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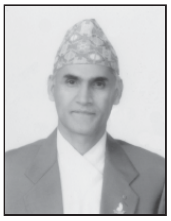
Contents

The front cover

1. Undated annonymous painting depicting cadastral cadastral Survey activity.

2. Cadastral data acquision using digital total station.

Advisory Council



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Editorial

Survey Department is in a process of migrating from traditional manual system of surveying and mapping to modern digital technology. In this context, it has already introduced some of the modern systems such as establishment of Geodetic Network and densification of control network by Global Positioning System Survey, Topographical base maps updating using Remote Sensing technology and Nepal-India border strip mapping by Geographical Information System technique and Digital technology is going to apply for cadastral mapping. However, it will be a gradual process to switch over from traditional systems to establish a complete system of digital technology.

Department had prepared a roadmap for its future vision through a two tier working group namely Technical Task Force and Think Tank. The first working group consists of Younger Officers who collects the required information for the assigned tasks and the later group consists of Senior Officers prepares and submits the detail report on the tasks to the Director General of the department. The first roadmap of the department includes the report on information sharing and communication mechanism, ten years working implementation plan, establishment of internal management system and a draft on human resource development policy and programmes. Besides these, the department is concentrating on three more important tasks such as capacity building for sustainable development, improve service delivery system for customers' satisfaction and organization restructuring for quality improvement. In order to address these topics, an action plan including short term and long term programmes of the department was prepared and submitted to the Ministry of Land Reform and Management.

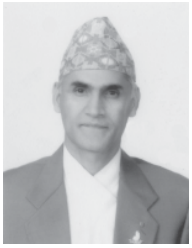
In this issue of the Journal, one of the Advisory Board members Mr. Suresh Man Shrestha, Chief Survey Officer, National Geographic Information Infrastructure Programme of the Survey Department kindly provided an article titled "**Let us give a Thought**" as a special contribution. So, I highly appreciate and would like to express my sincere thanks to him for his efforts.

Survey Department has completed its 49 years of service on May/June 2006 AD (Jestha 2063 BS), so the next issue of this journal of 2007AD (2064 BS) will be published as a special issue to commemorate its golden jubilee anniversary celebration.

Hope the readers will enjoy reading this issue of the Journal.

Rabin K. Sharma
Editor in Chief

Message from Director General of Survey Department



Survey Department has stepped into the 50th year of its establishment. As the National Mapping Organization of Nepal, it has been dedicated to providing quality service to the public for the past 49 years. I hope it will continue to improve and expand its services to the satisfaction of the public. This year will mark the 50th year of its service and there will be a yearlong golden jubilee celebration. During this time, we will reiterate our commitment of effective service delivery.

From chain survey to working in the digital environment, we have come a long way. I am proud to state that Survey Department has been able to adopt and utilize new technologies as they have evolved. Digital technology has revolutionized the surveying and mapping field. Data acquisition & updating, database creation, manipulation and analysis has never been easier.

The Nepalese Journal on Geo-informatics is publishing its fifth issue. There has been a visible change in the quality and content of the journal. It is doing a commendable job of spreading awareness of the geo-informatics field and its activities. Scientific papers and research papers along-with a wide variety of other relevant information are included in the journal. This has made the journal a magazine of high standard. I would like to reiterate here, to invite and include more papers and articles from outside the Survey department.

Between the publication of the 4th and the 5th issue of this journal, there have been some significant achievements made by the department. A proposal has been forwarded to upgrade the post of Amin from non-gazetted second class to non-gazetted first class. This is expected to bring more efficiency, motivation, responsibility and subsequently better service delivery to the public. Another proposal has been forwarded for the restructuring of the Survey Department. This will help in better service delivery by the department. A technical task force and think tank constituting of younger and senior officers of the department has submitted a report outlining a long-term and short-term objectives of the department. A radio program “Hamro jamin, hamro Napi” is broadcasted over the last year. This has aided to make the public aware of the activities of the department and has found much popularity especially in the rural areas.

Lastly, I would like to repeat my thanks to the members of the Editorial Board for their effort to come up with this fifth issue of the journal, authors for providing their invaluable articles, and members of the Advisory Board for supporting the endeavor of publishing the journal.

Enjoy Reading!

49th Anniversary
Jestha, 2063 BS

Toya Nath Baral
Director General

Maximizing Benefits of Space Technology for Nepalese Society

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Keywords: *Space application, Natural Disaster, Remote Sensing, Regional Cooperation*

Abstract

Advancements in the space technology have contributed to the human life considerably. The technology has been exploited for making human life easier and more secure in large extent. Space technology application for managing unavoidable natural disasters, human induced disasters and other societal problems/situations is one of such examples. Space technology application has brought the possibilities of real time mapping of disasters and its on-time management. Application of space technology in Nepal was brought into practice during 1970's. However, it has been realized that institutional infrastructure is yet to be developed to exploit the technological advancement of space technology. Survey Department is the leading organisation for launching space programs in Nepal. The department is working with collaborative approach with various organization to utilize the space technology information for the development activities in Nepal so that the benefits could be maximized for the society.

This paper tries to highlight on the state of the art of the space technology application in the country, the potential areas for maximizing space benefits for the society, the challenges to cope with the space technology applications and the area of regional cooperation required to enhance the space programs of the country .Lack of human resources and necessary infrastructures are the main constraints in Nepal for launching space programs effectively. Regional Cooperation could support the country in this effort.

Introduction

Advancements in the space technology have contributed to the human life considerably. The technology has been exploited for making human life easier and more secure in large extent. Space technology application for managing unavoidable natural disasters, human induced disasters and other societal problems/situations is one of such examples. Space technology application has brought the possibilities of real time mapping of disasters and its in-time management. The application of space technology was brought into practice in Nepalese society during 1970's. It has been used for surveying and mapping and land use mapping activities of the country.

Nepal, the Himalayan Kingdom, is a land locked country surrounded by China in the North and India in the rest of the directions. About 17 % of the land is plain and the rest is either hilly or mountainous. About 33% of the land, in the northern belt of the Kingdom, is perennially covered by snow. Only 67% of the land is suitable for human settlement. Due to very difficult geographical structure, the country lacks sufficient transportation networks, as a result of which people do not have easy access to different parts of the country. The diversity in geographical structure results in diversity in social structure and living styles. The social development, in terms of education, per capita, living standard, etc. is heterogeneous in nature. There is a vast gap in the extremities of various aspects of the society. Similarly, the geological structure in the hilly and mountainous country is hazardous. The Nepalese society is equally affected by various types of disasters like flooding,

[Presented at the 12th APRSAF Meeting , 11-30 October 2005, Fukuoka, Japan]

landslides, epidemics, etc. Space technology application for managing such disasters including the mapping of societal inequities could contribute in enhancing the respective effectiveness.

State of the Art of Space Technology Application in Nepal

Several Organisations in Nepal are involved in the use and application of space technology. These are: Survey Department, Ministry of Land Reform and Management, Department of Forest, Department of Hydrology and Meteorology, Department of Agriculture, Ministry of Science and Technology, Department of Urban Development and Building Construction, Department of Water Induced Disaster Prevention, Telecommunication Sector, Kathmandu Metropolitan, International Center for Integrated Mountaineering Development (ICIMOD), etc.

Survey Department, the National Mapping Agency of the Kingdom of Nepal, is the leading organisation to launch space programs in Nepal. However, the department is not at the state of launching space programs, as it ought to be. Use of LandSat imagery for the preparation of small scale map/land use map, establishment of Doppler Stations at various places of the country during Geodetic Network establishment, use of global positioning system for the geodetic network extension and updating topographic base map of the country using satellite data imagery are the various activities of the Survey Department in the field of space technology. Recently, Survey Department, with its co-partners, is involved to utilize satellite data for disaster management projects like earthquake disaster management and flood management in the form of mini-projects. These mini-projects are supported by Japanese Aerospace Exploration Agency (JAXA) and being undertaken in collaboration with Asian Institute of Technology, Thailand.

Ministry of Land Reform and Management is currently involved in the creation of land use maps (Land Utilization maps, Land Capability Maps, Land Cover Maps, Soil and Geological Maps, and Meteorological Maps) of whole the country using satellite imagery. Nepal Telecommunication authority is using VSAT technology for data communication by establishing information centers at village level. The other Space technologies are also applied on various activities of urban planning, water shade management, disaster studies and management, forest mapping, agricultural mapping, and geological mapping in Nepal.

Constraints of Space Technology Application in Nepal

Space Technology Application has been brought into practice, in various sectors of government and non-government organization in Nepal since 1970's. His Majesty's Government of Nepal has put the exploitation of the technology for the national interest in its national agenda. However, the application remains inadequate to exploit the full potential of this technology. Some of the constraints in exploiting space technology applications in the full potential are listed as [4, 7] :

- Lack of sufficient allocation of budget and resources for the investment in space technology application sector
- Lack of proper education, research and awareness in the field of space technology
- Lack of proper human resources and the expertise
- Lack of data sharing and co-ordination policies among the organisations involving with space technology application
- Lack of recognized platform to develop the overall space technology to improve access, sharing, integrated and use of space data

Potential Areas for Space Benefits in the Context of Nepalese Society

Information holds a key role for managing the problems of a society. Nepalese society is full of diversity in terms of geographical structure, ecological zone, culture, caste, ethnicity, etc. For proper planning and allocation of resources in justifiable manner, appropriate information of societal situations are required and this could be met by the exploitation of Space Technology with full potential.

It has been already proved that Space Technology applications for natural resource management, scientific management of agricultural land, disaster management and management of other various sectors of society is an effective tool for efficient management. Nepalese society is affected by various kinds of natural disasters. Flood, landslides, out bursting of glacial lakes, earthquakes, epidemics, etc. are the major types of natural disasters that are affecting Nepalese society in great extent. About 75 % of annual downpour of Nepal occurs over a period of three to four month, causing a loss of huge amounts of agricultural land and casualties. There are about 12, 000 landslides each year, 13 % of total area of *churia* and mid-hilly region suffers

from the effect of landslides. At least 44 glacial lakes in the Himalayas are at risk of outburst [5]. Thousands of people in Nepal will loss their lives, due to various types of epidemics, each year. For the study, projection and proper management of such disasters, space application would only be the proper solution.

Most of the Nepalese territory is not easily accessible and ground survey method for mapping is very difficult and time consuming. If one has to study the condition of glacial lakes, land slides and other natural disaster space technology could only be the appropriate means of surveying and mapping. Space technology could be used to acquire such information in time and provides tangible benefits in terms of minimizing losses and reducing vulnerability. Similarly Space technology application could also be used for Geodetic network extension using GPS technology, and Space image data base could also be used for updating land use information and updating of topographic base map of the country.

