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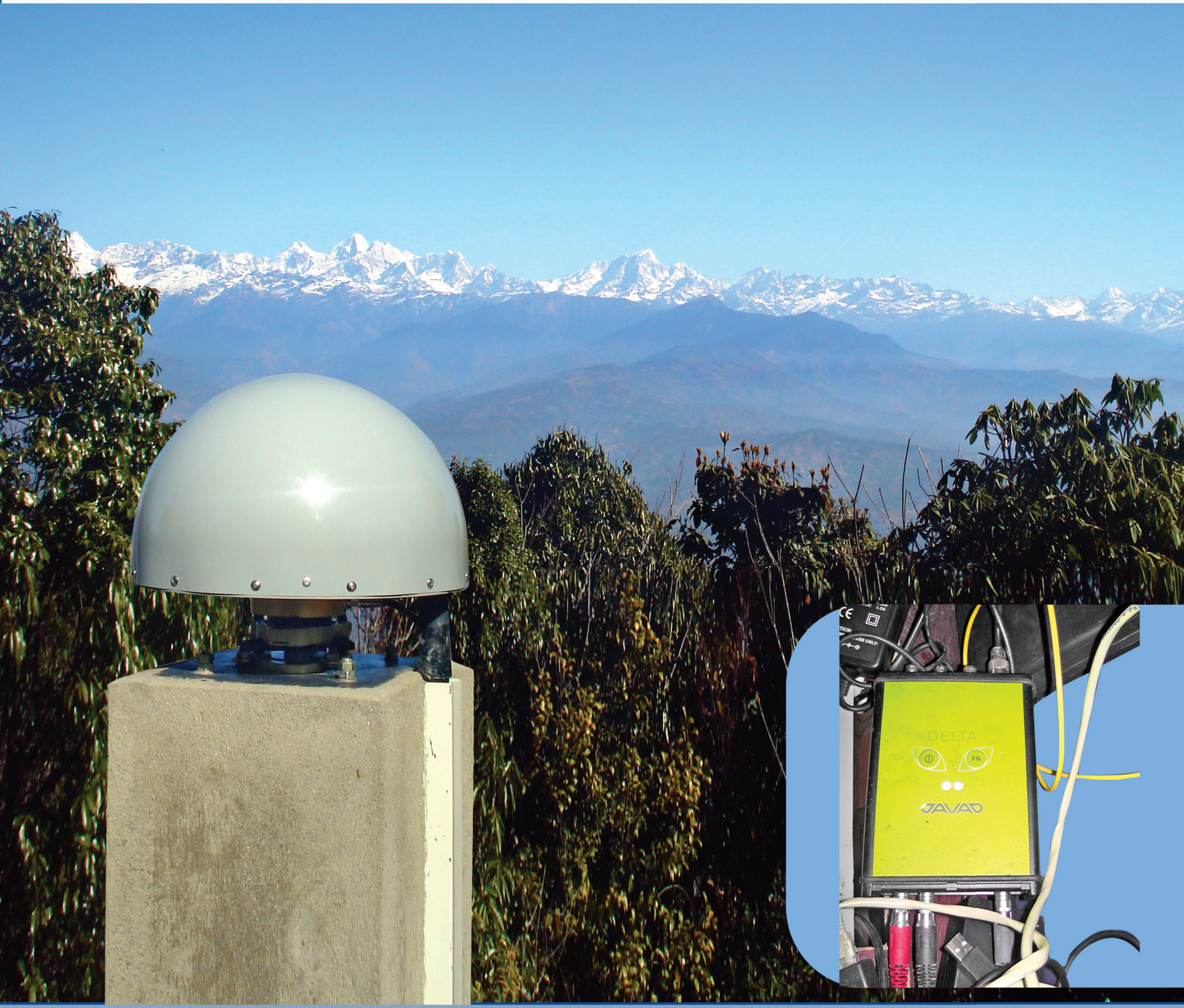

Annual publication of Survery Department, Goverment of Nepal

Mr. Ganesh Prasad Bhatta, Chief Survey Offier, Survey Department during Land Policy Visit, Singapore Land Authority on 23rd July - 2nd August 2013.

Mr. Ganesh Prasad Bhatta, Chief Survey Offier, Survey Department during Land Policy Visit, Malaysia Land Office on 23rd July - 2nd August 2013.

A scene of Western Regional Workshop conducted by Survey Department at Tanahun on 5th September 2013.

NGIIP, Project Chief Mr. Suresh Man Shrestha participated on Chengdu Forum on United Nations Global Geospatial Information Mangement, Chengdu, China on 15-17 October 2013

Deputy Director General Mr. Madhu Sudan Adhikari addressing the Second Geospatial High Level Forum Seoul, S. Korea on 12-15 November 2013.

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Editorial

It is a matter of immense pleasure to present the 13th issue of "Nepalese Journal on Geo-informatics" , the annual publication of the Survey Department. The journal aims to include research and informative articles in the field of geo-informatics and regular features concerning annual activities of Survey Department. For the convenience of the readers we have made all the past issues of the journal available online at www.dos.gov.np. and the last two issues on Nepali Journal on line (NEPJOL: www.nepjol.info). We sincerely acknowledge NEPJOL for providing us a platform to disseminate information on the new developments in the field of geo-informatics and also providing training to one of the member of the editorial board.

This journal is continuation to the preceding ones and we have made every possible effort to enhance the reading experience of the readers. From this issue we have tried to upgrade the journal by printing the pictures, figures and diagrams in multicolor. We hope this change helps the readers to study and analyze the facts more easily.

At last, I would like to express my sincere appreciation to Mr. Nagendra Jha, the Director General and the Chairperson of the Advisory Council for his invaluable guidance and kind forewords. Likewise, I would like to express my sincere thanks to all the authors, Members of the Advisory Council, Members of the Editorial Board and to all who have contributed for the publication of the journal. I do hope to receive similar cooperation in the future too.

2071 Jestha,
Kathmandu

Jagat Raj Paudel
Editor-in-chief

Forewords

It gives immense pleasure to put forewords on the 13th issue of the annual publication of Survey Department, 'Nepalese Journal on Geoinformatics'. In capacity of the Director General of the Department, I feel proud to see the journal as a prominent platform that offers an opportunity of exposure to the staff and professionals by sharing their professional and research contributions to the professional community. I wish the Department follows it along with its journey ahead.

I believe, the Department, as the National Mapping Organization (NMO) of the country, has greatly contributed to the mission of nation building since its establishment. Nationwide coverage of cadastre, topographic database, and geodetic control network are the greatest achievements so far of the Department, which are fundamental to support the activities of land administration and management, development planning, and construction of mega projects and infrastructure. I can assure that the Department keeps continuing the efforts of contributing to the mission of nation building in the days to come too.

Currently, Survey Department's activities are directed towards '2nd Generation Reform', which mainly includes technological transformation, enhancement of accuracy and completeness of its products, modernization of the methods of service delivery, and overall capacity building of the Department. In absence of required resources and capacity, the mission is moving with snail's pace though. I believe, the Department will be able to draw due attention of the Government in this line.

I have noticed tireless efforts of the members of the Advisory Council and Editorial Board to bring this issue published. I can imagine the hard work of the authors to produce the articles. Therefore, I would like to extend heartiest thankfulness to all of them for their kindness and expect the same in the next issues too.

Lastly, I would like to recall the history of the Department, which is to complete 57th year of its service to the Nation soon. I would like to congratulate all the staff of Survey Department in this occasion. Furthermore, I would also like to extend heartiest appreciation and respect to the great personalities who contributed to bring the Department at this stage.

Enjoy reading!

Nagendra Jha
Director General
Survey Department
2071 Jestha

Importance of Geo-informatics Professional Organizations of the World

Rabin K. Sharma

Abstract

Development of sustainable system in Geo-informatics profession is guided by the professionalism which can be achieved by the professionals through participation in the events of Geo-informatics professional organizations. The professional organizations could be national, regional and international. Each of these organizations has their own objectives to disseminate information and data of research work carried out by the organizations and institutions around the globe. The organizations disseminate the information through different means and media. The professionals should try to acquire those information which will play a role to be benefitted the professionals, institutions and the country itself. So it is believed that professional organizations of the world play an important role for the technological development as well as for the development of professionalism

Keywords

Professional, Geo-informatics Professional organization, Sustainable system, Professionalism, Beneficiaries

1. Introduction

Geo-informatics Professional organizations, in general, are non-governmental and non-profitable organizations. It is independent of political ideology and does not discriminate the castes, races, languages and religions. In other words, it accommodates only professionals of the field who has appropriate educational background. The professionals could be academicians, technicians, scientists, manufacturers and students from the corresponding organizations such as governmental, non-governmental, educational, private, consultants, equipment and software manufacturing companies, et cetera related to Geo-informatics profession.

Activities of the professional organizations are the appropriate platforms for the professionals to share, discuss, debate, et cetera for developing consensus to a certain issue or technology which could be best suitable for an organization. There are several Geo-informatics professional organizations in the world which disseminate information amongst the professionals through different means and media such as meeting, workshop, conference, journal, newsletter, web portal, et cetera. Therefore, the system within the professional organization provides opportunity to the professionals around the globe for participation in the event of the organization and the professionals should participate for contributing ideas as much as possible so that other professionals can gain experiences enabling to develop their career and display professionalism which, in turn, able to contribute for the betterment of the organization at work. This justifies, universally, the importance of Geo-informatics professional organization for the technological development.

2. Category of Geo-informatics Professional Organization

Geo-informatics professional organizations can be categorized into National, Regional and International organizations. Each has their own role in the professional and technological development.

2.1National Professional Organization

National Professional Organization is established in a country by a group of related professionals of a particular discipline of the country. Related Geo-informatics professionals could be from the discipline of surveying and mapping, forestry, remote sensing, geology, geodesy, et cetera. Each professional organization defines their own scope of works and objectives. These can be generalized as follows:

- Advocate application of new technology
- Support for formulation of norms, standards and policies for related field
- Create awareness of the technology to the concerned group of people or related organizations
- Disseminate related information and data to the concerned authorities
- Develop an environment to share and discuss about certain issues among the professionals

In Nepal, some of the major professional organizations from geo-informatics domain are Nepal Surveyor's Association (NESA), Nepal Geographical Information System Society (NEGISS), Nepal Remote Sensing and Photogrammetric Society (NRSPS), Geomatics Engineering Society (GES), et cetera *[2]*.

In order to fulfill the objectives of the organization, each organization executes some activities which are in general common to most of the organizations. Some of the common practices are as follows:

- Launch web portal of the organization to post relevant information and news of the profession
- Publish Newsletter and/or Journal with information on recent development of the technologies and appropriate articles from the professionals
- Conduct workshop, seminar, conference, talk program, panel discussion, *et cetera* to create awareness to the concerned authorities and/or individual professionals

2.2 Regional Professional Organizations

Necessity of regional professional organizations are realized because it is not practical and possible to sit together the professionals from all over the world for discussion of some technology or issues related to a particular system. In general, the professionals of under developed and developing countries may not participate in the events when organized in different regions than they are leaving because the cost for the participation may not able to manage unless they found some sponsor. Whereas for the professionals from the developed countries could manage for participation in anywhere in the world and they manage the cost either through the organization they are working or they bear the cost themselves. So a group of professionals from different countries belonging to a certain region establish the professional organization with definite objectives. They organize the activities in one of the countries of their own region so that they expect more participants from the region. At present, African region, Asia and the Pacific region, European region, North American region and South American region are recognized in the world.

In each region, there are so many Geo-informatics professional organizations. Some of the Asia and the Pacific regional organizations are Asian Association on Remote Sensing (AARS), Asia Pacific Regional Space Agency Forum (APRSAF), Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP), SAARC Networking Arrangement on Cartography (SNAC), et cetera *[3]*.

If the scope of area of the organization is wide, then the organization establishes the working groups and/or establishes a sister regional professional organization to deal with limited scope. For example: Asia Pacific Regional Space Agency Forum (APRSAF) has Earth Observations (EO), Communication Satellite Application (CSA), Space Environment Utilization (SEU) and Space and Education Awareness (SEA) Working Groups and some initiatives namely Sentinal Asia (SA), Space Application for Environment (SAE), The Regional Readiness Review for Key Climate Missions (Climate R^3) and KIBO-ABC which deals with their corresponding issues allocated either by APRSAF or their corresponding Working Group *[5]*. Each working group and initiative then defines its own progarmmes, conducts the programmes and finally reports the achievements in the plenary session of the immediate programme of respective Working Group or APRSAF.

In the case of AARS, working groups are not established and conducts conference once in a year in one of its member countries. However, when the time demands, the Association discussed about some of the current issues such as application of Rice Satellite, disaster occurred by Tsunami, et cetera as a separate activity of AARS.

2.3 International Professional Organization

In the course of technological development, several issues and problems could arises which is necessary to resolve for moving ahead. Therefore, scientists from the different parts of the world decided to establish organization representing the interested countries for discussion of the technical issues, identify the research areas, develop technologies for implementing the activities efficiently, educate other professionals and decision makers, et cetera. Based on these concepts, several international professional organizations from Geo-informatics area have been established and some of the International organizations are International Federation of Surveyors (FIG), International Society for Photogrammetry and Remote Sensing (ISPRS), International Steering Committee for Global Mapping (ISCGM), International Cartographic Association (ICA), International Union of Geodesy and Geophysics (IUGG), Group on Earth Observations (GEO), et cetera.

At the same time, new concepts and technologies could evolve, that could lead sometimes to establish a new professional organization. For example, in 1978, Global Positioning System (GPS) was developed for Positioning, Navigations and Timing (PNT) by the United States of America. This is the only system available to the user's communities for many years. At present, number of such systems are emerged for instance, GLONASS from Russia, GALILEO from Europe, and COMPASS/ BEIDOU from China. These systems are identified as global constellations. Furthermore, Regional Constellations as well as Satellite Based Augmented System from different countries around the world are also developed. In order to make use of these systems, not only for Positioning, Navigations and Timing (PNT) but also for non-PNT applications such as to compute wind velocity, height of sea waves, et cetera, a concept of Global Navigation Satellite System (GNSS) was developed. Noticing the growing of such system, Japan Aerospace Exploration Agency (JAXA) established an international organization: "**Multi-GNSS Asia (MGA)**" and initiated "**Asia Multi-GNSS Demonstrative Campaign**" for promoting and supporting activities of the MGA on 4th September 2011. This campaign aims the users enabling to use satellites from different constellations simultaneously at the same time *[1]*. This is one example how a new international organization is evolved.

Scope of works of most of these organizations is wide enough; therefore several commissions within the organizations are established to work on the limited field of work. For example, in ISPRS, there are eight technical commissions and in each commission there are several working groups. Similarly in FIG there are ten technical commissions and in the same way there are several working groups in each commission. Each working group conducts activities defined by the organization and reports the achievements in their corresponding Technical Commission. Then each Technical commission also implements activities based on their corresponding scope of works and then report their own achievements along with the achievements of their corresponding Working Groups in the plenary session of the mother organization.

Some of the organizations have limited scope of works and so they handle the activities of the organization itself and conduct their regular activities based on their plan of action. For example, ISCGM has a very limited scope of work so the Committee has no commissions or working groups. The initiative of ISCGM is to prepare the spatial resolution of the global map database of 1 km x 1 km that corresponds to a scale of 1:1 M for the printed maps *[6]*.

The activities of most of the international professional organizations can also be generalized as follows:

- Conduct conference regularly in definite period of time interval
- Conduct General Assembly for discussing different issues related with its scope of works
- Share information on research areas and publicize the status and findings of the research work

- Disseminate information through corresponding web portal

- Publish relevant information and data related to their corresponding domain

- Publish journal with high quality peer reviewed technical papers

- Publish code of conduct and professional ethics of the corresponding domain

- Inform its members and concerned communities about the achievements, coming activities, and other related information through hardcopy newsletter or e-newsletter

- Organize exhibition to demonstrate new technology and/or new products of the corresponding manufacturers

3. Relationship between professional organizations

As mentioned above, there exist so many national, regional and international professional organizations from the domain of Geo-informatics in the world. Resources in the Earth are limited so if the professionals have no communication, there could be duplication of work for the similar types of works which lead to the wastage of resources and also loss of time. So optimization in the use of resources is inevitable, that could be achievable only when there is communication and relationship between the organizations. In order to establish such relationship between the organizations, most of the organizations have made some provisions. Accordingly, governmental and national professional organizations can become member of regional and/or international organization. Similarly, regional organization can be a member of another regional organization and/or member of international organization. Some of the examples are as follows *[2]*:

- Survey Department is the member of Asia and Pacific Regional Space Agency Forum (APRSAF), Asian Association on Remote Sensing (AARS), Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP), SAARC Networking on Cartography Arrangement (SNAC), International Steering Committee for Global Mapping (ISCGM), International Federation of Surveyors (FIG), Group on Earth Observations (GEO), Sentinal Asia Joint Project Team (SA JPT), et cetera

- Land Management Training Centre is the Member of International Federation of Surveyors (FIG) and Sentinal Asia Joint Project Team (SA JPT)

- Nepal Remote Sensing and Photogrammetric Society (NRSPS) is the member of Asia and Pacific Regional Space Agency Forum (APRSAF) and International Society for Photogrammetry and Remote Sensing (ISPRS)

- Nepal Institution of Chartered Surveyors (NICS) is the member of International Federation of Surveyors (FIG)

- Sentinal Asia Joint Project Team (SA JPT) is the sister organization of Asia and Pacific Regional Space Agency Forum (APRSAF)

- Asian Association on Remote Sensing (AARS) is the member of International Society for Photogrammetry and Remote Sensing (ISPRS) et cetera

The reasons to become the member of other professional organizations are as follows:

- The member organization will be invited to participate in the events organized by the organization

- The member organizations are eligible to participate in the General Assembly of the organization where the delegate can share the ideas

- The member organization will receive all the information and decisions of the organization

- The member organization receives opportunity to acquire knowledge on the status of research activities of the world.

- Member organization sometimes receive opportunity to organize event of the professional organization

4. Importance of Professional Organizations

As a Geo-informatics professional, it is necessary to update professional knowledge, display talent, disseminate knowledge, and so on. The most appropriate platform for performing these activities is the events of professional organization where one could be part of the activity to contribute knowledge for development of profession. In other words, professional organization provides opportunity to participate in their events and these organizations are always trying to disseminate information and results of the research activities going around the globe through different means and media such as web portal, conference, newsletter, journal, et cetera. Based on these information and documents, institutions/organizations could modify existing system, develop suitable system, and conduct program to create awareness to the professionals and decision makers in the working field.

Any organization would like to establish a sustainable system to achieve its goal. This can be possible only when the professionals involved in the process possess professionalism. It is believed that the professionalism of the professionals may not be developed within the organization at work only but they should have some sort of affiliation with the professional organization(s) because, the professionals have better opportunities not only to broaden their horizon but also to enhance the knowledge, if they participate the activities of the professional organizations. This will, in turn, motivate them to display their professionalism *[4]*. Therefore, there is a high importance of professional organization for the sustainable development of profession.

5. Beneficiaries

The outcomes and achievements from the activities of the professional organizations are always beneficial to several sectors such as individual professionals, national institutions and even the country itself in different ways.

For instance, individual professional will be benefitted as follows:

- Acquire knowledge on several aspects of the profession
- Develop skill to prepare a research paper and to discuss with the counterparts
- Create opportunity to give own exposure with the foreign professionals
- Gain experiences for conducting an event in the organization
- Create opportunity to display professionalism in the profession
- Get opportunity to understand the culture of the country and to observe exciting and important sites of the organizing country

National institutions will be benefitted from the following aspects:

- Participated staff will motivate to feel ownership and responsibilities for the organization and dedicate to work harder than before
- Increase efficiency of the individuals at their workplace
- Create environment to apply newly develop technologies for increasing its efficiency
- Support in the capacity development within the institution/organization
- Get exposure of the institution in the international forum
- Receive opportunity to understand the status of similar institutions of the participating countries

Similarly, if the event is organized in the country, it will also be benefitted, in the following way:

- Enable to participate a large group of professionals of the country at one time
- Enable to develop sustainable technological system
- Support in the promotion of tourist industry and create environment to earn foreign currency in the country which are spend by the foreign participants
- Create environment to exchange culture with the foreigners

- Increase employment opportunity in different business sectors
- Recognize the country and related organizations by the world community

6. Conclusion

Professionals should have affiliation with the professional organizations to develop their professionalism. It is clear that the Geo-informatics professional organization could be national, regional or international. Each of these organizations has their own objectives and means to disseminate information to the professionals. There are provisions to establish relationship between different categories of the organizations. The easiest mean is to become the member of the other professional organization(s). The professionals, national institutions and even the country itself can receive several benefits from the activities, outcomes and documents of the corresponding professional organization. This will create environment to develop sustainable system in the institution. Thus, the professionals recognized the Geo-informatics professional organizations around the world are important organizations, specifically, for development of the career as well as for development of sustainable technological system.

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Influential Factors of Geo-Information Sharing

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Abstract

Information resources, spatial or non-spatial are used widely and wisely to improve the organization's operation in today's competitive environment. With the advancement of information and communication technology, information sharing is made feasible and practiced within various entities. However, information sharing can be complex. There are various factors that influence cross-boundary information sharing because each organization operates within complex information, organizational and national context. There can be differences in technology, knowledge, culture, politics, geography, resources, relationships and intentions. This paper highlights on the different factors that can influence the information sharing in different perspectives.

Keywords

Geo-information, sharing, cross-boundary, influential factors

1. Introduction

Information is a key resource in today's organizational environment. As stated by (Kolekofski, Heminger, 2003), Richard Nolan, in his article, "Computer Data Bases: The Future is Now" was one of the first to study the importance of information as an organizational resource. Though being crucial, it is often not shared and used. It has not been utilized to the extent as it could be. Information is associated with the objective in order to benefit the organization which also includes the sharing of information amongst those who can make profitable use of it.

When information is held by different stakeholders, exchange of information and materials is a must for resource combination (Haeussler, 2011). The information shared allows building on each other's work and achieve the result in faster and economical manner. Sharing information is considered as an important approach to increase organizational efficiency and performance (Steinel, Utz, Koning 2010). It has been made feasible due to the advances in information and communication technology. However, sharing information is a complex task (Steinel, et al 2010). The scientific progress and its societal benefits also hinge on the sharing of the information (Hauessler, Jiang, Thursby). New information plus the advancement in sciences is also created mainly through two generic processes: exchange and combination (Nahapiet, Ghosal).

Sharing of the information is found to be done in two major forms: *one- on- one* and the *General Sharing*. General Sharing takes place with the scientific community as a whole for example, through conference presentation (Hauessler, Jiang, Thursby). The one -on- one Sharing requests mostly concerned research- related information or research input that is, information which is often not published or cannot be published in journal, but provides the basis for research findings, for example software, database, description of laboratory process.

