIS. Therefore, as the authors explain, combined method has been applied in this study. The findings of the case studies are based on the analyzed statistics as well as interviews. The research has come up with the findings that GIS does not help savings in the organization, as Nedovic-Budic (1998) has highlighted. But I found the paper stressing that GIS is less capable in supporting better quality decision as well.

Campbell (1994) alone adopted a combination of methods, including a case study of 12 experienced authorities in implementing GIS and a comprehensive telephone survey of 514 local authorities in Great Britain. A key feature of the approach adopted towards the case studies was that interviews were undertaken with those involved both directly with GIS including potential users, senior managers, mapping and computer specialists. An element of participant observation was also involved in this process. The rationales behind the combined approach are the same as explained in the case of Campbell and Masser (1992). The finding of the study is that short term success can be achieved for relatively for small project. An idea emphasized by Nedovic-Budic (1998) in a broader perspective is that GIS users attach low importance to saving.

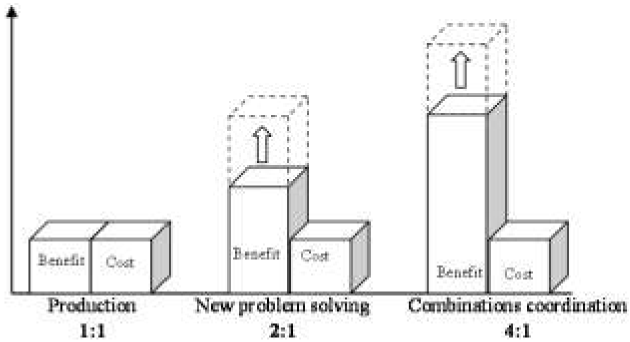
4. Planning and Policy making

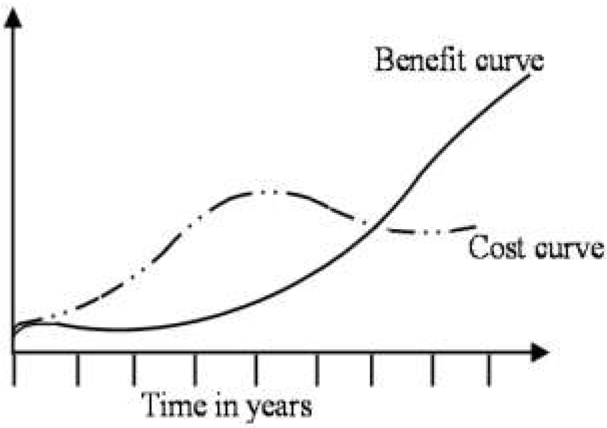
Worrall (1994) studied on the role of GIS-based spatial analysis in strategic management in Local government. The study was based on the study of relevant literatures. The research briefly explains how to overcome the difficulties of integrating the opportunities provided by the new technology embedded in a GIS to the whole range of strategic social, economic, demographic, and environmental issues currently facing public policy analysis in general and local government in particular. Finally the author develops a research agenda which will seek to enhance the role of GIS-Based spatial analysis. In a nutshell, Use of GIS can be made in analysis of spatial distribution of income based population, urban facility management etc so that proper policy can be developed to solve these problem in these areas.

Referring to Nedovic-Budic (1998) quotation that in “Worrall’s (1994) review of cost-benefit analyses conducted in the three UK authorities it is claimed that productivity gains and cost avoidance are possible with GIS, but not immediately”. To our observations this quotation/citation is wrong, because nowhere in the paper I could find such a paragraph except at a point it says that few GIS applications in local government have been formally cost justified and a cost-benefit model has also been developed. Although I can implicitly see there are many intangible benefits of GIS implementation in the paper.

5. Cost-Benefit

Tveitdal and Hesjedal (1991) have put forwarded the result of a case study carried out by “Nordic Kvantif”, a joint Nordic Project which focused on the quantification of the community benefits of digital spatial information carried during 1985-87. The result of the study is based on the Cost-Benefit Analysis (CBA). The reason to adopt CBA is that, it being an element in the overall appraisal, forces anyone involved in the decision making to analyze the impact of a project in a systematic way and, in the words of the authors, helps to recommend strategy for implementation. The report concludes that benefits of GIS rely on the level of its implementation. Nedovic-Budic (1998) has only highlighted the point that beneficial effects can be achieved if it is used for internal planning and administration in the actual organization with least ratio of benefits/cost 2:1. But additionally I saw that, the benefit cost is 1:1, if GIS is introduced as a production tool and it helps in the staff reduction that too not fully. The highest beneficial effect for the community can be achieved, if there exists inter-organizational coordination and they use the same geographical information for planning design and administration of public utilities, with the ratio of benefit and cost, at least, as 4:1. This is referred as “1:2:4 rule” for benefit from GIS introduction (figure below left). Furthermore, it takes time to accrue benefits from GIS for the user organizations (figure below right).

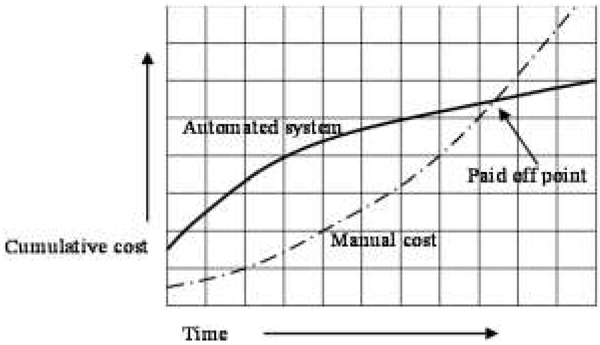




Smith and Tomlinson (1992) carried out analysis of the costs and benefits of GIS for the city of Ottawa. The benefits of 100 information products were measured through interviews with city of Ottawa staff members responsible for the individual products. 46 senior staff members from 10 departments were contacted to obtain data on both current and planned future uses of these products. In measuring costs, they were estimated in detailed from 1990 to 1996. The narrative descriptions of GIS products provided the basis for the detailed appraisal of benefits. Their approach was built on existing work dealing with assessment of investments in GIS. The methodology outlined advances existing methodologies that focus primarily on cost savings that are due to reductions in staff time from producing existing information products. Nedovic-

Budic (1998) uses example from Smith and Tomlinson, (1992) of GIS adoption in public sector agencies where substantial savings were calculated to justify that spatial data technologies results in long term benefits.

Antenucci et al (1991) have shown that GIS brings benefits into organization by comparing the cumulative cost of manual operation over a period of time to the cumulative cost of the implementing automated system over the same period of time. Benefit-cost analysis shown by them consists of costs of both systems for 10 consecutive years. They argue that the comparative approach (using benefits and cost) is helpful in weighing the positive and negative aspects, both quantifiable and unquantifiable of introducing GIS, and can be used to compare the relative merits of implementation alternatives. The authors conclude, as I saw, that although the earlier phase of implementation suffers high investment cost in comparison to the incurrence of costs in manual system, the cost curve declines as investments diminish and consequently benefits are enjoyed as the system become operational. The following figure shows this.



Additionally I found the classification of benefits. Out of 5 benefits type, 4 are quantifiable. They are efficiencies in current practice, expanded capabilities, unpredictable events, and sale of information services. The non-quantifiable benefit type is intangible benefits.

French and Wiggins (1990) conducted a mail survey technique to study the role of GIS and automated mapping in public planning agencies, in 35 agencies that had operational computerized mapping systems. This was a third survey in series they have undertaken to track the adoption and use of computing technology in the field of urban and regional planning. The authors state that as the sampling is based on the 1988 survey responses, the newest innovators may be somewhat underestimated. Even by knowing that limitation, they still argue that their data provide useful insight into the use of automated mapping and GIS in local planning agencies. The survey came up with findings on system development that half of the planning agencies they surveyed experienced a large positive returns or small positive returns unlike Nedovi?-Budi? (1998) highlighting on small returns on investment. Authors also emphasizes that in all samples used no one suggested that their system was not a good investment.

Johnson (1995) conducted a study to observe dissemination policies in Local Government GIS agencies in the US using a multiple case studies. The study presents several case studies; six case studies were selected for the research. The foremost criteria that the study includes equal numbers of open access and cost recovery sites. Other criteria included the extent of available documentation at each site, evidence of any interesting anecdote, the willingness of GIS administrators to participate and to some extent geographic diversity. In each case study, the primary method of data collection was phone interviews, at about two hours, with several follow up conversation with primary and secondary contact at each site. Phone and email discussions with state level policy makers were important in several cases for the prompt reply. The research found that many proprietary GIS agencies are likely to recover little funds, even when expectations are very high. On the open access side it was found that many open access policies are not tremendously successful either. Conclusion was that the benefits of both open access and cost recovery policies do not meet GIS agency expectations.

6. Effectiveness and Efficiency

Gillespie (1992) describes a model, called "digital benefit model" developed by USGS to measure the value of GIS in more than 40 case studies of Federal GIS applications. Two qualitative benefits, as the author says, namely, efficiency and effectiveness can be measured by using the model. The model requires 5 common independent variables to measure along with other 4 dummy variables to measure these benefits. The independent variables are: extent of the study area, physical amount of the relevant data, information dimension, complexity of environmental constraints, and likelihood of use in adversarial hearings. Depending on the size of the independent variable, the application of GIS can be classified as small, moderate and big. As these values differ according as the application type in an organization, only the case study method is appropriate for benefit measurement using this model. Apart from efficiencies of GIS, I see that effectiveness benefit can also be measured using the model and moreover, effectiveness benefits are much higher than efficiency benefits of GIS.

Issue like reduction on the cost of data collection has not been expressed by the author as Nedovi?-Budi? (1998) has stated in her paper but it says there is cost saving in the production of a result in comparison to the same production by the manual method.

7. Productivity and other issues

Landauer (1995) has focused on the usefulness, usability, and productivity of the computers. Concept put on the book chapter-wise has been made basically using macroeconomics. Usability assessment has been done by plotting benefit-cost ratio verses number of user test of the computer system. Since the usefulness and usability depends on the user perspective, the methodologies followed are case studies as understood between the lines since it has not been explicitly stated in the book. As Nedovi?-Budi? (1998) has highlighted, it states that introduction of computer does not increase the productivity in general. It has been recommended in the book that the productivity can be increased after increasing the usability and usefulness by the following four ways:

- w Reducing unnecessary and duplicate work by storing and transporting information electronically.
- w Improve the coordination and synchronization of work by better planning, monitoring, tracking and analysis.
- w support new high-productivity products and services that depend on powerful information processing.
- w Help individuals perform information work more efficiently.

Hitt and Brynjolfsson (1996) have found opposite to what Landauer (1995) has found regarding productivity. Hitt and Brynjolfsson (1996) studied on the issues of IT's economic contribution with the three issues: productivity, profitability and consumer surplus. Authors justify that although these issues are related, they are different topic in themselves and therefore value of IT in economic sense should not calculated by simultaneously taking them together. Therefore, they carried out empirical analysis by setting separate hypotheses pertaining to each of these issues and based on the secondary data collected by International Data Group (IDG). Hypothesis related to productivity was tested by using production function. For this, estimate of parameters were obtained using Ordinary Least Squares and enhancement of estimation was done by using Iterated Seemingly Unrelated Regression (ISUR) model with the assumption that productivity of IT firms is correlated with time. Business profitability was calculated by using the profitability function as the ratio of IT stuck to firm employees. Then relationship between IT and Profitability was tested by computing correlation and then using the regression function in year by year basis. The consumer surplus between two periods was calculated by using the translog function as a ratio of IT stock to Value added, the price of stock and Value added. The overall finding is that the IT has increased productivity and consumer surplus but not supranormal profitability. Additionally, for higher profits, they suggest that management should focus on IT's other aspects such as product position, quality or customer service.

Brown (1997) in her study seeks to ascertain the goals and challenges of GIS adoption according to local implementers. The method applied was a survey with non-random sample of the 262 local government members of the Urban and Regional Information System Association (URISA). The research used two types of questionnaires. The first was sent to those identified as being knowledgeable about GIS implementation process and the second was sent to users of the technology. Only 88 responses were obtained. The majority of respondent rated the GIS favorably in the better category for stimulating productivity, performance and customer service. The idea was also cited by Nedovi?-Budi? (1998). The author also concludes that the attitudinal and perceptual measures are preferred for examining the process of implementation and achievement outcomes from technological innovations. The quantitative measures are not able to adequately tap perceptions. Therefore a qualitative instrument is employed in this study to analyze perceptions of Information System Success. The research came up with findings that organizational impediments offered the greatest resistance to achieving GIS success.

8. Post-1998 research

8.1 Applying non-traditional approach for impact measurement

Nedovic-Budic (1999) have made a review of existing frameworks, methods and criteria used in evaluations of geographical Information Systems, Management Information Systems, other computerized information technologies and other information systems. The review is aiming at checking how the effects of GIS use should be measured specifically to the evaluation of GIS technology in urban planning. Using literatures review as an instrument for the research, she justifies that there exist varieties of frameworks, quantitative and qualitative criteria, and methods that can be used to assess GIS effects but none of them have been developed to specifically deal with evaluation of GIS in urban planning.

The author describes that the review of the potential measures of GIS effects draws on five broad frameworks, basically focusing the evaluative framework presented by DeLone and McLean (1992). Basing on evaluation dimensions by DeLone and McLean (1992), she tries to review all criteria and methods reviewed under each dimensions and complement by a discussion of measures and issues that are relevant in the context of urban planning. She adds one more dimension, societal effects to reflect the attention to societal issues that are present in the GIS literatures and the relevancy of societal to planning. After discussion, she came up with a table summary of the methods and criteria that can be used in evaluating GIS effects in planning and the planning situations to which these methods and criteria can be applied.

As to the measurement of organizational impact, she emphasizes the use of non-traditional cost-benefit analysis that turns the intangible benefits into some sorts of value. Such values signify operational (saving labor, clerical time etc), managerial (communication between managers, improved planning and improved use of manager time etc) and individual (deeper and broader exploration of alternatives, clear understanding of problems) benefits. She also highlights that measurement of productivity and efficiency are generally used methods to calculate the organizational performance.

One strong reservation I have in this paper is that the author says the effects are favorable if the ratio of cost to benefit is generally greater than 1. As to our understanding, the ratio of benefit to cost (not cost to benefit) should be greater than 1.