Efforts of Survey Department for Maximizing Space Benefits for Society

In the changing world of fast growing information technology, the user community is expecting real time geospatial information for their respective use. It is the responsibility of the Survey Department to cope with such expectations. Application of space technology is the best alternative in this regard. Furthermore, the department feels its responsibility to work for maximizing space benefits for the society and hence making its best effort in this line various activities are initiated. Some of the activities are :

a) Human Resource Development: Survey Department has initiated to use the Space imagery digital data on their map updating program. In house training and the abroad training on remote sensing technology with the collaboration of the Asian institute of technology (AIT) Bangkok are conducted for the human resource development purposes. However, more human resources on this technology are required to cope with the demand.

b) Data Sharing Mechanism: Survey Department has recently launched National Geographic Information Infrastructure Programme. The main objective of this programme is to establish a common platform for the geospatial information community for data sharing. Clearinghouse and Metadata facilities would optimize the optimum utilization of data produced by different organisations. Ultimately, the platform will help in maximizing the space application and avoid the duplication of work.

c) Awareness to the users and decision makers: Survey Department has realized that the Nepalese Society is lacking adequate awareness in the field of Space Technology Application. One of the major concerns of the department is to work for enhancing awareness on space application and its benefits. Besides 4th and 23rd Asian Conference on Remote Sensing at Kathmandu held during 1985 and 2002 [3] respectively, Survey Department has taken initiative to conduct various seminars on Space technology at Kathmandu which, of course, enhance the awareness to the users and decision makers. Recently a one-day "Seminar on Space Technology Applications and Recent Developments in Geo-Spatial Products" has been organized in Kathmandu by the department. The seminar was organized on August 17, 2005. About 200 professionals from different organizations such as governmental, non-governmental, international non-governmental, private sector, researchers etc. participated the seminar. The main objective of the seminar was to spread awareness on space technology to decision makers so that the interest of top level decision makers could be drawn towards the investment of government in this sector. The other achievement of the seminar was that various organizations got the platform to share their views, status and ideas related to space technology applications.

Nepal Remote Sensing and Photogrammetry Society conducted a one-day workshop on April 11, 2005 to celebrate its 14th Anniversary day. The members shared their knowledge on application of Remote Sensing for various purposes. The seminar was supported by Survey Department.

d) Affiliation with International Organisations: Survey Department is a member of various international organisations related with geoinformation science. International organizations related to space applications like Asia Pacific Regional Space Agency Forum (APRSAF), Japanese Aerospace Exploration Agency (JAXA), Asian Institute of Technology (AIT), Asian Association on Remote Sensing (AARS), Group on

Earth Observations (GEO), International Federation of Surveyor (FIG), International Society for Photogrammetry and Remote Sensing (ISPRS) and International Steering Committee for Global Mapping (ISCGM) are the organisations to which the department is affiliated with one way or another. The department is keeping in touch with these organisations for the promotion of space technology application in Nepal either by participating their events or by presenting its state of art of the technology.

e) Projects and research activities supported by JAXA: Survey Department was also involved on the Mini-project entitled "Study of change in land use of Kathmandu valley" with the collaboration of Japanese Aerospace Exploration Agency (JAXA) and Asian Institute of Technology (AIT), Thailand in 2004. The objective of the mini-project was to implement space development for promoting space technology. Survey department was working with Department of Urban Development and Building Construction (DUDBC), Nepal for this project. The second part of the Mini-project is shortly going to be started. This part will work for the mitigation of earthquake disaster in Kathmandu valley. DUDBC will be the supporting partner. Similarly, one more mini-project based on management of disaster caused by flood in Terai region has been accepted by JAXA for this year. The project will also be conducted with collaboration of AIT and Department of Water Induced Disaster Prevention (DWIDP), Nepal as supporting partner. The training programmes for both the mini-projects are being started at AIT from October 10, 2005. Four officials from Survey Department, one from DUDBC and one from DWIDP are participating the training.

Regional Co-operation

As the space technology is highly expensive, developing countries like Nepal cannot afford the expenses of launching space programs on their own. Regional co-operation is required for establishment of basic infrastructures including procurement of images and related software and production of the human resources in sufficient number to work with the technology Major sectors for which regional cooperation is expected can be listed as:

a) Human Resource Development: There are no any academic institutions related to space technology in Nepal. Opportunities for academic courses, advanced training, and other means of human resource development are considered as one of the most important areas for which regional cooperation is required. Furthermore, opportunities for participating at regional forums like seminars, workshops would also contribute in human resource development of the country in this sector.

b) Resource/Data Sharing: The opportunities for sharing regional resources to optimize the space application would contribute in a significant scale in this regard. Hence, such a platform should be created through the establishment of Regional Spatial Data Infrastructure (RSDI). Survey Department would act as a nodal point for resources and data sharing, so that other organization could share their information.

c) Disaster monitoring: Space technology can effectively provide information for disaster management. Space agencies and the end users should co-operate and share data for rapid response and application. Regional co-operation is expected on capacity building for data interpretation and the use.

d) Ground Station: Advanced Land Observing Satellite (ALOS), The International Space Station and Japanese Experimental Module (JEM) are currently under construction and will become operational in future. Ground base collaborative activities could be done by establishing satellite ground station at Kathmandu, Nepal, which will cover the region Autonomous region-Tibet (China), Nepal, India, Bangladesh, and Pakistan for efficient and effective utilization of JEM. Regional co-operation is expected on the establishment of satellite ground station at Nagarkot (near Kathmandu valley). Nagarkot Observatory of Survey Department is an ideal place for satellite ground station in this region.

Conclusion

Nepalese society has a number of potential areas where the space benefits could be maximized. Various natural as well as human induced disasters, from which Nepalese society is directly or indirectly affected, could be managed effectively by the exploitation of space technology.

It is the need of time to work for maximizing space benefits. Despite numerous constraints, Survey Department is making its best effort in this regard. Initiation of collaborative approach for space technology application for the management of different types of natural disasters is one of such efforts. The support of JAXA for capacity building of Survey Department by conducting mini-projects for disaster management has motivated the department to work in this area with greater effort. Coordination among the organisations involving in space technology application and enhancing awareness in its importance could boost up the effectiveness. Furthermore, regional cooperation in this sector including human resource development, a proper platform for data sharing, etc. is equally essential for maximizing space benefits for Nepalese society.

Acknowledgements

We would like to acknowledge the contribution of Mr. Krishna Raj Adhikari, Deputy Director General, a.i., Mr. Rabin K. Sharma, Deputy Director General, a.i., and Mr. Raja Ram Chhatkuli, Project Manager, Survey Department to prepare this paper.

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Private Discussions with Nepalese Professionals of Space Technology.

Technical Deficiencies and Human Factors in Land Disputes: in the Context of Nepalese Cadastral Surveying

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Key Words: Cadastral Surveying, Land Reform Program, Land dispute, Land surveyor, Land Ownership

Abstract

Systematic Cadastral Surveying, in Nepal, was initiated in 1964 to support the Land Reform Programme launched by His Majesty's Government of Nepal. Survey Department looks after these activities from the beginning. The activities are still in practice. The Cadastral Surveying (CS) is the foundation of land administration/management activities in Nepal. Inaccuracies and ineffectiveness in CS activities are the reasons for some of the cases of land disputes that exist in the Nepalese society. The reasons of inaccuracies and ineffectiveness in these activities have been considered in two broader perspectives: technical deficiencies and human factors. The paper is based on a research entitled " Identification of Technical Deficiencies and Human Factors in Land Disputes: in the Context of Nepalese Cadastral Surveying", which is mainly based on the studies of some of the cases of land disputes, interaction programmes with professionals and field observations, with the focus on identification of technical deficiencies and involvement of human being in various perspectives in the CS activities. Some reasons of possible land disputes because of the CS have been pointed out. SWOT Analysis was performed during the research work to develop guidelines for improvement in the accuracies and effectiveness of the CS activities in the line to mitigate land disputes. Some recommendations have been put forwarded to Survey Department in this regard.

Background

Major part of the national economy of Nepal depends upon agriculture. Land is the most important asset for Nepalese people. Nepal is a land locked country and about eighty percent of its geography occupies hilly and mountainous areas. The fertility of land and accessibility of transportation in these areas is negligibly low. As a result, most of the people are migrating towards the urban and plane areas. The trend of migration is very high in recent days. Consequently, the value of land in the urban and plane areas of the country is considerably increasing day by day. Every centimeter of land in these areas is precious and the value is constantly increasing. Landowners are, therefore, seriously concerned over the boundaries of land they own. As a result, various kinds of land disputes exist in Nepalese society. Unfortunately, some of them are due to inaccuracies and ineffectiveness in cadastral surveying activities. Broadly speaking, activities of Cadastral Surveying mostly depend upon the technology used and human resources involved. With this consideration, it can be assumed that the role of technology and human factor is influential in maintaining accuracy and effectiveness in cadastral surveying activities.

An overview of Nepalese Cadastral Surveying

The Nepalese Cadastral Surveying is basically conducted to prepare land records including ownership over a piece of land, the classification of land and area of land. The system of cadastral surveying was in practice for a long time in one way or another. However, Systematic Cadastral Surveying was started only in 1964 with the unveiling of Land Reform Programme in the country by His Majesty's Government of Nepal.

The Land Reform Programme imposed ceilings on land holding and hence the accurate record of area of every parcel of land was important. This step necessitated the beginning of Systematic Cadastral Surveying in the Kingdom. As cadastral maps were prepared during the cadastral surveying, it was made one of the essential

[Submitted to FIG Foundation 2005]

components for the registration of ownership over individual parcel. Since then, every parcel of land requires its plan to some scale with its dimension to be registered under the ownership of an owner [2].

The cadastral surveying of whole the country was completed in 1997 leaving some dense areas, as village blocks, and government and public lands lying beyond the cultivated and residential area. In the mean time, several commissions constituted at different times by HMG/Nepal for distributing lands to landless people and establishing new settlements surveyed the public lands. Various inconsistencies and incompleteness in documentation in the surveys conducted by these commissions were realized. Considering the incompleteness and various inferiorities, in terms of technology and resources, in the first round survey, cadastral resurveying was initiated formally in 1994, and is under progress at different 13 districts of the kingdom, one of which has been recently completed. However, it was also held in Kathmandu district in late 1970's for some reason.

Survey Department, the National Mapping Organization of the Kingdom of Nepal, under the Ministry of Land Reform and Management is responsible for carrying out cadastral surveying in Nepal. The department conducts these activities through two types of district level offices: Survey Parties *(Napi Goshwaras)* and Survey Offices. Survey Parties prepare original maps and documents related to ownership over a piece of land along with its class. Survey Offices technically support the land administration and management activities within a district. Updating the cadastral information on maps and records is the major responsibility of these offices. Plane Table Survey Method is still in use for cadastral surveying in Nepal.

Role of Nepalese Cadastral Surveying in Land Administration activities

District level Survey Offices and District Land Revenue Offices are established in the district to carryout land administration activities. Although both the offices are under the same ministry, Ministry of Land Reform and Management, they have different institutional status in the district. Land administration activities are based on Cadastral maps and documents prepared by Survey Parties, which are authentic documents in this regard. Cadastral map is essential for transfer of ownership on a land parcel. All the disputes related to ownership over a piece of land are resolved on the basis of maps and other documents. Even courts refer these maps and documents for taking judicial decisions for the cases of land disputes. Thus, cadastral surveying plays a significant role in land administration activities and hence it is a matter of public interest.