There are different perspectives and aspects on which the sharing of the information is affected.

2. Information Sharing in Different Perspective

Since few years, organizations have shifted from information protection approach to information sharing as a new goal (Steinel, et al 2010). Though sharing of information has received much attention, initiatives has often failed due to various reasons. Hence, to facilitate the cross boundary information sharing, it is critical to establish an understanding of factors that influence sharing and maintain collaborative relationships (Yang, et al 2012).

Moreover, researches have revealed that information sharing involve complex interactions between the participants due to the differences in their origins, values and the cultures [Gil-Garcia, 2010; Lam, 2005; Yang, et al 2012]. Within the national context, information sharing can be performed in three different perspectives (Slaughter): Interpersonal Information Sharing, Intra- organizational Information Sharing and Inter- organizational Information Sharing.

2.1 Interpersonal information Sharing

Interpersonal relationship is developed within many contexts: colleagues, neighbors, classmates, or members of community (Yang, et al 2011). Sharing information at the interpersonal level focuses mainly on the behavior that each individual have such a motivations, approaches and channels for an individual to share information with others. Information can be shared voluntarily in order to provide information to the people who are in need (Jarvenpaa, Staples; 2001). The information is shared among the needy using the simplest and cheapest technology available such as email and face-to-face (Erdelez, Rioux, 2000). The main reasons for sharing the information in these levels are (Marshal, Bly, 2004):

a. To establish mutual awareness between the information giver and taker
b. To educate or raise consciousness
c. To develop rapport

The information shared here is to strengthen social ties and relationships between the provider and recipient and reflect the common interest between them. However, information sharing in individual interest may also interact with various organizational factors like competition and collaboration that tend to hinder information sharing behavior.

Sharing of the information is also found to be influenced by the individual's belief and attitude about the information and its sharing. Beliefs influence the overall attitude about any object and beliefs, attitude, intentions and behaviors are interlinked (Kolekofski, Heminger, 2003). An experimental finding has shown the perception of organizational ownership and attitudes for information sharing differs with the type of information. Individuals are more liable to share personal knowledge that the tangible knowledge. Interpersonal relationship also plays an important role for sharing the information. (Kolekofski, Heminger, 2003) As suggested, "Belief about the information, interpersonal relationships, organizational factors and task relevancy determine an ownership or stewardship attitude which subsequently influence the likelihood of sharing information"

2.2 Intra- organizational Information Sharing

There is trend to encourage groups to share the information that they have within organizations (Dawes, Gharawi, Burke, 2012). Though in the bureaucratic model, the flow of information is strictly controlled. Due to this limited access of information and its sharing, one lacks the capability to develop integrated solutions of the problems. Literatures have revealed that there are many influencing factors for intra- organizational information sharing. The relationships between the factors are complex and have influence on each other. The following figure 1 shows the relationships between the factors which are present in three layers.

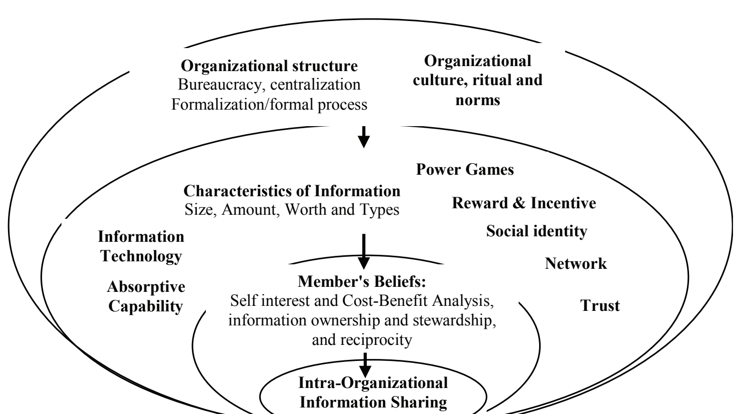

Figure 1: *Factors influencing intra-organizational information sharing [16]*

Layer 1: Though the ideal bureaucracy is efficient and fair organization, if it gets bigger the distributed duties in different hierarchies and sub units become reason of decreased efficiency. It may bring obstacles to share information between different departments because of having different functional mandates (Yang, et al 2011). Similarly the attitude and actions of organizational members for information sharing are highly influenced by organizational cultures, values and norms. When the culture of the organization makes emphasis on the fairness, affiliation and innovation, it can positively influence the intentions to share information. Information sharing may clash with the culture of the organization if its value is not a part of the organization's culture (Zheng et al, 2005).

Layer 2: Researchers emphasize on the importance of the incentive system to motivate the members of organization to share the information within different groups and departments (Yang, et al 2011). Performance based reward system is more likely to sharing of knowledge and information within members of organization and so is the bonus system which may also increase the quality of the information shared (Kolekofski, Heminger, 2003). Owning information is considered as owning power within an organization. Therefore information is taken as an asset and used by organization members to elevate their power and sharing it is viewed as loss of individual power and social influence within organization. Hence, sharing of information is less if more power game exists. Social networks as well are important to promote the information sharing. It includes individual and group contacts, communications and interactions that can promote trust and relationships that can enhance the sharing behavior (Kolekofski, Heminger, 2003). Some people always questions that why individuals require the information they possess while others will always keep an open mind to the requests for information in their possession. Trust is a critical factor between the involving individuals to share the knowledge and information (Zheng et al, 2005) and is willing to share if they feel that they are protected against opportunistic people. Moreover, the lacks of trust amongst organizational members create obstacles in sharing information. (Kolekofski, Heminger, 2003) The size, amount, type and perceived value for the requested information also influence the attitudes and intentions of the members of the organization to share the information. Two types of knowledge *explicit* and *tacit* are owned; explicit knowledge is objective and rational those are expressed in words, numbers, formulas and charts while tacit knowledge is subjective, difficult to communicate and express and based on experiences (Yang, et al 2011). Absorptive capacity depends on the prior knowledge, ability to recognize the value of new information and to assimilate and apply it on the practical and innovative use. Having this capacity individuals within organization are better capable to receive and use the shared information. The experienced has proved that the advancement of information technology develops information system to facilitate sharing of the information. However, if the implemented information technology is not easy and used efficiently, individuals within an organization, the use of IT will be lower and activities to share will tend to be lesser and sometimes could be negatively influenced (Yang, et al 2011).

Layer 3: Self interest of individual can reduce support for information sharing within an organization. "The information of any organization that is represented as a *product* is easier to share between individuals and is considered as property owned by the organization while information such as *expertise* is more difficult to share and considered as individual property" (Yang, et al 2011). Reciprocity is another force to drive the behavior of information sharing. The anticipated reciprocity is an important factor to positively influence the attitudes towards the sharing the information.

2.3 Inter-organizational Information Sharing

Some of the factors discussed above may also be applied to the inter-organizational scenarios. The public sectors have increasingly realized the importance of sharing information to improve the efficiency of the government agencies (Gil-Garcia et al, 2005). Interoperability across organizations represents cross boundary information sharing (Landsbergen, Wolken, 2001). The most influential factors viewed and defined by (Dawes et al, 2012; Zheng et al, 2009) are in three primary perspectives: Technology, Management and Policy. These three are the core elements in inter- organizational information sharing. The relationship between these three has been shown in the given figure 2.

The technological perspective: It is experienced that different organization have various types of hardware and software and it is a challenge to integrate heterogeneous information system in varying platforms, data quality, standard and schemas. Another critical factor for the cross- boundary information sharing is the levels of technological capability of various organizations. However, the advancement in the information technology has enhanced the effectiveness and efficiency of the inter - organizational collaboration (Zheng et al, 2005). Different frameworks are being applied to bride such information systems and heterogeneous databases with inconsistent data structures and definitions. The adoption of IT can also be a challenge because of the security and confidentiality, it is critical to design a system that can handle access authorization and authentication for shared information.

The organizational perspective: Researcher has specified that information sharing can involve complex interaction between participating organization due to the differences in their origins, values and culture. It is also pointed that some governmental organization with little or no knowledge of sharing information lacks the basic understanding of the benefits that can occur from cross boundary information. In addition to this, due to the bureaucratic organizational boundaries, government organizations are less aware of what information can be shared and retrieved from other agencies. Some other factors that resist the inter - organizational information sharing are traditional business process, perception of losing benefits and lack of resources. Organizations are not willing to share, without appropriate compensation, also because they have spent lots of budget, time, staffs and other resources to build the knowledge and information

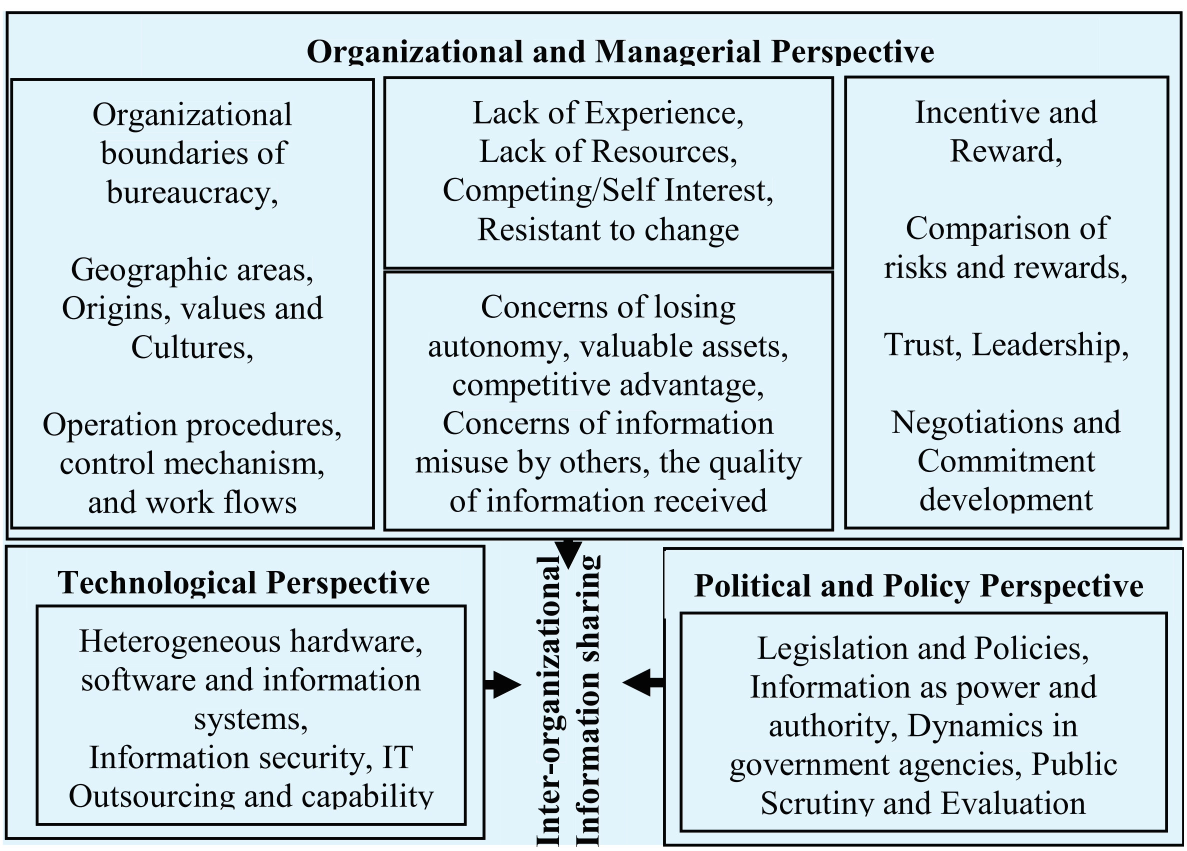

Figure 2: *Factors influencing inter-organizational information sharing in public sector*

The political and policy perspective: Legislation and policy influence strongly to share information and across organization especially in the public sector (Gil-Garcia et al, 2010). Researchers have found that legal and policy regulations can facilitate relationship building, risk reduction and trust development in inter-organizational information sharing when specific guidance on how to utilize information is proposed. Without the support of legislatures and policy makers, inter-organizational information sharing in public sector can be lose its priority status and lack necessary funding and resources to make projects sustainable (Zheng et al, 2005). However, laws and regulations may also sometimes be a barrier to obstruct cross-boundary information sharing in public agencies. Sharing of the information can be hindered because of policies itself that prohibit the information sharing of sensitive and regulated information for maintaining public safety and national security.

3. The Boundaries of Information Sharing

The discontinuities that represent the incoherence and gaps between the entities in the context of information sharing in different environments, tasks and relations to others are considered as boundaries (Yang et al, 2012). The difficulty of crossing the boundary may be lower if there exist no significant boundaries or has been removed. Barriers hence can be eliminated or overcome by using some efforts even if it tend to exist for a longer period of time and significant institutional changes has been made. Hence organizational boundary in information sharing and integration is also observed in two different dimensions: vertical and horizontal (Yang et al, 2012; 19). Organizational, personal, sectoral, geographic, development level and process boundaries falls within the vertical and horizontal dimensions. Researchers have claimed that boundaries in both the dimensions: vertical and horizontal are equally important and may exist simultaneously.

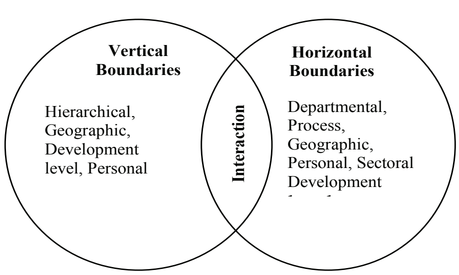

Figure 3: *An integrated framework of boundaries in information sharing and integration (Yang et al, 2012)*

4. The Geo-Information Sharing

Similar to other information, the speedy development and increased demand of the geographic information infrastructure has made geographic information an important tool in policy planning and decision making. Global issues, such as climate change, food and energy crises, peace operations and humanitarian assistance, all necessitate strong support for geographic information management on a global scale. Moreover, in the digital era location or place, is gaining increasing importance making the efficient and effective management of information a priority in both the public and private sectors and even more at the personal level. Over eighty percent of existing digital databases have a locational component. "Everything is somewhere" and location can be used as an integrator for both quantitative and qualitative information (Taylor, 2010). Additionally society is increasingly using location based information in day to day life including GPS, Google Earth and related spatially referenced databases knowingly or unknowingly. Governments too are using location or place in planning and budgeting.

Different organizations have quite different legal and policy mandates and these differences constrain the effective cooperation and sharing of the information between them. As in the case of other non spatial information, there are many barriers to the sharing of geo data and information too, which include technical, legal, administrative and political barriers. The technical barriers include the issue of interoperability. Although the technical issues are significant they are perhaps much easier to resolve than the legal, administrative and political ones (Taylor, 2010). Though it is widely recognized that collecting data multiple times for the same purpose is wasteful and inefficient, yet it continues to occur. Inadequate amount of spatial data is available and they too are limited by the quality, accuracy, and completeness of the underlying geospatial data. Constraint exists also on the knowledge of what data can be shared and in what form. Duplication of information exists and there is necessity to update several sites. The major difficulties faced in this domain are the multiplicity of spatial representations, the discrepancy regarding coordinates and some administrative constraints. (Laurini, 1994). To overcome these drawbacks standardization and sharing geo-information can be very fruitful.

"Technical interoperability has provided geographic information communities with substantial improvements for constructing geographic information system (GIS) capable of very low friction and dynamic data exchanges. These technical advances stand to provide substantial advantages for sharing geographic information however reaping these advantages in highly heterogeneous operational and organizational environments requires the understanding and resolution of semantic differences" (Harvey, Kuhn, Pundt, Bishr, Riedemann, 1999). Though different efforts have been made in this regard, obstacle still remains pertinent across organizations for data sharing and future developments of standards. Although the goals of transparent data exchange and remote access have to be reached by technical interoperability, work on interoperability provides a basis for facilitating data sharing and helping resolve redundancy problems (McKee 1998).

Ideally, spatial data/information sharing efforts would produce a national spatial data infrastructure, (NSDI). In addition to promoting the efficiency and interoperability of such a national system, NSDI is often promoted as "digital infrastructure" on par with other parts of the nation's critical infrastructure and underscore its role in the national economy and in national security. Cooperation is necessary to realize the overall vision of the NSDI, which is to assure that spatial data from multiple sources are available and easily integrated to enhance the understanding of our physical and cultural world (Folger, 2010).

5. Conclusion

Whether it is spatial or non-spatial information, it's sharing can neither be supervised nor imposed. It is influenced by many factors related to the environment and domestic relationships of the people and organization. The contextual difference among them generates divergence in the culture, intention, politics, knowledge, resources, geography, technology and varying organizational factors. However, if the individuals and organizations follow the norm of open science with the stronger conviction, there will be maximum probability for the information sharing. It is necessary to strengthen the norms and norm based mechanism which helps stakeholders to share information for the promotion of knowledge.

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Looking back 2013-2014

Annual Discussion Program on Cadastral Survey:

Cadastral Survey Branch organized an annual discussion program on 10-12 August, 2013 to review the program of previous fiscal year and discuss the program of running fiscal year. Heads/Representatives from Survey Offices having survey activities during the fiscal year 2069/70 participated the training and presented their annual progress reports. They also discussed and presented their working papers on the legal, technical, administrative and financial aspects of cadastral survey at their respective survey offices.

Participants of Annual Discussion Program on Cadastral Survey:

Regional Workshops for Survey Offices

According to annual program of fiscal year 2070/71, Survey Office Strengthening Program has targeted 5 regional workshops at each development region with the objective to interact with the heads of Survey Offices about their administrative, financial, planning, inspection and technical issues. Until now, four workshops have been organized to cover survey offices from these developmental regions. Details of each workshop are as follows:

Workshop	Date	Location
Far Western Development Regional Workshop	5th September 2013	Dhangadi
Western Development Regional Workshop	14th February 2014	Tanahun
Central Development Regional Workshop	6th March 2014	Kathmandu
Mid-Western Development Regional Workshop	21st March 2014	Nepalgunj

Such kind of workshops are being organized by survey department for the first time and it is being greatly appreciated and productive to get insights of survey activities of each offices.

Participants of Regional Workshop at Kathmandu

Participants of Regional Workshop at Dhangarhi

Participants of Regional Workshop at Tanahun

Orientation Program on Border issue

Border concerning issues are of national interest. In order to disseminate right information, Survey Department Topographical Survey Branch organized an orientation program on 6th September 2013 at Dhangadhi. The title of the event was "The Technical Aspect of Nepal - India Border Management and the role of Local Administration ". The technical issues concerning Nepal -India Border e.g. historical facts, idea, principles, border pillars, border maps, the activities done by Survey Department, the problems faced in the local level, long term and short term solution and the role of local administration were discussed.

The secretary of Ministry of Land Reform and Management was chief guest. The program was chaired by Mr. Nagendra Jha the director general of Survey Department. He addressed the function mentioning the objectives of the program and the role of survey department in the border management. Deputy Director General Mr. Madhusudan Adhikari shed light on the Technical Aspect of Nepal-India Border Management and the Role of Local Administration.

The Joint Secretary of the Ministry of Foreign Affairs, Joint Secretary of Ministry of Land Reform and Management, Regional Administrator, Chiefs of Nepal Army, Nepal Police, Armed Police Force, Chief District Officers, Local Development Officers and Chiefs of concern regional, zonal, district offices were the participants.

Orientation Program for the officials of Armed Police Force

Topographical Survey Branch under-Survey Department organized orientation programs on the technical issues of the Nepal-India International Boundary on 13th December 2013. Such orientation programs were organized ten different bordering districts namely Jhapa, Morang, Saptari, Siraha, Dhanusha, Mahottari, Sarlahi, Rautahat, Bara and Parsa. The programs were participated by the officials of Border Security Offices of Armed Police Force at district level and their Border out Posts in the respective districts. Main objectives of the program were to orient the participants on the international border, boundary pillars and boundary maps, in order to enhance their technical skill regarding border management and security. Similar program was also organized at Kailali as requested by the Far-Western Regional Head Quarter, Armed Police Force Baidhyanath Brigade, Attaria, Kailali.

Seminar on Global Navigation Satellite System:

Survey Department organized a seminar jointly with IT Professional Forum Nepal on 23rd December 2013. The theme of the seminar was Global Navigation Satellite System .

Stakeholders' consultative workshop

Survey Department organized a stakeholders' consultative workshop on the "Establishment of large scale Geographic Information Database for supporting Land Management, Development planning & Disaster Mitigation, Kathmandu Valley on 20th February 2014. Deputy director General Mr. Madhu Sudan Adhikari delivered the welcome speech. Chief Survey Officer Mr. Kamal Ghimire presented a paper on the project concept, Project Chief. Mr. Suresh Man Shrestha presented a paper on application of large scale Geo-information Databases. Representatives of Stakeholders organizations gave a brief remarks on the Workshop. Officiating Secretary Mr. Krishna Raj B.C. addressed the function as special guest. Development commissioner, Kathmandu Valley authority Mr. Yogeshwor Krishan Parajuli addressed the function as chief guest. DG Mr. Nagrendra Jha delivered closing remarks form the chair.

Workshops by Cadastral Survey Branch:

Cadastral Survey Branch organized Capacity building workshop (2070/11/11-2070/11/13) at Chandragadi, Jhapa with the objective to increase skills of the heads of Survey Offices on the issues like planning, administrative, financial and technical. Workshop was focussed on how to be more capable and accountable towards public to become service-oriented on these issues. Heads/representatives from Survey Offices of Jhapa, Damak, Illam, Dhankuta, Morang, Belbari, Sunsari,Saptari, Siraha and Lahan participated in the workshop.

Data Capture and Processing Training:

Cadastral Survey Branch conducted a training related to digital data capture and processing from 5th March 2014 to 23rd March 2014 . Surveyors from the five Survey Offices of Kathmandu Valley along with Survey Office Banepa and Cadastral Survey Branch participated in the training.

Training on Transformation parameter:

Survey Department, Geodetic Survey Branch organized a training program as per the annual program on the determination of transformation parameter on 14th April, 2014 at Nagarkot Observatory premise. The opening of the training program was chaired by the Director General Mr. Nagendra Jha.Head of the Geodetic Survey Branch, Mr. Jagat Raj Paudel delivered the welcome speech. Chief Survey Officer, Mr. Niraj Manandhar presented the progress of the parameter determination work.Project Chief of NGIIP Mr. Suresh Man Shrestha commented on the presentation.

Survey Office buildings under construction:

Survey Office buildings of Ilam, Jhapa, Biratnagar,Dhanusha, Mahottari, Bara Rautahat, Bhaktapur, Kalanki, Nuwakot, Kaski, Makawanpur, Surkhet , Puythan and Doti are under construction as per the annual program of the fiscal year 2070/071. After the completion of these buildings 43 Survey Offices out of 83 will operate from their own buildings.