8.2 GIS impact and its correlation with other factors

Gonzalez (2007) conducted a study to find the fundamental reasons for the GIS adoption at local level as well as impact and implications of GIS technology at organizational level. To assess integrated information systems as a strategic tool to support sustainable development in British local government taking case of geographic information systems (GIS), she conducted four case studies. Regarding the case study methodology in her research, the author justifies explicitly stating that the data and analysis are grounded in the condition of social existence in her case. There is tolerance of ambiguity and contradictions of the social reality being investigated and existence of prospect of alternative explanation. Data collection in the research was based on criteria-based sampling followed by semi structured interview and questionnaire.

Her finding claims that the degree of impact of the adoption of GIS in organizational level is correlated with four main factors which are: attitude of leadership and involvement of GIS staff within the organization; organizational commitment and support in terms of formal policy establishment and availability of resources for the GIS strategy; strategic vision and strategic thinking to assume GIS as enabling tool; and lastly, the necessity to set off a continuous and widespread GIS learning process that promotes inclusiveness with other organizational structures in order to create the link between the user needs and the GIS applications. She also concludes that GISs are implemented generally to support planning, decision making and e-government policies but not targeted to implement sustainable development at local level. In her own language 'better outcomes' is possible if the technology is adopted for long term project except for the specific initiatives for which the middle or short term 5-1 year is sufficient.

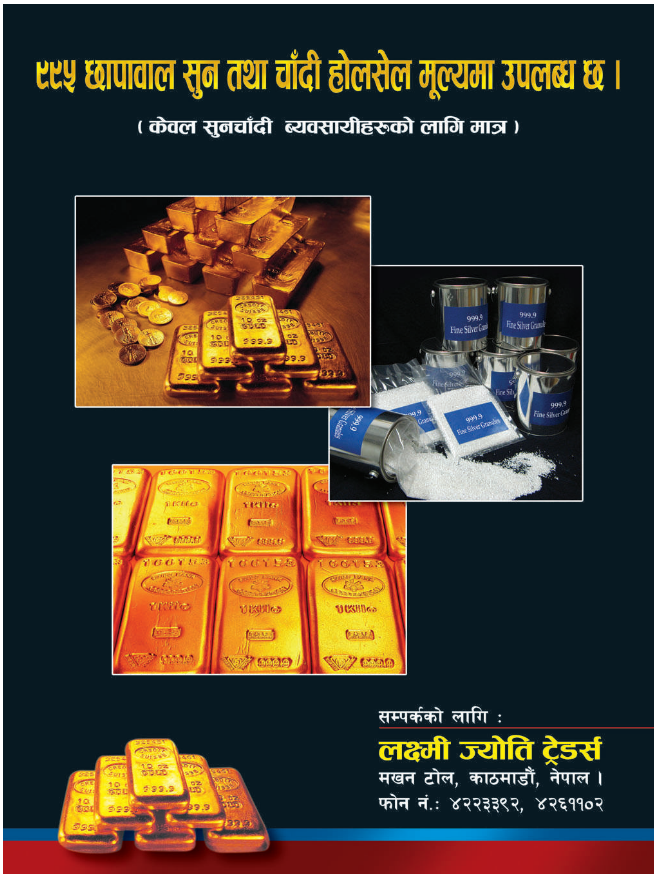
To critically comment on her findings through our view, I say that the author is completely failure to find any organizational impact of GIS from her studies. Her conclusive statement "...the councils do not measure GIS in terms of GIS function and in terms of GIS contribution to organizational improvements, the impact was clearly not feasible to verify. Within this context, the conclusion is that it is too early to give an unequivocal answer" proves this. She claims that apart from planning, technological and data frameworks, periodic process of GIS measurement for search of best practices and cross-sector approach to local sustainable development are critically essential to engage in GIS for the local authorities.

9. Conclusion

I conclude that there has been gradual enhancement in the concept of measurement of organizational impact of GIS from the mere measurement of tangible cost and benefits to the measurement of intangible benefits. I also witnessed that the concept of impact of GIS on sustainable development has been raised. However, it is found that there is not a single holistic approach to measure the impact of GIS due to its diversified field of application.

References

1. Antenucci J C, Brown K, Croswell P L, 1991 Geographic Information Systems—A Guide to the Technology (Van No strand Reinhold, New York)
2. Brown MM, 1997, "An empirical assessment of the hurdles to geographic information system success in local governments" State and Local Government Review 28 (3) 193-204
3. Campbell H J, 1994, "How effective are GIS in practice? A case study of British local government" International Journal of Geographical Information Systems 8 309 – 325
4. Campbell H, Masser I, 1992, "GIS in local government: some findings from Great Britain" International Journal of Geographical Information Systems 6 529 – 546
5. DeLone, W.H. & E.R., McLean, 1992, Information Systems Success: The Quest for the Dependent Variable, Information Systems Research, 3(1):60-95
6. French S P, Wiggins L L, 1990, "California Planning Agency experiences with Automated mapping and geographic information systems" Environment and Planning B: Planning and Design 17 441-450
7. Gillespie S R, 1992, "The value of GIS to the federal government" in GIS/LIS '92 Conference Proceedings, American Society for Photogrammetry and Remote Sensing-American Congress on Surveying and Mapping, S410 Grosvenor Lane, Bethesda, MD 20814-2160, USA
8. González, A. (2007), Assessing integrated information systems as a strategic tool to support sustainable development in british local government: the geographic information systems (GIS) case. Revista Chilena de Economía y Sociedad 1(2):pp. 89-114
9. Hitt L M, Brynjolfsson E, 1996, "Productivity, business profitability, and consumer surplus: three different measures of information value" MIS Quarterly 20(2) 121 -142
10. Johnson J P, 1995, "Case studies of dissemination policy in local government GIS agencies" Computers, Environment and Urban Systems 19 373 - 390
11. Landauer K, 1995, The Trouble with Computers (MIT Press, Cambridge MA)
12. Miles, Robert, H., 1980, Macro Organizational Behavior, GoodYear, SantaMonica, CA.
13. Nedovic-Budic Z, 1999, "Evaluating the effects of GIS Technology: Review of Methodsc", Journal of Planning Literature, Vol. 13(3), 1999
14. Smith DA, Tomlinson R F, 1992, "Assessing costs and benefits of geographical information systems: methodological and implementation issues" International Journal of Geographical Information Systems 6 241-256
15. Tveitdal S, Hesjedal 0,1991, "GIS in the Nordic countries", in GIS Applications in National Resources Eds M Heit, A Shortreid (GIS World, Fort Collins, CO) pp 75-81
16. Worrall L, 1994, "The role of GIS-based spatial analysis in strategic management in local management" Computers, Environment and Urban Systems 18 323 – 332



Study of the Ocean Mesosacle Features Using Sea Surface Temperature (SST): A case Study of Gulf Stream

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Abstract

Mesoscale features are the instabilities present in the ocean. These play important role in maintaining climate, energy balance and nutrients cycling within ocean and the atmosphere. Sea surface temperature (SST) is an important parameter that is estimated by the remote sensors in the study of the mesoscale features like eddies, fronts, meanders and upwelling. The sensors use infrared and microwave radiation to determine SST and helps in understanding the ocean process and changes. The present study focuses on the study of Gulf Stream mesoscale features using the remotely sensed satellite data.

Introduction

Sea surface temperature (SST) is a function of the radiation emitted by the water which depends on the temperature of the ocean. Depending upon the depth and instrument used for measurement, SST can be from the skin (SST_{skin}), subskin ($SST_{subskin}$) and any depth (SST_{depth}). The temperature sensors fitted in the buyos, ships gives the SST_{depth} while the microwave radiometers on ship can be used for measuring SST_{skin}. The satellites measure the SST_{skin} at 10-13 µm infrared wavebands emitted by water to measure the temperature. The variation of the temperature of the ocean with presence of different features makes it possible to detect with SST by satellites sensors. Mesoscale features are the structures that follow distinct pattern in oceans can be represented by the use of SST gradients. Besides temperatures various factors like baroclinic and barotropic instabilities, wind forcing and topographic interaction also aids in the formation of those features (Robinson 1994). These features are important because they maintain and help to transport heat, momentum and nutrients within and between the ocean and atmosphere. The measured data usability of the features however depends upon the sensor characteristics and their accuracy.

SST measurement by remote sensing can be grouped into thermal and microwave remote sensors. The thermal infrared sensors have spatial resolution of 1Km for detecting the micro and mesoscale features (0.3K-0.7K of rmse) but are affected by clouds, aerosols and atmospheric vapour. The microwave sensors are invariant to cloud but have low spatial resolution (50Km) and are affected by heavy precipitation. The most widely used infrared remote sensors are the Advanced Very High Resolution Radiometer (AVHRR), Moderate Resolution Imaging Spectroradiometer (MODIS), Advanced Along track scanning Radiometer(AATSR) and Advanced Microwave Scanning Radiometer-Earth Observation Satellite(AMSRE_E), Tropical rainfall measuring mission(TRMM) Microwave Imager (TMI) abroad (Guan and Kawamura2003). The geostationary satellites have high temporal resolution of 30 minute and can have diurnal SST data but the problems are the detection of mesoscale features with its low spatial resolution. There are also different ground based methods that measures SST with the help of buoy, ships that carries instrument to measure the SST_{depth} temperature. However these methods covers relatively small area and are point based measurements. The SST from space borne sensors is important in measuring the mesoscale features because of the high spatial and temporal resolution, regular sampling capacity and synoptic view of the ocean.

Gulf Stream is a western boundary current that originates from the Caribbean and Gulf of Mexico. It is a strong, warm and swift current characterized by high velocity and volume of flow that exert a considerable influence in the dynamics of the ocean basin because of the amount of water and the evaporation of the warm water that they carry.

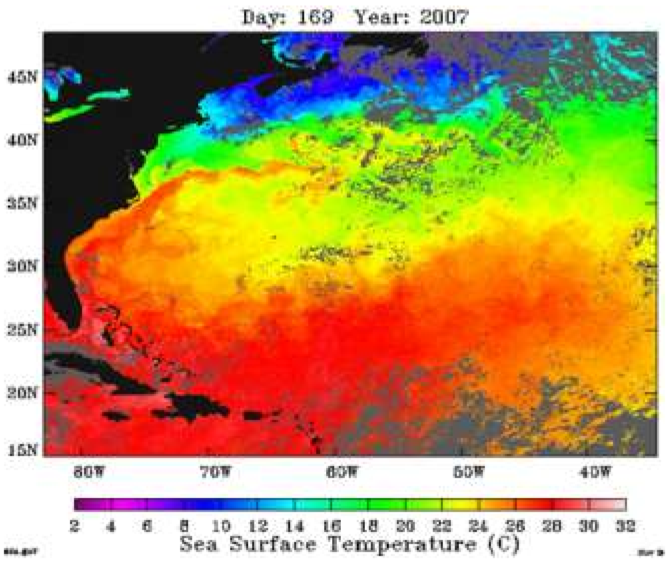

Figure 1: MODIS/aqua 8 days SST level 3 composite image showing Gulf Stream features in May 2007.

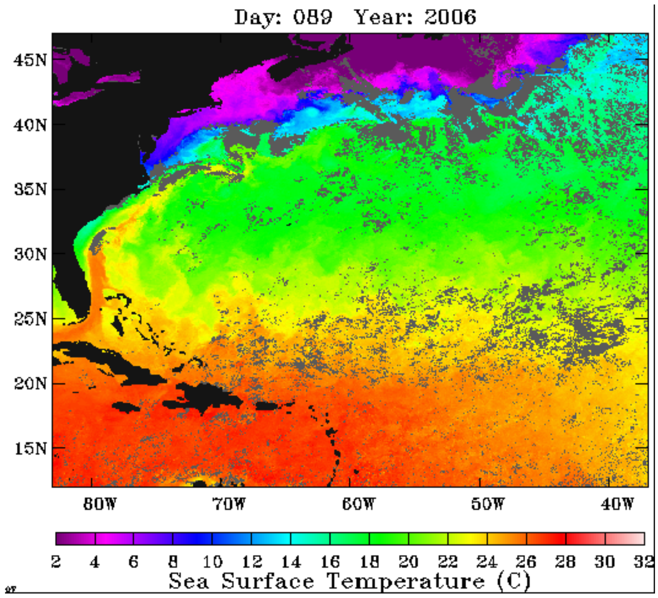

Figure 2: The initial stage of the Gulf Stream showing the fronts represented by different colours at varying temperature.

The Gulf Stream can be divided into three major sections, the loop current zone that originate from the Gulf of Mexico with narrow, linear and directed flow of water, the transition zone where it turns into Atlantic Ocean with increasing velocity and double in size, and the open sea zone where energy dissipates. The initial stage is characterized by the coastal interaction resulting in number of eddies and ocean fronts that are permanent in nature while the open sea stage is characterized by the formation of the rings. The Gulf Steam splits into a northern part that crosses Europe and a southern part that moves towards West Africa as seen in Figure 1. As the stream extends north it forms clockwise warm core ring with water from Saragossa Sea that can be traced for several months, and in south it forms anticlockwise rotating cold core ring that are engulfed by the cold water of Atlantic ocean(http://disc.sci.gsfc.nasa.gov/oceancolor/tutorials/module1.shtml). In the figure the splitting of the Gulf Stream is visible at around 380N, 600W at the downstream of Cape Hatteras. The image also shows Gulf Stream mesoscale features like eddies, front and meanders.

Oceanic fronts are relative narrow zone of horizontal gradients that separate the border area of different vertical structures. These fronts exhibit large variability over time scales from daily to inter-annul due to the instabilities in the ocean (Robinson 1994). SST can be used to find the narrow horizontal gradient that separates the two distinct layers of waters. The Gulf Stream itself is a large-scale front that separates the cooler continental and warmer Sargasso water where warm water of the stream creates the temperature gradient that separates water with different water temperature and moves relative to each other in horizontal direction (Robinson 1994). Various methods can be applied to detect the fronts in images. The most common method is the edge detection method. The figure 2 shows the oceanic fronts according the temperature gradient represented by different colour. The front separating the cooler coastal water from the warmer water near Cape Hatteras is represented by dark blue colour. There are four different water fronts north of the Gulf Stream which are distinct as shown by the colour at different temperatures. In the above figure The Gulf Stream is shown as orange colour (26^{0}C) acts as front separating the cold Atlantic water represented by green colour (18-20^{0}C). The instabilities of front in some lead development of meanders.