If we assess the institutional mechanism of land administration, technology adopted in cadastral surveying, political awareness about the essence of cadastre, and other various factors with the FIG Agenda of Cadastre 2014 it is out of reach for Nepalese context.

Cases of Land Disputes

In this paper 'land dispute' has been considered as the cases of disagreement or clashes between/among landowners regarding the ownership over land parcel caused because of cadastral surveying. It further addresses the cases of problems faced by landowners or cadastral surveying authorities both, the reason behind which remains the cadastral surveying activities.

Various kinds of land disputes exist in Nepalese society. As the cadastral surveying prepares fundamental base (maps and documents) for land administration, its effectiveness certainly depends upon the accuracy and quality of cadastral surveying. Land disputes come to the front during land administration activities such as transfer of ownership, demarcation of parcel owned, etc. Deficiencies in cadastral surveying are some of the causes behind land disputes. Some categories of land disputes identified:

a) Improper demarcation of parcel boundary on the ground.
b) Errors in trace copy of original cadastral maps and wear and tear of documents.
c) Errors in file maps prepared in larger scale from original maps.
d) Displacement in the location of features, natural as well as cultural, with respect to existing maps.
e) Implications due to impractical legal provisions.
f) Inaccurate representation of reality at the margins of island maps.
g) Problems with ownership in the land distributed by special commissions.
h) Wrong survey of reality.

i) Wrong marking of parcel subdivision on cadastral map.
j) Wrong interpretation of the agreement mentioned on the deed document prepared at the time of transaction
k) Encroachment of public lands.
l) Transfer of ownership over public land by local authority beyond the legal provision.
m) Mismatching of existing maps with new maps prepared by cadastral resurveying.
n) Lack of proper coordination between the District Land Revenue Office and Survey Party/Office.
o) Mistakes in documentations during cadastral surveying.

Reasons of Possible Land Disputes

Studying the cases of land disputes, some of the reasons of possible land disputes can be categorized as following :

a) Distribution of land by the government without providing ownership certificate.
b) Use of more than one duplicate copy of cadastral maps for cadastral information updating.
c) Improper adjudication of land parcel and/or inaccurate record of land area on the documents during cadastral surveying.
d) Negligible presence of landowners at the time of surveying their land parcel.
e) Unawareness of landowner with cadastral surveying activities and its impact in future.
f) Unnoticeable shift in the orientation of plane table during surveying.
g) Lacking of standardization and quality of instruments/equipments and accessories provided to the land surveyors.
h) Improper orientations of maps based on local control points.
i) Carelessness in measuring horizontal distances during cadastral surveying.
j) Poor visibility of land surveyors.
k) Focus on the amount of area rather the accuracy during cadastral surveying due to imposition of fixed target of certain area to be surveyed to the land surveyors.
l) Fieldwork carried out in off-season.
m) Gaps and overlaps at the margin of the adjoining sheets of island maps.
n) Lack of incentives to the land surveyors deputed for fieldwork.
o) Lack of necessary infrastructure and stationeries at the field office.
p) Independent check of fieldwork is either very limited or lacking.
q) Inaccuracy in control points established for surveying.
r) Lack of ethics and follow of professional code of conduct in the land surveyors and other official involving with cadastral surveying activities
s) Inaccuracy in surveying and mapping.
t) Unintentional mistakes in distance measurement using chain/tapes.
u) Carelessness in mapping and documentations of land distributed by special commissions.
v) Misinterpretation or misunderstanding of legal provisions
w) Lack of necessary technical knowledge to the land surveyor.
x) Easy access of unauthorized persons to the cadastral maps and documents at Survey Offices.

Technical Deficiencies in Cadastral Surveying

Technical aspect is the most important factor in maintaining accuracy and effectiveness in cadastral surveying. Performances of human being are limited by the available technology. A land surveyor cannot come up with better result than that could be achieved with available technology. However, one should try to make effective use of available technology to achieve optimum result.
Inaccuracy in surveying is mostly influenced by technical deficiencies. Use of traditional technology in the days of availability of modern and advanced technology can be regarded as root of technical deficiencies in Nepalese cadastral surveying. Various kinds of deficiencies can be noticed in the existing technology used and the other technical aspects that support the technology are also having deficiencies. On analysing the findings of field the deficiencies can be listed out as follows:

a) Inaccuracy in control points used for mapping.
b) Undefined parameters for coordinate transformation (i.e. transformation of coordinates from existing system to GPS system and vice versa)
c) Lacking of standardization and regular maintenance of instruments/equipments used for cadastral surveying

d) Poor quality of accessories used for preparing maps and documents
e) Manual technique of producing duplicate copy and file maps
f) Lacking necessary infrastructures during mapping
g) Poor archive of maps and related documents.

Human Factors in Cadastral Surveying as Reasons of Land Disputes

Land Surveyors, so called *Amin* in Nepalese society, have the most significant role in maintaining accuracy of cadastral surveying. The other officials involving directly in cadastral surveying activities have equally important role in this regard. Similarly, landowners are found to have significant role in helping to maintain accuracy in cadastral surveying with their indirect involvement in cadastral surveying activities. Basically for the preservation of public/government lands from unauthorised encroachment, the other roles of human being with indirect involvement in cadastral surveying activities could contribute significantly. The role of *Lekhandases (Lekhapadhibyabasayi)* is not clearly defined yet and their easy access to the maps and documents in Survey Offices has supported the unauthorised manipulation in maps and documents from third parties and malpractices during transaction. Inaccuracies in cadastral surveying ultimately result as the reason behind land disputes.

Human being by its nature is influenced by various factors. Some influencing factors, having significant role in land disputes, as analysed from field reality, have been pointed out as under:

a) Factors that influence Land Surveyors role:

Land surveyors' roles in cadastral surveying are found to be influenced by following factors:

- **Departmental Circulations regarding the speed of the work, i.e. fixing of target to be surveyed within a certain time frame**. Land surveyors are supposed to survey a full sheet of cadastral map in two months during field season [Technical circular from Cadastral Survey Branch]. The amount of detail and the nature of terrain are not taken into consideration. If the land surveyor remains unable to complete the targeted task, his/her performance is evaluated as poor. Hence, a land surveyor's prime concern remains over amount of area to be surveyed rather than accuracy of his performance.

- **Working environment:** Working environment plays a significant role in preserving quality of surveying activities. While interacting with land surveyors regarding the working environment, most of them had a complaint that survey works are forced to carryout in rainy season as well. Further, they are not provided necessary infrastructure at office.

- **Deficiencies in technical aspects**: Deficiencies in the technical aspects greatly hamper the performance of a surveyor and accuracy of surveying activities.

- **Motivation/ Incentives from the job**: Land Surveyors are lacking sufficient measures of motivation. A land surveyor hardly gets US$ 80.00 per month for his job. The amount is too little for his monthly expenditure. A land surveyor is not even provided travelling allowances while s/he goes for the fieldwork. The working hours for fieldwork are not same as that of normal office hours. A land surveyor may have to go to field either early in the morning or late in the evening. A land surveyor has to work on the off days also. No any extra allowances are given for the extra duty. On the one hand the monthly salary is not sufficient for necessary expenditure, on the other hand s/he does not have time for doing any extra job. Thus, land surveyors have to expect some financial incentives from landowners, which is illegal. To meet the expectation, land surveyors may overlook the reality and follow the landowner's interest. Ultimately, cadastral surveying looses the accuracy.

- **Individual Attitude:** Individual attitude of a Land Surveyor can influence the surveying of reality with true spirit of professional conduct. The quality and accuracy of survey works depend upon how the land surveyor performed his/her responsibility. Due care is required in case of cadastral surveying as it should demarcate actual boundary of parcel.

- **Professional Standard:** Professional standard in terms of academic background and trainings is the major factor that influences the performance of each individual. A professional having higher academic standard and sufficient training on required field certainly possesses higher skill and responsiveness to his profession.

Opportunity of continuous professional development like refresher trainings and academic degrees contribute considerably in enhancing the professional capability. Land Surveyors involving in the field surveying activities in Nepal are having the academic standard of high school with one year training courses. It is very hard to get an opportunity of refresher trainings. Such a professional standard can be considered as inappropriate with respect to their responsibility. Being the cadastral surveying activities to be done with public relations and bounded by legal provisions, a land surveyor has to tackle various kinds of challenges in the field. No creativeness can be expected in the performance from most of them. Sometimes wrong interpretation of legal provisions increases land disputes in the field. Many of such cases occur due to wrong understanding of meaning of legal provisions. Lack of refresher courses to the concerned professional obstructs organizational attempt of introducing advanced technologies, which Survey Department is facing at the moment. Hence, professional standard is one of the major factors that influences the land related issues.

- **External Pressure:** External pressure, basically from the persons affiliated to certain political party and officials holding administrative power, sometimes make the land surveyors and/or other officials involving in cadastral surveying activities to overlook the reality for their interest. The pressure seems higher for the cases of encroachments of public lands.

- **Legal and Supporting Documents:** Cadastral activities are endorsed remaining within a given legal framework. Many supporting documents are provided to make the dealing easier. Such documents, legal as well as supporting, should be clear and objective; otherwise their interpretation may mislead the land surveyors and other officials involving in the activities of cadastral surveying.

- **Ethics and Professional Code of conduct**: Ethics and professional code of conduct are the main sources that influence one's individual attitude. It is the responsibility of everybody to maintain ethics and follow professional code of conduct while serving for the nation. If someone lacks it, the activities performed by him/her lose the reality and accuracy. Cadastral Surveying being the profession by which each individual is highly affected in terms of securing ownership over property, high standards of ethics and follow of professional code of conduct are required.

b) Factors that influence the roles of other officials having direct involvement in cadastral surveying:

The officials other than land surveyor those directly involve in cadastral surveying are influenced by the factors such as working environment, technical deficiencies, motivation/ incentive from job, individual attitude, professional standard, external pressure, legal and supporting documents, ethics and professional code of conduct etc as mentioned above. The factors can be generalised for their respective responsibilities.

c) The other human factors influencing cadastral surveying activities to cause land disputes

Some other human factors that influence the cadastral surveying activities to cause land disputes can be pointed out as follows:

- Lack of awareness regarding the importance of cadastral surveying and its impact in future
- People do not hesitate to occupy larger extent of land even in it or some part of it is not under their ownership
- Involvement of Land mafias/ political leaders/ interested groups in the issues of land disputes
- Irresponsiveness of concerned authorities and personalities
- Lack of proper coordination among the agencies involving in the land administration activities
- Exploitation of legal provisions for ones benefit

Some Strategies to mitigate land disputes

Following strategies have been developed by performing SWOT Analysis in the line to mitigate land disputes:

a) Upgrade the professional and academic standard of land surveyors
b) Enforce code of conduct and professional ethics for land surveyor and other officials involving in cadastral surveying activities
c) Fix the target to be surveyed scientifically so that the land surveyor could focus on accuracy during cadastral surveying
d) Increase the amount of remuneration and incentive to land surveyors

e) Provide necessary infrastructure and financial resources for cadastral surveying activities
f) Enforce to follow existing working manuals and technical circulars strictly
g) Introduce modern technology in cadastral resurveying
h) Establish digital system of service delivery
i) Make digital archive of map and documents
j) Involve licensed surveyor in cadastral surveying activities
k) Implement single window service delivery system in land administration sector
l) Amend existing laws and acts to overcome the difficulties and shortcomings in the line to mitigate land disputes
m) Develop appropriate land policy for mitigating land disputes
n) Make the system of publicity effective and organise awareness programs to make active participation of public in cadastral surveying activities
o) Make the participation of landowner in adjudication process compulsory
p) Enforce the provision of punishment for unauthorised encroachment /holding of land
q) Develop a mechanism of prohibiting unauthorised persons' access to the maps and documents
r) Define the role and jurisdiction of a *Lekhandas (Lekhapadhibyabasayi)* in land administration activities clearly
s) Develop a mechanism for proper coordination between / among district level organisations involving in land administration activities

Conclusions

The maps and documents prepared by Cadastral Surveying are the foundation of land administration and management activities in Nepal. Systematic cadastral surveying is underway since 1964 under the responsibility of Survey Department and resurveying has been initiated in some districts since a decade back after the achievement of nationwide coverage leaving some village blocks and public/ government lands.