Integrated Approach for Building Extraction from InSAR and Optical Image using Object Oriented Analysis Technique

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Abstract

Building extraction in built-up area is of great interest for visualization, simulation and monitoring urban landscape which is used for town/city planning as well as regional planning. Building extraction in urban areas based on merely a single high resolution optical data is often hard to conduct and to improve quality of building detection with consistency, completeness and correctness. Optical images are one of the major sources of individual building extraction from orthoimage but most of these do not produce anticipated result especially to building's shape and outlines in dense urban environment. Extraction of objects from InSAR images is a complicated phenomenon for interpretability due to side looking geometry and effects of layover, foreshortening, shadowing and multi bounce scattering. In this study, buildings and building blocks are extracted from fusion of optical and InSAR data using object oriented analysis (OOA) technique. The improvement of building footprint has done with rectangular fit for building hypothesis and building height from normalized digital surface model (nDSM) based on fuzzy membership function. The results of building extraction has found reasonably good and accurate in planned urban layouts. The quality of building extraction has highly dependent on settlement density, contrast and other image characteristics.

Keywords

SAR interferometry, orthoimage, object oriented analysis technique, building extraction.

1. Introduction

Building extraction in built-up area is of great interest for visualization, simulation and monitoring urban landscape which is used for town/city planning as well as regional planning. Building extraction in urban areas based on merely a single high resolution optical data is often hard to conduct and to improve quality of building detection with consistency, completeness and correctness. With the advancement in technology and increasing general awareness among people, the need for using high resolution and Very High Resolution Satellite (VHRS) optical images for various applications is realized and hence the ever escalating demand for high resolution and VHRS optical images. The current and future high resolution earth observations satellites having a spatial resolution of 1m and higher resolution with stereo capabilities can go a long way in the field of mapping in terms of cost, time and accuracy. Nowadays, there is increasing interest of high resolution and VHRS optical images like IKONOS, Geoeye-1&2, Worldview-1/2, Quick bird, Cartosat-1/2, which have opened up the opportunities for exploiting man-made structures in urban area like building, roads are visible in more detail independently; are used in research activities and implementation of development works. Synthetic Aperture Radar (SAR) has become a key remote sensing technique, at present, due to its all weather capability, independence of daylight and its ability to penetrate into the objects. The space borne satellites like TerraSAR-X, TanDEM-X, SAR-Lupe, RISAT-2 and Cosmo-SkyMed-1/2/3/4 are providing VHRS images in fine grid of geometric resolution of one meter. Additionally, the appearance of a particular buildings in satellite images depends on look angle of the sensor so that building; which has not oriented in azimuth direction with respect to the sensor are often hard to detect, for this, Interferometric SAR (InSAR) image acquisition from two orthogonal flight line direction has been introduced (Thiele et al., 2007). InSAR has the advantages of providing height information of buildings which facilitates for detection for 3D building model. Multi-aspect InSAR data from four aspect is used for model based building detection and reconstruction (Bolter and Leberl, 2000). Building extraction in urban areas based on merely a single high resolution optical data is often hard to conduct. Features of additional sources of data may be needed to improve quality of detection, completeness and correctness. Several works have already dealt with the integration of features derived from high resolution optical data and SAR (InSAR) data with the goal of building detection. Building blocks have been detected and reconstructed with combining high resolution optical and InSAR data. The classification of both data sets separately within a multi-layer neural network for building hypothesis with height of building using rectangles fit. Building detection has reconstructed semi automatically with the combine features of high resolution optical satellite imagery with high resolution SAR data. Building hypothesis of optical data are validated or rejected based on a classification of the SAR image making use of roof textures, bright lines and shadows. Building and its height are derived simultaneously exploiting the different optical and SAR sensor geometries (Khim, N., 2011).

2. Study Area and Data Description

Study Area:

The study area is Dehradun; which is located in the Garhwal region with geographical extent 30°17′49.42″N to 30°18′22.65″N latitude and 78°03′45.04″E to 78°04′21.95″E longitude. It is capital city of Uttarakhand with 236 km north from India's capital city New Delhi and is one of the alternative developed urban centres for population growth. It is situated in the Doon Valley on the foothills of the lesser Himalayas and Churiya Range (Shivalik Range) hill. It is nestled between two of India's mightiest rivers; the Ganges on the east and the Yamuna on the west. The city is famous for its picturesque landscape and slightly milder climate and provides a gateway to the surrounding region. The city is located at altitude of 600 m above MSL. It is a crowded city, more or less having typical characteristics like planned and unplanned built up areas with many buildings, roads, parking areas and some areas with vegetation, such as trees, shrub and tropical forest. It is well connected and in proximity to popular Himalayan tourist destinations. The location diagram of study area is shown in figure 1.

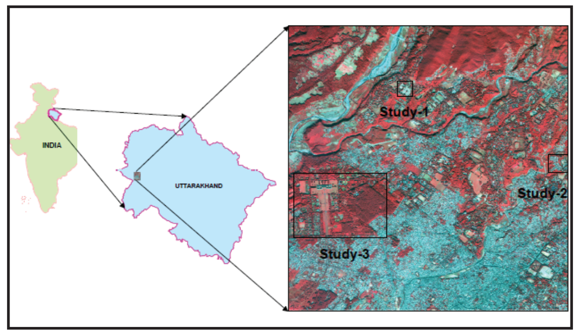

Figure1: Study Area

Data Description:

The following datasets were used in the study; these are listed below in Table 1.

Data Type	Year	Resolution	Source
Remotely Sensed Data:			
Cartost-1 Stereo Image	2006	2.5m	DOS
ALOS PALSAR Image	2010		IIRS
Quick Bird Image	2012	2.4m	IIRS
SRTM DEM	2004	90m	
Base Map:			
Topo map	1996	1:50000	SOI
Field Data:			
Ground Control	2012		Field Works
Ground Truth	2012		Field Works

3. Methodology

For the extraction of building and building blocks, it requires building footprint which has obtained from orthoimage of the very high resolution satellite image then its improvement and refinement has done with building height information and additional different indices such as NDVI, NDWI, SSI etc. For that, firstly orthorectification of the optical images is generated then building height information is estimated from DSM and DEM which has generated from SAR interferometric process. Lastly, building footprint is extracted by the OOA method. By combining the extracted building footprint and the estimated building height information, 2.5D building is modeled and the height of 2.5D building model is assessed with reference building height, generated by using the Cartosat-1 and Aster DSM along with the field visit with a clinometer.

3.1 Orthoimage Generation

Orientation of images is the reconstruction of image object position and its relationship i.e. the model of the earth surface at the time of image acquisition. Interior orientation defines the internal geometry of a camera or sensor as it existed at the time of image capture. In this process, the variables associated with image space are defined and primarily used to transform the image pixel coordinate system to the image space co-ordinate system. Exterior orientation defines the position and angular orientation of the camera that captured an image. The variables defining the position and orientation of an image are referred to as the elements of exterior orientation. The elements of exterior orientation define the characteristics associated with an image at the time of exposure or capture. The angular or rotational elements of exterior orientation describe the relationship between the ground space coordinate system (X, Y, and Z) and the image space coordinate system (x, y, and z). These are defined with roll, pitch and yaw (Grodecki and Gene, 2003). Generally in the satellite image processing, RPC file with ground control point (GCP) collected from differential global position system (DGPS) for refining orientation parameter. Stereo model is displayed and 3D co-ordinate measurement is done with entering the GCPs in the block of stereo model in proper location in all images and corresponding co-ordinate in the ground. The image matching technique with cross correction coefficient and different statistical measures has applied to determine the matching point followed by generating epipolar images which includes: block configuration, tie point extraction, point transfer, mass point, gross error detection, and tie point selection. The ground coordinate of these points is calculated with bundle block triangulation (satellite triangulation) and error is adjusted using by least square adjustment.

Accuracy assessment estimate the probability of error happens in the work for the quality control of work is achieved in whole process. For the accuracy assessment GCPs are collected in sufficiently well distributed for training set of sample to estimate the error occurs in work. Accuracy is usually evaluated in terms of Root Mean Squared Error (RMSE) of residuals between imagery derived coordinates with respect to GCPs coordinates. If the positional accuracy is within the acceptable limit of 1 pixel of RMSE, then DSM has been generated. With GCPs and tie points in the model, image points coordinate into 3D co-ordinates of the ground features is computed as DTM mass points using space forward intersection technique in Leica Photogrammetry Suite (LPS) software and automatic DSM production has generated. DEM has generated from DSM using opening filter. nDSM is generated from DEM subtracted from DSM. Orthoimage production process consists of two steps: orthorectification and resampling. Orthorectification process has done using oriented image with GCPs and DEM of the image area. Resampling process computes the new geometric and radiometric properties of the image after orthorctification (Schenk.T., 1999). Orthoimage is free from relief and tilt displacement, scale distortion and as a like the plannimetric map (Toutin, 2004).

3.2 DSM generation by SAR

Interferometry InSAR processing has done with SARscape in ENVI 4.3 software as the following approach.

Baseline Estimation:

Baseline is an important parameter of the process of InSAR, which directly influences the accuracy of DEM generated and based on data selection in terms of spatial as well as temporal. DSM generation from InSAR images is dependent on the perpendicular baseline in such a way that 2π ambiguity height (m) determines the sensitivity of the interferogram.

Height ambiguity (ha) based on the perpendicular baseline (B) is calculated as:

$$h_a = \frac{\rho\lambda \sin\theta}{2B\cos(\theta-\alpha)} \quad 1$$

Where λ is the radar wavelength, θ is the look angle from nadir and α is the baseline orientation angle (Xu et al., 2001).

Co-registration:

SAR interferometry requires pixel-to-pixel match between common features in SAR image pairs. Thus co-registration is an essential step for the accurate determination of phase difference and for noise reduction and the alignments of SAR images from two antennas. The entire purpose of the co-registration is to align the samples for phase differencing. The correlation window is used to search for offsets between master and slave images at the sub pixel level co-registration (Sahraoui et al., 2006).

Multi-looking:

Multi-looking processing has been used to reduce phase noise in SAR interferometry processing. Phase noise gives a difficulty to create DEM from an interferogram. If the phase noise, which is mostly caused by radar thermal noise, speckle due to coherent SAR processing, decorrelation, and registration noise, is too strong, some fringes of an interferogram is totally lost which have cause errors in InSAR DEM.

Interferogram Calculation:

After the two single-complex images are co-registered, the interferogram is computed according to:

$$I = S_1 . S_2^* = |S_1| . |S_2^*| . e^{j\varphi} \quad 2$$

Where S1 and S2* are the corresponding complex values of the co-registered images. Interferometric phase can be clculated as (Yu and Ge, 2010):

$$\varphi = \varphi_f + \varphi_t + \varphi_o + \varphi_d + \varphi_a + \varphi_n \quad 3$$

where f is the flat earth phase, t is the topographic phase, o is the phase from the objects in the earth surface, d is the deformation phase, a is the atmospheric delay phase and n is the noise from measurement and can be removed by using an Interferogram filtering method and a multi-looking (resampling) process. Since the temporal baseline has 46 days interval in the study is too large, so there is also deformation phase. If the atmospheric delay phase can be ignored, then Equation 3 reduces to:

$$\varphi = \varphi_{flat} + \varphi_{topo} + \varphi_{obj} \quad 4$$

Interferogram Flattening:

The constant phase (due to the acquisition geometry) and the phase expected for a flat Earth or for a known topography are separated from the interferometric phase. Cartosat DSM has used for interferogram flattening which split the initial interferogram into two components: synthetic phase and flattened interferogram.

Coherence Generation and Adaptive Filtering:

Given two co-registered complex SAR images (S1 and S2), the interferometric coherence (γ) is defined as the absolute value of the normalized complex cross correlation between the two signals (Cloude and Papathanassiou, 1998)

$$\gamma = \frac{\left|\sum_{n=1}^{N} S_1{}^{(n)} . S_2{}^{*(n)}\right|}{\sqrt{\left(\sum_{n=1}^{N} |S_1{}^{(n)}|^2 . \sum_{n=1}^{N} |S_2{}^{(n)}|^2\right)}} , 0 \leq \gamma \leq 1 \quad 5$$

where N is the number of pixels in the moving window for coherence estimation, and which is complex numbers and the complex conjugate.

Phase Unwrapping with Region Growing Method:

The unwrapping phase consists the redistributing with each pixel its absolute phase. Two algorithms (region growing, minimum cost flow) are used for phase unwrapping process; in essence, none of these is perfect and different or combined approaches should be applied on a case by case basis to get optimal results. In two unwrapping algorithms, the accuracy of the result depends on the path chosen to perform the unwrapping. Phase Unwrapping is the process that resolves this 2π ambiguity.

Orbital Refinement:

Orbital refinement is used for registration process of the interferometric geometry which is the most important steps in DSM generation process. The accuracy of the registration is depended on the precision baseline as well as precision of error in the horizontal and vertical obtained in an InSAR DSM. It is thus important to precisely reconstruct the orbital trajectories of the satellites in order to know their position exactly. Also, the orbital parameters of the satellites are not accurate enough to allow a rigorous transformation from the phase to heights, the orbital refinement is needed (Singh, 2003). For optimizing, 14 GCPs from DGPS are used to calculate the correction parameters, was selected on the flattened interferogram. The GCPs must be well distributed throughout the entire scene.

Phase to Height Conversion and Geo-coding:

The absolute calibrated and unwrapped phase combined with the synthetic phase is converted to height with geo-coded into a map projection. Geo-coding was done by considering the WGS-84 datum, UTM 43N map projection.

3.3 Building Foot Print using OOA technique: Visual Image Interpretation:

The visual image interpretation was carried out using the visual image interpretation element such as shape, size, association, shadows, texture and tone. There is difficulty for the extraction of object correctly for the spectral complexity of urban areas where different neighboring objects, such as building, parking areas or road, are constructed with same materials or an object are made from different materials, e.g. a building is built with concrete, metal, bricks, tiles or synthetic materials and mixed to each other.

Multiresolution Segmentation:

Multi-resolution segmentation algorithm is based on a bottom-up region-merging process starting with one-pixel to form image objects. Smaller image objects are subsequently merged into larger ones, forming segmentations with objects in different scales. The merging decision is based on a homogeneity criterion i.e. having similarity among adjacent segments. This homogeneity criterion is defined as a combination of spectral and shape factor. In the homogeneity criterion, three parameters are computed: scale, color and shape. The scale parameter is applied to determine the maximum acceptable heterogeneity for the resulting image objects. Scale parameter are directly proportional to the size of image objects i.e. scale parameter is large size then bigger image objects in size but less in numbers and vice versa. Further, homogeneity criterion depends on a combination of color and shape parameters. The value of the shape factor modifies the relationship between shape and color criteria are modifying by the shape and color criteria. Shape factor is the combination of the compactness and smoothness. The value of the compactness factor modifies the relationship between compactness and smoothness criteria are modifying by the compactness and smoothness (Definens, 2007).

Rule Based Classification:

Different characteristics of these segments like spectral characteristics, shape, orientation, texture, proximity or adjacency to other objects can be calculated to develop rule sets which are used to classify the segments. For classification of distinct objects exactly, some customized rule set were created based on feature properties analysis using spatial, textual, contextual information, nDSM and spectral indices such as NDVI and SSI. Using a threshold value of NDVI, the vegetation feature can be segregated to other feature. Similarly, water bodies can be extracted segregated by using NDWI threshold value. The shadow can be classified by using SSI, which is quite effective to distinguish shadows in high resolution images. After removing the vegetation, water bodies and shadow; the taller objects/ features compare to other features are considered as building. So, the height information from the nDSM can be applied for extraction of the taller objects in the image applying threshold of nDSM. But, the buildings extracted from this way can be roughly distinguished because the nDSM is not accurate enough and the uncertainty of the DSM/ nDSM. But, some parking area, bare ground or road areas may be also classified as building features, whereas some existing building areas may not be classified in the building class as well. For this instance, area (spatial property), brightness (spectral property) and relative border to buildings (contextual property) are used to differentiate buildings from remaining other objects. On the other hand, the actual buildings which were unclassified can also be reclassified by utilizing the similar spatial, spectral and contextual information or a combination of these properties (Definens, 2007).

4. Results

Orientation (interior and exterior) of Cartosat-1 was done with the RPCs and 14 GCPS (3 GCPs for full control, 5 GCPs for Horizontal control, 2 GCP for vertical control and 4 GCPs for check point). With image matching technique 51 automatic tie points were generated and used for controlling the entire scene for the satellite triangulation process within the bundle block adjustment and adjustment was carried out applying the least square adjustment technique. The satellite triangulation error has found 0.70 pixels which has acceptable limits. DEM generated for single from Cartosat-1. Orthoimage of the Quick bird image were produced by using DEM.

The SAR interferogram was generated by cross-multiplying, sub-pixel by sub-pixel, the first SAR image with the complex conjugate of the second. Its interferometric phase is the phase difference between first and second images. The synthetic phase was subtracted from the interferometric phase, the flattened interferogram (φ remaining) was calculated using Cartosat-1 DEM and coherence image was generated. The flattened interferogram is only modulo 2π; phase unwrapping process was done to this 2π ambiguity of the interferogram and unwrapped phase image was generated.

The orbital refinement was done using 10GCPs in well distributed location for refining orbital inaccuracies and calculating the absolute phase values. RMSEs were computed for the orbital refinement from interferogram output with the ellipsoidal height and different levels of the external Cartosat-1 DEM and found 10.532m. The phase to height conversion was done for reconstruction of InSAR DSM in 10m grid size on the ground range geometry with UTM projection in 43 Zone and vertical height value in meters with reference to WGS-84datumis shown in Figure 2.

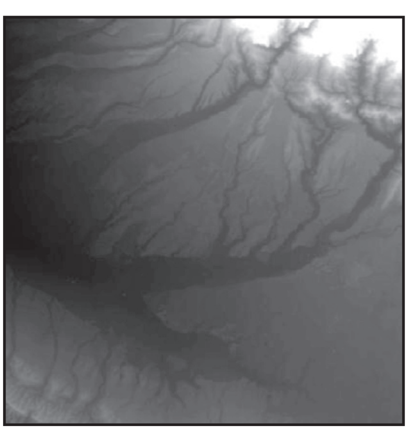

Figure2: DEM from ALOS PALSAR

The buildings in the image have different spectral properties and not pre- defined parameters of scale, shape, color which were equally applicable to get best fitting segments for all building footprints. In this study, a set of parameters was chosen by trial and error method, for the extraction of building footprint which fits practically in the image. Some considerations have taken in mind that the image has not be over or under segmented and over segmentation. The multi-resolution segmentation, scale 20, shapes 0.3 and compactness 0.6 was used as a parameter set (in Figure 3).

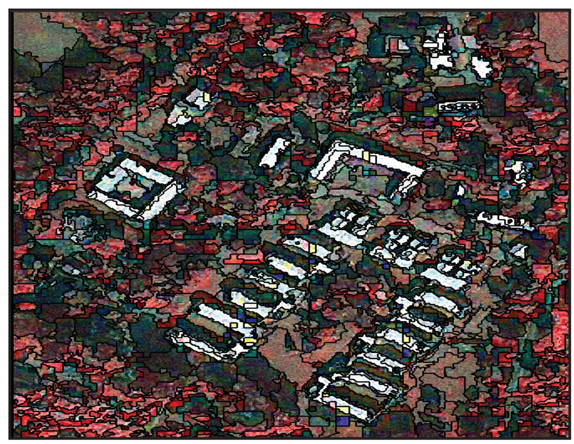

Figure 3: Multi-resolution Segmentation

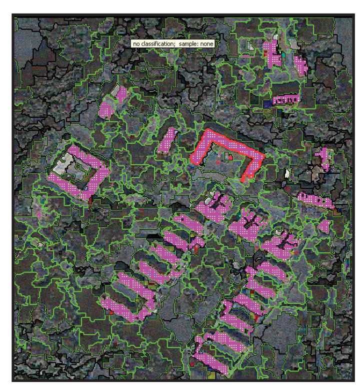

Figure 4: Refinement of Building Footprint

In rule based classification, nDSM was used for separation of taller objects in the image which may be vegetation or building. Vegetation was separated by using NDVI and shadow was extracted using SSI and NDWI. The refinement was done with the membership function of the fuzzy logic with some threshold and optimization of the rule set in feature space of spectral (brightness, standard deviations, max. diff.), spatial (asymmetry, area, compactness, rectangular fit) and contextual (relative boarder to building, relative boarder to vegetation, relative boarder to open space) properties. The refining building classified result is shown in Figure 4.

The refined building features were export in vector format in polygon feature and finally get the actual extracted building (in Figure 5).

Figure 5: Extracted Building Footprint

The overall accuracy and kappa statistic compared to sample used for classification were directly computed and found 92.3% and 0.829 respectively. For the position based and object based accuracy assessment, reference building in this area were digitized on the ortho-rectified Quick bird image. The position of the extracted buildings was calculated on the basis of building centroid which was identified in both, reference and extracted building. The displacement between reference and extracted building was measured and found that the minimum displacement was 0.671m and maximum up to 2.259m with the average of 1.796m. For object based accuracy assessment, the number of buildings in the reference image and extracted by OOA technique were compared. The number of correctly extracted, missed and wrongly extracted buildings were analyzed and identified in spatial analysis tool within ArcGIS 9.3. The different quality measure such as correctness, completeness and extracted percentage were calculated. The result is shown in Table 2.

Accuracy Measure	No. of Building
Building in Reference Image	48
Extracted Building	42
True Positive(TP) Building	41
False Positive(FP) Building	-
False Negative(FN) Building	1
Split Factor	-
Missing Factor	0.0244
Completeness (%)	97.62
Correctness (%)	100
Error of Omission (%)	2.38
Error of Commission (%)	0
Overall Accuracy (%)	98.81

5. Conclusion

Building extraction in urban area using OOA technique depends upon the spectral, spatial and contextual information. Proper segmentation of image is always helpful for accurate building extraction and quality of extraction is not completely depends upon the initial segmentation. The spectral variability within an object and/or a class and spectral similarity among different class, the extraction of building is not get straightforward in dense urban area in VHRS image. The shape, size and contextual information are useful for distinguish different feature characteristics of image objects and nDSM plays important role in building extraction with comparing height of the image objects. The result of extracted building are fairly good quality having regular structure in dense, complexity of urban structure with less irregular pattern and shadow effect.