The Gulf Stream meanders show a wavelike lateral movement pattern along its path. The wavelength and the propagation speed changes as it moves from the Gulf of Mexico to Atlantic Ocean particularly at Cape Hatteras where it enters the open ocean. The downstream propagation rate decreases from 45Kmday^{-1} with wave length of 180Km to about 14 Kmday^{-1} and wavelength of 500Km (Tracey and Watts 1986). The meanders form generally at east of 75^{0}W (Mau et al 1978). In the figure 3 it can be seen that the meanders are formed at 38^{0}N 57^{0}S which is east of 75^{0}W. The meander deformation produce isolated eddies as in the case of Gulf Stream.

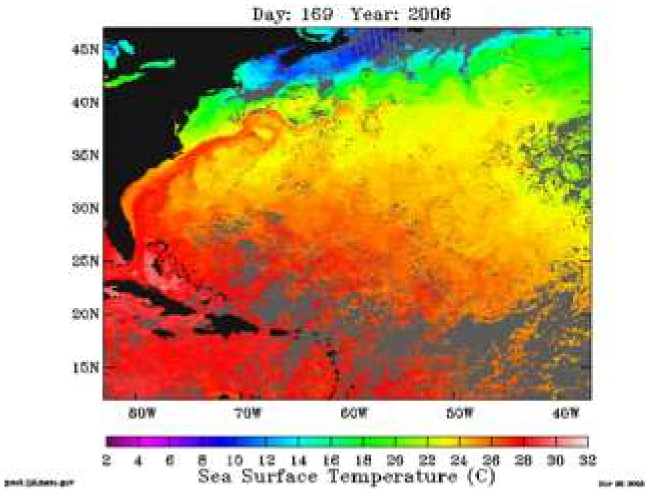

Figure 3: The meanders and the circular eddies formed in Gulf Stream. This is a MODIS 8 days SST composite at year 2006 May provided by NASA ESIP tool

Eddies are the mesoscale features that are formed by baroclinic instability, topographic generation and wind forcing (Robinson 1994). Eddies identification is based on detecting borders delimited by strong horizontal thermal gradients in relation to their adjacent waters. The change in gradient is however dependent on the intensity and stage of the eddy formation. The Gulf Stream shows different pattern of eddies along its course and the most prominent are the circular eddies with warm or sold cores. These eddies are formed due to the development of the meander in the Gulf Stream that increases in size and pinches off. If the pinch off takes place to the northern hemisphere it is the warm core eddies and if to the right of the stream it is the cold core eddies that moves towards Mid-Atlantic water.

In the figure the meanders pinching can be seen at 37^{0}N, 68^{0}W and the cold core eddies is seen in 38^{0}N 57^{0}S. The temperature can be predicted to be 18-20^{0}C at the core of the circular eddy which is about 10^{0}C cooler than the surrounding water. The average life of these type of eddies are generally more than six months with higher life span of the warm core eddies than those of cold core eddies (Lai and Richardson1975). In the figure it can also be seen the small scale eddies at the right side of stream near North Carolina.

Besides the expert judgment and manual detection of the mesoscale features, there are models that have been designed to detect the features automatically. These models basically uses two approaches: matching the thermal gradient maps with analytical description of the target structure and generating artificial neural networks to train the algorithms based on approximate matching and parallel distribution of process information (Castellani 2006).

Conclusion:

The instabilities in ocean cause variation in temperature, which is sensed by sensors to detect, monitor and map the mesoscale features. The clouds and atmospheric effects that affect the measurement of SST can be reduced by combining SST data from various sensors and ground based measurements for the better measurement. The SST data of Gulf Stream showed the variation in the spatial and temporal pattern of eddies, fronts and meanders that can be identified, monitored and predicted with the analysis of the gradient of SST variation.

References:

1. Castellani, M. 2006, ‘Identification of eddies from sea surface temperature maps with neural networks’, International Journal of Remote Sensing vol.27, no. 8 pp. 1601-1618.
2. Guan, L. and Kawamura, H. 2003, ‘SST Availabilities of Satellite Infrared and Microwave Measurements’, Journal of Oceanography vol. 59, pp. 201-209.
3. Science focus- Classic CZC Scenes, Chapter 6: The Gulf Stream (Western Boundary Current) [online] Available: http://disc.sci.gsfc.nasa.gov/oceancolor/classic_scenes/06_classics_boundary.shtml [Accessed 2008, November 20].
4. Lai, D. Y., and Richardson, P. L. 1977, ‘ Distribution and movement of Gulf Stream rings’, Journal of Physical Oceanography v0l. 7, pp. 670-683.
5. Maul, G. A., Witt, P. W., Yanaway, A. and Baig, S. R. 1978, ‘Geostationary satellite observations of Gulf Stream meanders: Infrared measurements and time series analysis’, Journal of Geophysical Research vol. 83, pp. 6123-6135.
6. Robinson, I.S. 1994, ‘Satellite Oceanography: An introduction for the oceanographers and remote-sensing Scientists’, John Wiley and Sons, England.
7. Tracey, K.L and Watts, D.R. 1986, ‘On Gulf Stream Meander Characteristics Near Cape Hatteras’, Journal of Geophysical Research vol.91, no.c6, pp. 7587-7602.

Planetary mapping

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Abstract

Many countries are planning or sending manned or unmanned spacecrafts or probes outsides the earth. They have/are being developed GNSS and deep space networks to fix the position of and communicate with satellites and other objects. The rockets, ICT, star tracker /astro-fix, inertial measurement system and sensors, remote sensing and other systems are developed. Star tracker, GNSS, IMU, LiDAR, remote sensing and satellite spectroscopy are developed to acquire the data remotely. The terrestrial surveying and mapping techniques could be miniaturized for celestial mapping. Various international surveying communities also created commissions to standardize the data capture, recording and analysis of data of celestial bodies. Therefore, surveyor should study and participate in these programmes.

Background

Mapping of solid surface of planet, satellite, minor planet and other celestial bodies are new areas of exploration and mapping. The mapping of the moon and mars completed and mercury is under progress. New generation of surveyors will also involve in mapping of solid crust of celestial bodies beside of the earth. The terrestrial planets have solid crusts, the Jovian planets have liquid surface, the sun like star has gaseous surface and minor planets and other smaller celestial bodies have frozen gaseous solid surfaces. Some planets have no atmosphere, some has opaque and some have transparent atmosphere. The mapping involves precise measurement of orbit of the planet, latitude and longitude and altitude of the point on the surface, composition of the crust, atmosphere and core as well as situation of gravity, magnetic and effect of solar wind fields. The position of satellite which is being used to study is required to know accurately in relation to the celestial body.

Many countries like USA, Russia, EU, China, India are planning or sending manned or unmanned spacecrafts or probes outsides the earth. They have/are being developed GNSS and deep space networks to fix the position of and communicate with satellites. The rockets, ICT, star tracker /astro-fix, inertial measurement system and sensors, remote sensing, other systems are developed in miniature form.

Most of the study of universe is being carried out by terrestrial or orbiting telescopes and satellite mission flyby or orbiting the celestial bodies. The detail mapping of bodies is usually carried out by sending satellite or probes equipped with the positioning, imaging, altimetry and other measurement equipments to the bodies. It can be an example of present Messenger used for mapping of the mercury which briefly describe as publish materials.

Messenger mission

MESSENGER (MErcury Surface, Space ENvironment, GEochemistry, and Ranging) is a NASA-sponsored scientific investigation of the planet Mercury and the first space mission designed to orbit and detail mapping of the planet. The MESSENGER spacecraft launched on August 3, 2004, and entered orbit about Mercury on March 18, 2011 UTC to begin a yearlong study of the planet.
The primary science objectives of the mission include:

- determining accurately the surface composition of Mercury
- detail mapping of the planet
- characterizing the geological history of the planet
- determining the precise strength of the magnetic field and its variation with position and altitude
- investigating the presence of a liquid outer core by measuring Mercury's libration
- determining the nature of the radar reflective materials at Mercury’s poles

w investigating the important volatile species and their sources and sinks on and near Mercury.

Information for attitude control is provided by star trackers, an inertial measurement unit, and six sun sensors.

Communications

The probe includes two small deep space transponders for communications with the Deep Space Network. The high gain antenna is used as transmit-only at 8.4 GHz, the medium-gain and low gain antennas transmit at 8.4 GHz and receive at 7.2 GHz, and all three antennas operate with right-hand circularly polarized (RHCP) radiation. One of each of these antennas is mounted on the front of the probe facing the sun, and one of each is mounted to the back of the probe facing away from the sun.

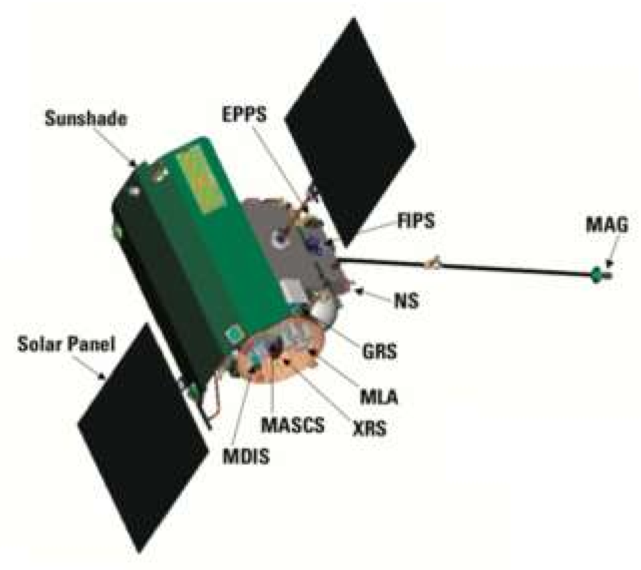
Power

The space probe is powered by a two-panel, gallium arsenide/germanium (GaAs/Ge) solar array providing an average of 450 watts at Mercury. Each panel is rotatable and includes optical solar reflectors to balance the temperature of the array. Power is stored in a common-pressure-vessel, 23-ampere-hour nickel hydrogen battery, with 11 vessels and two cells per vessel.

Computer and software

The computer system is based on the Integrated Electronics Module (IEM), a device which combines core avionics into a single box. The computer features two radiation-hardened IBM RAD6000, a 25 megahertz main processor and 10 MHz fault protection processor. For redundancy, the spacecraft carries a pair of identical IEM computers. For data storage, the spacecraft carries two solid-state recorders able to store up to one gigabyte each. The IBM RAD6000 main processor collects, compresses, and stores data from MESSENGER's instruments for later playback to Earth.
MESSENGER uses a software suite called SciBox to simulate its orbit and instruments, in order to "choreograph the complicated process of maximizing the scientific return from the mission and minimizing conflicts between instrument observations, while at the same time meeting all spacecraft constraints on pointing, data downlink rates, and onboard data storage capacity

Scientific instruments



MESSENGER Satellite with instruments

Mercury Dual Imaging System (MDIS)

Includes two CCD cameras, a narrow-angle camera (NAC) and a wide-angle camera (WAC) mounted to a pivoting platform. The camera system will provide a complete map of the surface of Mercury at a resolution of 250 meters/pixel with 20–50 meters/pixel images of regions of geologic interest during the orbiting phase. Colour imaging is possible only with the narrow-band filter wheel attached to the wide-angle camera.
It is acquiring of near-global coverage at •'98500-meters/pixel and Multi spectral mapping at •'982-kilometers/pixel during the flyby phase.

Radio Science (RS)

It measures the gravity of Mercury and the state of the planetary core by utilizing the spacecraft positioning data to determine the position of the spacecraft during both the cruise and orbital phases of the mission, observes gravitational perturbations from Mercury to investigate the spatial variations of density within the planet’s interior, and a time-varying component in Mercury’s gravity to quantify the amplitude of Mercury’s libration and provide precise measurements of the range of the MESSENGER spacecraft to the surface of Mercury for determining proper altitude mapping with the MLA.

A nadir-looking monochrome global photomosaic at moderate solar incidence angles (55°–75°) and 250-meters/pixel or better sampling resolution, a

25°-off-nadir mosaic to complement the nadir-looking mosaic for global stereo mapping, completion of the multispectral mapping begun during the flybys and high-resolution (20–50-meters/pixel) image strips across features representative of major geologic units and structures during Orbital Phase .

Gamma-Ray Spectrometer (GRS)

It measures gamma-ray emissions from the surface of Mercury to determine the composition by detecting certain elements (oxygen, silicon, sulphur, iron, hydrogen, potassium, thorium, uranium) to a depth of 10 cm.

Neutron Spectrometer (NS)

It determines the hydrogen mineral composition to a depth of 40 cm by detecting low-energy neutrons that result from the collision of cosmic rays and the minerals.

X-Ray Spectrometer (XRS)

It maps mineral composition within the top millimeter of the surface on Mercury by detecting X-ray spectral lines from magnesium, aluminum, sulphur, calcium, titanium, and iron, in the 1-10 keV range.

Magnetometer (MAG)

It measures the magnetic field around Mercury in detail to determine the strength and average position of the field.

Mercury Laser Altimeter (MLA)

It provides detailed information regarding the height of landforms on the surface of Mercury by detecting the light of an infrared laser as the light bounces off the surface which may be summaries as following:

Provide a high-precision topographic map of the high northern latitude regions.
Measure the long-wavelength topographic features at mid-to-low northern latitudes.
Determine topographic profiles across major geologic features in the northern hemisphere.
Detect and quantify the planet's forced physical librations by tracking the motion of large-scale topographic features as a function of time.
Measure the surface reflectivity of Mercury at the MLA operating wavelength of 1,064 nanometers.

Mercury Atmospheric and Surface Composition Spectrometer (MASCS)

It determines the characteristics of the tenuous atmosphere surrounding Mercury by measuring ultraviolet light emissions and the prevalence of iron and titanium minerals on the surface by measuring the reflectance of infrared light.
3.9 Energetic Particle and Plasma Spectrometer (EPPS)

It measures the charged particles in the magnetosphere around Mercury using an Energetic Particle Spectrometer (EPS) and the charged particles that come from the surface using a Fast Imaging Plasma Spectrometer (FIPS).