Some cases of land disputes that exist in Nepalese society are because of inaccuracies and/or ineffectiveness in Cadastral Surveying activities. The reasons of inaccuracies and ineffectiveness in cadastral surveying activities have been observed in two broad perspectives: technical deficiencies and human factor.

Use of traditional technology itself is realised as the major technical deficiency in cadastral surveying. Inaccuracies in control points, lacking standardisation and regular maintenance of the instruments/equipments used, inferiority in the quality of accessories used, manual method of map preparation etc. are the technical deficiencies that directly influence the accuracy of cadastral surveying.

Regarding the role of human factors in cadastral surveying activities, Land Surveyor has the most significant role, supported by other officials directly involving in cadastral surveying activities, in maintaining accuracy of cadastral surveying. Various cases of land disputes are due to landowners' negligence or unawareness about cadastral surveying activities. Lack of sincerity in performing respective responsibilities of various personalities with indirect involvement in cadastral surveying activities is the other factor that promotes the possibilities of land disputes. Easy access of unauthorised persons to the maps and documents not only increases the rate of wear and tear but also possibility of losing important documents is high. Interference of *Lekhandas (Lekhapadhibyabasayi)* in land administration activities sometimes results in land disputes.

Recommendations

Following recommendations have been put forwarded to Survey Department, the national authority for cadastral surveying. It is expected that the execution of these recommendation would greatly contribute in the mitigation of land disputes because of cadastral surveying. The recommendations are as following:

a) The technology used in cadastral surveying along with the other supporting factors has a number of deficiencies. Going ahead with the same technology will never make the cadastral surveying free from the reason of land disputes, rather it will expand. As Survey Department has already introduced digital technology in the sectors other than cadastral surveying, the department possesses some infrastructure and human resources. Introduction of digital technology in cadastral surveying could contribute in minimizing the possibilities of land disputes. Using the available resources of the department the technology could be

introduced on pilot basis, based upon the result of which the use could be expanded. Hence, it is recommended to introduce digital technology in the Cadastral Surveying sector as well.

b) Land Surveyors *(Amins)* have the most significant role in maintaining accuracy of cadastral surveying, as they collect primary data. The professional standard of these officials is not enough to maintain the standard of cadastral surveying. Further, the existing professional standard of land surveyors cannot contribute in technology transfer. Hence, it is recommended to work in the line to upgrade the professional standard of Land Surveyors.

c) Monthly salary of a land surveyor and other staffs involving in cadastral surveying activities is very low. Land surveyors are deputed for fieldwork without any travel and field allowances. The working environment at the office is not good enough. Due to these reasons, land surveyors and other field staffs are highly demotivated. For possibilities of malpractices and negligence in maintaining accuracy of cadastral surveying it may be one of the reasons. Hence, it is recommended to motivate land surveyors and other staffs by increasing financial incentives and arrange for proper working environment.

d) Some cases of land disputes are due to unclear legal provisions. General public is facing a number of disputes during cadastral resurveying due to the provision of verifying the new map with existing maps. Although the intention of verifying is not to exactly overlap the new map with existing map, the provision is either misinterpreted or misunderstood. Further, the working manual and technical circulars do not provide any clear-cut way to deal with such cases. Similarly, there are many cases that are not practical. Hence, it is recommended to amend existing laws, technical circulars and working manuals to meet the requirements in the line to mitigate land disputes because of cadastral surveying

e) Many of the cases of land disputes are due to unawareness or negligence of landowners with cadastral surveying. As the literacy of Nepalese society is low, most of the people from rural areas are even unable to read the notices. In the urban areas, people are always busy with their business. Their active participation cannot be expected without prior notice or information. Hence, it is recommended to enhance public awareness regarding cadastral surveying.

f) During the research, it was realised that one door policy for service delivery in land administration sector would provide better services to the public. Hence, it is recommended to determine the framework for establishing single window service delivery system.

g) The research only concentrates on technical deficiencies and human factor in cadastral surveying to cause land disputes. During the research, it is realised that legal and institutional aspects are equally important factors in land disputes. It is recommended to carry out further research in this sector.

h) During the research, it is also realised that Nepalese land administration is lacking National Land Policy that drives the land administration activities to meet the national objective of poverty reduction. Further research is recommended to find out the proper issues that could contribute in formulating National Land Policy to mitigate land disputes.

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Informal discussions with senior level officials of the department during the research period.

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Analysis Of 3D Cadastre Situation In Nepal

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Keywords: 3D Cadastre, Real Estate Object, Apartment, Joint Residential Buildings

Abstract

The history of cadastre prevails that the records of land are kept in a text form as a basis to collect revenue and could be refer to one dimension cadastre. His Majesty's Government (HMG) of Nepal declared to launch Land Reform Program on 1964 AD. The main purpose of the program was to impose ceiling on land holding. For this purpose, it was necessary to determine the area of land hold by a land owner. In this way, the concept of two dimension cadastre was realized and the land registration was started with the help two dimension cadastral maps. As the population in urban area is ever growing and the land is fixed, the use of space under and above the surface seems to be one of the solutions to address the issue. So, there is a need of registration of vertical dimension of the legal status of real estate objects. The 3D information is becoming essential for land administration in Nepal.

HMG of Nepal has adopted a policy to build apartments and joint residential building in urban area for optimal use of available space. Although, some juridical measures exist to address registration of vertical dimension of legal status of real estate objects in the available act, a lot of institutional and technical problems are facing for registration of apartment and room in a multi storey building in Nepal. Therefore, it is necessary to make a good institutional arrangement and develop a system to visualize 3D cadastre to link with cadastral maps and related land records.

This paper first investigates the 3D cases practices in Nepal. There are more than eight such issues to be considered for the implementation of 3D cadastre. It then further elaborates about the three aspects; institutional, technical and legal to be considered for the 3D cadastre in Nepal. A low cost solution for the 3D mapping of the apartment or multistory building has investigated. The findings of this research will help the policy makers for the effective implementation of 3D cadastre in Nepal.

Introduction

According to (Henssen, 1995) Cadastre is a methodically arranged public inventory of data concerning properties within a certain country or district, based on a survey of their boundaries. Such properties are systematically identified by means of some separate designation. The outlines of the property and the parcel identifier normally are shown on large-scale maps which, together with registers, may show for each separate property the nature, size, value and legal rights associated with the parcel. Cadastre 2014 gives reliable and complete information on the legal situation of land by taking into consideration all legal impacts on land (Kaufmann and Steudler, 1998). The traditional cadastre focused on land parcel but modern cadastre focused on land object. It gives the real situation of 3D objects in land parcels.

The history of land recording in Nepal was started from one dimension (i.e. keeping the record only) and now the registration of two dimensions (i.e. measuring the length and breadth of the parcel and calculating area) is in practice. Basically, the legal boundaries of parcels used for the registration of the legal status are fixed in 2D space. Due to the high population growth and growing interest in using space under and above the surface (Particularly in the urban areas) there is a need of registration of vertical dimension of the legal status of real estate objects. To be able to define

and manage the juridical situation satisfactory, 3D information are becoming indispensable for land administration in Nepal (Sharma and Paudyal, 2005).

In Nepal, the registration of partition of house or a building in strata basis is in practice. In field book, deed documents and land ownership certificate (Moth and Lal Purja) the legal status of partition of house or a building has mentioned. But the accurate geometric dimension and linking with cadastral map is lacking. HMG Nepal has given high priority to construct apartments and joint residential buildings in urban areas for optimal use of available space and to protect the agriculture land. Recently, the real estate business in Nepal is booming. The real estate agents and housing companies are more interested to invest money in the real estate business. They have constructed joint residential buildings and apartments and selling it. Till date not a single apartment owner has got "the ownership certificate from Land Registry Office. There is no legal security of ownerships with these apartment owners. They cannot sell it as well as use it for mortgage. There are a lot of institutional and technical problems about the registration of apartment and room in a multi storey building. These apartments and rooms are neither shown on the cadastral maps nor linked with cadastral maps. There is a challenge to Cadastral Offices (Survey Sections) to find the right geometric descriptions of these 3D real estate objects and link with cadastral maps.

3D Cases Practice in Nepal

There are more than eight real estate objects to be considered for the implementation of 3D cadastre in Nepal. They are

- Partition of a house or building in Strata basis
- Distribution of the flat in a Multi Stored Buildings
- House of higher mountains
- Underground flat (Parking area, shopping malls, godam etc.)
- Underground manmade and natural features (Drainage, tunnel, cables, caves, streams etc.)
- Sky Bridge above pubic and private properties
- Common passage below the private properties
- Vertical strata (May be empty 3D objects)

Partition of a house or building in strata basis

The partition of a house or buildings in strata basis is practiced in Nepal since the systematic cadastral survey began in Nepal. In the beginning, the description of partition of a house or building was recorded in the field book during adjudication and provide land ownership certificate to the owners. There is no mechanism of recording the spatial parts of that unit. For security of ownership and to solve the boundary dispute and right and responsibilities in the common place of that building the concept of 3D cadastre is becoming the important.

Distribution of the flat in a multi stored buildings

HMG Nepal has encouraged to the housing company to invest money for residential multi storey building to protect the agricultural land and optimal use of space. There is a need of showing such building in the cadastral map. Now the concept of documentation and approval of AS_Built drawing of such residential building by cadastral office and showing the foot print of such building in cadastral map is realizing. For modeling of such 3D building in the near future, there is a need to harmonize the co-ordinate of AS-Built drawing with the co-ordinates of cadastral maps.

House of Higher Mountains

In Nepal, the houses of higher mountains are constructed in the slopes. To protect the house from cold, some rooms of the house are constructed inside the grounds. The part of roof of lower house is made base to construct upper house. There is overlapping rights above and below the house. So there is a need of concept of 3D cadastre in the rural area of Nepal too.

Underground Flat (Parking area, shopping malls, godam etc.)