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Multihazard Mapping of Banepa and Panauti Municipalities

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Abstract

A combination of rough topography, steep slopes, active tectonic and seismic process and intense impact of monsoon rain has made the fragile environment of Nepal vulnerable to a variety of natural hazards. Most frequent hazards are floods, landslides, epidemics, fires, earthquake and other hydro-meteorological disasters, causing heavy loss of human lives as well as economic loss including housing and infrastructures (MDRIP, 2009). Hence, hazard assessments are the need of the hour. They help district and regional decision makers, policy makers and development agencies prepare disaster risk reduction plans. The chosen study area was Banepa and Panauti municipality. Separate hazard assessments have been performed for four hazards, namely, earthquake, flood, landslide and industrial hazards.

Earthquake hazard zone maps have been made following the Probabilistic Seismic Hazard Assessment (PSHA) approach for 500 year return period to produce seismic intensity distribution maps in the form of Modified Mercalli Intensity (MMI) maps using Trifunac and Brady formula. Flood inundation maps have been made using HEC-RAS and HEC-GeoRAS extension for ArcGIS for return periods of 2, 10 and 500 of Chandeswori and Punyamata rivers. Landslide hazard susceptibility map has been made using the Stability Index Mapping (SINMAP) extension for ArcGIS that uses an infinite-slope equation accurate *for debris flows. Industrial hazard maps that depict the vicinity that falls within various ranges of danger in the event of different industrial hazards like fire, Vapor Cloud Explosion (VCE) and Boiling Liquid Expanding Vapor Explosion (BLEVE) have been prepared as well. Finally, a composite multi hazard map has been prepared by combining all the four hazards.*

Keywords: earthquake, flood, landslide, industry, hazard assessment, composite multi-hazard

1. Introduction

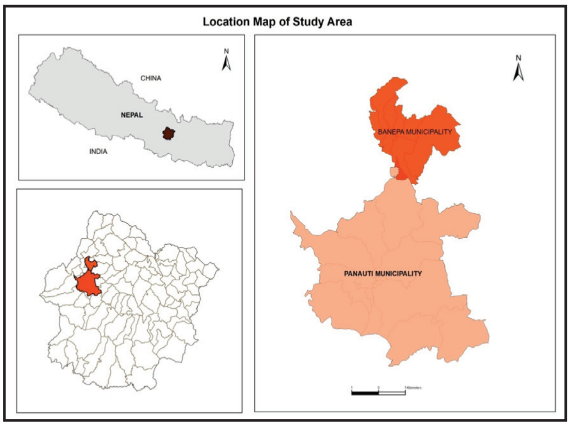
Nepal is prone to various geological and hydro-meteorological hazards owing to its diverse geographical coverage that includes rough topography, steep slopes and active tectonic and seismic processes.

The impact of multiple hazards has aggravated in recent years due to catalytic factors like climate change, rapid urbanization, and continual urban growth rates that result in high physical exposure and lack of preparedness both at national and local levels. In Nepalese context, mainstreaming disaster risk reduction efforts in municipal governance and development plans stills occupies low priority against other development plans. Further, the location of most urban cities in risk prone areas with loose networks of migrant populations increases the risk factor.

Multi hazard maps serve as guidelines to prepare effective disaster mitigation plans at local and national levels by depicting the intensity and probability of hazards in a given geographical location. Multi-hazard maps of landslide, earthquake, flood and industrial hazards are first prepared to produce composite multi-hazard maps of Banepa and Panauti. The resultant maps can help to identify the most vulnerable sectors and assist stakeholders to adopt necessary measures to increase resilience of the residents.

2. Study Area

The study areas comprised of Banepa and Panauti municipalities of Kavrepalanchok district. The spatial extent of Banepa municipality is between 27°37'01" to 27°39'03" north latitude and 85°30'45" to 85°32'52" east longitude geographically; and the spatial extent of Panauti municipality is between 27°33.5' to 27°37' north latitude and 85°29' to 85°33.5' east longitude.



3. Materials Used

Datasets used for the project included socio-economic data, Quickbird images at 0.6m spatial resolution, geological map, 20m DEM, topographic map with 20m contour interval, building inventory and land cover data along with Seismic Hazard Map of Nepal prepared by Department of Mines and Geology, 2002.

4. Methodology

The general framework (Figure 1) adopted to prepare multihazard maps can be listed as:

- Preparation of earthquake hazard maps in form of PGA and MMI maps using PSHA approach.
- Flood depth and inundation maps for 2, 10 and 500 year return periods using HEC-RAS and HEC-GeoRAS extension of ArcGIS.
- Generation of landslide hazard susceptibility map from SINMAP analysis and a GIS based spatial multi-criteria evaluation technique.
- Vector analysis to depict hazard indices for fire hazards, Vapor Cloud Explosion (VCE) and Boiling Liquid Expanding Vapor Explosion (BLEVE).
- Perform weighted sum to derive the final composite hazard maps that depicted the multi-hazard region.

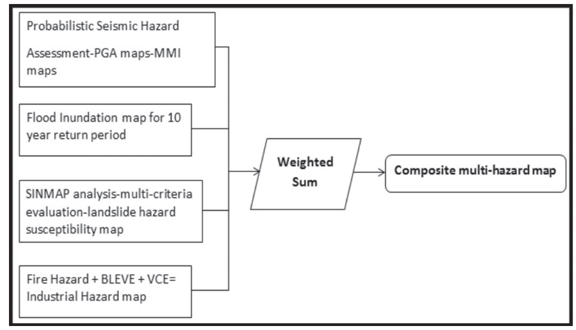


Figure 1: Overall method of multi-hazard mapping

Among the different faults identified by The National Building Code Implementation Project (1993), the (Main Central Thrust) MCT 3.3 fault with potential 7.6 Richter scale was chosen for earthquake hazard mapping since it is the closest active fault that can generate the worst scenario earthquake for the study area.

PSHA approach was chosen to describe earthquake hazard in terms of the level of ground shaking that has a 10% chance of being exceeded in 50 years corresponding to a return period of 475 years.

First, the regional seismicity model is prepared based on an arbitrary scenario earthquake that occurs as a local earthquake. Next, attenuation model is created that represents the isoseismic contours at bedrock level and was generated using R.R.Youngs et.al, 1997 analysis followed by the site response model that describes how local geology affect the ground shaking experienced during an earthquake. The subsurface amplification values derived are used along with the attenuation model to produce surface Peak Ground Acceleration (PGA) maps. The PGA maps were modified to MMI maps using Trifunac and Brady 1975 relationship. The MMI maps are more intuitive and provide qualitative measure for earthquake intensity.

Flood hazard assessment consists of hydrologic/ hydraulic analysis; topographical analysis followed by feature creation from satellite image; steady flow simulation and further processing to delineate flood inundation and flood depth maps. Field discharge measurement and cross section survey were followed by TIN preparation from contours to obtain base layer; layers of river centerline, banks, flowpaths and cross-section were created by digitizing existing topographic data with simultaneous referral to satellite images, using RAS Geometry of HEC-GeoRAS extension in

ArcGIS 9.3. Land-use map was used to extract the Manning's n value based on Manning's Roughness coefficient. Then, flow frequency analysis was computed from WECS/DHM (Water and Energy Commission Secretariat/Department of Hydrology and Meteorology) formula.

These preprocessed data were used as input for one dimensional Steady Flow Analysis in HEC-RAS which was run using the peak discharge value corresponding to the return periods flood event. The simulated HEC-RAS model was then visualized in ArcGIS environment through its HEC-GeoRAS extension using RAS mapping where: HEC-RAS export was used to define Flood Inundation extent followed by water surface generation. Finally, flood inundation and flood depth maps for 2, 10 and 500 year return periods were produced.

Due to the presence of eleven reliable landslides inventory in the study area, a deterministic method by using SINMAP model was used to prepare landslide susceptibility map where weights selected for multi criteria analysis are based on the report of (MHRA, 2011) and expert opinion. Semi-quantitative indicators have been used with resulting landslide susceptibility expressed in a scale from 0 – 10 for better representation of spatial variability. Only the final susceptibility was classified into qualitative classes of very low, low, moderate, high, and very high.

Eight indicators have been input to generate landslide hazard susceptibility maps. Three indicators were obtained from the SINMAP analysis and rests are obtained from secondary data. A spatial multi-criteria evaluation technique has been implemented in GIS system. Each indicator was processed, analyzed and standardized according to its contribution to hazard and percentage of existing landslide lies on different indicators. The indicators were weighted using comparison and rank-ordering weighing methods, and weights were combined to obtain the final landslide susceptibility maps. Eight thematic layers comprising from six conditioning factors and two triggering factors were created. The thematic layers were ranked into several classes from safe condition to the most prone condition for landslide hazard. Those layers are then combined with different values of weighting.

Different probabilistic mathematical calculations were performed for fire hazard map. At first, buffer zones of 25, 50, 75 and 100m were classified. The effects of thermal radiation on these zones were determined using mathematical formula. This produced different hazard intensity zones.

VCE and BLEVE were determined only for selected depots. Mathematical equations estimated the effective distances for VCE and BLEVE to be 120 and 80m respectively. Following parameters were considered for assessing the impacts of fire hazard:

- Availability of fire brigade
- Fire spreading environment
- Fire fighting mechanisms

Then, the different degrees of hazard zone were determined and the building inventory data were overlaid to determine very high, high, medium and low vulnerability zones.

The produced hazard maps were used to prepare composite multi hazard map (Figure 2). For this, individual hazard maps were given values 1, 2, 3 according to their output ranges for flood, landslide, industries and 2.5, 2.75, 3 for earthquake hazard maps. Weighted sum was done to derive the final composite hazard maps that depicted the multi-hazard region under three hazard regions, low, medium and high.

5. Results

The PGA distribution map for MCT 3.3 local earthquake scenario reveals that the municipal region would experience PGA range of 179 - 269 gal (i.e. 0.18g-0.27g). For Banepa, the core municipal areas would experience PGA of 230 - 260 gal (Figure 2a). The core part of Panauti would experience PGA range of 230 -260 primarily due to its alluvial soil composition which amplify earthquake waves. The outskirts would face less PGA since the geological composition of residual and colluvial soils comparatively minify ground motion than alluvial soils.

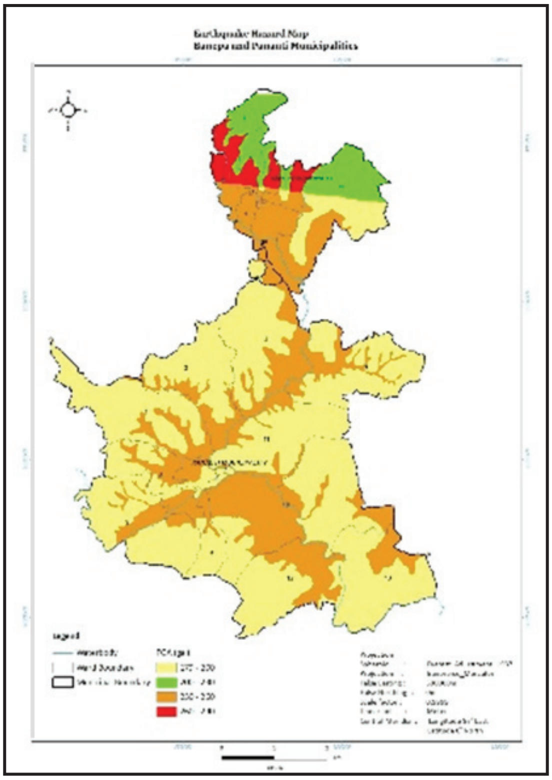


Figure 2a: PGA map

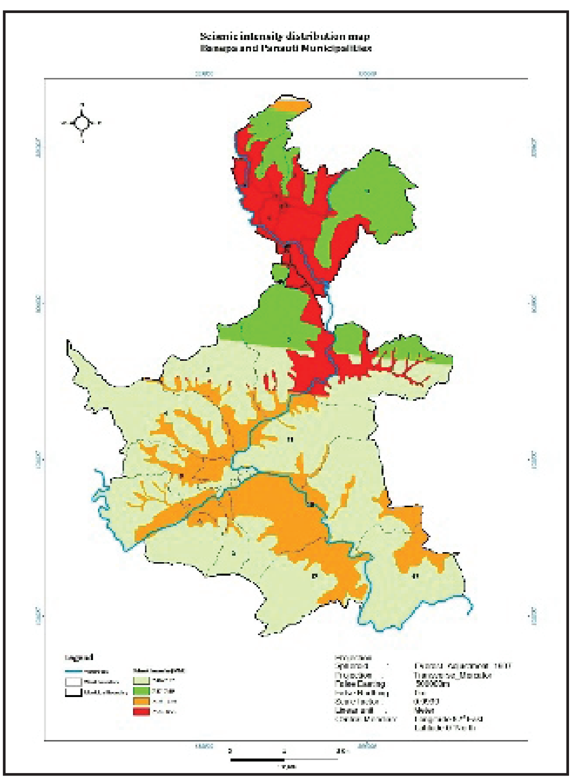


Figure 2b: Trifunac and Brady MMI map

The MMI maps reveal that the central and southern parts of Banepa fall within very high seismic hazard zone of 7.94 - 8.55 MMI. In contrast, only 165 hectares of Panauti fall under very high seismic zone but 2659 hectares cover the high hazard zone. Panauti is relatively less vulnerable with major region falling within the lowest range of 7.46 - 7.57.

Flood inundation maps (Figure 3a) for 10 year return period (RP) show that 50.17 hectares and 0.389 hectares land fall under significant flooding region in Banepa and Panauti respectively. Flood depth was categorized into slight, moderate and significant depth based on specifications prepared by HAZUS. 25 buildings in Banepa were located in significantly vulnerable region compared to none in Panauti. The results obtained from landslide susceptibility maps (Fig 4b) are ranked from 35-450, which defines the landslide susceptibility from safe (very low) to very susceptible (very high). These maps further classified into five zones shows 5.16% of total land area nearly 34.5 sq.km falls under very high, 9.60% fall under high and 23.77% fall under moderate hazard index respectively.

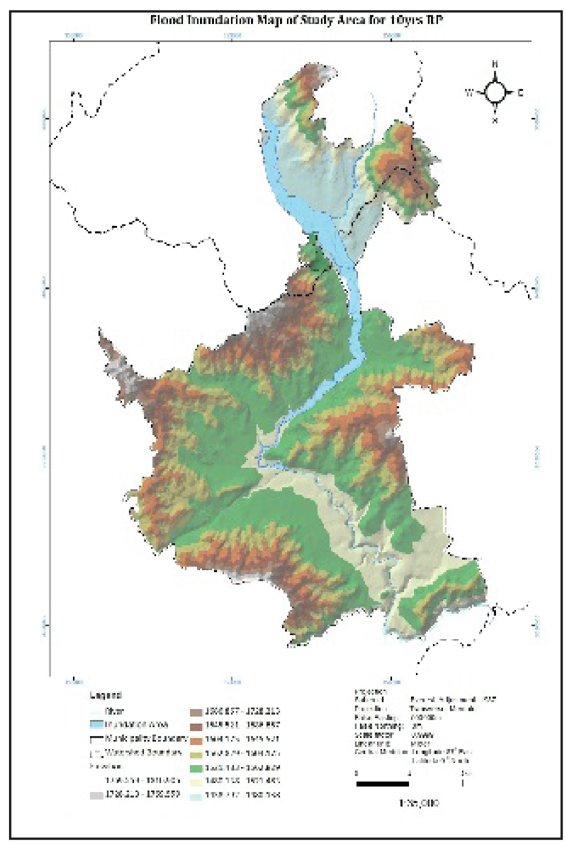


Figure 3a: Flood inundation map for 10 yr RP

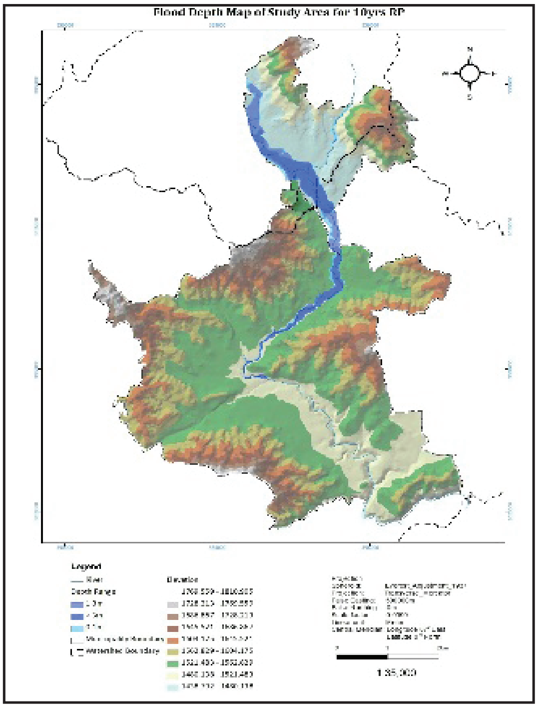


Figure 3b: flood depth map for 10 yr RP

For industrial hazards, the chance for a fire accident is quite low due to less storage of inflammable materials and most buildings being RCC/RBC type. However, lack of abundant fire extinguishers/ brigades could even amplify a small fire.

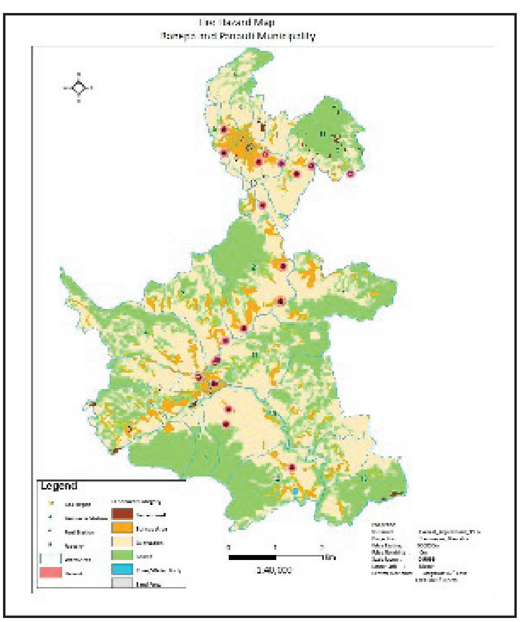


Figure 4a: Industrial hazard map

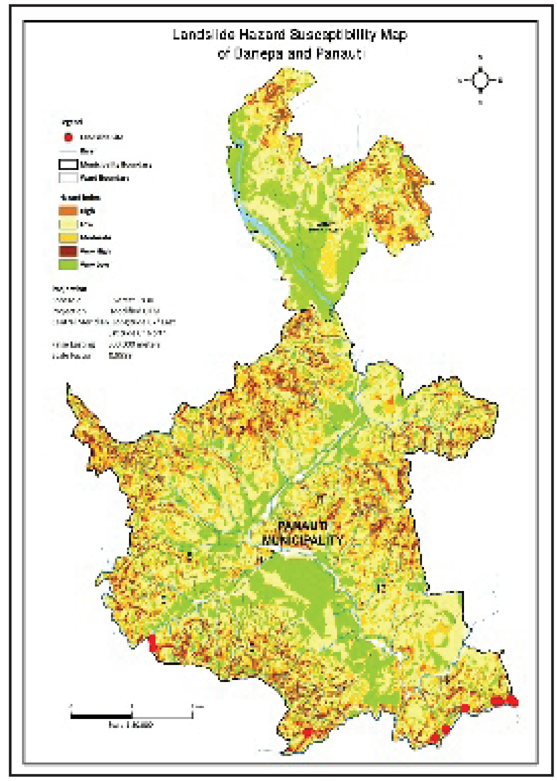


Figure 4b: landslide hazard susceptibility map

Probabilistic industrial hazard maps showing different hazard indices for fire hazards, VCE and BLEVE were prepared based on rapid assessment field survey done to summarize the status of industrial hazards and preparedness level. Fire hazards maps (Fig 4a) show very-high, high, medium, and low zones on the basis of heat achieved within selected buffer distances of 25, 50, 75 and 100m respectively.

6. Conclusion

Four hazard assessments were performed to produce hazard maps of three geological hazards namely earthquake, landslide, flood and one technological hazard- industrial hazard. The results include PGA distribution maps, MMI maps, landslide susceptibility maps, flood inundation, flood depth maps and industrial hazard maps showing the zones of different intensity or probability of certain hazard. The hazard maps have been used as a basis to calculate exposure statistics to predict the vulnerability scenario. This scenario has been used to study the vulnerability assessment.

The results of the research project suitably indicate that Panauti is more vulnerable to industrial and landslide hazards compared to Banepa. However, comparatively Panauti is less vulnerable to earthquake and flood hazards than Banepa. The hazard assessment performed could be used to formulate land use plans, disaster risk reduction plans in order to bolster our own adaptive capacity.

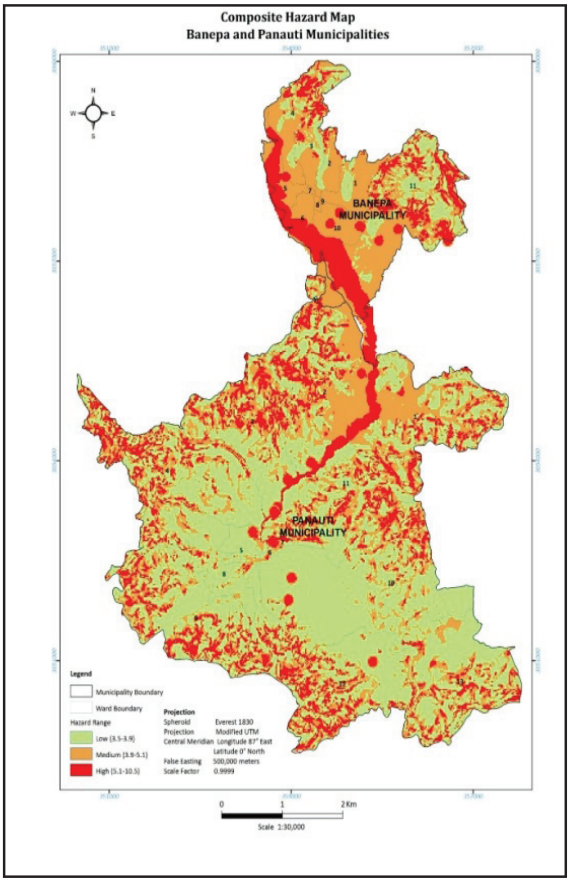


Figure 5: Composite Hazard Map of Banepa and Panauti Municipalities.

7. Recommendation

- Due to constant change of geospatial features over time, regular map updating and field validation are necessary to maintain validity, accuracy and reliability of the hazard maps.
- Landslide inventories need to be increased for accurate landslide hazard assessment and risk estimation
- More shear wave velocity measurements must be done to build a database of the site average shear-wave velocities that can be used to verify, calibrate and possibly improve the original earthquake hazard maps.
- Liquefaction potential should also be considered to fortify earthquake hazard maps.
- Field cross-section measurement is recommended for better results in flood hazard assessment.
- Effect of wind direction and river presence could also be considered to enhance industrial hazard assessment.