Control points (Attitude data)

LiDAR Survey with GPS in Nepal

The control points in terrestrial LiDAR and aerial mapping works in Nepal, is carried out by using differential GPS receivers located at one or two first order trig. points and another GPS receiver on aircraft / helicopter equipped with LiDAR altimeter, inertial measurement unit and imaging camera. It can be similarly used by imaging satellite if they have reception of sufficient number of GNSS satellites.

In case of mars mission, four Doppler satellites were used in addition to other facilities to fix the position imaging satellites. Presently star tracker/ astro-fix which is instrument to fix its position by observing stars, inertial measurement unit and sensors are used to determine the instant position of satellite like Messenger satellite. The deep space network which is the network of 3 stationary satellites of the earth stationed separately by USA, Russia, EU, China and India, is used for communication and to control the position of satellites.

Parameters

The parameters are latitude, longitude and mean surface / sea level, major and minor axis of celestial bodies. Mean position of north and south the axis of rotation is the equator which is origin of latitude and a fix point on the surface is the origin of longitude which is decided by International Astronomical Union (IAU) and mean surface level (altitude) is fixed on the basis of starting point of sea like depression on the surface. The Major axis (a) and minor axis (b) will be fixed on the basis of ground based observations and finalized by the shape of mean surface level. The map projection generally for the globe will be Mollweide projection.

Imagery

The imagery will be both mono and stereo images using dual imaging system. The cameras will have narrow and wide angles. The resolution of bodies will be 250 m to 500 m pixel during the flyby phase and the stereo images will taken from the cameras inclined to the nadir with 250m like resolution during orbital phase. Special areas of interest may take at higher resolution of 25-50m pixel.

Opaque celestial bodies like Venus will be imaged using radar imagery to avoid poor visibility.

Altimetry

The height variation and nature of the surface of the bodies will be measured from the LiDAR altimeters of the altitude is lower than 1500 km. Otherwise, it is measured photogrammetrically. Hight of certain points on the bodies will be measured from other techniques and ground based techniques. The satellite gravety observation will also be carried out, which will assist on determinate of mean surface level and composition of the body.

Mapping

Ortho photos and DEM will be generated using photogrammetric techniques. Vector data will be created and annotation will be carried out. The features will be classified as agreed internationally by ICA. The feature names will be assigned as approved IAU. The feature symbols and classifications will be generally agreed from the planetary cartography commission of ICA.

Resources data

The magnetic and gravity field observation, surface and atmospheric compositions of the body will be observed by magnetometer, gravimeter, radio science and various spectrometers respectively. They will be transmitted to ground station and analyzed by ground based laboratories. These data will provide situation of magnetic field and seasonal variations on the surface, the chemical composition of outer crust and the core. It will also provide the composition of atmosphere, geology as well as effects of solar wind, magnetic field on the surface.

Conclusion

The technology is being developed for mapping and detail study of the surface or crust and composition of inner and outer surface of the celestial bodies. The satellites or probes are being sent by various countries. Various surveying communities like ISPRS, ICA, IAU, IGA are also created commissions to standardize the data capture, recording and analysis of data of celestial bodies. Therefore, surveyor should study and participate in these programmes.

References

- Norton Star Atlas,
- Messenger Mission, Wikipedia
- Messenger Mission. NASA, www.nasa.gov

An Approach to Improve Instructional Method of Training

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Abstract

Instructional method of training is one of the very popular techniques of training. In this method instructor transfers knowledge to the students through lecturing and evaluates their performance by the tests. One should always try to improve the teaching technique to produce highly skilled human resources. In order to achieve these, basic needs in training and the basic elements of the training must consider properly. Human factors also play vital role for producing better products so this paper will enunciate all these components for improving instructional method of training.

Key Words: Training, Instructor, Class, Basic needs, Basic elements, Human factors.

Introduction

Training is to teach on a particular field to a group of people who have no knowledge before and to get them to learn on it. The art of giving instructions to such group is known as teaching by "Instructional Method". Lecturing in training is a means of communication to transfer knowledge from an instructor to the students and receiving response from the students on the subject matter taught by an instructor. So teaching is a two way communication system. The instructor delivers lectures on a subject and evaluates the level of the students through the tests. The instructor receives response through the test results and the scores of the class reflect the quality of teaching as well as the standard of the class. The current teaching system seems to be exceptionally exam oriented which enforces established ideas but does not promote to creation of new ones. This system is gradually replacing by introducing explorative and problem solving types of exercise to prepare the class for the challenges they will encounter in their real world.

Training should be conducted in a better teaching-learning environment so that the class should feel an hour long delivery lecture terminates like half an hour. In order to create such environment, instructors should be motivated to teach the class in a balanced way so that theoretical lessons no longer dominate practical knowledge but complement the skills to overcome the challenges the students will face. On the other hand, the students should be self-encouraged to learn and develop skills enabling individual to deal effectively with the demands and challenges of everyday life.

So in order to being designing a successful teaching practice, some basic needs and basis along with the concept on human factors related to teaching should be considered. However, the instructors must contribute for further improving the instructional method using her/his experiences and skills for producing highly trained and skilled human resources.

Objective of Training

The objective of training is to improve behavioral change to be effected in knowledge, skills, attitudes, techniques and experiences. In other words, training is to impart new knowledge, develop practical skills, influences old attitudes, practice new techniques and over all to increase experiences. Obviously experiences can not be taught in classroom. It is the result of practicing the use of knowledge, skills and techniques over a period of time and may be in a number of different situations. These key words are interrelated and should not isolate; otherwise the training will be incomplete.

Needs in Training

There are two basic needs in training: the instructor and the class. The instructor must have sufficient knowledge of the subject and proper skills to teach. Secondly, the class (trainees) must have desire to learn. If an instructor does not have adequate knowledge on the subject to teach, the instruction will be useless and it will have negative impact in future. On the other hand, the situation will be worsening if the class has no intention to learn. However, in the later case, an experienced instructor may improve the condition with her/his skills to motivate students for learning.

Basic Elements of Training

In order to accomplish a training programme successfully, the following basic elements of training must consider properly.

Aim

The aim of teaching has three stages namely immediate aim, ultimate aim and final aim.

- The immediate aim is to deliver lecture of the lesson in hand and the lesson must be clear, concise and understood by all the students of the class.
- The ultimate aim is to cover all the topics of a particular subject so that the trainee could understand the subject and could use the knowledge at her/his work place. This can be achieved by capturing a series of immediate aims.
- The final aim is to complete the course covering all the subjects given in the curriculum of the training programme. This will develop the mind and skill of an individual trainee in a methodical and patient manner over a period of time.

Planning

Proper planning is a key to success of the training. The planning consists of the management of the following:

Facilities:
The facilities include syllabus, library, study room, training aids and store. A copy of syllabus must be issued to the instructor so that she/he knows about the subject, content and the number of hours she/he has to teach in the class. She/he needs a library to collect all the information relevant to the subject. So a library which should be equipped with reference books and a quiet study room must be provided to the instructor. Furthermore, arrangements must be made to have access on the internet and to provide facilities for the production of teaching aids such as charts, posters, models, power points, etc.

Class Room:
The class room must be in a quiet place and it must not be disturb by any activity occurring outside the class room. The design and the layout of the class must ensure the comfort based on the following so that the trainees could stayed without any strain or difficulty for watching the activities in the class:

- Adequate space for seats and benches
- Proper lighting and ventilation
- Space for writing board, extra boards for charts, models, etc.
- Provision for over head projector or multi-media projector

Management

Proper management also plays important role to motivate instructors as well as students so the management should arrange the following to facilitate the instructors and the students:

- Transportation
- Accommodation and provision for refreshment
- Facilities for the production of teaching aids and documents
- Recreational facilities
- Extra Curricular activities
- Salary or allowances payment
- Collection and distribution of individual mail
- Internet facilities

Preparation

The effectiveness of the lecture(s) depends upon the quality of preparation by the instructor. Educational philosophy dictates that the teacher must be well prepared before entering the class even if the lesson is very simple and common. So although the instructor is a "Master" in the subject, she/he should not deliver lecture without preparation as this may sometimes adversely affect her/his professional reputation. Preparation includes the following:

- Finding: Find the content of the lecture as per the syllabus and collect the reference materials.
- Knowing: Know the subject matter by studying the reference materials.
- Sifting: Sift the subject matter in such a way that the essentials are closely examine
- Organizing: Organize the subject matter systematically and logically so that it can be deliver in the class effectively. This includes the preparation of lesson plan, hands out, presentation slides/ power point, etc.

Motivation

As stated earlier, the students must have a desire or interest to learn. So, if such interests do not shown by the class the instruction will not be effective. However, by following some basic rules of motivation carefully, it could create interest to the class. They are as follows:

Advertisement: A well laid out programme including who is taking which subject is displayed in the notice board and at places where the students are hanged out frequently, such advertisement will bind to attract attention to them. Furthermore the notices can be made more attractive by adding some catchy slogans such as "what is special on this week" or some pictorial poster, etc.

Realism: The academic approach of conducting class must be avoided. The lecture should be made as realistic as possible and the subject matter must be related to things and happening in real life, so wherever possible, use the real thing to demonstrate or give real examples.

Competition: If an instructor could create an atmosphere for competing each other among individuals or groups, this will lead to enthusiasm for learning and consequently there will be better performance of the students. However, the competition must be friendly, healthy and free from biasness.

Variety: Seeking change is a human nature. This applies in the teaching field also. So, change of subject matter or a variation in the lecture presentation will help the class to avoid being bored, to promote the interest of the class and to accelerate the learning. So sometime telling a humor, short story, current weather condition, etc. will motivate the class to concentrate on the subject matter. But they must be natural, effortless and relevant. But, the quality of humor should never be cheap, satirical and it should not be introduced frequently.

Surprise: One of the most important factors for delivering instructions is to keep the brain of the class active. To do this the instructor should surprise the class from time to time by allowing them for performing some relevant activities such as quiz, project or experiments without giving prior notice.

Curiosity: It is a natural phenomenon that the person involve in an activity will have curiosity to know how she/he is progressing. Similarly, the individual in the class will always trying to know how she/he is doing and will also try to compare her/his performance with their other colleagues. Therefore, the instructor must tell the progress of the class in general and individuals in particular, it not only gives a sense of achievement and pride to the good ones but also serves as a stimulant for the weak ones to emulate.

Evaluation: After delivering certain portion of instructions, it is necessary to assess to which extent the students have assimilated the knowledge and also to provide the students a sense of achievement. So, the instructor should evaluate the class from time to time to judge the level of the class so that the instructor enables to evaluate whether the class requires further training and revision or to proceed further. Method of evaluation could be different nature such as homework assignments, class tests, oral tests etc. While asking questions, the instructor must remember the following:

- Consider standard of the class
- Avoid ambiguity
- Put question and give time the class to think about the answer
- Ask answer from any individual
- Avoid asking always from a particular student
- Frame the question for the subject matter not for the language ability.

But at the end of the subject it is necessary to take a final test. Students must be informed well ahead of the dates of the test and try to convince the class to prevent 'test fear'. The instructor should complete examining the answer sheets within a reasonable time period and should discuss on the test result soon after the result is published. The result of the final test will indicate the quality of the teaching as well as the standard of the class. While setting the question paper for conducting the test, the following criteria should reflect in the questions:

- Easy to understand and no ambiguity
- Comprehensive and cover all aspects of taught as far as possible
- Easy to mark and assess.
- Realistic so that assessment be made to cheek the knowledge that can be applied in practice

Activity

The instructions even from a good instructor could be effective only when if she/he succeeds to keep the class reasonably engaged by assigning some activities. The activity could be either physical or mental depend on the nature of the subject. If the students are allowed to handle physically the equipment related to the subject being taught, the students will easily learn the lesson. If the lesson is purely theoretical, the instructor could keep the class mentally active either by conducting workshop to present findings of their assignment in the class or by questioning technique in which the instructor permits the class to put questions.
The instructor must regulate the class based on the following criteria for question and answer:

- Adopt a friendly and encouraging attitude and help to frame the question, if necessary to reframe it.
- Repeat the question so that the class can understand it clearly.
- Give chance to answer from the class instead of answering it by herself/himself.
- Modify the answer if necessary or give correct answer if the class could not give proper answer or do not know the answer
- Give a brief general answer if the question is irrelevant but sincere

- Be firm and discourage if the question is irrelevant and not sincere
- Never to bluff, if the instructor does not know the answer but to accept ignorance and give right answer later.

Use of Senses

The instruction will be effective or will be grasped easily by the class if sense appeal mediums such as the teaching aids and the senses are used. The more the mediums are used, the longer the subject matter remains in the students mind. It is worthwhile to mention a Chinese proverb to justify the importance of using teaching aids and is as follows:

"Tell me and I will forget
Show me and I will remember
Involve me and I will understand
Step back and I will act"

The mediums could be the following:

- Auditory: Such as tape recorder, radio, etc and these aids are appeal through the sense of hearing
- Visual: Such as charts, model, films, slides, video, etc. and these aids are appeal through sight.
- Muscular: Such as instrument, part of equipment, etc. which has to be physically handled by students and appeal through sense of touch.
- Organized aids: Such as group work assignment, demonstration, etc. in which the students has to involve themselves.

Human Factors

Human factors in the context of training are the characteristics and attitude of the instructor. So the training will be more effective, if the instructor has high moral characteristics and positive attitude towards the teaching and consequently the organization could produce better products. The elements of the characteristics and attitude are given below.

Characteristics

A good instructor should possess the following characteristics:

Identity: Students start assessing the instructor from the moment before she/he comes in the class or before she/he speaks the first word. A good presence is a natural asset however even without it one can be equally impressive if the instructor is well turned out, display good natured, agile and cheerful and be pleasant in the class. So, the instructor must convince the class for the possession of better identity through her/his behavior. However, the instructor should possess the following identity:

- Stand smiling, make inspiring gestures and make the ambience of the class most agreeable.
- Be knowledgeable in the subject
- Be simple, straight forward and open to the students.
- Pour out ideas with utmost confidence
- Satisfy every question and dispel every doubt
- Avoid creating fear in the class
- Avoid habit to distract the class.
- Give reference to illustrate an issue
- Excavate the issue even with an allusion
- Establish eye contacts with the trainees.

Enthusiasm: Enthusiasm is contagious so if the instructor has great enthusiasm to deliver lecture it will definitely have a positive impact on the class for listening. At times, the class may demand such instructor for the other subject also, even if the instructor does not express interest on that subject.