In the urban areas, the parking place, shopping malls and godams are constructed undergrounds. The ownership of underground construction is different with the ownership of buildings. So there is also a need of concept of 3D cadastre.

Underground manmade and natural features (drainage, tunnel, cables, caves, streams etc.)

In Nepal, the underground natural features like streams, caves etc are the properties of Government. The ownership of drainage, tunnels, cables (pipelines, telephone lines, electricity lines, internet lines) are the properties of related public organizations. These underground features are situated below the private or public properties. So the case of 3D cadastre is very important in this case too.

Sky Bridge above pubic and private properties

The sky bridges are constructed above the public, private or government properties. The ownership of Sky Bridge is different from the ownership of properties below it. Hence there is a need of 3D cadastre in this case.

Common passage below the private properties

In the dense populated urban area of Nepal, a very narrow passage has left below the private houses. The passages are just like the tunnel and it is for the common use. Now, only as a description the use right of common passage is mentioned in the ownership certificate. The passages are very important access for the settlements. For reconstruction of building the spatial measurement of such passage are very important. Hence, it is also a typical 3D cadastre cases practice in Nepal.

Vertical strata (May be the empty objects)

The transaction of vertical empty strata is not practice in Nepal. But due to the shortage of available residential land in urban area of Nepal there is a growing demand of transaction of empty space above the roof. For the transaction of such empty space there is a need of concept of 3D cadastre.

Institutional, Technical and Legal Aspect for 3D Cadastre

For the effective implementation of 3D cadastre; all three aspects institutional, technical and legal are important. A brief description has given in the following section.

Institutional Framework:

According to (North 1990) institutional are defined as 'the humanly devised constraints that shape human interactions'; the rule of the games and organizations are the players of the games. Later (Feder and Feeney 1991) distinguished three basic categories of institutions, namely the constitutional order, institutional arrangements, and normative behavioral codes.

Ministry of Land Reform and Management (MoLRM), Ministry of Local Development (MoLD) and Ministry of Housing and Physical Planning (MoHPP) are the main three Ministries responsible for implementation of 3D cadastre in Nepal. These Ministries are mandated to formulate and implement the policies and programme for implementing 3D cadastre. The Department of Land Reform and Management (DoLRM), Survey Department (SD) under MoLRM are responsible for registration and maintenance of 3D cadastre. The Department of Urban Development & Building Construction (DUDBC) under MoHPP is responsible for regulating and monitoring of 3D real estates like buildings and other overhead/underneath structure of public utilities. Likewise, the Local Authorities (Municipalities and Village Development Committees (VDC's)) are responsible for the valuation, taxation, permitting, as well as right, restriction and appeal about 3D real estate objects. The details of 3D cadastre related organizations in Nepal have given in the section below.

Organizations involving for 3D cadastre in Nepal

There are basically five organizations involving for implementing 3D cadastre in Nepal. A brief description has given below.

- Survey Department (SD)
- Department of Land Reform and Management (DoLRM)
- Department of Urban Development & Building Construction (DUDBC)
- Housing Company/ Real Estates Agents
- Local Authority (Municipality/VDC)

It was realized from the workshop held on may 3, 2005 at Kathmandu, that there should be the following three different roles of organizations for the implementation of 3D cadastre in Nepal (CSB, 2005).

- **Regulating:** Ministries, Departments such as a DUBC, SD, DoLRM, Municipality/VDC etc.
- **Development:** Departments such as, DUDBC, Housing Companies/ Real Estate Agents, Municipality/VDC, Utilities services related organization etc.
- **Consumer:** Housing Companies/ Real Estate Agents, Individual Owner, Developer, Line Ministries, DoLIA, Financial Institutions, Insurance Companies, Lekhapadhi Professional (Notary), Lawyers, Academia, Consultancies etc.

Existing role of different 3D cadastre related organizations

Role of DUDBC

- Permit issue for land development and construction
- Monitoring/regulating of land development and construction
- Overhead/underneath structures of public utilities
- Planning

- Development
- Management

Role of Local Authority (Municipality/VDC)

- To provide construction permit for apartment housing
- Monitoring and regulating of apartment housing
- Taxation
- Right, restriction and appeal overhead and underneath structures of public utilities

Role of SD

- Show foot print of 3D real estates objects on cadastral maps
- Prepare 3D cadastre specification
- Approve and authenticate AS_ Built drawing and link with cadastral maps
- Provide 3D real estate objects information

Role of DOLRM

- Improve the existing registration system to incorporate the registration and updating of 3D real estate objects
- Improve the land ownership certificate and deed document format to incorporate rights/interest, restriction and responsibilities for 3D registration
- Improve the legislation for 3D real estate registration
- Improve service delivery for 3D real estate objects registration

Role of Real Estate companies; an example of housing development

- Get planning and construction approval from DUDBC
- Construct the buildings as per approved plan
- Fulfill the terms and conditions as per agreement with apartment owners
- Execute AS_Built survey as per the specification of SD
- Promote real estate market

Legislative Framework:

According to Molen (2003) the role of institutions and appropriate legal frameworks and transparent public administrative structures are very important for the implementation of 3D cadastre. The following laws related to land administration and real estate ownership currently govern the 3D real estates registration in Nepal.

- Muluki Ain (Common Law Codes)
- Land (Survey and Measurement) Act, 1962
- Land Administration Act, 1967
- Land Revenue (Administration and Revenue) Act, 1977
- Joint Residence Ownership Act, 1997
- Local Independent Administration Act, 1998
- Housing Act, 2000
- Town Development Act, 1989

Muluki Ain is equivalent to a common law and this law prevails where there is no any specific law in any specific subject. Before enactment of subject specific acts, land administration was used to be governed by chapters of this law. After enactment of Land Revenue Act, 1977 and Land Act, 1962 many of the provisions made in this law have been ineffective. For the implementation of 3D cadastre still some section of this law can be useful.

In Land (Survey and Measurement) Act, 1962 (8th amendment) there is the provision of measurement and registration of separate ownership for a floor or room in a building. The attribute information of ownership about the part of a building can be recorded in the field book and land ownership certificate. But still there is not clear description about the ownership (right, restriction and responsibility) of common place such as ladder, roof, passage etc.

In land Administration Act, 1967 and Land Revenue Act 1977, there is a lack of description about the 3D registration of real estate objects.

In Joint Residence Ownership Act, 1997, there is a provision of registration of flat/apartment in a multi storey building. Still there is need of linking of this Act with other land registration Act and clear description about the right, restriction and responsibilities about joint residential area. The role and responsibility of local authority for land management is mentioned in the Local Independent Administration Act, 1998. Likewise, Housing Act, 2000 and Town Development Act, 1989 describes about the housing development and urban development.

Technical Framework

The technical framework consists of 3D cadastral mapping, 3D real estate objects registration, creation of 3D cadastral database and visualization of 3D real estate objects.

3D Cadastral Mapping: In Nepal, only the 2D parcels are surveyed in the field so there is a lack of 3D cadastral mapping. At the time of adjudication and boundary survey

the description of 3D real estate objects had recorded on the field book. The ownership certificates are prepared based on these field books. The system of 3D cadastral mapping is not yet developed. Only the x and y co-ordinates of the parcels are recorded on the cadastral maps. Now due to the high land value and growing demand for transaction of house above and below the surface there is a need of numerical cadastral mapping and 3D cadastral mapping in the urban area. The corner points of each of the real estate objects are to be shown with x,y,z co-ordinates.

3D real estates objects registration: In Nepal, the 3D real estate objects like the room in a building can be registered at the land registry office. Still the identification of real estate objects and their spatial parts recording system is not sufficient. The existing registration system could not fully incorporate the security of ownership for 3D registration. Now it has been realized that the land registration system should incorporate the 3D real estate objects registration. The AS_Built drawing of each of the real estate objects will be documented with deed documents with its description and kept at the cadastral office linking with cadastral map.

Creation of 3D cadastral database: The cadastre of Nepal is parcel-based land information system. The existing cadastral databases are based on 2D information of land parcel. Now the concept of 3D land object is emerging. For low cost approach for 3D cadastral database, the foot print of real estate objects are shown on the cadastral map and the AS_Built drawing of 3D real estate objects are kept separately as a file map. The 3D real estate objects has unique ID derived from the parcel ID. Survey Department Keep the documents at AS_Built drawing of each of the real estate objects. The AS_Built drawing is also geo-referenced with national geodetic system. A separate AS_Built layer has made for each of the real estate objects in GIS system and hyperlinked with cadastral maps to incorporate the 3D information**.**

Visualization of 3D real estate objects: According to the cadastre 2014 document, the cadastral mapping will be changed to cadastral modeling. The 3D real estate objects will be visualized in term of 3D model. With the help of new ICT and GIS/CAD tools the 3D real estate objects will be visualized.

Conclusions

This paper investigate that there are more than eight real estate objects to be considered for the effective implementation of 3D cadastre in Nepal. Different Departments under different Ministries are involving for the 3D real estate objects registration in Nepal. There is a need of effective institutional arrangement for the registration of 3D real estates and improvement of the legal security of spatially complex rights. The AS_Built drawing georeferenced to the national geodetic coordinate system are the base for the technical solution of 3D cadastre. For the time being a hybrid solution for data modeling of 3D cadastre is useful for Nepal.

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Calendar of International Workshop/Seminar/Conference

ISPRS Commission I Symposium
Paris 2006:From Sensors to Imagery
Paris, France
3-6 July 2006
E: isprs2006@colloquium.fr
W: www.colloquium.fr/sfpt2006

IEEE/IGARSS 2006
International Geosciences and Remote Sensing Symposium (IGARSS)
Denver, Colorado
From 31 July-4 August 2006
E: ieeegrss@adelphia.net
W: www.ewh.ieee.org/soc/grss/igarss.html

Inl'l Workshop on 3D Geoinformation 2006
Kuala Lumpur, Malaysia
7-8 August 2006
E: alias@fksg.uthm.my
W: www.fksg.utm.my/3Dgeoinfo2006

26th ESRI User Conference and 4th Survey and GIS Summit
San Diego, CA, USA
7-11 August 2006
E: uc@esri.com
W: www.esri.com

Map Asia 2006
Bangkok, Thailand
29 August-1 September 2006
E:info@mapasia.org
W:www.mapasia.org

9th International Symposium on High Mountain Remote Sensing Cartography
Graz, Austria
14-22 September 2006
E: viktor.kaufmann@tugraz.at
W: www.kfunigraz.ac.at/goeww/hmrsc/hmrsc_9

12th Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP)
Bangkok Thailand
18-22 September 2006
E: sec@pcgiap.org

XIII International Federation of Surveyors (FIG) Congress
Munich, Germany
8-13, October 2006
E: jbuchmueller@hinte.messe.de
W: www.hinte.messe.de

27th Asian Conference On Remote Sensing (ACRS)
Ulaanbaatar, Mongolia
9-13 October 2006
E: msaandar@mongol.net
W: www.acrs2006.ub.mn

Global Spatial Data Infrastructure (GSDI) 9 Conference
Santiago, Chile
6-10 November 2006
E: gsdi9@igm.cl
W: www.igm.cl/gsdi9

13th International Steering Committee for Global Mapping (ISCGM)
Santiago, Chile
11 November 2006
E: sec@iscgm.org
W: www.iscgm.org

13th Asia Pacific Space Agency Forum (APRSAF)
Jakarta Indonesia
22-24 November 2006
E: secretariat@aprsaf.org
W: www.aprsaf.org

Cambridge Conference 2007
Cambridge U.K.
15-20 July 2007
E: nmonetwork@ordnancesurvey.co.uk
W: www.ordnancesurvey.co.uk/nmonetwork

ISPRS 2008 Beijing
The XXI Congress of the International Society for Photogrammetry and Remote Sensing
Beijing, China
3-11 July 2008
E: loc@isprs2008-beijing.org
W: www.isprs2008-beijing.org

Principal – Agent theory approach for determination of appropriate 'Activity Model' for cadastral information updating in Nepal

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Keywords: Activity Model, Cadastre, Principal - Agent Theory Approach, OO Modeling Technique, Parameters

Abstract

In Nepal due to the increased need of agricultural based economical activities and rural to urban transactions process there is a need of reliable and ready access to cadastral information. The Ministry of Land Reform and Management (MoLRM) has targeted to develop nationwide LIS for updating and dissemination of reliable and accurate land information. A LIS consists of two databases an administrative/legal system i.e. attribute data and a digital cadastral map i.e. spatial data containing the ownership, value and use of land. The Department of Land Information and Archive (DoLIA) has started developing district wise LIS. This approach needs much more resources in comparison to the centralized LIS. From financial perspective the updating of cadastral information is much more expensive than the land registry information. So, there is a need of determination of appropriate "Activity Model" for cadastral information updating process.