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Obituary

All the officials of Survey Department pray to the Almighty for enternal peace to the departed soul of the following officials of the department and remembered them for their contribution towards the achievement of the goal of the department.

1.	Late Mr. Singeshwor Prasad Yadav	-	Survey Officer
2.	Late Mr. Ram Prasad Shrestha	-	Surveyor
3.	Late Mr. Saroj G.C.	-	Surveyor
4.	Late Mr. Thakur Prasad Chaudhary	-	Nayab Subba
5.	Late Mr. Rajendra Prasad Pandit	-	Surveyor
6.	Late Mr. Jitendra Prasad Yadav	-	Surveyor
7.	Late Mr. Rajendra Rajak	-	Surveyor
8.	Late Mr. Lali Thakur	-	Amin
9.	Late Mrs. Kamala Bohara	-	Helper
10.	Late Mr. Ram Tapeshwor Pandit	-	Helper
11.	Late Mr. Tek Bahadur Tharu	-	Helper

Price of Maps

S.No.	Description	Coverage	No. of sheets	Price per sheet (NRs)
1	1:25,000 Topo Maps	Terai and mid mountain region of Nepal	590	150.00
2.	1:50 000 Topo Maps	HIgh Mountain and Himalayan region of Nepal	116	150.00
3.	1:50 000 Land Utilization maps	Whole Nepal	266	40.00
4.	1:50 000 Land Capibility maps	Whole Nepal	266	40.00
5.	1:50 000 Land System maps	Whole Nepal	266	40.00
6.	1:125 000 Geological maps	Whole Nepal	82	40.00
7.	1:250 000 Climatological maps	Whole Nepal	17	40.00
8.	1:125 000 Districts maps Nepali	Whole Nepal	76	50.00
9.	1:125 000 Zonal maps (Nepali)	Whole Nepal	15	50.00
10.	1:500 000 Region maps (Nepali)	Whole Nepal	5	50.00
11.	1:500 000 Region maps (English)	Whole Nepal	5	50.00
12.	1:500 000 maps (English)	Whole Nepal	3	50.00
13.	1:1 million Nepal Map	Nepal	1	50.00
14.	1:2 million Nepal Map	Nepal	1	15.00
15.	Wall Map (mounted with wooden stick)	Nepal	1	400.00
16.	Photo Map		1	150.00
17.	Wall Map (loose sheet)	Nepal	1 set	50.00
18.	VDC/Municipality Maps	Whole Nepal	4181	40.00
19	VDC/Municipality Maps A4 Size	Whole Nepal	4181	5.00
20.	VDC/Municipality Maps A3 Size	Whole Nepal	4181	10.00
21.	Orthophoto Map	Urban Area (1: 5 000) and Semi Urban Area (1: 10 000)	-	1 000.00
22.	Administrative Map	Nepal	1	5.00

Price of co-ordinates of Control Points

Type	Control Points	Price per point
Trig. Point	First Order	Rs 3 000.00
Trig. Point	Second Order	Rs 2 500.00
Trig. Point	Third Order	Rs 1 500.00
Trig. Point	Fourth Order	Rs 250.00
Bench Mark	First & Second Order	Rs 1 000.00
Bench Mark	Third Order	Rs 250.00
Gravity Point	-	Rs 1 000.00

Road Network Planning for Sustainable Urban Development in Kirtipur Municipality, Nepal

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Abstract

Road network deals with the development of a comprehensive plan for construction and operation of transportation facilities. In order to develop efficient and better transport facility, it is necessary to have a proper road network. In sustainable road network planning, planners put into consideration factors like gradients or slope, land-use and geology with community and governmental interest. These different considerations make the planning process complex and generate confusion in the decision making process. The use of geographic information system (GIS) and multi-criteria analysis (MCA) has helped planners to reduce complexity and to achieve desired and more accurate results. MCA prevents the imposition of criteria limit and gives opportunity to decision makers to enter their own judgments. This provides a better communication among the decision makers and the entire community for creating a more open choice for analysis and possible changes if necessary. In this study, road network has been analyzed with optimal least cost path algorithm of spatial analysis in GIS using different ancillary data layers and each layer weight-scoring has been computed with MCA in spatial decision support system (SDSS). The optimal least cost path would provide the best option with certainty and considers a gradient, connected neighbors, thematic cost and surface distance in three dimensional spaces. The path gradient can be adjusted as per the requirements, depending upon the terrain conditions and possible to design a more realistic route automatically with appropriate parameters.

Keywords
Road planning, multi-criteria analysis, spatial decision support system, optimal least cost path.

1. Introduction

Road planning deals with definition of circulation infrastructure pavements, roads and terminals. It also covers the physical and operational characteristics of public transport (Vasconcellos, 2001). Effective road path is an essential interest of every developing country and acts as a means of interconnectivity between different parts and regions within and outside the country. Road network provides the country's economic and social well-being for the mobility of people and goods, but also over the long term it influences patterns of growth, land use and economic activities. But, road network development has damage and fragments the natural environment. Human- kind's quest for development has led to a point where any further development threatens the last remaining natural reserves. So, finding the optimal balance between infrastructure creation and nature conservation is achieving greater importance for sustainable development (World Bank, 2010).

Road network needs to the identifying and reserving of land for urban transport facilities that support connectivity between different location of urban place. Road network planning plays an undeniably key role in the economic growth of any region/ country. So, the planning can be done heedlessly and detrimental to the biophysical and social environment of the region. In road route planning generally one or a few alternative routes are proposed for environmental impact assessment (EIA) and strategic environmental assessment (SEA) using SDSS. An efficient road route planning system that directly takes into account the environmental, social and economical considerations in formulating, assessing and selecting alternative routes are proposed for sustainable infrastructure development (Keshkamat et al., 2009).

During the last decade, RS and GIS technology have been used for route-planning process. Costs are increased by long structures, by large volumes of cut and fill, and by unbalanced cut and fill. For designing the high quality road, needs suitable spatial data such as geology, land use, slope, soil and drainage. GIS coupled with MCA has helped to enhance multi-criteria decision making associated with planning process (Roy, 1996; Maha, 2012). The use of GIS with MCA has helped for decision makers towards actualizing the optimal route for desired choice and enhance in decision making process (Chakhar & Martel, 2003; Geneletti, 2004).

2. Study Area & Data used:

Study Area Kirtipur municipality has high rate of urban growth and urban sprawl has prevalent with the rapid development of urbanization and motorization. There is need of a comprehensive road network planning for the establishment systematic of dreamland city. The location of study area is shown in Figure1.

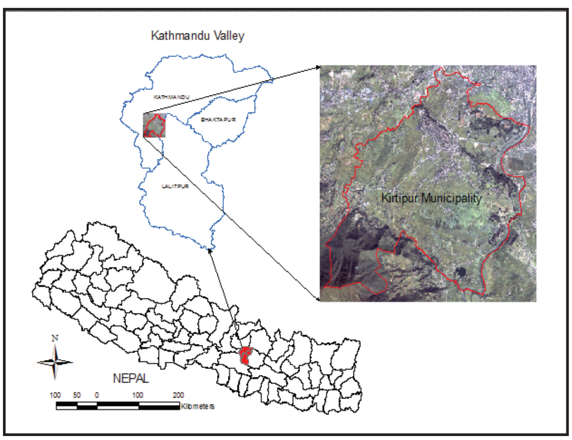

Figure1: Study Area

Its location is 27º 38’ 37" to 27º41’ 36" N and 85º 14’ 64" to 85º 18’ 00" E with it extent and at present has 19 wards and covers 17.87 sq. km. It is bordered by the Bagmati River with Lalitpur Submetropolitian City to the east, Machhengaun Village Development Committee (VDC) to the west, Kathmandu metropolitan city (KMC) to the north, and Chalnakhel VDC to the south. The town was built initially within a wall surrounded strategically by dense vegetation and opens ground as outer rings. Data used The following datasets were used in the study; these are listed below in Table 1.

Table1:

Description of Data used

Data Type	Year	Scale / Resolution	Source
Remotely Sensed Data:			
GeoEye -1	2012	2m	UBMP
Base Map:			
Topo map	1996	1:25000	DOS
Urban map	1998	1:2000	DOHUD
Ancillary Vector Layers/Data:			
Geology	2007	1:30000	NLUP
Field Data:			
Ground Control Point (GCP)	2012		Field Works
Ground Truth	2012		Field Works

3. Road Alignment

Road alignment is the location of the centre line of the road in the ground. It has included two components; one is the horizontal alignment which is the straight connected path with its horizontal deviation and horizontal curves and other is the vertical alignment which is the change in gradient defined by ruling gradient and the vertical curves of the road. It is chosen carefully based on the consideration of the road construction cost with its maintenance and road improvement, operation of vehicle cost and accident rate with its requirement and different factors (Khanna & Justo, 1971).

Road Alignment Requirements: The basic requirements of ideal alignment between two terminal stations are short, easy, safe and economical.

Road Alignment Factors: The various factors are considered while selecting the road alignment. In general, obligatory points, traffic flow, geometric design, slope stability, drainage, resisting length, economic condition are considered as factors in road network planning (Khanna & Justo, 1971).

4. Methodology

The procedure helps to select a least cost route that is supposed to be the best and reducing overall road development and maintenance costs. The proposed route planning procedure can be divided into the following four basic steps:

4.1 Thematic Cost Raster: A scoring system in the range of 0 to 9 is used, with zero signifying the minimum cost and 9 implying the highest cost. Similarly, the influence factor of each layer is weighting with between 0 to 1 values so that the whole influence of the thematic cost raster is 1 or 100%. The weighting-scoring (rating) values are based on a comparative study of various thematic data layers and discussions with experts working in the area of transportation engineering. Multi Criteria Evaluation is used for the thematic cost raster generation and is computed as (Saha et al., 2005):

$$\text{Thematic Cost Value} = \Sigma\ \text{Weight} * \text{Score} \qquad 1$$

4.2 Selection of Connected Neighbors: Neighbourhood is the location within proximity of some starting-point or grid cell. In a 3x3 pixel window, there are eight direct neighbors (two horizontal, two vertical and four diagonal). The turn angle interval (angle between an incoming and outgoing path at a pixel) for the route is restricted to a minimum 450 angle. In GIS, a raster based model based on the neighborhood relationship concept are used to each pixel can be represented as a network node. This step involves finding various possibilities of the connected nodes in terms of horizontal and vertical factor respectively in terms of moving direction with the horizontal relative moving angle (HRMA) and the moving from one cell to another cell in vertical direction with the vertical relative moving angle (VRMA) to slope or gradient.

4.3 Calculation of Neighborhood Movement Cost (NM-cost): Once connected neighbors are found, the cost of moving to the connected neighbor from a source is called as neighborhood movement cost (NM-cost and calculated as (Saha et al., 2005) :

$$\text{NM Cost} = \text{Surface Distance} * \text{Thematic Cost Raster} \qquad 2$$

However, if the topography is uneven, the slope of the terrain varies in different ranges with different directions. Therefore, the NM-cost must consider this direction dependency (anisotropy), for which, the NM-cost may be given as:

$$\text{NM Cost} = \text{Surface Distance} * \text{Thematic Cost Raster} * \text{Slope Cost} \qquad 3$$

4.4 Selection of least-cost route: For direct horizontal/ vertical connection involves finding least cost shortest path using path distance and is calculated as (Saha et al., 2005):

$$\text{Path distance} = \text{Surface Distance} * \text{Thematic Cost Raster} * \frac{\Sigma \beta_i \times p}{n} * q; i=1,\ldots,4 \qquad 4$$

where p & q are the horizontal and vertical factor for each cell respectively and n is the total number of cell. Similarly, for the diagonal direct connection, i.e. the Bishop's pattern, the neighbour-distance is calculated as:

$$\text{Path distance} = \text{Surface Distance} * \text{Thematic Cost Raster} * \sqrt{2} * \frac{\Sigma \beta_i \times p}{n} * q;\ i=5,\ldots,8 \qquad 5$$

where p & q are the horizontal and vertical factor for each cell respectively and n is the total number of cell. Accumulation path distance is the accumulation cost to from cell to the end cell and given by

$$\text{Accumulation Cost} = \Sigma a_i \qquad 6$$

where   is the path distance of the link from one cell to the adjacent another cell.

5. Result & Analysis

Triangulated irregular network (TIN) surface was generated using contour data in 2m contour interval from urban base map TIN surface was smoothed for the purpose of engineering quality contours using linear interpolation and converted into DEM with TIN to Raster tool in ArcGIS 10 (in Figure 2).

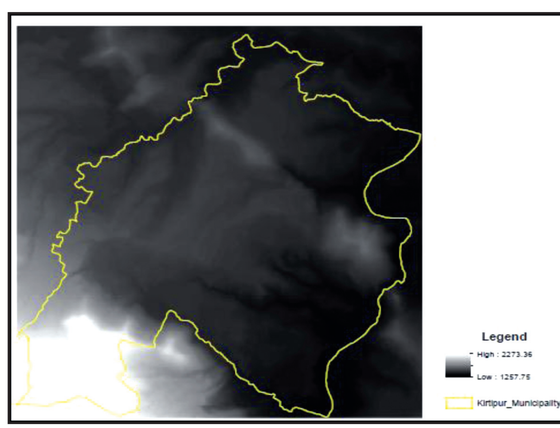

Figure 2: DEM of the Study Area

Land use land cover (LULC) map for the year 2012 were prepared by maximum likelihood classifier (MLC) technique of multi-spectral Geoeye-1 images.

LULC map was categorized into five classes such as built-up, agriculture, forest, water body and open space. The validation of classification results were done for the quantification and evaluation of error using confusion matrix which compares the class-by-class based on the training samples and classification result classes. These error matrices were evaluated and the overall accuracy has found 87.67% with KIA 0.8337. The LULC map is shown in Figure 3.

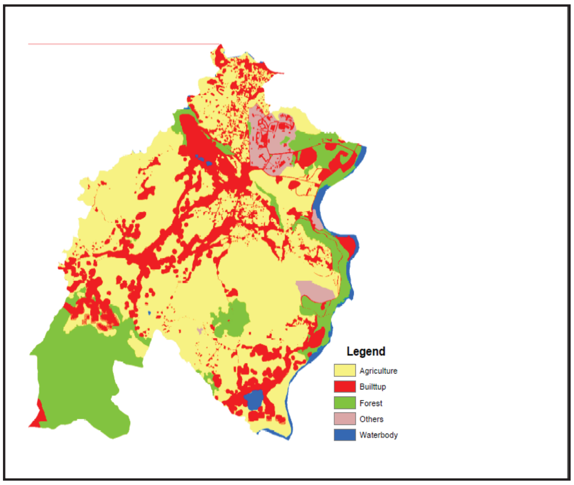

Figure 3: Land use land cover

The thematic road network was generated from ortho-rectified Geoeye-1 image. The road network was categorized into four classes as highway, feeder road, major road and minor road. In road raster; some pixels have the raster value of highway, feeder road, major road and minor road but not cover all pixels by these road types having discrete type of geographic phenomenon. So, this discrete geographic phenomenon was converted into continuous phenomenon by reclassification of No data of road raster into one category as No Road. The continuous raster of road network map is shown in Figure 4.

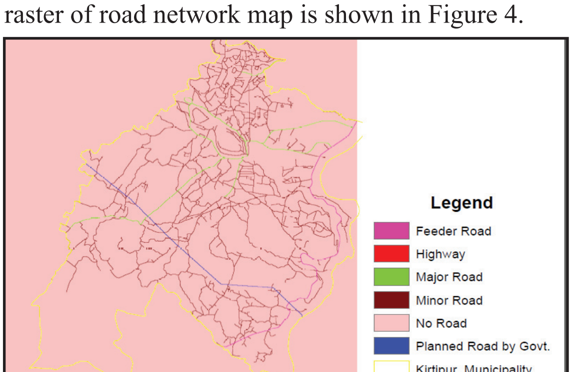

Figure 4: Reclassified Road Network

The thematic drainage network was also generated from ortho-rectified Geoeye-1 image. The drainage network was categorized into four classes as river/ lake, khola, major stream and stream. In raster drainage; some pixels has the raster value of river/ lake, khola, major stream and stream but not cover all pixel by these drainage type having discrete type of geographic phenomenon. So, this discrete geographic phenomenon was converted into continuous phenomenon by reclassification of No data of drainage system raster into one category as No Stream. The continuous drainage system map is presented in Figure 5.

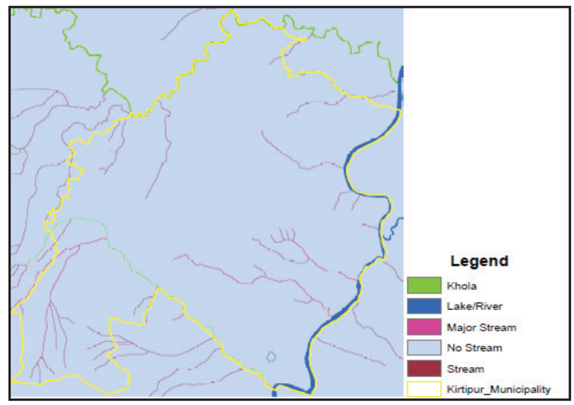

Figure 5: Reclassified Drainage Network

The thematic distance to settlement layer was generated from the existing settlement from the LULC map and verified from Geoeye-1 image using Euclidian distance in spatial analysis tool and found distance ranges from 0m to 1732m. These ranges of distance to settlement was categorized into six categories from 0m to 100m, 100m to 300m, 300m to 500m, 500m to 1km, 1km to 1.5 km and 1.5 km to above. The result of reclassification of distance to settlement map is shown in Figure 6.

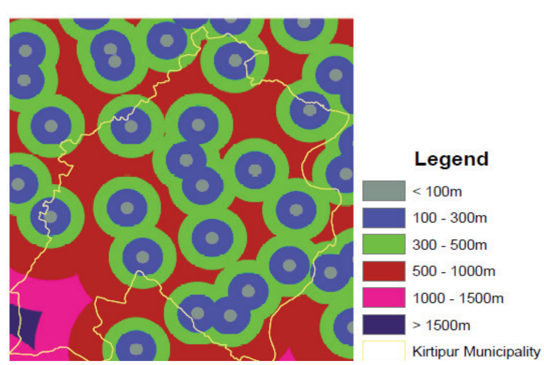

Figure 6: Reclassified Distance to Settlement

The slope was derived from the DEM and its ranges from 00 to 720. This range of slope was categorized into five categories such as from 0% to 5%, 5% to 10%, 10% to 15%, 15% to 20% and 20% to above. The result of reclassification of slope map is presented in Figure 7.

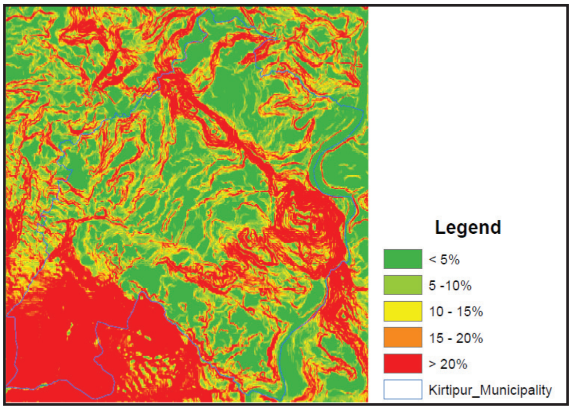

Figure 7: Classified Slope Map

The thematic cost raster surface was generated with the weighted overlay of different raster having different score (attribute rating) and weight (factor/criteria rating) consultation with expert using MCE technique in customize tool with model builder and python. Slope is the most important parameter in road planning in a mountainous terrain for maintaining the ruling gradient of road alignment. Slope is categorized into five sub-categories and individual sub-categories have rating with its score value in the ordinal number from 0 to 9. Road construction and maintenance in the steep slope is high cost comparative to the flat terrain. The score of different slope categories are shown in Table 2.

Table 2: Score of Slope Category

Slope	Score
< 5 %	2
5-10%	5
10-15%	7
15-20%	8
> 20%	9

LULC data has required for estimating the cost of land acquisition during road route planning. The areas covered with river sediments are also not suitable for road construction, as these are susceptible to flood inundation. The score of different LULC categories are shown in Table 3.

Table 3: Score of LULC Category

LULC	Score
Agriculture	6
Built-up	8
Forest	4
Open Space	2
Waterbody	9

Lithology mainly concerned with structure of rock type which has been considered mainly for the costs of blasting, excavation, cut-and-fill works, etc. The score of different lithology categories are shown in Table 4.

Table 4: Score of Lithology Category

Lithology Category	Score
Quartizite	9
Slate	7
Limestone	5
Lacustine	3
Alluvial Fan	1

The road network is mainly defines its order by the road type. The road type map has been used here to consider the reduction in the cost of construction so that planned route followed the existing route of road. Generally, where the existing metallic road such as highway and feeder road exist, there is no need for more excavation work for base and sub-base only upgrading is required. The score of different road categories are shown in Table 5.

Table 5: Score of Road Class

Road Class	Score
Highway	1
Feeder Road	3
Major Road	5
Minor Road	7
No Road	9

The drainage system is categorized by the order of the stream. The drainage-order map has been used to consider the cost of a possible bridge construction. Generally, the width of the river channel increases with increasing order of drainage, which results in a corresponding increase in the cost of bridge construction. The first- and second-order drainages (streams) have been assigned very low ratings where as higher-order drainages (river/khola) has assigned the high value. The pixels without any channel have been assigned a low cost. The score of different drainage type are shown in Table 6.

Table 6: Score of Drainage Type

Drainage Type	Score
River	9
Khola	7
Major Stream	5
Minor Stream	3
No Stream	1

For the accessibility to people, distance to settlement is an important factor in the road planning. Main road inside the settlement is not good for the vision of safety to avoid accident. The score of distance from settlement are shown in Table 7.

Table 7: Score of Distance to Settlement

Distance to Settlement	Score
< 100m	9
100- 300m	2
300-500m	5
500-1000m	7
1000-1500m	8
>1500m	9

The proposed road alignment alternatives were generated based on slope, LULC, lithology, road network, stream system and distance settlement. The first alternative weight was assigned from expert knowledge and validated from Analytic hierarchy process (AHP) pair wise comparison. In all pair wise comparison test we get overall consistency having limit less than 0.1. The weight obtained from the AHP pair wise comparison for the alternative 1, alternative 2 and alternative 3 are shown in Table 8.