Voice: Voice is a natural gift so it is difficult to improve it. However, the instructor should speak in such a way that it should be heard by the trainee sitting in the last bench with the voice loud and clear. But it should not be so loud that it causes auditory discomfort to the students sitting in front desk.

Delivery: Speaking is an art and lecture delivery is a major asset of the teaching. So attention to be made so that the correct and required information delivered to the student. The instructor must practice to use simple language to speak and in a reasonable speed so that the student can catch it and emphasis must be made for the important words and statements. She/he should try to avoid or minimize to express meaningless expression such as "You See", "I mean", "Right then". If such words are used, the students will concentrate more on the words than the lecture.

Patience: In general, a class consists of students with varying mental caliber and temperaments. So while dealing with such a heterogeneous group of persons, she/he should never loose temper, show signs of disgust and exasperation instead she/he should be considerate, sympathetic and helpful. Otherwise, the class will loose the confidence over the instructor and the situation will go out of control so she/he should deal the class very seriously and patiently, Firmness: Firm control over the class is essential to put the class in discipline. This does not mean the strictness or unfriendly, rather it will motivate the students to maintain discipline or not showing any tendency to get away from the class. So, firmness will gain respect and even may receive admiration from the students.

Mannerism: Mannerism is very much related to the behavior and habit of a person. So, the instructor must concentrates on the class and subject she/he is dealing. She/he should avoid any unpleasant activities (such as playing with a bunch of keys, tapping the leg, walking up and down, unknowingly displaying discomfort etc.) which distract the class from what she/he are saying .

Attitude of Instructor

The attitude of the instructor determines the level of the class. If the class has enthusiasm to learn, but the attitude of the instructor is negative then the students could not receive the instructions as expected. Consequently, the class will demand a new instructor. A positive attitude of an instructor is reflected by the several factors and they are as follows:

Knowledge of the class: The instructor should keep the knowledge of the class such as name of each student, their strong and weak points, likes and dislikes, etc. Each student has her/his own individuality and likes to recognize by the teacher. So if the teacher calls a student by her/his name, it will elicit much better response.

Faithful: The instructor must be faithful not only to colleagues but also to the organization. If the instructor gives speech in derogatory term of any other colleagues or organization it will be self defeating. So, team spirit attitude among instructors must always be fostered.

Friendliness: The instructor should not display superiority, hostile, aggressive or bullying attitude towards the class as a whole or towards an individual student. The teacher must create an environment to the class that she/he is with them to help, teach and guide. Even when checking and correcting the assignment, the student should feel that they are being advised and helped to improve her/his weakness and not being criticized for their performance.

Sarcasm: Sarcasm or cynicism kill warmth and friendliness and pollute the atmosphere of the class. A student once belittled will never forgive the instructor and this will result in a loss of confidence in both ways. So the student will hardly believes that the instructor will ever treat better and the instructor, in most of the cases, will be bias to the student in a negative sense.

Favoritism: Favoritism in a class is a very unhealthy attitude for the class. It hurts the student and creates jealousy. So personal likes and dislikes should be eschewed or at least keep as far behind the screen as possible. In the beginning, only the unfavorable ones do not regard for the instructor, but in the long run favored one will also loose respect.

Familiarity: There is an old proverb that "Familiarity breeds contempt". So the instructor should maintain the dignity attaching to the position of 'Teacher' and should never let it down from the class. This does not mean that the instructor is snobbish, standoffish or self-centered.

Conclusion

Training plays a vital role especially when new things have to be taught to a group of persons at a time. Instructional method is one of the effective methods to educate them in which the instructor delivers lectures on a topic and the trainees listen to it. This paper tried to outline the guidelines to be followed by the instructors for achieving commendable results from the training. Furthermore, the instructor must keep in mind that the class consists of persons with different background and different nature so she/he must deals class carefully and must try to contribute to further improve the methods of teaching.

References

1. Klaus M.V. Keussler; Types of Teaching and Training Methods; 1985
2. Rabin K. Sharma; Human Resource Development Policy in Space Technology Sector in Nepal, 2004
3. S.K. Parthasarathi: Instructional Method in Training, 1980

Dissecting Web Coverage Service (WCS) and its Clients

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Introduction

The phenomenon on the earth is monitored by two major scientific communities. They are GIScience community and Earth Science (ES) community. These communities have their own data models for representing the same geographic phenomenon. GIScience community collects datasets as static features with accurate earth location. Information related to location as well as time is stored as attributes. In ES community, geo-phenomenon are stored as set of parameters that vary as continuous function in 3- dimensional space and time (Domenico et al., 2007). The datasets are stored as multidimensional array structure and time is stored as dimension of the structure.

Both communities provide data to the wide range of users using web services. Two communities have their own family of protocols. GISciecne community has OGC Web Coverage Service (WCS) for data access and Catalogue Service for Web (CSW) for searching metadata. Likewise ES community has developed set of protocols like OPeNDAP for data access and Thematic Realtime Environmental Distributed Data Services (THREDDS) catalogue for finding datasets. In this article WCS will be discussed with its different clients available.

Web Coverage Service (WCS)

WCS, one of the standards by OGC, supports networked interchange of geospatial data as "coverage" based on subsetting, scaling and reprojection. The term coverage is defined by ISO and OGC as "space varying phenomenon" i.e. geographic object with some extent whose values depend on location and time. Clients can choose portions of information available on server based on spatial and other constraints similar to Web Map Service (WMS) and Web Feature Service (WFS). However there are some characteristics of WCS that make it different from WMS and WFS. "Unlike the WMS, which portrays spatial data to return static maps (rendered as pictures by the server), the WCS provides available data together with their detailed descriptions; defines a rich syntax for requests against these data; and returns data with its original semantics (instead of pictures) which may be interpreted, extrapolated, etc.-and not just portrayed". "Unlike WFS which returns discrete geospatial features, the WCS returns coverage representing space-varying phenomena that relate a spatio-temporal domain to a (possibly multidimensional) range of properties"(OGC, 2008).There are three basic operations of WCS that are: GetCapabilities, DescribeCoverage and GetCoverage. GetCapabilities returns XML document that describes services provided by WCS server and brief description of coverage. DescribeCoverage allows clients to request detail information of about available coverages. Server responds with XML document that describes services available for selected coverages. GetCoverage operation is performed after GetCapabilties and DescribeCoverage operations. This operation allow spatial, temporal and band subsetting, scaling, reprojection, and final result packaging, including data format encoding. One GetCoverage operation returns single coverage at a time that is encoded in a well-known coverage format like HDF-EOS, NITF, and GeoTIFF.

Detailed Functional Description

The mandatory and optional parameters for each operation are discussed below.

GetCapabilities: GetCapabilities returns an XML document that describes service and data collections from which clients may request coverages.

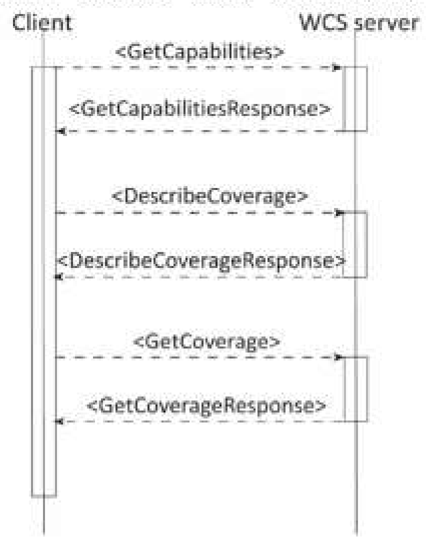

Figure : Basic operations of WCS

DescribeCoverage:
DescribeCoverage operation returns an XML document that describes one or more coverages served by WCS. It provides the information for a client to assess the usability of data and to formulate Get Coverage requests.

DescribeCoverage Response:
In response to a Describe Coverage request, WCS returns XML document whose top-level element is a Coverage Description containing Coverage Offering elements for all coverage requested. Coverage Offering extends Coverage Offering Brief, to provide additional details on the domain and range of a coverage offering. Some of mandatory and optional Coverage Offering elements are: name (Coverage Offering Brief), label (Coverage Offering Brief), supported CRSs, supported Formats etc. The service must support at least one of the following formats:

- GeoTIFF
- HDF-EOS
- DTED
- NITF
- GML

GetCoverage:
GetCoverage returns values or properties of regularly spaced locations, bundled in a requested format. GetCoverage Request Mandatory:

- SERVICE: "WCS".
- REQUEST: "GetCoverage".
- VERSION: the requested version.
- COVERAGE: the name of the coverage requested. The current version supports a single coverage request only.
- CRS: name of the coordinate reference system in which requested domain constraints are expressed (BBOX).
- BBOX: minx, miny, maxx, maxy, minz, maxz (minz and maxz are optional).
- TIME: time1, time2, or min/max/res. This is used to request a subset corresponding to the specified time instants or intervals. The parameter "res" is optional.
- WIDTH, HEIGHT, DEPTH: all integers are used for requesting a coverage to be returned with a specific grid size, i.e. number of grid points or cells.
- RESX, RESY, RESZ: the parameters RESX and RESY define the grid-cell size along the first and second axes of the coordinate reference system given in RESPONSE_CRS. RESZ is optional for 3D grids. Either these or WIDTH, HEIGHT, and DEPTH are required, but if interpolation is not supported for the requested coverage, both sets of parameters will be ignored. In that case, BBOX alone will be used for sub-setting.
- FORMAT: the format to be used for returning the coverage.

GetCoverage Response:
The response to a valid GetCoverage request is a coverage extracted from the coverage requested, with the specified spatial reference system, bounding box, size, value sets, and format.

WCS versions
The recent version of WCS is 2.0 announced in November 2010. WCS version 2.0 is modified to support GML coverage model. WCS 2.0 supports all GML and ISO coverage types. The earlier versions 1.1.0 had functional changes like use of GridCRS in coverage description and requests, hierarchical coverage description. The WCS versions are modified during addition of extensions like processing extensions, transaction operation extension. The early versions of WCS were 0.5and 0.7 that specifies operations of WCS.

WCS Clients
WCS Clients are software packages or modules that are capable of performing basic WCS operations. An ideal WCS client is capable of communicating with OGC-compliant coverage servers for accessing multidimensional geospatial data and handling different coverage-encoding formats. Besides performing basic client-server communication, WCS clients are capable of accessing, visualizing coverage, and interacting with the user. The client also provides georectification, reprojection, and reformatting functions. The execution of those functions is performed according to the requirements of users and capabilities of the servers. "The interaction between WCS client and OGC compliant web coverage servers provides interoperable, personalized, on-demand data access and services of remote sensing data"(Di et al., 2002).
Some of the available WCS clients are explained below.

gvSIG
gvSIG is desktop GIS application that can handle most of the raster and vector data formats. Moreover it is capable of capturing, storing, handling, analyzing and deploying any kind of referenced geographic information. It can access to remote servers using OGC complaints specifications WMS, WFS and WCS (gvSIG, 2010).

gvSIG supports WCS version 1.0.0 and contains WCS client that allows user to access raster data and add to geographical view that can be overlapped with other information from local or remote data servers. The data can be discovered using embedded catalogue service. So user can select data services from the catalogue or can provide the URL of the service provider. After connecting to the server gvSIG receives metadata information. The detail information about coverage is given in the next stage. In that stage it provides the list of available coverage data, file format, CRS and interpolation methods. In addition, temporal subsetting and band selection is also possible. Users have to select appropriate choices from the dialogue boxes before gvSIG executes "GetCoverage" in order to display coverage data. It is developed in platform independent environment using Java and designed to be easily extendable. There is provision of advanced functionalities like scripting support. This allows operations to be performed using external scripts.

OWSLib

OWSLib is an open source python OGC library that can access remote data sources using WMS, WFS and WCS specifications. It offers common API for accessing service metadata and wrappers for basic WCS operations: GetCapabilities, DescribeCoverage and GetCoverage (Domenico & Lowe, 2009). It supports 1.0.0 and 1.1.0 versions of WCS. The first step is to instantiate a WebCoverageService object for a particular WCS service. This will call the "GetCapabilities" method of the server and populate appropriate python metadata attributes. The several available coverages are provided. Users can explore more information about a particular coverage (for example spatio-temporal extent, available output formats).

```
>>> airtemp.timelimits #get the temporal extents
['2024-01-15T00:00:00.0', '2054-12-15T00:00:00.0']
#find out which output formats are supported
>>> airtemp.supportedFormats
['cf-netcdf', 'GeoTiff']
```

This calls the DescribeCoverage method on the server to retrieve coverage specific metadata. DescribeCoverage requests can be expensive i.e., it can retrieve long list of coverage of different time. In order to maintain performance the detailed metadata is only retrieved from the server if it is specifically requested by the client. By using the information gained during "DescribeCoverage", a GetCoverage request is formulated and sent to the server.

```
output=wcs.getCoverage(identifier='AirTemperature',
time=['2024-01-15T00:00:00.0'], bbox=(-80,30,50,60), format='cf-netcdf')
>>> f=open('test.nc', 'wb')
>>> f.write(output.read())
>>> f.close()
```

The output coverage file is then written to disk and viewed using suitable software. OWSLib can also supports Catalogue Service for Web (CSW) and can be used to discover metadata information of data providers. Python has libraries to read scientific data formats, such as HDF(pyhdf) and netCDF (pynetcdf) and it can be combined with OWSLib. So OWSLib module can be incorporated easily into standard-alone desktop or web-based client as middleware between software components.

GDAL

GDAL is a translator library for raster geospatial data. It presents a single abstract data model to the calling application for all supported formats. It also comes with a variety of useful command line utilities for data translation and processing. It supports over 50 raster formats range of raster data formats including HDF4, NetCDF and also can access WMS and WCS servers using GDAL WCS driver. The current driver supports WCS 1.0.0 and WCS 1.1.0 servers. In addition it provides utilities for data translation, image warping, subsetting, and various other common tasks (GDAL, 2010). WCS server is accessed by creating a local service description XML file. The file contains the coverage server URL, and the name of coverage. There should be no spaces or other content before the<WCS_GDAL>element. The example XML file is shown below.

```
<WCS_GDAL>
<ServiceURL>http://laits.gmu.edu/cgi-bin/NWGISS/NWGISS?
\</ServiceURL><CoverageName>AUTUMN.hdf</CoverageName>
</WCS_GDAL>
```

GDAL can be accessed from various programming platforms like python, c++, perl. It is used by different open source GIS applications like GRASS, MapServer, QGIS, and OpenEV as primary data access engine.