This research paper provides an approach for determination of appropriate 'Activity Model' for cadastral information updating in Nepal. The Principal - Agent (P-A) theory approach has been used for the determination of appropriate 'Activity Model'. Six different options according to the P-A relationships were evaluated with twenty institutional and technical parameters and found that CC (central authority and central activity) is optimal for cadastral information updating procedure. Eight different processes for the cadastral information updating are identified and modeled them using object oriented modeling techniques with UML activity diagram. Two ways of verification has been used to test the model. The model is conceptually tested developing use cases with the help of activity diagram. The feasibility of the model is tested using Arc cadastre software with the direct link to geo-database.

Introduction

The high level political objective of Nepal is poverty reduction. Appropriate Land Reform and Management strategies could be one of the means to reduce the poverty. The major objectives in the Land Reform and Management sector are to ensure sustainable land use and management, update and maintain land records/information, and increase access of the poor to land resources and ensure effective utilization through enhancement of their skills [6]. In order to meet the above mentioned objectives land information system (LIS) would be a viable and inevitable system. A LIS consists; on the one hand, of databases containing spatially referenced land-related data for a defined area and, on the other, of procedures and techniques for the systematic collection, updating, processing and distribution of the data [5]. The usefulness of LIS depends upon up-to-date ness, accuracy, completeness and accessibility, and upon the extent to which the system is organized for the benefit of the user rather than that for the producer.

In Nepal, the Ministry of Land Reform and Management (MoLRM) is mandated for the tasks related to Land Administration (LA). Under this Ministry, Department of Survey (DoS) and Department of Land Reform and Management (DoLRM) are responsible for the tasks of cadastre and land registration. Both the Departments maintain land records (cadastral maps and ownership records) at their district offices. Under the same ministry Department of Land Information and Archives (DoLIA) is responsible for building a nation-wide LIS. Besides this, the Trust Corporation is responsible to handle the administration of Trust land. Within the district, the local authorities such as Municipalities and Village Development Committee (VDC's) are responsible for the land taxation

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and mainly dependent on data and services provided by the district survey and land registry offices. The Land Management Training Centre is responsible for the human resource development in the sector of land registry and cadastre. The Ministry of Land Reform and Management (MoLRM) has targeted to develop nationwide LIS for updating and dissemination of reliable and accurate land information. A LIS consists of two databases an administrative/legal system i.e. attributes data and a digital cadastral map i.e. spatial data containing the ownership, value and use of land. The Department of Land Information and Archive (DoLIA) has started developing district wise LIS. This approach needs much more resources in comparison to the centralized LIS. More over, from financial perspective the updating of cadastral information (CI) is much more expensive than the land registry information.

This research paper provides an approach for determination of appropriate ''Activity Model'' for cadastral information updating in Nepal. The Principal - Agent (P-A) theory approach has been used for the determination of appropriate ''Activity Model''. Six different options according to the P-A relationships were identified and evaluated with twenty different parameters and found that CC (central authority and central activity) is optimal for cadastral information updating procedure. Eight different work processes for the cadastral information updating are identified and modeled them using object oriented (oo) modeling techniques with UML activity diagram. Two ways of verification has been used to test the model. The model is conceptually tested developing use cases with the help of activity diagram and physically using Arc cadastre software with the direct link to geo-database.

Institutional and Technical Parameters

According to Radwan and Bishr, [7] Geographical Information Infrastructure (GII) has mainly two components; institutional and technical. Bogaerts [1] emphasizes five aspects that are crucial for a well functioning cadastral system; political aspects, legal aspects, organizational aspects, financial aspects and technology. He has formulated some critical success factors about these five aspects. The most critical success factors for cadastral system are legislation, organization, financing, data and its quality, technology used and human resources. Among these, organization and management are the most critical in the context of the Phare countries [2]. Likewise, Steudler [8] has defined five evaluation areas; Policy level, Management level, Operational level, External factors and Review process, and formulated some evaluation aspects and good practice for the evaluation of land administration system. Likewise, Tuladhar [9] suggests the following eight critical success factors (CSFs) for the implementation of Parcel Based Geographical Information System (PBGIS).

- Institutional support, including political support
- Legal
- Financial
- Organization including co-ordination and co-operation
- Management including market orientation and information requirement
- Technical including system development, system installation infrastructure establishment and maintenance
- Standard
- Quality Management

Incorporating all these literatures for the determination of appropriate 'Activity Model', two aspects institutional/ organizational and technical are considered and the parameters are formulated for the evaluation based on these two aspects. Twelve institutional parameters and eight technical parameters are formulated based on the literature study and local expert's consultation for the determination of appropriate 'Activity Model'. The Twelve institutional parameters and eight technical parameters are tabulated in Table 1.

Institutional and Technical Parameters for evaluation of CI Updating

Institutional Parameters	Technical Parameters
1) Land Policy	1) Physical Infrastructure
2) Resources	2) ICT Support
3) Cost	3) Market Adaptation
4) Stakeholders Interest	4) Technical Expertise
5) Political Interest	5) SDI Support
6) WF Management	6) Data Security
7) Cultural Aspect	7) Data Management
8) Co-ordination and Participation	8) Quality Management
9) Customer Satisfaction	
10) Funding Agency's Interest	
11) Process Time	
12) International Declaration	

Table 1: Institutional and technical parameters for evaluation of CI updating process

Principal – Agent (P-A) Theory Approach

The method used here for the determination of appropriate 'Activity Model' for cadastral information (CI) updating is Principal-Agent (P-A) theory approach. According to de Vries [4] the neo-institutional economics (NEI) has various perspectives like Property Right Theory, Transaction Cost Theory, Principal-Agent (P-A) Theory and Bureaucracy Theory. The P-A theory focuses on authority and sharing of responsibilities. In P-A relationships there are three aspects to be considered. The first aspect is the definition of who has authority/ responsibility (principal) and who is carrying out on behalf of authority (agent), the second aspect is to which extent can principal control/check agent and the third is to which extent agent can achieve authority / responsibility. Based on this, basic concept of P-A relationship for cadastral information updating, the following idea has been generated.

Who is principal and who is agent?

There are four different organizations involving for CI updating process; Centre Office, District Office, Private Sectors and Local Authority. According to P-A relationship the principal could be either Centre Office or District Office; the activities could be done by Centre Office, District Office or Private Sectors.

To which extent can principal control/ check the agent?

The most important thing in the P-A relationship is to know exactly who is controlling to whom and to which extent they are controlling [3]. For the optimal P-A relationship, there should be limited power delegated to the agent. In some extent the principal should control/ check the agent such that the total agency cost is optimal.

To Which extent can agents achieve authority / responsibility?

The most important thing in the P-A relationship is to determine which activities should be outsourced to the agent and up to which extent. In the cadastral information updating process, some of the activities should be outsourced. For example, some of the activities of district cadastral office like scanning and digitization of cadastral map, field works etc. could be outsourced to the private sector. Hence, it should be made out in advance that which activities should be given to the private sector and how to control the quality of work carried out by the private sector

From the basic principal of P-A theory, there are six different options; CC, CL, CP, LC, LL and LP (Table 2) for CI updating process.

Activities / Authority	Central	Local	Private
Central	CC	CL	CP
Local	LC	LL	LP

Table 2. Six possible scenarios on the basis of P-A relationship

A brief description of these six possible scenarios on the basis of P-A relationship is given as below.

CC: In CC, both the activity and authority remain at central level.
CL: In CL, the authority remains at central level and the activity at local level.
CP: In CP, the authority remains at central level and the activity at private sector.
LC: In LC, the authority remains at local level and the activity at central level.
LL: In LL, both the authority and activity remain at local level.
LP: In LP, the authority remains at local level and the activity at private sector.

Evaluation of Six Different Options According to P-A Relationship

According to the table 2, there are six different options incorporating P- A relationship approach. An evaluation table was formed as parameters in the rows and six options in the columns and for each of the parameter the best option has been marked with a tick. In the beginning the best option for each of the parameter was selected by literature review and author's own experience. Later, the same table was distributed to the local experts for the verification and their feedback was incorporated. The result f findings has been shown in the table 3 below.

Parameters		CC	CL	CP	LC	LL	LP	NA
Institutional	1) Land Policy							√
	2) Resources	?						
	3) Cost	?						
	4) Stakeholders Interest					?		
	5) WF Management	?						
	6) Political Interest							?
	7) Donor Interest							?
	8) Customer Satisfaction					?		
	9) Cultural Aspect					?		
	10) Co-ordination and Participation					?		
	11) Process time		?					
	12) International Declaration							?
Technical	1) Physical Infrastructure	?						
	2) ICT Support	?						
	3) Market Adaptation	?						
	4) Technical Expertise			?				
	5) SDI Support		?					
	6) Data Security		?					
	7) Data Management	?						
	8) Quality Management					?		
	Total	7	3	1	0	5	0	4

Table 3: Evaluation of six different options according to the P-A relationship

In Nepal, the Land Policy is not formulated yet, as a result it can not be evaluated what option would be appropriate for the CI updating according to the P-A relationship. Politicians do not have any interest on the updating mechanism, as this is the organizational matter. Donors or funding agencies work on the basis of how they are approached. International declarations do not impose any compulsory mechanism to be followed for cadastral information updating. On the basis of these facts, the institutional parameters; land policy, political interest; donor interest and international declaration do not have any implications about the options about cadastral information updating. The institutional parameters like resources, cost, WF management favors for the Central Activity Central Authority (CC). But the parameters like stakeholders interest, customers satisfaction, cultural aspect and co-ordination and participation favors for the Local Authority Local Activity (LL).