Table 8: Weight of different Alternatives

Factors	Weight		
	Alter-1	Alter-2	Alter-3
Slope	0.25	0.22	0.23
LULC	0.20	0.19	0.19
Lithology	0.15	0.15	0.15
Road Network	0.15	0.17	0.19
Drainage Network	0.15	0.14	0.11
Distance to Settlement	0.15	0.12	0.13

Path distance and path direction i.e. back link of the surface cost path computes the total cost surface from the source location to each and every pixel. The result of path distance and path direction were computed from source (Kirtipur Centre Nayabazar) using path distance spatial analysis tool (in Figure 8).

Figure 8: Path Distance and Direction from Source

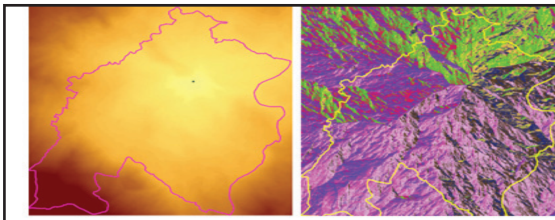

Figure 9: Path Distance and Direction from Source

Least cost path route was computed from the optimized path distance and its back link raster (path direction) to the different destination location using least cost path algorithm (cost path) in spatial analysis tool in ArcGIS 10. The proposed road network in 2030 obtained using least cost path for major road from Nayabazar Kirtipur as source (existing urban centre) to different destination location which will be future urbanized. The proposed three alternative road networks from different weight for thematic cost surface and then least cost path were determined (in Figure 9).

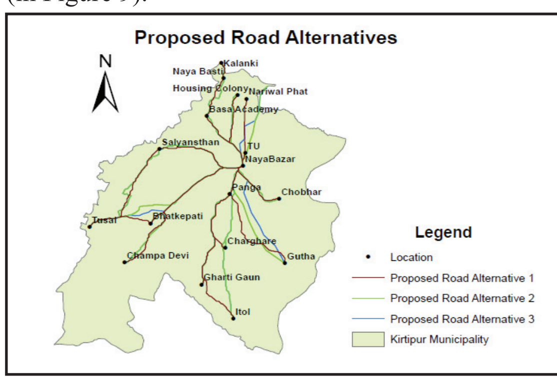

Figure 9: Road Network Alternatives

The multi-criteria analysis was carried out using weighted summation method and interval standardization for ranking of alternatives in Definite Software. Sensitivity analysis was also conducted to analyze the sensitivity of ranking through assessment of the score and the weight uncertainty in defining the priority of alternatives. Relative importance for each effect showed that the road length is most important compared to others effects. The result of multi-criteria is shown in Figure 10. The uncertainty in length and gradient used are 0.10% and 0.15%

respectively. Road network alternative 1, 2 and 3 have total accumulation value 0.75, 0.50 and 0.67 respectively. The results indicate that proposed road network alternative 1 is better compared to proposed road network alternatives 2 and 3.

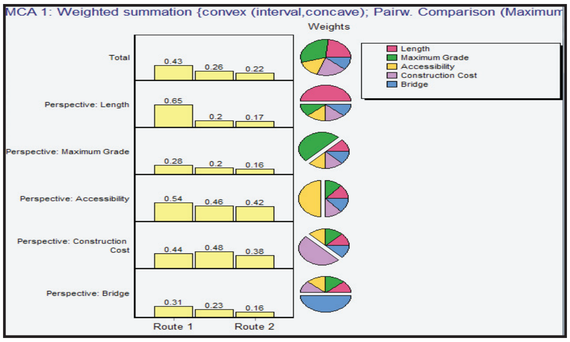

Figure 10: Multi-criteria Analysis

From multi-criteria analysis and sensitivity analysis the proposed road network alternative 1 is the best for construction having less length and suitable maximum gradient. The road length and suitable gradient of proposed road network alternative 1 is minimum ranking level, so this alternative is selected for purposed road network in future 2030.

6. Conclusion

The planning of road has become a complex task with the consideration of different criteria's/factors associated with its weight-scoring. The analysis for sustainable road network planning has achieved with the ground parameters, expert knowledge and model in ArcGIS or customized with python. In spatial analysis assessment, the intermediate and final results from the model has based on its pre-assumption of criteria consideration and related with its weight-score. MCE within SDSS has analyzed based on the raster based spatial analysis; which provides a wealth of capability for incorporating terrain information surrounding the location of infrastructure development. Road network planned using least cost path algorithm gives good result considering the engineering parameters. It is fast and efficient technique considering with gradient, friction surface, connected neighbors in 3D.The road route gradient can be adjusted as per the requirements, depending upon the terrain conditions. Hence, it is possible to design a more realistic route in an automated way by changing some of the parameters as needed.

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Calendar of International Events

Geospatial world Forum
5-9 May, 2014
Geneva, Switzerland
E: info@geospatialworldforum.org
W: www.geospatialworldforum.org

ISRPS Technical Commission IV Symposium Services.
14-16 May 2014
Suzhou, China
E:Isrpstc4@nsdi.gov.cn
W: www.isprs.org/2014tc4symposium

The Third International Workshop on Earth Observation and Remote Sensing Application
11-14 June 2014
Changsha, china
E:eorsa2014@gmail.com
W: www.eorsa.2014.org

FIG XXV International Congress
16-21 June, 2014
Kuala Lampur, Malaysia
E:fig@fig.net
W: www.fignet/fig2014

The 21st Meeting of ISCGM
August, 2014
New York, USA
W: www.iscgm.org

GI Science 2014
8th International Conference on Geographic Information Science
23-26 September, 2014
Vieana, Austria
E:gisceince2014@geoinfo.fuwien.ac.at
W: www.giscience.org

35th Asian Conference of Remote Sensing
27-31 October, 2014
Ney Pyi Taw, Myanmar
E:acrs2014@gmail.com
W: www.acrs2014.com

Third Meeting of UN-GGIM-AP
November, 2014
Bali, Indonesia
W: www.un-ggim-ap.org

Digital Earth Summit 2014
9-11 November, 2014
Nagoya, Japan
E:jianghao@radi.ac.cn
W: www.isde-j.com/summit2014

The 21st session of the Asia Pacific Regional Space Agency Forum (APRSAF-21)
2-5 December, 2014
Tokyo, Japan
E:secretariat@aprsaf.org
W: www.aprsaf.org

FIG working week & General Assembly
17-21 May, 2015
Sofia, Bulgeria
W: www.fig.net/fig2015

International Conference on Intelligent Earth Observing & Application
26-27 June, 2015
Guilin, Guangxi, China
W: www.glut.edu.cn

Technical Aspects of Digitization of Cadastral Maps

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Abstract

Mankinds of the 21st century are seeking for qualitative matters. They can't be satisfied only with the normal service; they expect value added service i.e. qualitative service. To cope the customer's satisfaction, almost all sectors are enhancing their performance and service delivery system using the information technology. Digitization of cadastral map is very essential for providing effective, reliable and qualitative cadastral services. Having the digitized cadastral maps and GIS database we can have a lot of advantages related to storage, management, retrieval, analysis, dissemination, update as well as IT enabled effective and reliable cadastral service delivery. In the present context of being scarcity of conventional instruments, ammonia paper and other accessories, it is crucial to enroll into this process and modernize land information in order to run with time, technology and international community.

Keywords

Digitization, Scanning, Geo-referancing, GIS, Seamless Database, Edge Matching, Computer based Cadastral Service Delivery

Background

Mankinds of the 21st century are seeking for qualitative matters. They can't be satisfied only with the normal service; they expect value added service i.e. qualitative service. To cope the customer's satisfaction, almost all sectors are enhancing their performance and service delivery system using the information technology. For this, service providers are adopting modern computer technology. Before adopting the computer technology the most important step is to convert the analogue format data to the digital format in order to provide prompt, effective and quality service delivery. The digital conversion is possible basically by two methods. The first method is data entry of the analogue information in the designed and customized computer application and the next method is scanning of the analogue documents and further processing. In dictionary we can see, Digitizing is central to making a digital representation of geographic features, using raster or vector images, in a geographic information system i.e. the creation of electronic maps, either from various geographic and satellite images or by digitizing traditional paper maps. Digitization is also used to describe the process of populating databases with files or data. Therefore in our context, Digitization of cadastral map is the process of conversion of analogue(Paper/Cloth) maps to the digital form. More specifically it is the process of conversion of analogue map to vector map with its associate database.

Introduction

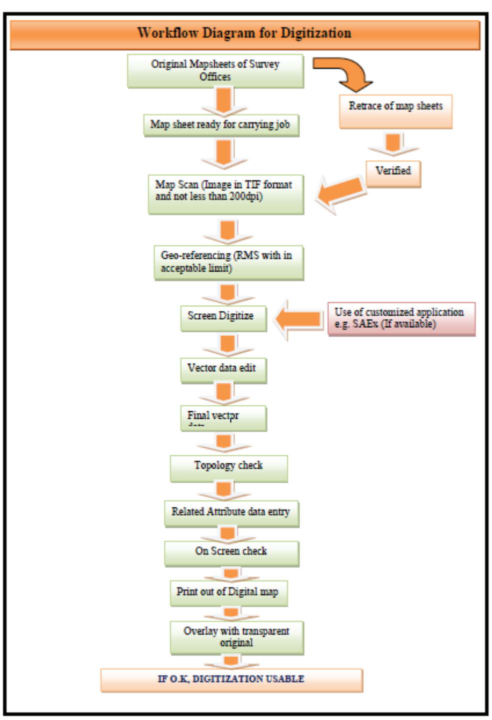
Cadastral map is a fundamental data that prescribes parcel numbers, land boundaries, classification of land and ownership of land parcels. It aims at defining and guaranteeing legal property boundaries and determining the area and perimeter to give information on the size and nature of land use. It is a very serious matter regarding to the property right of every citizen therefore providing computer based efficient and effective cadastral service is highly essential. Obviously, there could be two possible methods for computerizing cadastral services. The first method could be possible with the primary data acquisition i.e. survey and mapping with computer technology which definitely enhances quality of data (if perfectly done). But it may be a very long process that takes more time, money and efforts. The next method could be the digitization of analogue maps and preparation of geodatabase. This method could be effective, less time consuming and economic as well. Special care and precaution should be taken while doing digitization. Actually, it is a secondary data acquisition of cadastral data through which each and every information of analogue maps are converted into digital form.

Steps of Digitization

Digitization of cadastral maps is the process of acquiring vector map from the existing analogue maps. It means source of vector data is the existing analogue maps. Therefore source must be clean, clear, unfold, non scratched and non shrinkaged. Practically it may not be possible to get such ideal cadastral maps in survey offices due to overuse of maps in day to day activities. Hence before scanning, the primary step should be tracing of analogue map.

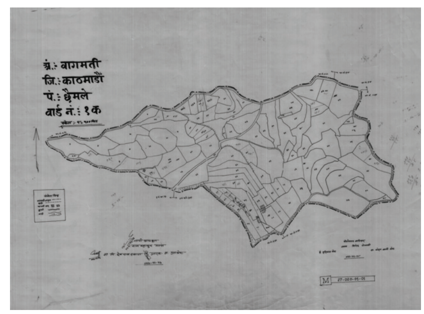
1. Tracing of analogue maps

Definitely, quality of the product depends upon the source adopted. In order to achieve clean, clear, scanned image; scanning source must be fine. Therefore it should be taken as a necessary step prior to scanning of cadastral map. Tracing should be done from the original cadastral sheet. If the original sheet itself is also in poor condition, it is better to obtain the certified maps from the general public or financial institution for tracing purpose. Tracing should be done using standard materials and then verified & approved by the authorized personnel. In case the cadastral map on the clothing paper, even being fine, it should be strictly retraced on permatrace as such clothing material is not appropriate to fed into the scanner.



2. Scanning

Scanning is the next important step. Actually it is the process of conversion of analogue maps to raster images. Scanning should be done with a roller scanner with at least 200 dpi (dots per inch) resolution in grey scale.



Scanning on 200 dpi resolution is equivalent to ground pixel size of 0.3175m for 1:2500 map which is sufficient. Precaution should be taken to feed the traced cadastral map such that it will be completely vertically aligned and no warning will occur. The scanned cadastral maps will be better to store in "TIFF" format without compression. It is important to check the image with maximum zoom and diagonal check in order to ensure that there will be no distortion in the scanned image. Maps should be properly strengthen and should be made dust & dirt free. Also, calibration of scanner should be properly done for better scanning results.

3. Geo-referencing

3.1 Geo-referencing of Grid Sheets

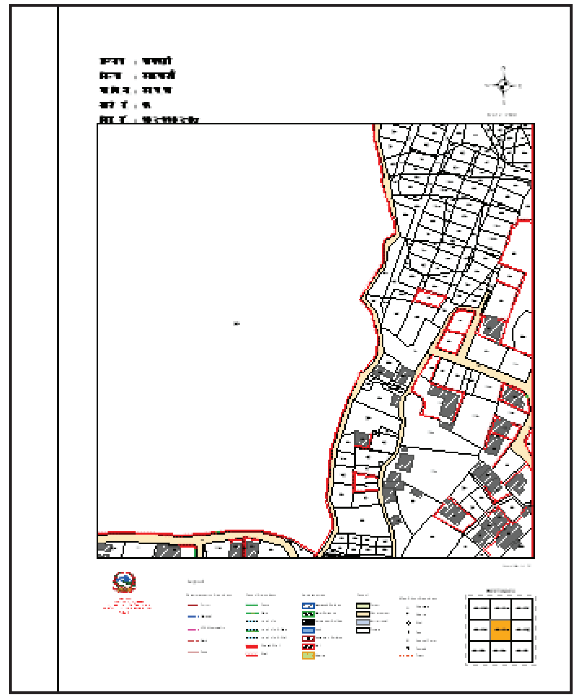
As, there are known co-ordinates of the four corners of grid in Grid Sheets. By the help of the known co-ordinates we can geo-reference the Grid Sheets. While inputting the co-ordinate of the corners of grid, the corner tics should be sharply identified. Using the four corner tics and 1st degree polynomial transformation produced images sometimes has slight mismatch and gaps at the edge with other adjoining sheets. This may due to the wrong or displaced corner tics and warped sheet boundaries. This can be resolved by feeding the co-ordinate of the control points within the grid sheet and using 3rd degree polynomial transformation to rectify the image. After geo-referencing the rectified images should have the RMS error less than the specified tolerance level.

3.2. Geo-referencing of Free Sheets

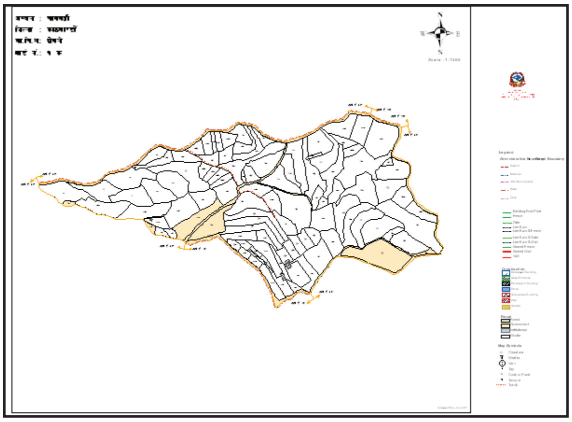
Geo-referencing of free sheet is a very difficult and challenging task. As there are no more known points in the sheets we can't feed the coordinates directly. To geo-reference the free sheet we have to identify the certain scattered points or details, than we have to go to field survey for finding out the coordinates of the identified points. Practically, it is very difficult and time consuming task. Instead of geo-referencing of free sheet from the real ground co-ordinate system, we can geo-reference with an arbitrary coordinate system. There could be two possible methods for this. One could be drawing a grid with fixed dimension on a free sheet; we can give arbitrary coordinate and geo-reference arbitrarily. This method may be quite complicated as there need to draw perfect grid manually on original map. Another alternative method of geo referencing the free sheets is geo-reference with the help of "TIFF world file" (.tfw) file. Actually, it is a geo-referencing of scanned map pixels to an arbitrary coordinate system. Each scanned free sheet image in TIFF format are scaled to ground coordinate scale with a reference .tfw file. This is a text file containing the pixel reference and associated ground coordinate or arbitrary ground coordinate. The .tfw file format is readable for all GIS and CAD software. This method may be quite easy and convenient for geo referencing of cadastral maps with arbitrary coordinates.

4. Digitization

The scanned images after geo-referencing either ground coordinate system or arbitrary coordinate will be ready for digitization. Actually digitization is the most important step through which vector data is generated from the raster data or scanned image. Digitization can be done automatically, semi-automatically and manual techniques. But cadastral map is the sensitive data related to property right and a single millimeter variation may cause a serious problem; manual or on screen digitization



technique is the most appropriate technique as it is very accurate and reliable technique of digitization. Digitization can be done using various GIS and CAD softwares. It is more appropriate to use customized application based on ArcGIS to bring uniformity and consistency in digitization process. e.g. In our context SAEx (Spatial Application Extension), a customized application of ArcGIS software can be used as it contains certain feature class with definite fields with required characters. It is better to digitize after mosaicing the adjacent images so that edge matching problem can be minimized to some extent. Digitization should be seriously done by the experienced digitizers more preferably, the surveyors with GIS knowledge. While digitizing the image should be zoomed at least six times of the original and the digitizing lines should pass through the center width of the zoomed image. Special care should be taken for snapping within the tolerance on the node, vertex and edge in order to reduce topological errors. The digitized data should be topologically error free. The topology should be checked using the topology tools in GIS software. Digitization can also be understood as the digital tracing of the cadastral maps with mouse. While digitization each and every parcel should be seriously digitized in clockwise direction with minimum possible points.



5. Attribute Data Entry

After digitization and topological error check, the next step is the attribute data entry. In this step attribute data associated to individual parcel is entered in the attribute table. E.g.. parcel number, land use, land classification, VDC name/code, district name/code, ward no., Grid sheet number/ free sheet number, building type, boundary type etc. Area and perimeter of each parcel with the feature class/shape file will be automatically calculated and other information related to parcel. And other information can be given manually. Feature class/ shape file can be created as per requirement with required fields and characters. If we are working under customized application e.g. SAEx we can give the attribute information as per the field in the feature class. Giving the attribute information related to the feature class, we can have the whole information in a single click. Attribute should be used as per the standardized code (if available) to bring uniformity in data so that linking and merging of data will be possible in future.

6. Digitized data check

The digitized data should be thoroughly checked on computer screen to ensure the each and every parcel and other information of the cadastral image is correctly digitized. For this the vector data is overlaid over a scanned image. This can be taken as a step of Geometric check of the vector data generated. After that, each and every parcel numbers and their respective attribute information should be checked in a detailed way so that the parcel number and other attribute data are completely corrected. This can be taken as attribute check. Both checks should be done on computer screen as "Heads-up Checking" of digitized data.

7. Print and Overlay Check

After on screen data checking, the vector map should be printed out with a appropriate plotter on the original scale and size i.e. A0/A1 of the source map so that each and every parcel and details can be checked one by one to ensure that the digitized data product and the original analogue maps coincides exactly and there will be no error in digitized data and could be used for computerized service delivery to the general public and other stake holders. Sometimes, the printed maps coincide only with the overlaid parcels and adjoining parcels but mismatch gradually with the far parcels. Therefore before printing, plotter should be well calibrated and adjusted. The final overlay check or final verification should be done by overlaying the printed maps over analogue maps using glass table to check overlay accurately and precisely.

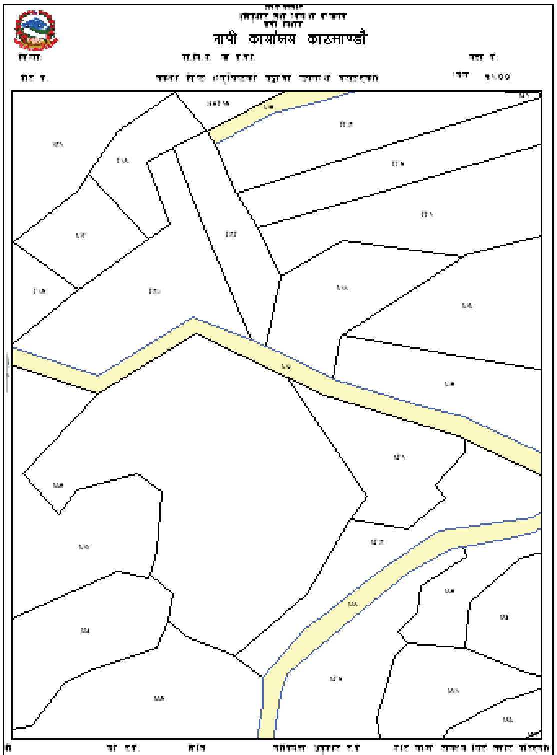
8. Digitization and Geodatabase Usable

After all these abovementioned checks on the digitized data and geodatabase, the final product can be acceptable and usable for day to day cadastral activities in concerned offices. Special care and attention should be given for cent percent checking of the generated data although being complex, time consuming and tedious because small and minor mistakes in digitization may bring severe problems and complication during service delivery.

Benefits:

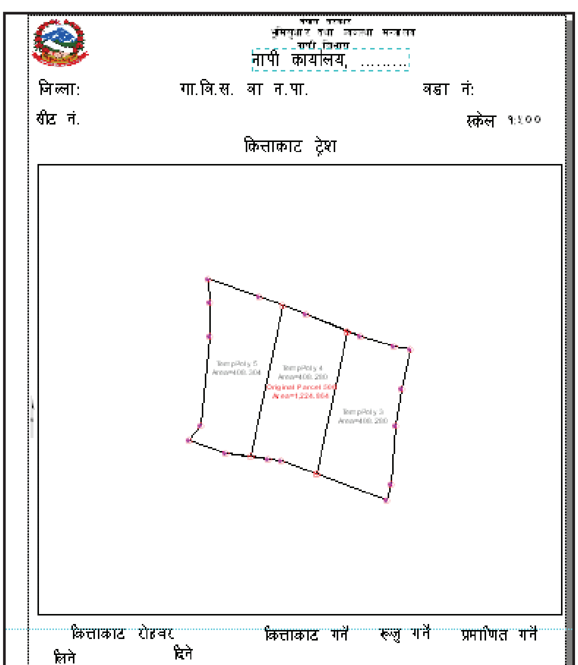
(1) Effective and Quality Service Delivery

After digitization, effectiveness on service delivery will be increased and quality on service delivered will be enhanced. Service seekers will get prompt, transparent, reliable and consistent service delivery from survey offices. Parcel split, Parcel merge, Map Print can be done very accurately and precisely. The



Computer printed cadastral map

area of an individual parcel will always be same i.e. consistent results; which is almost impossible in traditional methods. Once area and dimension accepted it will be forever. There will never a



Parcel Split precisely with GIS Software

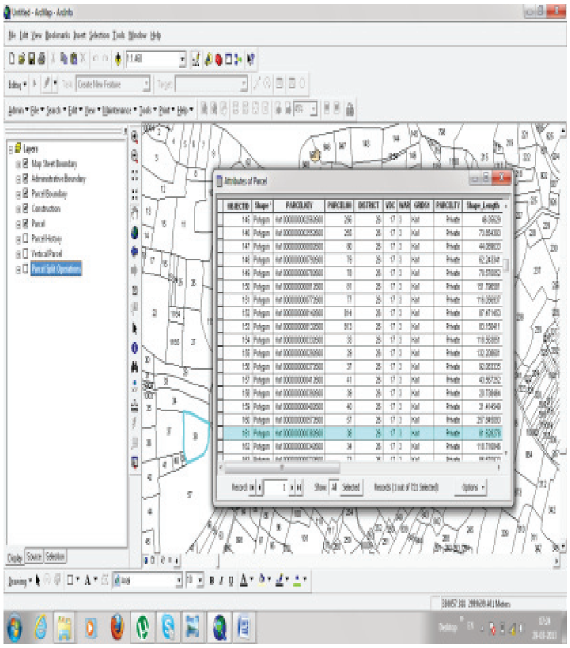
discrepancy in area and dimension even in a meter square and centimeter. Area and other relevant information can be obtained from a single click. Public will able to get computer printed cadastral maps in portable size i.e.A4/A3 size papers. Ammonia prints could be totally replaced and we can get rid from dependency on sunlight for map print. Parcel split trace (kittakat trace), Parcel trace (kitta trace), Map print can be given in any scale and size.