Multi-Protocol Geoinformation Client (MPGC):

Multi-Protocol Geoinformation Client (MPGC) is the OGC compliant multi-purpose client that can access geospatial data using WCS, WFS, WMS and Web Registry specifications. MPGC supports WCS 0.5 and 0.7 versions. MPGC can handle range of datasets like HDF, GeoTiff, GML, JPG, PNG, and GIF. Besides accessing subset of multi-dimensional data in different formats, it has functionalities like reprojection, resampling, reformatting, subsetting and visualization as well as analysis of multi-dimensional data (MPGC, 2005). MPGC is equipped with Catalog Service for Web (CSW) specification so that services can be discovered and registered. The server URL can also be taken as input from users. The list of coverage data is derived from

"GetCapabilities" and other attributes for each data like bbox, range set, resolution, and spatial reference system, are derived from the "DescribeCoverage" response. On the basis of these information user can select particular coverage data. After choosing data, users can subset coverage data in spatial, temporal, resolution/size and range dimensions. Then "GetCoverage" request is sent on according to setting made by user and coverage is retrieved. The MPGC is a standard alone thick client based on Java platform. It uses the HDF Java Native Interfaces, which calls the HDF library.

Gaia

Gaia is an open-geospatial viewer that can access multiple geospatial sources such as OGC WMS, WCS and WFS, commercial services such as Microsoft Bing Maps, OpenStreetMap and Yahoo! Maps. This client supports various file formats including ESRI Shapefiles, Google EarthKML/KMZ, DXF, MIF, Geography Markup Language (GML) and GML for Simple Features (GMLsf)(Gaia, 2010). Gaia supports accessing WCS server versions 1.0.0, 1.1.0 and 1.1.1. The list of WCS servers is provided that can be added and updated. Once a server is chosen, different available coverage are extracted. The required coverage can be selected and added as layer after inspecting provided preview and short information. There is provision of spatial subsetting using parameters but time subsetting is not possible in the current version. It supports GeoTIFF and NetCDF file formats.

The comparison between different WCS clients is shown in following table. The criteria for choosing best WCS clients are:

- Interpolation
- Spatial subset
- Temporal subset
- WCS version support
- Format of GetCoverages
- Extensibility
- Integration into client server architecture.
- Metadata/ Catalogue support
- OPENDAP/THREDDS support

Conclusion

Most of the WCS clients support the mandatory functions of the WCS and also provides support for most of the raster formats like NetCDF and GeoTIFF. The possibility of integration into system as middleware to access WCS server was also examined. The advanced functionality of using scripting language can enable the client program to act as middleware. gvSIG has scripting functionality with jython. Similarly OWSLib and GDAL can be used with programming languages.

Large volume of earth observation data are provided in the internet using OPeNDAP standard but only few data servers have adopted WCS standards. So it would be better if WCS client can also access data servers implemented using OPeNDAP standards. The WCS clients are unableto connect OPeNDAP servers. Nevertheless python module named Pydap can be used to access OPeNDAP. OWSLib module supports the latest version of WCS, can connect with CSWservers, and has possibility to use as middleware. It can be used along with other python modules that can connect with OPeNDAP server. So OWSLib is most appropriate WCS client.

Table : Comparison between different WCS client applications.

	OWSLib	gvSLG	GDAL	Gaia	MPGC
Interpolation	Yes	Yes	Yes	No	Yes
Spatial Subset	Yes	Yes	Yes	Yes	Yes
Temporal Subset	Yes	Yes	Yes	No	Yes
WCS version support	1.0.0,1.1.0	1.0.0	1.0.0,1.1.0	1.0.0,1.1.0, .1.1.1	0.5,0.7
Format of Get coverages	GeoTIFF, HDF, Net CDF	Geo TIFF	Most of the raster formats	GeoTIFF Net CDF	Geo TIFF, HDF, NetCDF
Extensibility	Yes	Yes	Yes	Yes	Yes
Integration into client server architecture	Yes	Yes	Yes	No	-
Metadata/Catalogue support	Yes	Yes	No	No	Yes
OPeNDAP/THREDDS	No	No	No	No	No

References

Di, L., Yang, W., Deng, M., Deng, D., & McDonald, K. (2002). Interoperable access of remote sensing data through NWGISS. In Geoscience and remote sensing symposium, 2002. IGARSS'02. 2002 IEEE international (Vol. 1, pp. 255–257).

Domenico, B., Caron, J., Davis, E., Nativi, S., & Bigagli, L. (2007). GALEON: standards-based web services for interoperability among Earth sciences data systems. In Geoscience and remote sensing symposium, 2006. igarss 2006. ieee international conference on (pp. 313–316).

Gaia. (2010). Gaia Geospatial Platform. http://www.thecarbonproject.com/gaia.php/.

(Accessed date: 2010.10.12)

GDAL. (2010). Geospatial Data Abstraction Library. http://www.gdal.org/. (Accessed date: 2010.10.27)

gvSIG. (2010). gvsig. http://www.gvsig.org/. (Accessed date: 2010.10.25)

MPGC. (2005). Multi-Protocol Geoinformation Client. http://geobrain.laits.gmu.edu/mpgc/. (Accessed date: 2010.09.12)

OGC. (2008). Web Coverage Service(WCS) implementation standard, version 1.1.2, OGC (No.07-067r5).

Land Cover Change and Urban Settlement Extraction in Kathmandu Valley using Remote Sensing: A Proposition

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Introduction

People migrating to urban area in search of opportunities and facilities is not a new phenomenon. Throughout history, the increasing in urban settlement has been occurring as a default process. But with the enhancement in transportation and communication facilities in the modern age, and with the improvement in people's lifestyle filled with aspirations of progress and better quality of life, the rapid swelling in urban areas has been historic. Urban spatial areas have expanded in an accelerated speed during the last five decades, and rates of urban population growth are higher than the overall growth in most countries because urban areas are the locus of economic activity and transportation nodes (Masek et al., 2000).

A modern nation must have all means and resources to regulate, analyze and monitor the booming urbanization settlement in its cities. A planned record and know-how of inhabited area not only helps in planned settlement but also in emergency planning, hazard mapping and disaster management. Remote Sensing with all of its means and resources has become a valuable tool for this kind of assessments. The following text deals with the ways of extracting urban settlement area from Landsat images and then moves to classification of the land cover changes. This proposition can be adopted with minor rectifications for the above assessment. The primary area of interest here is Kathmandu Valley, the capital city of Nepal. Use of the output and applicability can be widespread, discussion of which is beyond the scope of this paper.

Obtaining Satellite Imagery

Landsat is a mid-resolution satellite affording imagery with synoptic view yet detailed enough to characterize the human scale processes, e.g.: urban growth. There are three sensors used in the Landsat program. The Multi Spectral Scanner (MSS) mission ran from 1972 to 1993 and had four spectral channel covering the green, red, and (2) near infrared channels. The spatial resolution was 57 or 60 meters. The Landsat Thematic Mapper (TM) mission began in the mid-80's and Landsat 5 is still in operation. This sensor features seven spectral channels at 30 meters spatial resolution. The Landsat 7 Enhanced Thematic Mapper (ETM) mission began in 1999 and is still operational. It features the same spectral channels as the TM sensor, with the addition of a second thermal channel and a 15 meter panchromatic channel. On May 31, 2003 the ETM scan line corrector failed and ETM images since that time are missing large portions each scene. On USGS sites these images are designated as SLC-Off and use of these images is generally not recommended.

There are many sites that can be used to locate and obtain Landsat satellite imagery. Three recommended sites are GLOVIS and Earth Explorer by the USGS and the Global Land Cover Facility (GLCF) at the University of Maryland. The most complete collection of Landsat data can be found at two USGS sites; GLOVIS and EarthExplorer. A broad collection of Landsat data spanning the entire time of the program, beginning in the early 1970's can be found. The user interface and download processes are a bit different for each site. There are several international sources of Landsat images which typically charge $1,000 or more per scene. More information about each is listed below:

- GLOVIS - http://glovis.usgs.gov/
- Earth Explorer- http://earthexplorer.usgs.gov/
- GLCF-http: http://glcf.umiacs.umd.edu/

A. Land Cover Change:
The classification of the downloaded image can be done through following ways:

- Supervised Classification
- Unsupervised Classification

Unsupervised Classification

Unsupervised Classification is a technique for classifying land cover features in a digital image. In the unsupervised approach, the dominant spectral response patterns that occur within an image are extracted and the desired information classes are identified through collection of ground data i.e. by visits to the site in the image.

In popular remote sensing software like ENVI, Unsupervised Classification is provided by way of two modules named IsoDATA and k-means.

IsoDATA

The Iterative Self-Organizing Data Analysis Technique (IsoDATA) is a widely used clustering algorithm which makes a large number of passes through the remote sensing dataset. It uses the minimum spectral distance formula to form clusters. ISODATA begins with either arbitrary cluster means or means of an existing signature set, and each time the clustering repeats, the means of these clusters are shifted. The new cluster means are used for the next iteration. The ISODATA utility repeats the clustering of the image until either a maximum number of iterations have been performed, or a maximum percentage of unchanged pixels have been reached between two iterations. For our purpose IsoDATA can be used with 20 iteration to obtain the result.

K-Means

K- means is one amongst the numerous clustering algorithm, that accepts from the analyst the number of clusters to be located in the data. The algorithm then arbitrarily “seeds” or locates, that number of clusters centers in the multidimensional measurement space. Each pixel in the image is then assigned to the cluster whose arbitrary mean vector is closest. After all pixels have been classified in this manner, revised mean vectors for each of the clusters are computed. The revised means are then used as the basis to reclassify the image data. The procedure continues until there is no significant change in the location of class mean vectors between successive iterations of the algorithm. Once this point is reached, the analyst determines the land cover identity of each spectral class.

Supervised Classification

In a supervised classification, the analyst identifies in the imagery homogeneous representative samples of the different surface cover types (information classes) of interest. These samples are referred to as training areas. The selection of appropriate training areas is based on the analyst's familiarity with the geographical area and their knowledge of the actual surface cover types present in the image. Thus, the analyst is "supervising" the categorization of a set of specific classes.

The training sites for the Kathmandu Valley can be developed based on following classes:

- Green Vegetation
- Urban built up
- Roads
- Water body
- Free Space

The classified image can then be imported to GIS software for mapping purpose.

B. Extraction of Urban Feature:

An urban area is a complex ecosystem composed of heterogeneous materials. Nevertheless, there are still some generalizing components among these materials. Ridd (1995) divided the urban ecosystem into three components, i.e., impervious surface material, green vegetation, and exposed soil while ignoring water surfaces. However, the open water is an important component of the urban surface and has to be taken into consideration Xu (2007). Hence while extracting features from Kathmandu Valley, the urban land-use can be grouped into the three generalized categories, i.e. built-up land, vegetation, and open water. Based on these three elements, three indices, NDBI, SAVI, and MNDWI, can be selected in this study to represent above three major land-use classes, respectively.

Soil Adjusted Vegetation Index (SAVI):
Though Normalized Differential Vegetation Index (NDVI) is widely being adopted in the remote sensing of vegetation, some study suggest to employ SAVI to highlight vegetation features due to its advantage over NDVI when applied in an area with low plant cover such as the urban areas. SAVI can work in the area with plant cover as low as 15 percent, while NDVI can only work effectively in the area with plant cover above 30 percent (Ray, 1994).

The SAVI is calculated using the following equation (Huete, 1988):

$$\mathrm{SAVI} = \frac{(NIR - Red)\ (1 + l)}{NIR + Red + l}$$

where l is a correction factor ranging from 0 for very high densities to 1 for very low densities. A value of 0.5 can be adopted for our purpose.

Modified Normalized Difference Water Index (MNDWI)

McFeeters (1996) proposed the Normalized Difference Water Index (NDWI) to delineate open water features, which is expressed as follows:

$$NDWI = \frac{GREEN - NIR}{GREEN + NIR}$$

where GREEN is a green band such as TM2, and NIR is a near infrared band such as TM4.
Xu (2005) modified the NDWI by using a middle infrared (MIR) band such as TM5 to substitute the NIR band in the NDWI. The modified NDWI (MNDWI) is expressed as follows:

$$MNDWI = \frac{GREEN - MIR}{GREEN + MIR}$$

Normalized Difference Built-up Index (NDBI):
The built-up land image can be produced using the NDBI of Zha et al. (2003) with the following equation:

$$NDBI = \frac{MIR - MIR}{MIR + MIR}$$

The images obtained from the three indices can be treated as three bands in new image data set which can undergo supervised classification using maximum likelihood algorithm for extraction of built up land features.

Accuracy Assessment

Packages like ENVI can calculate a confusion matrix (contingency matrix) using either a ground truth image or using ground truth regions of interest (ROIs). In each case, an overall accuracy, producer and user accuracies, kappa coefficient, confusion matrix, and errors of commission and omission are reported.

Here, we can use the test site ROIs that we collect in the above step to assess the classification accuracy.

Conclusion

Knowledge of land use, land cover and extraction of built-up features is important for many planning and management activities. With rapid urbanization, it has become difficult to keep a track of changing land use and constructed features. However, the use of Remote Sensing can ease the process to a great extent and produce a highly accurate output. The methodology mentioned above can be adopted, keeping some spaces for correction, in and around Kathmandu Valley for various planning, and disaster management activities.

References:

Masek, J.G., F.E. Lindsay, and S.N. Goward, 2000. Dynamics of urban growth in the Washington DC metropolitan area, 1973–1996, from Landsat observations, International Journal of Remote Sensing, 21(18):3473–3486

Ridd, M.K., 1995. Exploring a VIS (vegetation-impervious surface-soil) model for urban ecosystem analysis through remote sensing: Comparative anatomy for cities, International Journal of Remote Sensing, 16(12):2165–2185.

Xu, H.,2007. Extraction of Urban Built-up Land Features from Landsat Imagery Using a Thematic-oriented Index Combination Technique. Photogrammetric Engineering & Remote Sensing,73 (12):1381-1391

Xu, H., 2005. A study on information extraction of water body with the Modified Normalized Difference Water Index (MNDWI), Journal of Remote Sensing, 9(5):511–517.