The availability of Physical infrastructure, ICT support, and technical expertise are superior in the central office. The availability of the components of market adaptation is more in the centre. The availability of data at one place makes easier for data management. Hence the technical parameters like physical infrastructure, ICT support, market adaptation and data management favors the Central Authority Central Activity (CC) option. Likewise, the technical expertises are more in the private sector so it favors for the Central Authority Private Activity (CP). The Local Activity (CI recording and processing) and Central Authority makes the SDI support and more data secured hence SDI support favors CL. Likewise, the option Local Authority Local Activity (LL) favors for the quality management.

For the Multi Criteria Analysis (MCA), the weight of each of the parameter is assumed equal and it can be concluded from the evaluation result that the option Central Authority Central Activity has got the maximum weight i.e. seven. From the analysis it can be concluded that the option CC is optimal incorporating the P-A relationship.

Appropriate 'Activity Model' by Incorporating P-A Relationship Approach

From the above evaluation the option CC is the optimal according to the P-A relationship approach. For the determination of appropriate 'Activity Model', also, the same P-A relationships approach has been adopted. The first aspect in P-A relationship approach is identification of who has authority/ responsibility (principal) and who is carrying out on behalf of authority (agent). There are four organizations, central office, private sectors, district office and local authority involving for the CI updating process. The central office and district office is the principal and private sectors and local authorities are the agent for the centralized CI updating process. The second aspect of P-A relationship approach is to determine which extent can principal control/check the agent and the third aspect is to which extent agent can achieve authority / responsibility. Considering this second and third aspect of P-A relationship the activities done by each of the organization has been determined. The appropriate 'Activity Model' incorporating P-A relationship has been shown in the Fig. 1.

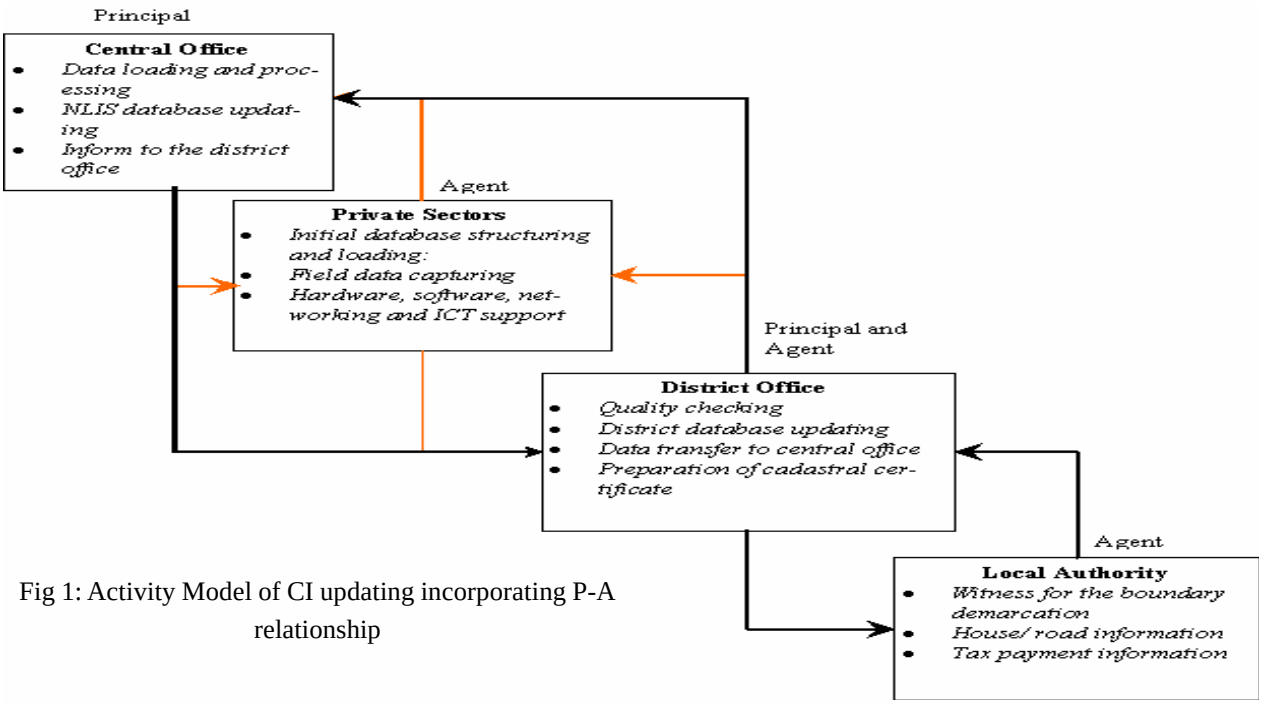

Fig 1: Activity Model of CI updating incorporating P-A relationship

The Central Office could be the principal for CI updating. The main activities of Central Office are data loading and processing, NLIS database updating, inform to the District Office. The Private Sectors are the agent and their main activities are initial database structuring and loading, field data capturing, support for hardware, software, networking and ICT. The District Office could be the principal for some of the work process and agent for the some of the work process. The main activities of District Office is quality checking, district database updating, data transfer to the Central Office and preparation of cadastral certificate. The Local Authority could be

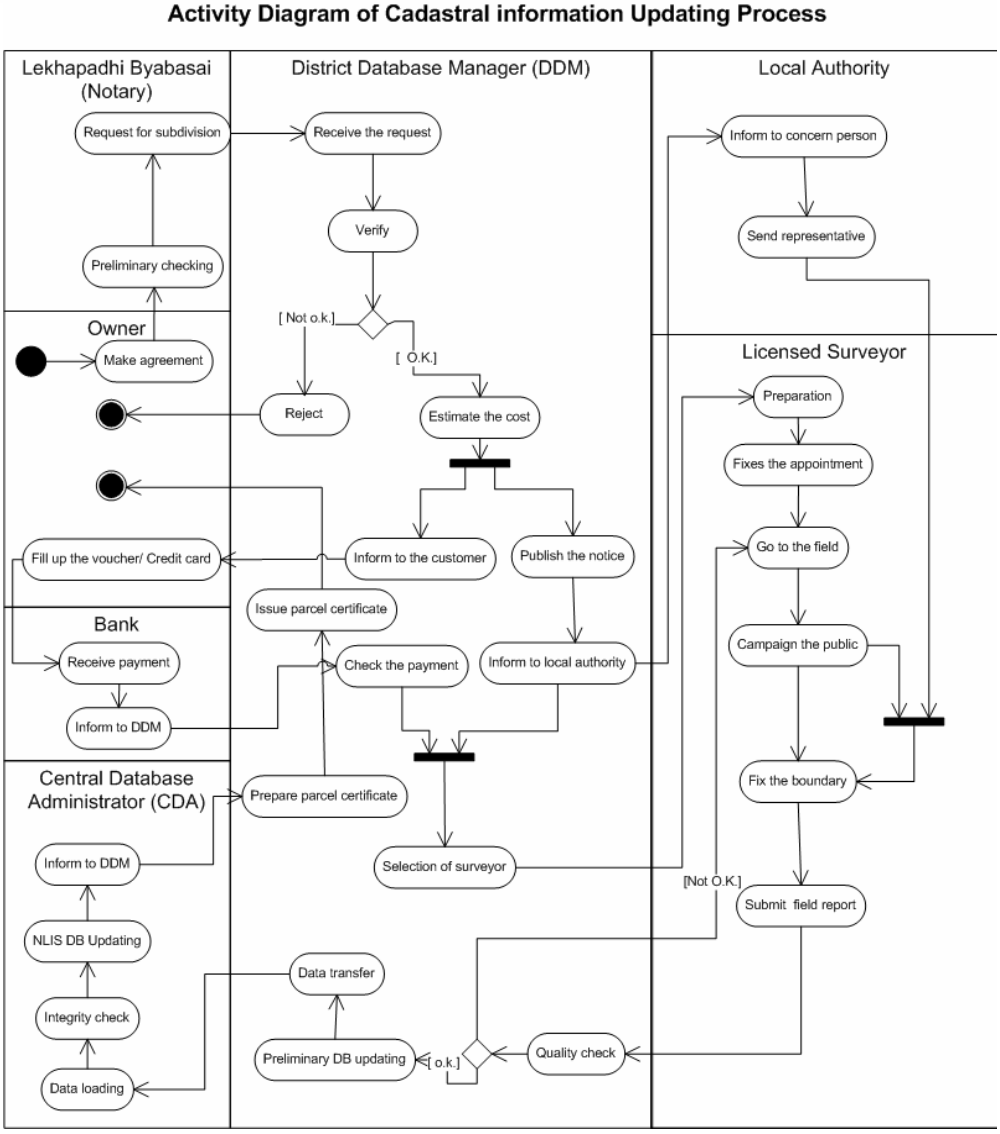

Fig 2: Activity diagram of Cadastral Information updating process

the agent for CI updating process. The main activities done by the Local Authority are witness for the boundary demarcation and to provide house/road information and tax payment information.

Modeling of Cadastral Information Updating Process

The CI updating process has been modeled taking Object – Oriented (OO) modeling approach. The worldwide accepted standard modeling language; i.e. the unified modeling language (UML) having Object -Oriented (OO) concepts has been used for modeling updating process. The Visio 2003 software has been used for modeling activities and The UML activity diagram is used to explore and describe the activities in CI updating processes.

There are seven main actors involved for the CI updating process. The Owner, Lekhapadhi Byabasai, District Database Manager (DDM), Bank, Licensed Surveyor, Local Authority and Central Database Administrator (CDA) are involved in the CI updating process. The activities for CI updating process involve the following 20 main steps displaying the following basic flow of events and alternatives with seven actors.

The Lekhapadhi Byabasai performs preliminary checking of the documents and sends the request for the subdivision of parcel. The District DB Manager (DDM) checks the application and verifies it. The DDM estimates the cost and informs the owner. The Bank receives the payment and informs to the DDM. The DDM assigns the field work to the licensed surveyor and publishes the notice.

The Licensed Surveyor retrieves the necessary data from database and makes the preparation for field work. He/She then fixes the appointment with owners and local representative and fixes the parcel boundary in the presence of local representative and owners. The licensed surveyor prepares the field report with field sketch and measurement and signed by local. The Licensed surveyor submits the field report to the District Database Manager (DDM). The DDM checks the quality of field work and updates the preliminary spatial database at District Office. The DDM transfers the updated information to the Central DB Administrator (CDA). The CDA loads the data and checks the integrity. The CDA updates the NLIS database and informs the DDM. The DDM prepares the parcel certificate and issues it. The new owner receives the parcel certificate or the Lekhapadhi Byabasai receives the parcel certificate on the behalf of new owner. One copy of parcel certificate will be sent to the Land Registry Office.

In the beginning; the District Database Manager transfers the updated CI to the Central Office. According to the P-A relationship both authority and activities for the updating of CI is at Central Level. When communication infrastructure will be developed and become affordable the NLIS database will be directly accessed and updated by DDM i.e. the activities will be transferred to the District office and authority will be at the Central Office.