(2) Safe Storage and management of Cadastral Data

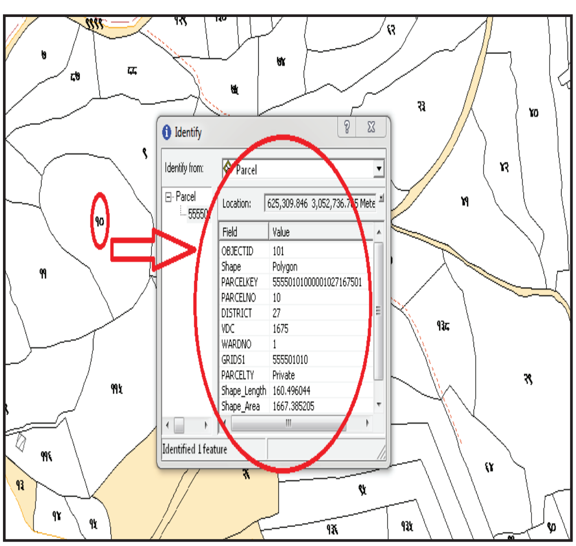
The major problem in conventional method is difficulty in storage and management of cadastral maps. Basically, there are two sheets of each cadastral map; one is original and next is trace copy. The trace copy is used for carrying out day to day activities and original copy will be updated at the end of each day. The maps will be wear and tear due to overuse and the maps will be faint, shrinkaged, stretched as well as mutilated too. There will be gradual deterioration of the cadastral maps. There is frequent need to retrace the cadastral maps. Original sheet, trace sheet and frequently traced trace sheets are difficult to store and manage even in a single or multiroom. This may also create a confusion to identify the trace maps and update maps. After digitization all these issues can be easily addressed. All the digitized data can be stored on a single hard disk or on a single computer. Backup in next computer or hard disk or DVD can be kept for safety of the data. Data will be retrieved from the computer and day to day activities will be done from a single chair and computer. There will be no need of tracing and retracing of cadastral maps.

CD/DVD Hard Drive Computer

(3) Working in GIS Environment



After digitization of cadastral maps, there will be a drastic change in the working environment i.e. from conventional environment to computerized GIS environment. Cadastral maps can be stored, managed, retrieved analyzed, disseminated and update within GIS environment. Using the GIS software and environment we can have various kinds of advantages. Various kinds of analysis can be easily done and can reduce the one day work in one minute. Various queries can be easily done needed for planning, policy making and other developmental activities. E.g.. how many parcels are less than 2 Anna 2 Paisa in certain specified area, how many parcels



and how much area are covered by government or public in certain area, what is the buffer zone of road in the 15 meters expansion and how much area should be given compensation. Analysis and visualization with various parameters can be easily done and useful information can be extracted.

(4) Reduces Repetition of work

After having digitized data, there will no need of trace and retrace of cadastral maps time to time. There will no need of preparation of isolated file maps and parcel plans as the digitized data it can be zoomed in and out to any scale as per requirement. In traditional method, it is necessary to make file maps if we want to enlarge the parcel. If the parcel is small and difficult to split and mention parcel number, a file map is prepared in next separate permatrace which is difficult to store, manage and retrieve. In addition there will be more chances of introducing errors while making file maps. Digitized data will help to reduce such repetitive works.

(5) Reduces Duplication of work

Cadastral data is the fundamental data and is highly essential in every development activities. E.g.. while construction or upgrading of road, irrigation, transmission line, railway, canal, drinking water, sewerage etc. it is very necessary to identify the parcel and area coverage of the alignment. And concerned organization will acquire and digitize the cadastral maps to have cadastral information. If we share or sell the prepared digitized data there will be no duplication of work and it will bring homogeneity on data and definitely reduces time, cost and effort.

(6) Data Linkage

With the digitized data we can link other relevant data and information. For example if we have scan fieldbooks images, plot register images, we can hyperlink the parcel with the respective fieldbook and plot register image so that we can also have field book and plot register information on a single click. It means all the associated documents can be linked and obtained from a single click. Moreover, we can have linkage with the other attribute data of Land Revenue Office by LAN network generating common key on database. As a result, on a single click of parcel we can have information of area, perimeter, land use along with owner's name, owner's father's name and so on.

(7) Information Sharing

With the digitized data throughout the country helps to establish land Information System (LIS). The digitized data can be shared in uneditable or view only mode with various stakeholders' organizations, banks, financial institutions, and local bodies to assist in their respective activities. We can also generate good revenue from this information sharing. This can be done through local network or web based network.

Some Technical Issues

Digitization of cadastral maps has many advantages. In the modern era of information communication technology, digitization of cadastral maps and providing computer based cadastral service is highly essential. However, there are some technical issues that should be addressed for computer cadastral services.

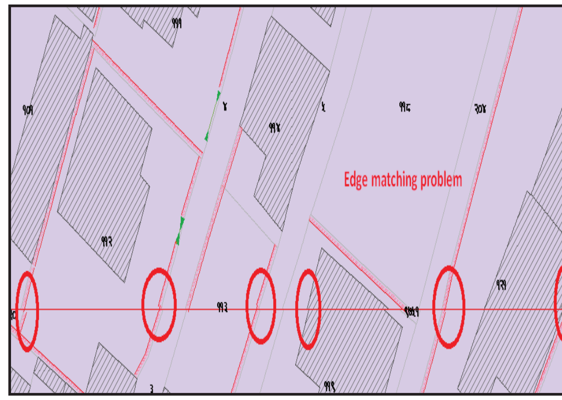
(1) Area Difference between Legal Area and Digitized Area

Area calculation from the analogue maps which we accept as a legal area are based on the traditional manual method whereas area calculation of the digitized cadastral data is based on modern computer methods. Naturally there will be discrepancies in area between digitized area and legal area. The legal area was calculated using computing scale and grid with approximation method and eye judgment techniques whereas area of digitized and cadastral map is calculated by the software itself based on digitized data. This is a common and worldwide issue after digitization.

Possible solution

The legal area and digitized area should be studied and analyzed. The first solution could be the digitized area will be compared to the legal area and a standard discrepancy could be made for acceptance. While calculating the legal area by the traditional method, two surveyors calculate the area of the same parcel, if the area difference calculated by two surveyors lie on the specified tolerance level, the first area is acceptable. Likewise we can accept the digitized area if it falls on the given specified tolerance level. Moreover, a study could be made between the area of digitized area and legal area and a new tolerance level could be defined. If the area between digitized and legal area falls on the defined tolerance, digitized area could be accepted and further activities could be done from digitized area. If the discrepancy doesn't fall in tolerance level , digitized data should be checked. If it is correct than the legal area from the analogue map should be checked. If necessary, field verification should also be done. The alternative solution could be the defining the tolerance level in percentage basis depending upon size of parcel. e.g.0.5% for less than $500m^2$, 1% for more than $500m^2$. Many countries adopt this technique to address this solution.

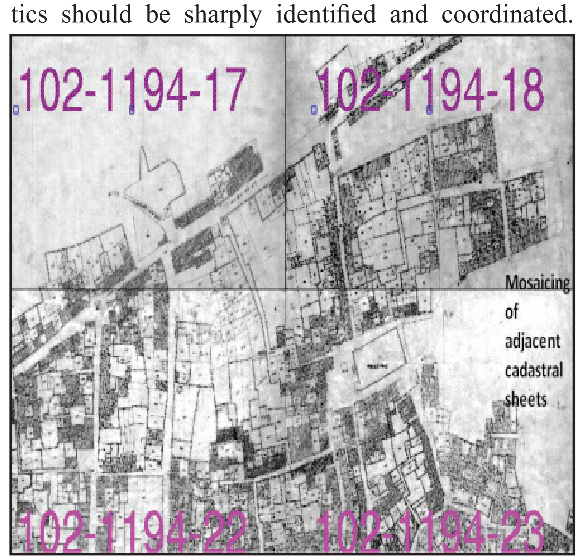
(2) Edge Matching



It is another serious issue felt during digitization of grid sheets and making seamless database. This problem arises when the same parcel lying in different sheets doesn't exactly coincide on the adjacent sheets. This problem may be due to shrinkage or stretched on the boundaries of original cadastral maps and improper geo-referencing of the sheets. This problem may be also due to error in source or analogue maps. It means the parcel may not be edge matched while matching manually too i.e. due to problem in mapping or in re-tracing.

Possible solution

To minimize this problem, a fresh traced copy (without that shrinkage and expand) analogue map should be used for scanning. While geo-referencing corner tics should be sharply identified and coordinated.



The next important step to reduce this problem is Mosaicing the adjacent scanned image and clipping to meet parcel in the edge before digitization. Digitization should be done through the center of the edged parcel if the mismatch between them is less than the tolerance level. Alternately, temporary solution could be tracing of that edged parcel from the analogue maps in a separate permatrace and then scan, geo-reference and digitize to carry out day to day activities.

(3)Adjustment of File Maps

Due to constraint of zooming in or enlarge on the analogue maps due to its static nature, file maps are prepared when the parcel is small and difficult to split and write parcel number within it. They are prepared in large scale by enlarging proportionally. Theoretically, such file maps should have the same orientation, shape and area to the parent parcel. But practically, they may vary in shape and area in many cases due to various reasons. While digitization such file maps should also be adjusted to their respective parent parcel to make a complete integrate database but being variation in area and shape, it may difficult to do and may cause serious problem in many cases.

Possible solution

Rectifications of such file maps can be done according to legal document i.e. deed and then integrated to the parent database. Alternatively, as a temporary solution, a separate scanning of the filemap can be done and then referenced and digitized in a separate database. To manage and retrieve easily such separate database, hyperlink can be made in the database of parent parcel. Restriction for preparing file maps should be made after implementing digitized database.

(4) Mistakes in Parcel Split

Sometimes, parcel split by a surveyor will be incorrect and inaccurate. Such mistake may be un intentional due to excessive work pressure, lack of sincerity or sometimes intentional due to wrong intention of concerned officials. Such parcels are clearly identified after digitization.

Possible Solution

Such parcel can be corrected according to the deed at the time of transaction of that parcel by splitting the parcel exactly as per mentioned in the deed.

(5) Data Security

Data security is another genuine issue after digitization. As mentioned earlier, all the digitized data can be stored and managed from a single computer or from a single hard drive. There is a maximum probability of transferring of data from Pen drive, DVD or other storage device so that such data could be misused and misinterpreted for various malfunctioning activities. Besides, data on computer or hard disk could be last or damaged due to virus or damage of hardware.

Possible Solution

For well management and security of the digitized data, data should be kept only on a single computer. i.e. on a server computer. Software should be run from client computer with LAN network. System Administrator should be allocated giving full responsibility of the data security and backup. Antivirus should be kept on server. Password of server should be given only to system administrator and office chief. USB and DVD-ROM of the server should be made disabled. In client computer, data should not be imported and every activity should be done directly using the database of server with the username and password provided by system administrator. Backup should be kept by system administrator in next storage device also. A third backup can be kept in respective department with the responsibility of authorized person. Server should be kept with special care in well air conditioning. Server with mirroring facilities should be used so that data can be recovered from next mirrored hard disk, in case, a running hard disk of server is damaged.

Conclusion

Finally, Digitization of cadastral map is very essential for providing effective, reliable and qualitative cadastral services. Digitization of cadastral map is very sensitive task. Among the various types of maps, cadastral maps being related to the rights of property; its sensitivity should be seriously realized before digitization of cadastral maps. Skilled and well knowledged digitizers, preferably surveyors with cadastral knowledge, can only digitize cadastral maps in a qualititative manner. Having the digitized cadastral maps and GIS database we can have a lot of advantages related to storage, management, retrieval, analysis, dissemination, update and IT enabled effective and reliable cadastral service delivery. In the present context of being scarcity of conventional instruments, ammonia paper and other accessories, it is crucial to enroll into this process and modernize land information in order to run with time, technology and international community.

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Use of Geo-Informatics in Flood Hazard Mapping: A Case of Balkhu River

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Abstract

Flood is one of the striking water induced disaster that hits most of the part of the world. In Nepal also it is one of the serious disasters which affect the human lives and huge amount of property. The study describes the technical approach of probable flood hazard analysis. Segment of Balkhu River within the Balkhu catchment of area 44.37 km2 from Kirtipur gorge to Bagmati confluence was taken as area of study. The total length of the study segment was 5485.89 m. One dimension HEC-RAS (Hydrologic Engineering Center-River Analysis System) model was used for the analysis. The study shows that higher flood depth increases and low flood depth decreases with increase in intensity of flood. Also, huge area of barren land area is affected by flood and few percentage of settlement area is affected by flood indicating the damages to the human lives. Huge area of barren land indicates that in future human lives are more prone to disasters as those lands have gone through planning for future settlement.

Keywords

Geo-informatics, flood hazard, flood frequency, Balkhu River

1. Introduction

Natural hazards have always been viewed as the detrimental consequences of the people's use of their environment (Penning-Rowsell *et. al* 1986). Every year, natural disasters take place in various parts of the world, killing a number of persons and destroying great deal of properties. Causes of natural hazards could be water, air, glacier etc. Among them, water induced disasters have recently been recognized as a world wide problem with loss of lives and properties and prolonged negative effects and untold miseries (Chalise et. al.1995).

Flood is one of the striking water induced disaster that hits most of the part of the world. Tsunami of Indonesia and Katrina of USA are the examples of severe natural disasters that brought floods in large magnitude which killed huge number of people and brought about tremendous amount of economic loss. Intensity and duration of flood greatly depend on pattern of the storm, characteristic of drainage basin as well as other factors too (Hoggan, 1997). Generally, high intensity rainfalls are assumed to be the main flood-generating events (Buttle and Xu 1988). Beside intense rainfall in urban areas, development of infrastructures, buildings pavements etc which increases surface runoff are the major causes of floods. Streets and paved areas are networked by channels of surface drains and underground sewers which decreases time lag to the river channel thus delivering it more rapidly to the river and hence causing urban floods. In addition, the constriction of river channel by bridge supports or riverside structures reduces carrying capacity of the channel. In recent years, among worldwide events, 90% of natural disasters have been related to weather and climate with nearly 70% of the people affected in Asia due to floods (Shrestha, 2006). South Asia ranks first in nearly all statistics related to water-induced disasters, particularly floods (Eriksson, 2006).

Water induced disasters of varying intensity and magnitude affect various parts of Nepal regularly. The principal triggering factor is the monsoonal rainfall which is mostly confined between June and September every year (Chalise, *et. al*. 1995). About 80% of annual rainfall occurs during monsoon season and thus, extreme floods during monsoon season occur due to this concentrated spells of heavy rainfall (Shakya, 1998). The draining of natural wetlands and the spread of towns across the countryside and many other human interventions has reduced infiltration leading to more frequent and higher floods (Shakya, et. al., 2006). In most of the urban cities of Nepal, flooding is due to the combination of extreme rainfall and urbanization. However, issue of urban flooding was highlighted when Katmandu got flooded in 2002 with total human death of 27. Most of the rivers were flooded with huge loss of property. Balkhu River was heavily flooded and flood level reached nearly 2.5 m from base at Oriental Colony and flood overtopped natural bank and extended up to 40 m either sides up to Tribhuvan University main gate (Ranjit, 2006). Three people living near the bank of Balkhu River lost their life among 27 deaths. The major cause of the flooding was the constriction of river channel for the human settlement.

Thus flood forecasting is very important for minimizing flood damage and loss of life and hence should be an integral part of flood control system (Singh and Singh, 1988). Among various non structural measures need for disaster mitigation, hazard mapping is one of the important nonstructural measures (Mahato, et. al., 1996). Land flood hazard areas can be delineated based on hydrologic studies for selected flood peak magnitudes and topographic information (Joshi, 1987). Flood hazard mapping is a process in which the aerial coverage of flood water is depicted in maps showing areas under different depth for particular flood event caused by direct flooding and / or impounding of water of rivers and tributaries of a particular return period (Sharma, 2004). However, flood hazard mapping and risk assessment in Nepal is still very rudimentary where most of the flood protection works are carried out at local level without proper planning and without considering the problem at the river basin scale (Awal, 2007).

2. Objectives

Major Objective of the study is to estimate flood disaster in a GIS environment. The specific objective of this study includes:

- Preparation of land use map
- Flood frequency analysis for different return periods
- Flood hazard mapping

3. Methods and Materials

GIS can be equated to both a computer database and a computer system for producing maps. There has been a significant increase in the use of Geographic Information System (GIS) globally in recent year. The technique provides operational tools for making policy, for planning for management and for making decision (Karim, 1995). The overall methodology used for the study is presented in figure 1.

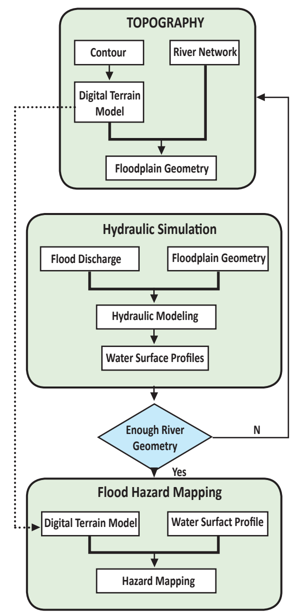

Figure 1: Flow diagram.

Erdas Imagine 9.0, Arc View 3.2a, HEC-RAS and HEC-GeoRAS as interface between ArcView and HEC-RAS were selected for the study and required available data were collected from different sources.

3.1 Data Requirement

The basic data input required for ArcView with GeoRAS extension are:

- River network data (left bank, right bank and main channel)
- Flow paths
- Digital Terrain Model (DTM) in the form of Triangulated Irregular Network (TIN)
- Cross section data normal to the river flow
- Land use map of the study area

Whereas, the HEC-RAS requires,

- River network data

- River geometry data
- Manning's roughness *(n)* value (Table 1)
- Flood discharge of different return period
- Levee geometric data

Table 1: Manning's roughness coefficient for different land use classes. *(USACE, 2002)*

S.No.	Land use type	Manning's Coefficient
1	Cultivation	0.035
2	Built-up area	0.017
3	Vegetation	0.100
4	Barren land	0.030

3.2 Data Preparation & Analysis

Contours with 1 meter interval were prepared by photogrammetry. On the basis of this and the contour developed by Kathmandu Urban Development Project (KUDP) with 2 meter interval, TIN was generated. The river network data was digitized from the map compiled from photogrammetry. The cross sections were taken at 25 m interval. The river segment where there is meandering, the cross sections are further added according to the requirement. The length of cross section ranged from maximum 441.65 m to 54.41 m. Total 195 cross sections were taken for the analysis (Figure 2).

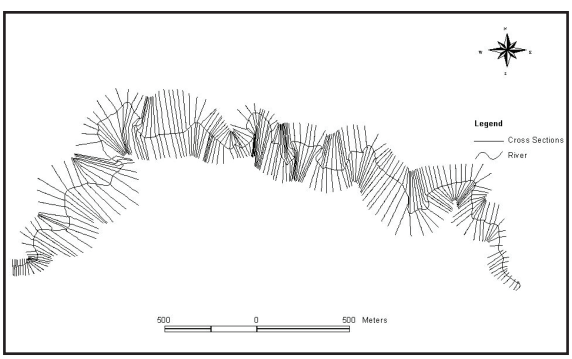

Figure 2: Cross section along the study segment of the river.

Land use map of the study area was prepared by using Erdas Imagine V 9.0. IKONOS image of 2006 AD was used for the preparation which was collected from National Land Use Project, Ministry of Land Reform and Management.

Flood frequency analysis was done on the base of equation developed by Water & Energy Commission Secretariat (WECS) and Department of Hydrology & Meteorology (DHM) for 2-year and 100-year floods.

$$Q_2 = 2.29(A_{<3K})^{0.86}$$
$$Q_{100} = 20.7(A_{<3K})^{0.72}$$

Where Q is the flood discharge in m^3/sec and A is basin area in km^2. Subscript 2 and 100 indicate 2-year and 100 year flood respectively. Similarly, subscript 3k indicates area below 3000m altitude.

Further, following relationship was used to estimate floods at other return periods.
$Qf = \exp(\ln Q_2 + s\sigma_1)$ (WECS and DHM, 1990)

Where $\sigma_1 = Ln \frac{Q_{100}}{Q_2 x 2.326}$ and *s* is the standard normal variants whose values are given in table 2.

Table 2: Value of standard normal variant for various return period.

S.No.	Return period (T) in years	Standard normal variate (s)
1	2	0
2	5	0.842
3	10	1.282
4	20	1.645
5	50	2.054
6	100	2.326
7	200	2.576
8	500	2.878

Source: Sharma and Adhikari 2004

Table 3: Discharge values for different return periods.

S.No.	Return Period	Flood Discharge (m^3s^{-1})
1	10 year	147.9
2	20 year	192.03
3	50 year	257.72
4	100 year	313.42

After preparing all required data, the import file was created which is imported in HEC-RAS. This is the major part of the model where simulation is done. All the required modification, editing was done at this stage. The flood discharge for different return periods were entered in steady flow data. Reach boundary conditions were also entered in this window. Then, water surface profiles were calculated in steady flow analysis window. After finished simulation, RAS GIS export file was created.

The flow data were entered in the steady flow data editor for four return periods as 10-year, 20-year, 50-

year and 100-year. Similarly, upper most cross section RS (River Station) 5484.67 was taken as upper stream boundary. Boundary condition was defined as critical depth for both upstream and downstream.