Zha, Y., J. Gao, and S. Ni, 2003. Use of normalized difference built-up index in automatically mapping urban areas from TM imagery,International Journal of Remote Sensing, 24(3):583–594.

McFeeters, S.K., 1996. The use of normalized difference water index (NDWI) in the delineation of open water features, International Journal of Remote Sensing, 17(7):1425–1432.

Huete, A.R., 1988. A soil-adjusted vegetation index (SAVI), Remote Sensing of Environment, 25(3):295–309

Methodology for Assessing the Role of Land Tenure in Hydropower Development

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ABSTRACT
An assessment framework is required to assess how issues related to land tenure and property rights are impacting the success of hydropower development. It is difficult to find the methodologies to assess the role of land tenure in hydropower development. Therefore, the main objective of the study is to develop an assessment framework for assessing the role of land tenure in hydropower development. The desk study is followed by the literature review and is started with critical reviewing of scientific literature in the land tenure in hydropower development. Based on the scope of an assessment, various aspects; elements are identified for an assessment. Scope in an assessment is the evaluation areas that provide reference for the assessment framework. The aspects are the breakdown of these evaluation areas. The elements are the smaller units of aspects for an assessment. Based on these elements strategies are developed by strength, weakness, opportunity and threat (SWOT) analyses. The strategies are the way to achieve the objective and indicators are measurable variables such as types, number of stages, percentage of respondents etc. and are developed based on the strategies. It is found that good practices criteria are optimal performance of indicator. Finally, the reveals that an assessment framework is important because it provides guidelines and determines the aspects that should be focused in an assessment. Good practices and indicators are the methods for assessing the role of land tenure in hydropower development.

Introduction

An assessment is the systematic collection, review and use of information for depth understanding from different sources [1]. Based on this definition of an assessment, an assessment framework is defined as the conceptual structure for the collection, review and use of information to guide the study for developing an assessment fraework. It is difficult to find the methodologies to assess the role of land tenure in hydropower development. Therefore, it is necessary to develop an assessment framework from scratch for assessing the role of land tenure in hydropower development. An assessment framework is very important to assess how issues related to land tenure and property rights are impacting the success of hydropower development. An assessment framework provides guidelines and identify the aspects that should be considered in an assessment [2]. An assessment framework finds the aspects that are to be expected and to be considered during an assessment process [3]. It shows that formulating assessment framework is essential to include, review and use core aspects. Land tenure assessment is required for determining the real cause of conflicts and also for the implementation of a plan and program to support local communities [4]. The main objective of the study is to prepare the assessment framework for assessing the role of land tenure in hydropower development.

Methods and Materials

The desk study is selected for the study. The desk study is followed by the literature review. The study is started with critical reviewing of scientific literature in the land tenure in hydropower development. The scientific literature such as journal articles, conference papers, books and documents including research/project reports are used for the purpose of this research and are mentioned in reference section.

Findings

Some cases of an assessment approaches are found with their specific objective which are discussed as follows.

Comparative evaluation approach

At first goals are defined and the ways to get that goal in this approach. One or more qualitative and quantitative indicators for each goal are formulated and benchmark is developed for each indicator. Optimal benchmarks are developed as best practice [5]. The overview of framework for this approach is given in the Table1.

Goals	Indicators	Bench mark (% , yes, no, value)	Source
Goal 1	Indicator 1 for Goal 1 Indicator 2 for Goal 1	Benchmark 1 Benchmark 2 Benchmark 3 Benchmark 4	Best practice 1 Best practice 2
Goal 2	Indicator 1 for Goal 2 Indicator 2 for Goal 2	……….	Best practice 3 Best practice 4
…………	………		……….

Logical framework matrix approach

In this approach, key elements of project are structured in a way to give target input, planned activities, and expected output and are interconnected logically [6]. It gives the basis for formulation of action plan and a framework for evaluation. The overview of the logical framework matrix approach is given in the Table 2.

Table.LFA approach for evaluation by [6]

Intervention logic	OVI	Mov	Assumption
Purpose	Purpose OVI	Purpose Mov	Assumption
Output	Output OVI	Output MoV	Assumption
Activities	Input	Budget	Assumption
			Precondition

Good practice criteria approach

This approach of evaluation consider the evaluation area, aspects, indicators and good practice criteria for the evaluation[7,8]. The overview is shown in the Table 3. For each indicator, good practice criteria are developed for the evaluation.

Table.Good practice criteria approach by [7,8]

Evaluation Area	Aspects	Indicators	Good Practices
Policy level	Relevant Aspects	Relevant indicators	Good practice for each indicators
Management level	Relevant aspects	Relevant indicators	Good practice for each indicators
……………….	…………….	……………….	……………

Comparison of Evaluation Approaches

An approach followed by [7] involves mainly policy level, management level and operation level as an evaluation area. The central elements defined for the evaluation is the integrated form of objective, strategy, outcomes and indicators and result evaluation. These elements are correlated with the various evaluation areas whereas LFA approach is widely applicable in evaluation of LAS project of international donor. Many donors such as World Bank and Asian Development Bank (ADB) request the application of it in project proposal and reports. An approach used by [5] for evaluation of national LAS followed the goal concepts (Table 1). By comparing the characteristics of each approach it is found that no any approach can be perfectly used for the assessment of role of land tenure in hydropower development which considers the evaluation areas as the political decision making, planning and feasibility, design, implementation and operation stage.

An assessment framework for the Hydropower development

An assessment framework for this study is more influenced by the idea of [7] and [5]. The Figure 1 gives an overview for an assessment of role of land tenure for this research. Based on the scope of an assessment, various aspects; elements are identified for an assessment. Scope in an assessment is the evaluation areas that provide reference for the assessment framework. The aspects are the breakdown of these evaluation areas. The elements are the smaller units of aspects for an assessment. Policies, Governance, Tenure and rights on land, Threats and power degree, land acquisition are the major aspects for assessing the role of land tenure as reviewed from [4]. External factor and impact are also the key aspects for the assessment in Land Administration System [8] . These aspects are chosen for the assessment in this research because these aspects have correlation with the scope of hydropower development. The stakeholders' capacity and expectation are the external factors whereas social and environmental effects and stakeholders' satisfaction are the impacts. Based on these elements strategies are developed by strength, weakness, opportunity and threat (SWOT) analyses. The strategies are the way to achieve the objective and indicators are measurable variables such as types, number of stages, percentage of respondents etc. and are developed based on the strategies. Good practices criteria are optimal performance of indicator and are developed from the literature review. Indicators and good practice criteria are the methods to assess the role of land tenure within the scope.

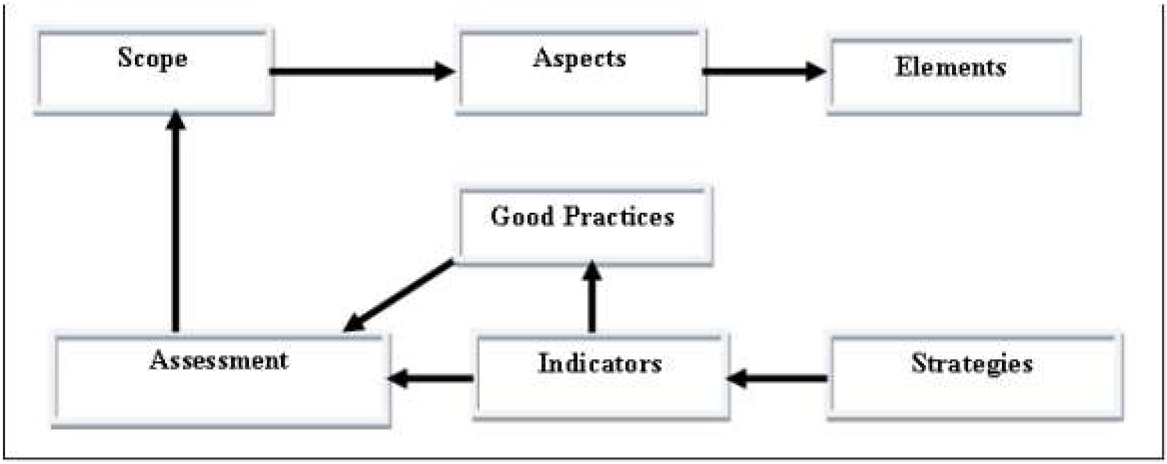

Figure.An Assessment Framework

Following scope, aspects and elements are identified for assessment of role of land tenure in hydropower development [9].

Table .Scope, Aspects and Elements for an assessment

Stages/Scope	Aspects	Elements
Political decision making	Policies: Land, hydropower and environmental policies	Policy formulation approach, access to land, equity in access to land & sustainability
	Governance	Public participation, access to information & transparency
Planning and feasibility study	Tenure and rights on land	Forms of rights, ownership & Land use
	Governance	Public participation, access to information & transparency
	External Factors	Stakeholders expectation
Design	Governance	Public participation, access to information & transparency
	External Factor	Stakeholders expectation
Implementation	Land acquisition	Resettlement and compensation
	External Factors	Stakeholders capacity & stakeholder satisfaction
	Governance	Public participation, access to information & transparency
	Threats and power degree	Land conflicts
Operation	Impact	Improvement of socioeconomic status and biological environment & stakeholder satisfaction
	Governance	Public participation, access to information & transparency

Strategies, Indicators and Good practice for an Assessment

SWOT analysis is commonly known for the situation analysis within the strategic planning process. The situation analysis is the way of identifying strategic fit within internal strengths and external opportunities while working on internal weakness and external threat [6]. The strategies in this study are developed by SWOT matrix method because it is easy, flexible and basic tool in the strategic planning process comparing to other methods such as balanced score card and strategic grids. The SWOT matrix is represented in the Table 3.5 and matches external and internal factors.

Table.SWOT matrix

Internal Factors	Strength	Weakness
	- Improvement of land tenure security by land registration - Upgrading of Land tenure. - Improvement livelihood of people	- Manage all types of land required for hydropower development. - Relocation/Resettlement of the affected people - Provision for access to information to affected people. - Implementation of good practice
External Factors	**Opportunity**	**Threats**
	- Public awareness can be increased - Right to access land can be increased - Equity in access to land	- Stakeholder's satisfaction - Cooperation and coordination with funding agencies - Identifying various land conflicts - Sustainable hydropower projects - Better policy formulation. - Maintain properly the land records.

Indicators and good practice criteria

The indicators are formulated to develop the household and interview questionnaire for the collection of data based on the strategies formulated in the Table . Optimal performance of the indicators is defined as good practice criteria. An assessment of the land tenure in hydropower development on defined indicator is used to compare to related good practice criteria. The overview of aspects, strategies, indicators and good practices criteria are shown in the Table 3.7. Indicators and good practice criteria are the basis for the assessment.

Table 6. Strategies, Indicators and good practice

	Strategies/goals	Indicators	Good Practices
Policy	Improve equity in access to land	Status of equity of land in project area.	Equitable to all.
Policy	Provide access to land.	Number and ways of access to land	All should have access to land and ways are based on the existing ground condition.
Policy	Support sustainability	Kinds of social, environmental and economic impact by the project.	Socially, environmentally and economically feasible.
Policy	Follow better policy formulation approach	Types of land policy formulation approach	Policy formulation is based on bottom up approach to incorporate interest of affected families
	Manage all ownership and use rights.	Types of ownership and use rights in the project area.	Ownership /use of land is based on the existing ground condition.
	Support tenure upgrading.	Status of land registration certificate issued.	All rights are registered

	Strategies/goals	Indicators	Good Practices
Tenure & right	Improve land tenure security.	Status of legally recognized land rights.	
	Support land registration and land market system.	Transactions status before and after implementation of the project.	Transaction status is improved.
	Increase Public awareness	Stakeholder involved in awareness program.	All stakeholders are participated in awareness program
Governance	Improve public participation level	- Benefits of participation - Number of participation stage and respondents.	- Participation and benefits is ensured - The stakeholders' interest is well addressed in each stage of participation
	Provide information for affected people	- Access to information for affected people. - Source of dissemination of information.	- Access to information is easier for these people - More source is used for dissemination
	Involve local stakeholders and communities	Types of people getting information easily.	All stakeholders are timely and sufficiently informed about the project.
	Define role and responsibility of stakeholders	Ways of involving stakeholders regularly in the project	Roles are well defined
Acquisition	Adopt suitable acquisition and compensation procedure	- Types of acquisition and compensation procedure. - Number of affected people - valuation procedures	- Method of land acquisition is commonly accepted in the context. - Less people is affected - Scientific valuation procedure is applied
Threats	Identify the various land conflicts	- Types of land disputes/conflicts in the project - Ways of resolving land conflicts	- Ensure minimum conflict - Mechanism for resolving conflicts is available.
External factor	Identify stakeholders expectation Build stakeholders capacity	- Various types of benefits that can be expected from the projects - Types of employee in the projec - Types of training for the affected families - Stakeholder and their role	- Strategies for post construction benefits are available. - Use of local resources as far as possible. - stakeholders capacity is increased
Impact	Improve social and environmental conditions. Measure stakeholders satisfaction level	- Types of training carried out - Number of employed family members. - Effect on education by the project - Status of access to basic facilities due to hydropower project in the area. - Types of family structure. - Satisfaction level in getting compensation and implementation of the project. - Types of mitigation measures	- Local resource is given a first priority. -Affected families income level has been improved. - Socioeconomic status of the affected families has been improved. - Affected families are satisfied with the procedure. - Mitigation measures is applied

Discussions

It is difficult to find the appropriate methodologies to assess the role of land tenure in hydropower development. Various approaches such as Comparative evaluation approach, Logical framework matrix approach and Good practice criteria approach are identified during the study. But no approaches are perfectly can be applied for the assessment of role of land tenure in hydropower development. Therefore, this assessment framework is developed from beginning by reviewing various literature for assessing the role of land tenure in hydropower development. This assessment framework is more influenced by combination of these three approaches. It is no doubt that an assessment framework is very important to assess how issues related to land tenure and property rights (LTPR) are impacting the success of hydropower development. An assessment framework provides guidelines and identify the scope, aspects, elements that should be considered in an assessment. Indicators and good practice criteria are the methods to assess the role of land tenure within the scope of the development. Various indicators are developed based on the strategies which can be used to formulate the questionnaire for the data collection. It is important to be considered all the aspects and elements (as mentioned in Table 4) in assessing the role of land tenure.

Conclusion and Recommendation

An assessment framework is important because it provides guidelines and determines the aspects that should be focused in an assessment. Determining the scope of an assessment is essential to identify the extent up to which it should be carried out. Land policies, Land tenure and rights, Governance, threats and power degree, land acquisition, external factors and impacts are the key aspects for an assessment. The strategies are developed by SWOT matrix and are used as goals for an assessment which helped to formulate the indicators. Indicators are the key variables which supports in formulating the questionnaire. A good practice criterion is an optimal performance of indicators and is the methodology to assess the role of land tenure in hydropower development. This assessment framework is developed to assess the role of land tenure based on some literature as mentioned in reference section. Further study can be carried out to validate the strength of this assessment framework.

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REFERENCES

1. Palomba, C. A., & Banta, T. W, Assessment Essentials: Planning, Implementing, and Improving Assessment in Higher Education. San Francisco: Jossey-Bass, 1999. 4.
2. Reijersa, H. A., & Mansarb, S. L. Best practices in business process redesign:an overview and qualitative evaluation of successful redesign heuristics. The International Journal of management Science (2004).
3. Crisp, B. R., Anderson, M. R., Orme, J., & Lister, P. G.,Learning and teaching in social work education: Textbooks and frameworks on assessment (2005).
4. Galudra, G., Sirait, M., Pasya, G., & Fay, C,A Rapid Land Tenure Assessment Manual for Identifying the Nature of Land Tenure Conflicts (2009).
5. Bandeira, P., Sumpsi, J. M., & Falconi, C, Evaluating land administration systems: a comparative method with an application to Peru and Honduras (2009).
6. Groenendjik, E. M. C., & Dopheide, E. J. M.,Planning and management Tools (2003) Enschede, International Institute for geoinformation science and Earth Observation, ITC.
7. Steudler, D., A Framework for the Evaluation of Land Administration Systems (2004). The University of Melbourne, Melbourne.
8. Steudler, D., & Williamson, I. P.,Evaluation of National Land Administration System in Switzerland Case Study Based on a management model(2005).
9. Ghimire,S.Assessing the role of land tenure in hydropower development fpr social and environmental effects.MSc Thesis.(2011), University of Twente. Faculty of Geoinfomation Science and Earth Observation,ITC, the Netherlands

Prefeasibility Study of Mini-Hydropower at Eastern Part of Sagarmatha Region

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Abstract

Villages of eastern part of Khumjung VDC, Sagarmatha region are deprived of source of electricity except solar power which seldom fulfils the lowest electricity demand of the region. This study hence is directed toward the prefeasibility study of hydropower at Imja River situated at Dingboche Village. The study depicts the possibility of a mini-hydropower of 585 kW from the River at Dingboche Village with its intake at Bibre Goth, 2 km upstream the River from Dingboche.

Keywords: Mini-Hydropower, Topographic Survey, Imja River

Introduction

Four villages, Dingboche, Chhukkung, Pheriche and Lobuche of the Khumjung VDC, Sagarmatha Region lack any source of renewable energy except solar power, which is unable to meet the general demand of electricity. The energy demand of the region is mainly for the room heating system and cooking. According to Vaidya (2011) the sources of energy supplies at this regions are kerosene brought from Kathmandu, fodder collected from a few hours walk downhill and cattle dunk which contributes 50%, 30% and 20% respectively. Even with all those sources, the demand of energy on the peak tourist season is seldom met. Hence, a sustainable source of electricity in this region is inevitable in long run.

The Imja River is one of the tributaries of Dudh Koshi River, flowing through Dingboche village. There have been previous studies on possibility of generation of hydro-power from Imja River (Vaidy, 2011) (Allard et al, 2011). People at Dingboche have even established a company named as Dingboche Bidhyut Co. and its desk study has called for a hydropower capacity of 200kW in 2009 (Allard et al, 2011). Nevertheless, the detailed study regarding the possibility of hydropower at this area is inevitable. Hence, this study is directed towards pre-feasibility study of mini-hydropower plant at Imja River at Dingboche.

Study Area

The study area is the region of Imja River at Dingboche extending up to Bibre Goth, 2 Kilometres east to the Dingboche. Dingboche village lies at eastern part of Khumjung VDC, Sagarmatha Region. The nearest villages to Dingboche are Pheriche, Chhukung and Lobuche. There are 6 lodges and 14 residential houses at Chhukung, 21 lodges and 11 residential houses at Dingboche, 13 lodges and 10 residential houses at Pheriche.Most of the people

FIGURE Study Area

living in this region are associated with tourism and hospitality business as this region is regarded as one of the major trekking destination of world. Potato and barley are the major agricultural products produced here. Very few population practice cultivation of lettuces, radish and carrots but they are limited to household use only. Agricultural products, produced here seldom last for some months.

Field Survey and Analysis

A reconnaissance survey of the region resulted on best possible sites for prospective intake, forebay and powerhouse. In order to cover the area including all the entities of powerhouse, a set of traverse survey was carried out at Dingboche region. The traverse loop consisted 11 control points as shown in Table 1. The traverse loop was referenced to two national control points of third order established by Department of Survey, Nepal. Survey works were carried out with total station (PENTAX R425v).

The instrumental error is ± (2 + 2 ppm x D) mm. The contributions of the weather and personal error increase the error though. Despite extreme weather condition, the total error of the traverse loop at Dingboche retion whose total distance was 4270m was 8 cm, 35 cm and 25 cm on Easting, Northing and Elevation respectively, which were adjusted in respect to the traverse length.

Based on these established control points, detailed surveys of prospective intake, forebay, and powerhouse were carried out. The survey included the recording of the topographic features and points to depict the general topography. Nevertheless, for penstock, cross-sections were recorded at chainage interval of 25 m starting from powerhouse. Discharges were measured at intake region and tail race region using salt-dilution method and tracer method using sulphorodamine G. A power-demand survey was carried out with the help of Khumbu Alpine Conservation Council (KACC).

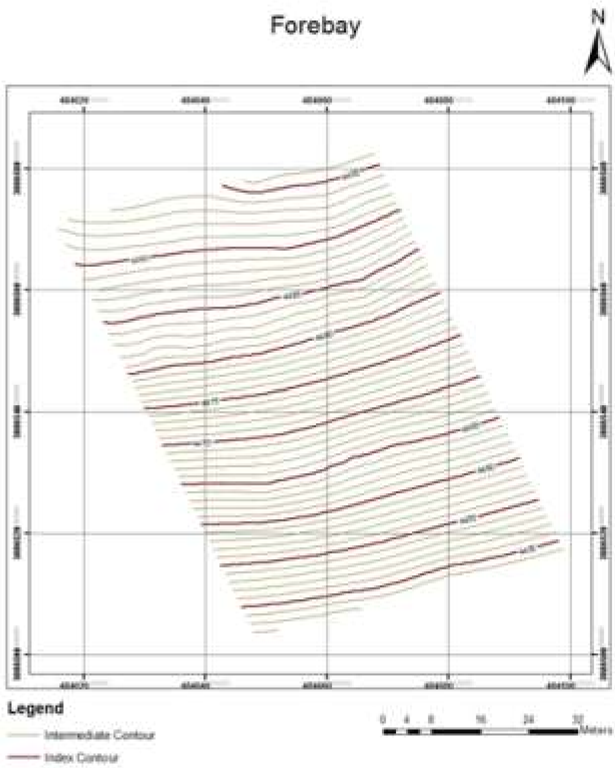
Unfavourable weather condition hampered the work to some extent which resulted on incomplete survey of prospective canal.

TABLE Adjusted Traverse Coordinates

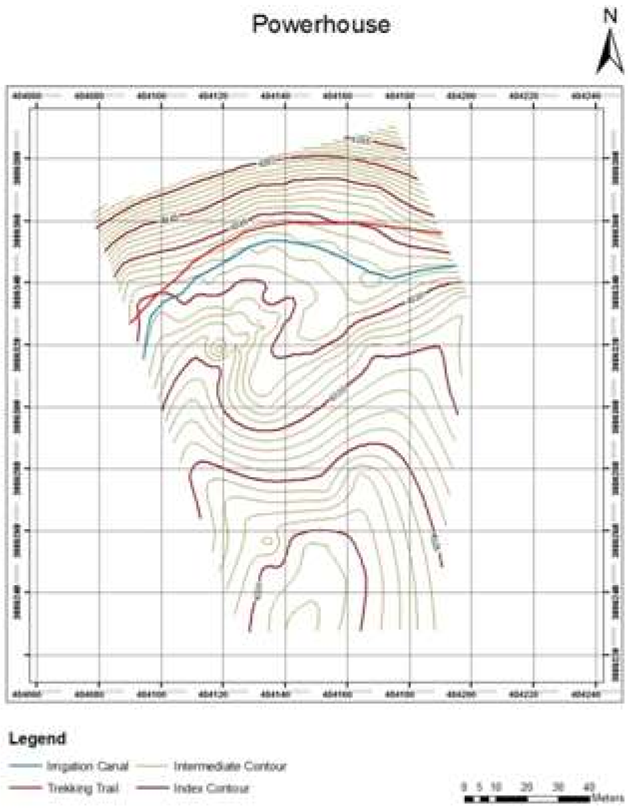
SN	Easting	Northing	Elevation
CP1	483959.3810	3086026.0180	4311.097
CP2	483846.4095	3086237.8766	4323.011
CP3	484150.5430	3086323.6699	4336.509
CP4	484356.8034	3086386.5077	4340.334
CP5	484569.2525	3086443.2551	4357.078
CP6	484858.0591	3086466.0293	4382.920
CP7	485185.1415	3086446.4367	4413.708
CP8	485485.0402	3086594.3599	4459.024
CP9	485799.2563	3086657.1855	4482.071
CP10	485120.1673	3086373.5130	4401.198
CP11	484368.0581	3086345.7722	4340.899

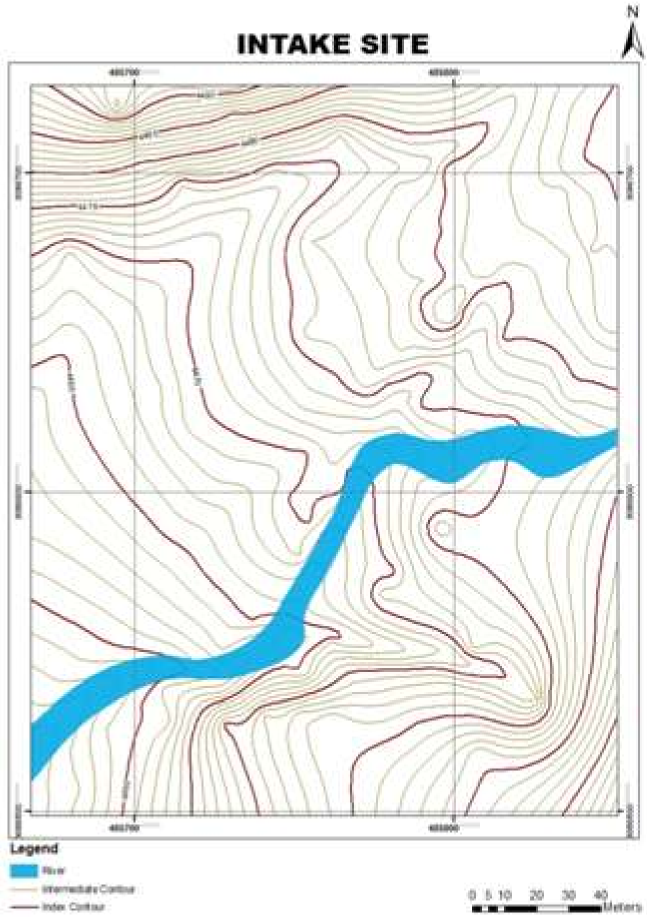
Result and Discussion

Detailed topographic maps of intake, forebay and powerhouse region with control interval of 1m was prepared. As the control points were derived from national control points of third order, the projection system used was Modified UTM projection system with Everest-Bangladesh datum. The forebay (Figure II) and powerhouse (Figure III) lies at Dingboche Village, just after the end of village at East. The Coordinates of the proposed forebay are 484056.6544 Easting, 3086537.3073 Northing and 4470 Elevation above mean sea level and the proposed powerhouse are 484153.525 Easting, 3086331.416 Northing, and 4336 Elevation above mean sea level. The proposed intake region (Figure IV) lies at the point near Bibre Goth, 2 km upstream from Dingboche. The coordinates of intake point are 485772.273 Easting, 3086615.104 Northing and 4471 Elevation above mean sea level.



The discharge of the Imja River at intake region and tailrace are 2.72 and 2.85 m3/s respectively. Observing the monthly average discharge, medium irrigation project methodology (MIP Method) suggests the discharge available be used for the plant should be 0.6317 m3/s throughout the year. Gross head available for the plant is 135 meters. If efficiency of the plant taken 70%, the total power generated would be 585 kW.





A research by Vaidhya (2011) suggested the maximum power of 400 kW generated from an intake site around 500 m upstream of Dingboche and a powerhouse around 1.5 km downstream with head difference 80m. However, this studies show with the same distance of canal, more power can be generated as more head can be gained.

As per the demand survey, the average energy demand on the peak hour per household at Dingboche, Pheriche, Chhukung and Lobuche counts to 5KW. The total household at those villages excluding Lobuche is 75. If we assume the total household to be 100 including Lobuche, the total energy demand on the peak season counts up to 500 kW. Driven by the economic activities of this region, the households are increasing. Incorporating this fact, the energy demand of the region is anticipated to increase in future. Hence, in order to hold the peak demands of energy, a mini-hydro power plant of full capacity (585 kW) is required.

Conclusions and recommendation

The study reveals the potential of 585 kW of electrical energy from the Imja River at Dingboche village which could be shared with nearest three villages namely, Pheriche, Chhukung and Lobuche. The access to clean energy will address the need of reducing green house gas emission as well raising adaptability to climate change risk. This study does not take the current geological data into account. Hence detail survey with geological analysis is suggested for future studies.

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References

1. Allard J., McKinney C. D. (2011) Hydropower Site Study at Imja Lake and Dingboche Village. http://www.crwr.utexas.edu/online.shtml

2. Vaidhya S. L. (2011), Dingboche Mini-Hydro Recognisance Visit Report.

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