Table 4: Critical depth value for different return period.

S. No.	Return Period	Critical Depth (m)	
		Upstream	Downstream
1	10-year	1312.945	1274.223
2	20-year	1313.399	1274.419
3	50-year	1314.009	1274.683
4	100-year	1314.445	1274.884

Sub critical analysis was done in steady flow analysis. Then after, water surface profiles were computed. The resulted was exported creating the RAS GIS export file and required flood depth and hazard maps were prepared simultaneously.

4. Results

4.1 Flood vulnerability analysis

The assessment of the flood area shows that a large percentage (more than 80 %) of vulnerable area lies on the barren land (Figure 3). Another effected area includes settlement area which shows the considerable impact of flooding on the human beings.

Table 5: Land use vulnerability for different return periods.

Land use class	Total Vulnerable Area (m^2)			
	10-year flood	20-Year flood	50-Year flood	100-year flood
Cultivation	12973	14064	15352	16183
Vegetation	15707	16676	18121	19185
Built-up area	59157	69979	79444	89517
Barren land	269173	281422	296786	313869
Total	357010	382141	409703	438754

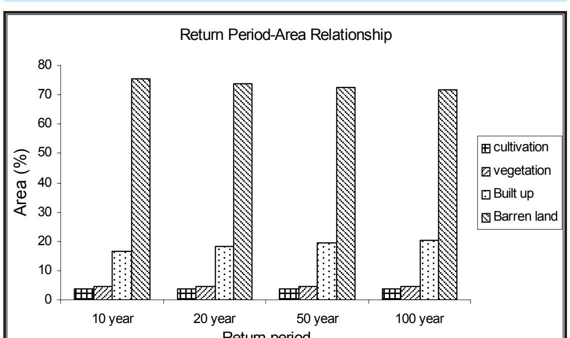

Figure 3: Flood area for different return period.

4.2 Flood hazard analysis

Water depth is the determining factor for the quantification of the flood hazard and potential of damage. In this study, hazard level is determined by reclassifying the flood grid depths at the interval of 0-0.5, 0.5-1, 1-1.5, 1.5-2, 2-2.5, 2.5-3 and >3. The area bounded by the flood polygon with these depth intervals were calculated to make assessment of the flood hazard level.

Table 6: Classification of flood hazard according to depth of water.

Water depth (m)	Total Flood Area (m^2)			
	10 years flood	20 Years flood	50 Years flood	100 years flood
0-0.5	65195	54733	40436	44959
0.5-1.0	118708	107254	84304	61793
1.0-1.5	89524	99249	100448	111826
1.5-2.0	40835	45106	68456	59824
2.0-2.5	30293	41304	41525	52171
2.5-3.0	25294	22599	35823	40419
>3	17446	42235	69092	98098
Total	387296	412480	440083	469089

The classification of flood depth area shows that most of the flooding area has water depth less than 2 meter. The area under flood with water depth greater than 3 m increases considerably with increase in intensity of flood. Flooded area with higher flood depth increases and lower depth decreases with increase in intensity (figure 4).

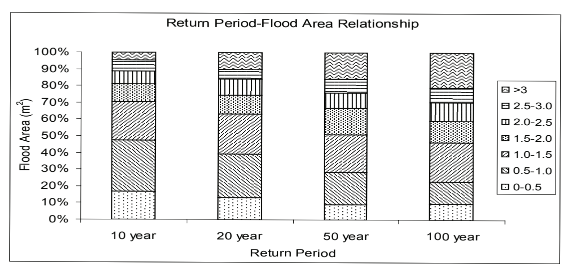

Figure 4: Relationship between return period and flood area.

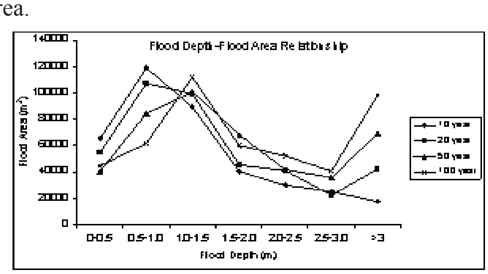

Figure 5: Relationship between flood depth and flood area.

The curves were also plotted between flood discharge, flood depths and flood area to examine the relationship between those parameters. Figure 5 and 6 shows typical plot between these parameters at the lowest cross section (RS 1.608). The plots show the gradual reduction of the slope of the relationship curve with increase in discharge.

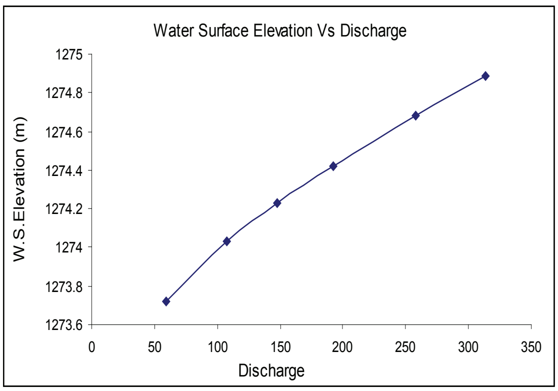

Figure 6: Flood stage versus discharge (at RS 1.608).

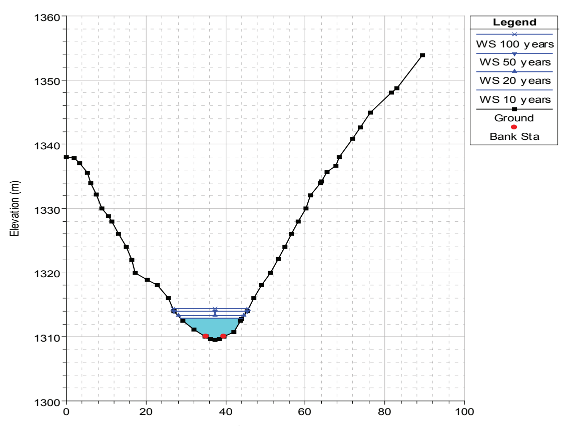

Figure 7: Cross section of upper stream (RS 5484.67) showing water surface for different return periods.

5. Conclusion and discussions

River floods related problems in the areas at the bank of the rivers are increasing with the settlement at the flood plain areas. Many squatter settlements by landless people developed at the flood plains of different river are causing serious problems. Construction of high walls, dams, embankment etc. have been made to overcome the flood damage, but is not able to control the flood due to the squeezing of the river channel. From the result obtained from the model application, it is seen that there is considerable flooding in the study area even at flood discharge of 2-year return period. This shows that channel capacity is not enough to carry the flood discharge. Even in 2-year return period, the flood depth exceeded 3 meter. Thus the flood vulnerability map shows risk to the settlement area in the floodplains implying the need of further flood protection. The flood vulnerability was assessed with regard to land use pattern of the study area. It shows that huge percentage of vulnerable area lies under cultivation land in different flood frequencies. Part of settlement area is also affected by different flood frequencies showing considerable impact of flooding on the human beings of the area.

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22nd Anniversary Program of NRSPS

The 22nd Anniversary Program of Nepal Remote Sensing and Photogrammetric Society (NRSPS) was organized on April 29, 2013. The programme was initiated by Rabin K. Sharma, President of NRSPS. After opening of the programme, Babu Ram Acharya, former Secretary of Government of Nepal released Earth Observation: Volume V; Annual Newsletter of NRSPS in which two articles: GNSS in the path of using Multi-GNSS by Rabin K. Sharma and Hosting QZSS/GNSS monitoring network site at Geodetic Observatory by Niraj Manandhar were included. He also delivered a very inspiring speech as a Chief Guest of the programme. Besides that the Editorial Board started to include the message from one of Professional Organization. In that issue of the Newsletter, message from Madusudan Adhikari, President of Nepal Surveyor's Association (NESA) was included.

This year, the Society observed its anniversary with the delivery of felicitation message from some of the professional organizations. Accordingly, Punya Prasad Oli, Vice President, Nepal Institution of Chartered Surveyors (NICS), Dr. Krishna Poudel, President, Nepal GIS Society (NEGISS) and Saroj Kumar Chalise, General Secretary, Nepal Surveyor's Association, (NESA) addressed the gathering of the NRSPS members with their corresponding felicitation messages.

Geo-spatial International Workshop

Institute of Engineering, Ministry of Education, Ministry of Land Reform and Management, Ministry of Science, Technology and Environment, International Society for Photogrammetry and Remote Sensing (ISPRS) and Nepal Remote Sensing and Photogrammetric Society (NRSPS) jointly organized an "**International Workshop on Advanced Geo-spatial Technologies for Sustainable Environment and Culture"** *as an event of ISPRS Technical Commission VI, Working Group 6 (WG VI/6)* from September 12-13, 2013 at Pokhara. The workshop was conducted as per the format of ISPRS WG VI/6, following the instructions given by the Advisory board chaired by Babu Ram Acharya and the decisions from the Steering Committee chaired by Prof. Dr. Bharat Raj Pahari. Technical Committee chaired by Prof. Dr. Hikmat Raj Joshi was responsible for managing technical papers and the Organizing Committee chaired by Assistant Prof. Narayan Gautam was responsible for overall organizing and managing the event. The workshop was inaugurated by Prof. Dr. Hira Bahadur Maharjan, Vice Chancellor, Tribhuvan University. Rabin K. Sharma, President, NRSPS is one of the Steering Committee members and Durgendra M. Kayastha, Vice- President is one of the Technical Committee members delivered vote of thanks in the opening and closing ceremony respectively. The President also got opportunity to present the resolutions of the workshop in the closing ceremony. The workshop could draw attention of about 140 participants from six countries, namely, Bangladesh, India, Japan, Switzerland, Thailand and the host country Nepal including 18 students from Land Management Training Centre and Kathmandu University. During the Workshop, four Keynote speeches were delivered two each by Prof. Dr. Armin Gruen, and Prof. Dr. Shunji Murai, Chair and Co-chair, WG VI/6 respectively, one technical presentation from Intergraph SG and India Pvt. Ltd. and twenty three technical papers in six technical sessions of different sub-themes. Nine organizations exhibited and demonstrated their products and capabilities in their corresponding booths of the exhibition which was considered as a part of the workshop. The workshop concluded successfully adopting six point resolutions.

In the Workshop, it is not only shared and discussed some of the state of the art, ideas, technology and tools in this field, but also discussed some of the very practical and down to earth problems prevalent in the field and probable solutions. Therefore, the Workshop provided the forum to expose the members of the Society in an international arena and offered opportunity for better informed about the recent developments of several topics related to the theme of the workshop.

Read more about this workshop from the **Newsletter, Earth Observation**, Volume VI, 2014 of NRSPS.

Major Programmes for the Year 2014

The Society planned for carrying out the following programmes for the year 2014:

1. Commemorate Anniversary Program
2. Dissemination of Information on Space Technology Application
3. Networking with Related Agencies and Institutions
4. Amendments of the Statutes of NRSPS
5. Presentation Program on some relevant themes
6. Launching Membership Driven Programme

NEPAL GIS SOCIETY (NEGISS)

Women Development Training Center, Jawalakhe, Lalitpur, Nepa, PO Box 7141, Kathmandu, Phone No. 977-1-5545525 (Office), Email: nepalgissociety@gamil.com URL: www.negiss.org.np

The Nepal GIS Society (NEGISS) is a professional society founded in July 23, 1995 and registered at Chief District Office Lalitpur by following regulation of the Government of Nepal. It has over 200 members including life, general, student and associated types. The NEGISS holds regular meeting of its executive members and one annual general body meeting (AGM) regularly. Society organizes workshop and seminar twice in a year regularly during its anniversary and International GIS Day event. Beside these, Society publishes a newsletter, journals, and books. The association supports and recognizes its members through sharing ideas, knowledge and experiences in the field with organizing different programs in view to helping on planning and resources managements for sustainable development of the country. Since the establishment, Society is regularly involving on capacity building of the university youths, individuals, and institutional professional staffs through training, talk programme, workshop and seminars. Society is also sincerely hoisting its nation building responsibility through regular renew, following financial discipline, registered within the government tax system by taking permanent account number (PAN), value added tax (VAT) number with the practice of regular auditing and transparent account systems.

Society is the GIS Professional's forum. The Society has a capability of handling GIS /RS technology. Society, at present, has latest version of ArcGIS 10x software license copy, image processing and modeling. Society has its own office set up within the Women Development Training Center (WDTC) complex Jawlakhel with hardware and other peripherals. More than 500 copies of books, GIS manual, user's guide, digital CDs of case studies, case study reports and journals are managed within the office of the Society. These resources are made available for free consultation and reading to students and individual by sitting within the office. Society has been formed with clear objectives of furthering the use and application of Geo Information Science and spatial data analysis technologies in the country as an aid to our mainstream endeavors in ensuring sustainable human development through effective management and mobilization of our resource base. Networking among the professionals, advocacy, capacity building training and research are the major activities to attain the objectives.

Recently completed major activities of the Society

- In close collaboration with SERVIR-Himalaya MENRIS/ICIMOD and AITM Society was involved for Youth Awareness Programme for the application of Earth Observation Systems and climate Change workshop on December 2013
- Training and hands-on-workshop organized for technical staffs of SMUSDP, ADB TA 7982 - NEP Project target Municipalities, i.e. Dharan, Biratnagar, Janakpur, Birgunj, Siddharthanagar, Butawal and Nepalgunj, from 25 August to 06 September 2013,
- GIS Map and Database Preparation on Master Plan of Tourism Development and Management of Rukum District, funded by Nepal Tourism Board and Rukum DDC - 2013
- Small Irrigation Sub-Project in Nepal, Funded by Directorate of Agriculture Extension (DAE), Ministry of Agriculture Development, GoV, Nepal 2012
- Compiled small irrigation database and published a book on" Small Irrigation System in Nepal: An Analytical Preview from Agricultural Perspective of Batch I Irrigation Sub-projects under CMIASP. (Krishna Poudel and Suresh Sharma). – Lalitpur: Directorate of Agriculture Extension, Government of Nepal, 79 pages
- Geographic Information Systems in Local Development (in Nepali), written by Dr. Krishna Poudel, 2011

Advisory Committee Members

Prof. Dr. Mangal Siddhi Manandhar

Dr. Binayak Bhadra

Mr. Buddhi Narayan Shrestha

Director General, Department of Survey

HoD Central Department of Geography,TU

HoD MENRIS, ICIMOD

President, Nepal Engineering Association

President, Nepal Geographical Society

President, Nepal Geological Society

President, Computer Association of Nepal

Mr. Pramod S. Pradhan, Former President

Executive Committee 2011-2013

President - Dr. Krishna Poudel

Vicepresident - Mrs. Sushila Rajbhandary

General Secretary - Mr. Govinda Joshi

Secretary - Mr. Karuna Bhakta Shrestha

Treasurer - Mr. Madhav Adhikari

Member - Dr. Ila Shrestha

Member - Dr. Dinesh Pathak

Member - Mr. Bholanath Dhakal

Member - Mr. Santosh Kokh Shrestha

Member - Mr. Madan Kumar Khadka

Member – Mr. Bipin Kumar Acharya

Nepal Surveyors' Association (NESA)

NESA CEC
Secretariat

Mr. Madhusudan Adhikari
President
Mr. Ambadatta Bhatta
Chief Vice President
Mr. Saroj Chalise
General Secretary
Mr. Prakash Dulal
Secretary
Mr. Durga Phuyal
Secretary
Mr. Sahadev Ghimire
Treasurer
Mr. Dadhiram Bhattarai
Co-treasurer
Mr Hari Prasad Parajuli
Member
Ms. Jyoti Dhakal
Member

NESA CEC
Other members

Mr. Ram Sworup Sinha
Vice President
Eastern Development Region
Mr. Tanka Prasad Dahal
Vice President
Central Development Region
Mr. Gopinath Dayalu
Vice President
Western Development Region
Mr. Ramkrishna jaisi
Vice President
Midwestern Development Region
Mr. Karansingh Rawal
Vice President
Farwestern Development Region
Mr. Premgopal Shrestha
Member
Ms. Geeta Neupane
Member
Mr. Laxmi Chaudhari
Member
Mr. Kamal Bdr. Khatri
Member
Mr. Bijubhakta Shrestha
Member
Mr. Sahadev Subedi
Member
Mr. Balam Kumar Basnet
Member
Mr. Nawal kishor Raya
Member
Mr. Santosh Kumar Jha
Member
Mr. Khim Lal Gautam
Member

Background

Utilizing the opportunity opened for establishing social and professional organizations in the country with the restoration of democracy in Nepal as a result of peoples movement in 1990, Survey professionals working in different sectors decided to launch a common platform named Nepal Surveyors' Association (NESA) in 1991, as the first government registered Surveyors' Organization in Nepal.

Objectives

The foremost objective of the association is to institutionalize itself as a full fledged operational common platform of the survey professionals in Nepal and the rest go as follows

- *To make the people and the government aware of handling the survey profession with better care and to protect adverse effects from it's mishandling.*
- *To upgrade the quality of service to the people suggesting the government line agencies to use modern technical tools developed in the field of surveying.*
- *To upgrade the quality of survey professionals by informing and providing them the opportunity of participation in different trainings, seminars, workshops and interaction with experts in the field of surveying and mapping within and outside the country*
- *To upgrade the quality of life of survey professionals seeking proper job opportunities and the job security in governmental and non governmental organizations*
- *To work for protecting the professional rights of surveyors in order to give and get equal opportunity to all professionals with out discrimination so that one could promote his/her knowledge skill and quality of services.*
- *To advocate for the betterment of the quality of education and trainings in the field of surveying and mapping via seminars, interactions, workshops etc*
- *To wipe out the misconceptions and ill image of survey profession and to uplift the professional prestige in society by conducting awareness programs among the professionals and stakeholders*
- *To persuade the professional practitioners to obey professional ethics and code of conduct and to maintain high moral and integrity*
- *To advocate for the ratification of Survey Council Act and Integrated Land Act for the better regulation of the profession and surveying and mapping activities in the country.*

Organizational Structure

The Organization is nationwide expanded and it has the following structure
14 Zonal Assemblies ZA, 14 Zonal Executive Committees ZEC
5 Regional Assemblies RA, 5 Regional Executive Committees RAC
Central General Assembly CGA, Central Executive committee CEC

Membership Criteria

Any survey professional obeying professional ethics and code of conduct, with at least one year survey training can be the member of the Association. There are three types of members namely Life Member, General Member and Honorary Member. At present there are 2031 members in total.

Activities

The Surveyors' day was celebrated organizing various programs including sports & blood donation on 16-18, Bhadra 2070

Price of Aerial Photograph and Map Transparency

Prduct	*Price per sheet*
a) Contact Print (25cmx25cm)	*Rs 300.00*
b) Dia-Positive Print (25cmx25cm)	*Rs 1000.00*
c) Enlargements (2x)	*Rs 1000.00*
d) Enlargements (3x)	*Rs 2000.00*
e) Enlargements (4x)	*Rs 3000.00*
Map Transparency	
*a) 25cm * 25cm*	*Rs 310.00*
*b) 50cm * 50cm*	*Rs 550.00*
*c) 75cm * 75cm*	*Rs 800.00*
*d) 100cm * 100cm*	*Rs 1250.00*
Diazo/Blue Prints	*Rs 80.00*
Photo copy	*Rs 50.00*
Photo lab facilities	*US$ 200/day*

In case the materials provided by the clients, the office will charge only 40% of the marked price as service charge.

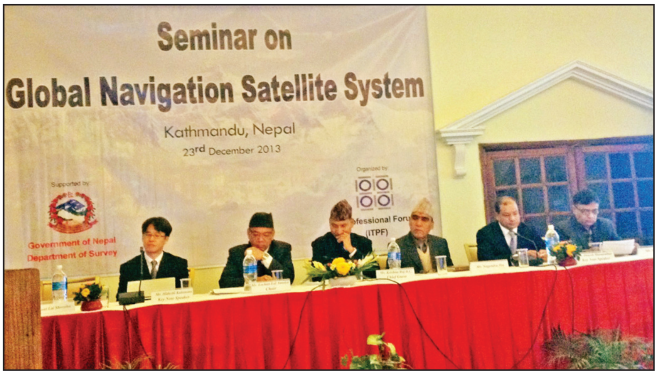
Price of Digital Topographic Data Layers

LAYER	*Rs/Sheet*
Administrative	*100.00*
Transportation	*200.00*
Building	*60.00*
Landcover	*300.00*
Hydrographic	*240.00*
Contour	*240.00*
Utility	*20.00*
Designated Area	*20.00*
Full Sheet	*1000.00*

Image Data:

Digital orthophoto image data of sub urban and core urban areas mintained in tiles conforming to map layout at scales 1:10 000 and 1:5 000, produced using aerial potography of 1:50 000 and 1:15 000 scales respectively are also available. Each orthophoto image data at scale 1:5 000 (couering 6.25 Km^2 of core urban areas) costs Rs. 3,125. 00 . Similarly, each orthophoto image data at scale 1:10 000 (covering 25 Km^2 of sub urban areas costs Rs 5,000.00.

Price of SOTER Data	*Whole Nepal*	*NRs : 2000.00*



A scene of Seminar on Global Navigation Satellite System organized by Survey Department jointly with IT Professionals Forum on 23rd December 2013

Participants of Stakeholders' Consultative Workshop on the Establishment of Large Scale Geographic Information Database for supporting Land Management, Development Planning and Disastar Mitigation in Kathmandu Valley on 20th February 2013.

Chief Survey Officer Mr. Krishan Prasad Sapkota addressing the Orientation Program on Border Issues on 13th December 2013 at Kailali.

Participants of orientation Program on Boarder Issue on 13th December 2013 at Kailali.

Participants of Mid-Western Regional Workshop organized by Survey Department on 21st March 2014 at Nepalgunj.

Making Sense of Geo-spatial data for total solution in National and Local Development Activities

Available Maps and Data

- Geodetic Control data
- Aerial Photographs
- Topographic Base Maps
  - Terai and middle mountain at the scale of 1:25,000
  - High hills and Himalayas at the scale of 1:50,000
- Land Resources Maps
- Administrative and Physiographic Maps of Nepal
- Maps of
  - Village Development Committees/Municipalities
  - District, Zone and Development Region
- Digital Topographic Data at scales 1:25,000 & 1:50,000
- Cadastral Plans
- Orthophoto Maps
- Orthophoto Digital Data
- SOTER Data
- VDC Maps (Colour)
- Topographic Digital Data at scales 1:100,000 1:250,000 1:500,000 1:1,000,000

Available Services

- Establishment of control points for various purposes of Surveying and Mapping
- Cadastral Surveying
- Photo Laboratory Services
- Surveying and mapping for development activities
- Topographic and large scale mapping
- Digital geo-spatial database support
- GIS Development

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