Verification of the Model

There are two methods used for the verification of the 'Activity Model'. The first one is the model was conceptually verified by developing use cases with the help of activity diagram each of the use cases were realized developing sequence and class diagram in UML. The second one is the model was experimentally verified with the help of ArcCadastre software.

Verification 1

The UML use case diagram is used for the conceptually verification of the model. The purpose of use case diagram is to list the actors and use cases, and show which actors participate in which use case. There are six actors interacting with four use cases in a system whose boundary is defined by 'Cadastral Information Updating Process' is shown in the fig 5.2 The six actors are; Lekhapadhi Byabasai, Bank, Licensed Surveyor, Owners,

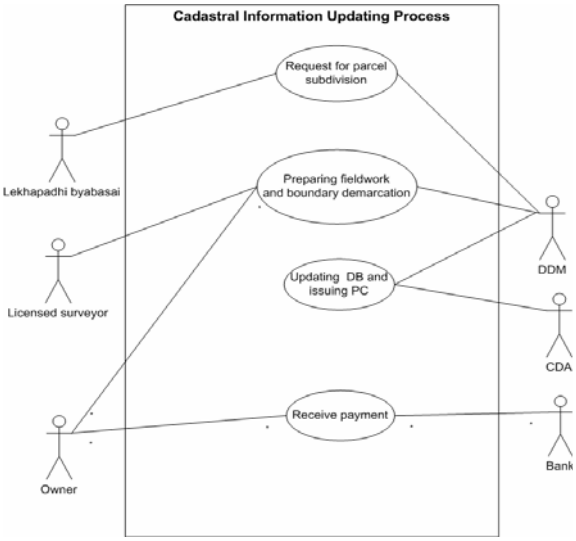

Fig 3: Use case diagram of Cadastral Information updating process

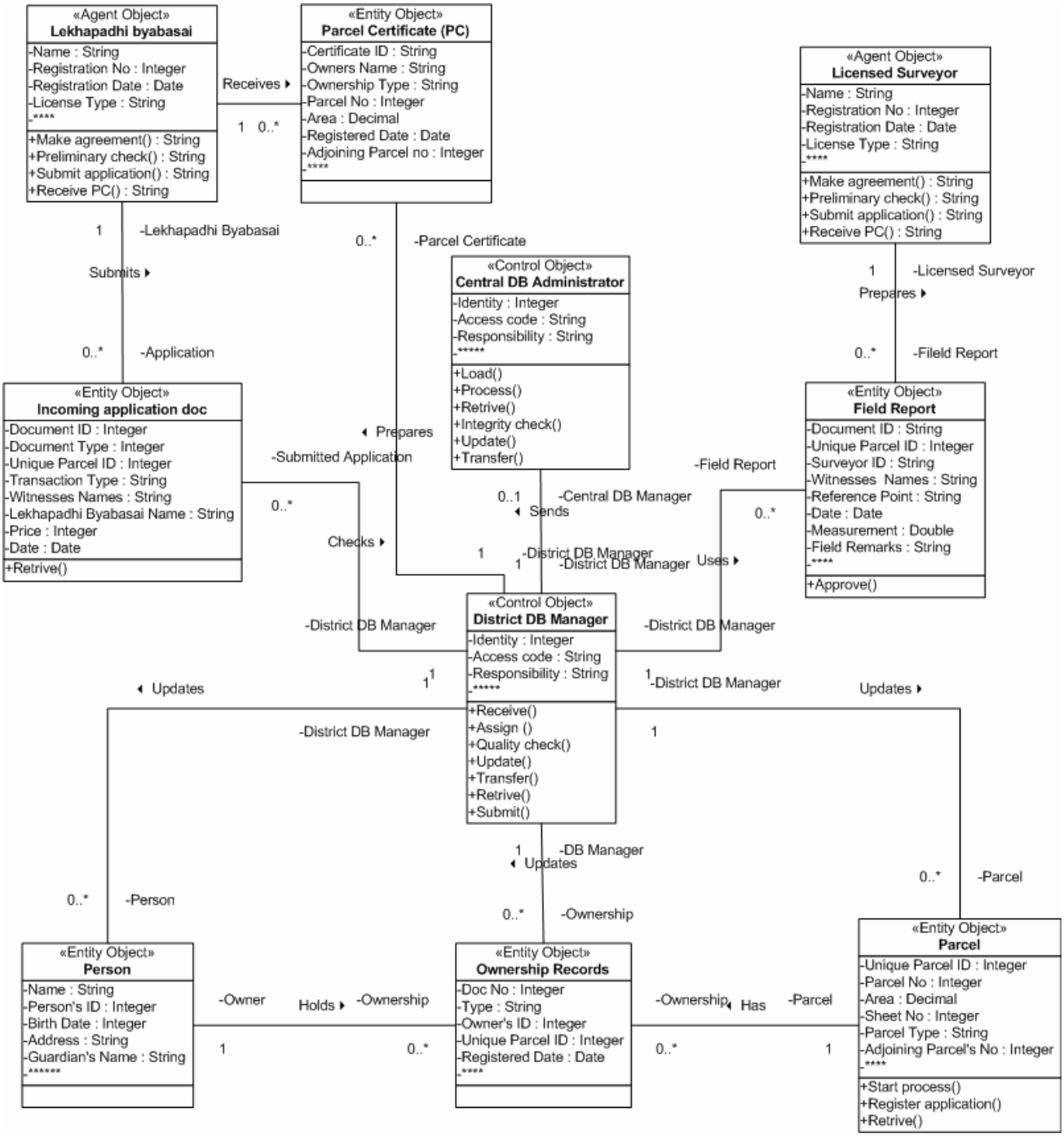

Fig. 4: Class diagram of Cadastral information updating process

District Database Manager (DDM) and Central Database Administrator (CDA). There are four use cases: Request parcel subdivision, Receive payment, Preparing field work and boundary demarcation, Updating database and issuing PC.

In the CI updating process, the use cases developed in Fig. 3 have realized modeling the actors and use cases into three stereotypes control object, entity object and agent object. According to the P-A relationship, the object having authority is modeled as control object and the object, which performs activities, is modeled as agent object. All the information necessary for the updating process is modeled as entity object. The Lekhapadhi Byabasai & licensed surveyor are the Agent Object; Central DB Administrator & District DB Manager are the Control Object and Incoming application documents, Field report, Person, Ownership records, parcel and parcel certificate (PC) are the entity objects. The class attributes and operations with various relationships among objects are shown in the Fig. 4

The four use cases developed in the Fig. 3 for CI updating process are also realized through four sequence diagrams.

Verification 2

Digital cadastral map derived from the cadastral map of 1: 500 scales and connected to the national geodetic reference system has been used for the experiment with ArcCadastre. First both spatial and non-spatial data were taken from DoLIA and linked using Arc GIS software. Those data were loaded in the ArcCadastre software. There are three preliminary works: creation of a new job template, creation of a job database from a template and creation of a new job from a job template to be done to organize the work processes in workflow editor in ArcCadastre software.

With the help of activity diagram described in Fig.1, the CI updating process is designed using ArcCadastre workflow editor. The workflow was saved as xml file format. The main workflow has been created for the CI updating process linking with four sub-processes as shown in Fig. 5. Workflow for each of the sub processes is also created and linked with the main workflow. The conditions are also created in the work flow.

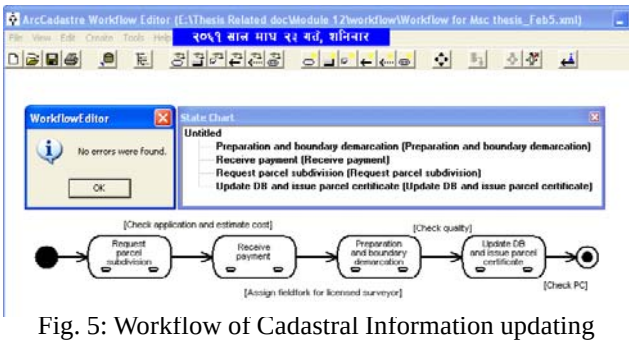

Fig. 5: Workflow of Cadastral Information updating process

Finally, a job template is created with the help of workflow described above. A new job is created with the help of job template and tested with the map document. The result is shown in the Fig. 6 below.

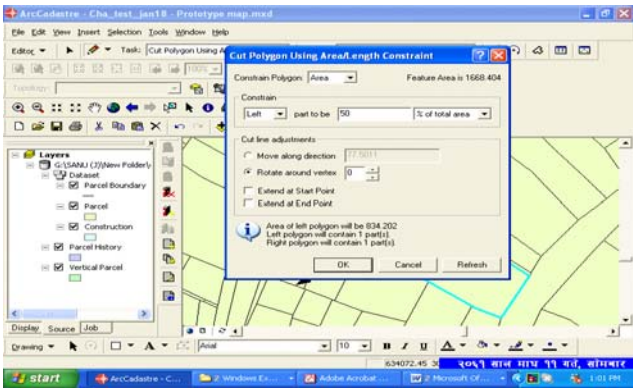

Fig. 6: Workflow tested with the cadastral map in ArcCadastre

Conclusions

This research first gives the introduction about the LIS development in Nepal and describes about the institutional and technical parameters to be considered for the determination of appropriate 'Activity Model' for cadastral information updating. The principal –Agent (P-A) theory approach is applied for the determination of 'Activity Model'. The 'Activity Model' was modeled using Object Oriented (O-O) modeling technique and verified conceptually with use case diagram realizing through class and sequence diagram and physically with ArcCadastre software with direct link to geo-database (cadastral map). This research concludes that the Centre Activity Centre Authority (CC) is optimal for Nepal for CI updating process incorporating P-A relationship approach.

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Participation in international events by the officials of Survey Department

-Global Mapping Training Course
Mr. Narayan Kumar Shrestha, Survey Officer
11 Srawan- 29 Aswin, 2062(26th July-15th October 2005), Japan

-12th Asia Pacific Regional Space Agency Forum (APRSAF) Meeting
Mr. Toya Nath Baral, Director General
25-27 Aswin, 2062 (11-13 October 2005), Fukuoka, Japan

-Mini-Project Training
Mr. Kalyan Gopal Shrestha, Chief Survey Officer
Mr. Sudarshan Karki, Survey Officer
Mr. Nirmal Kumar Acharya, Survey Officer
Mr. Balam Kumar Basnet, Operator
24 Aswin- 18 Kartik, 2062 (10 October-4 November, 2005), AIT, Thailand

- Training Course on NSDI for PCGIAP Member countries
Mr. Ganesh Prasad Bhatta, Survey Officer
26 Aswin- 11 Kartik (12- 28 October 2005) Hyderabad, India

-26th Asian Conference on Remote Sensing
Mr.Rabin K. Sharma, Deputy Director General; a.i.
Mr.Sudarshan Karki, Survey Officer
21-25 Kartik, 2062(7-11 November 2005) Hanoi, Vietnam

-Professional Education
Mr. Giri Raj Khanal, Survey Officer, GIM3
Mr. Hajari Yadav, Survey Officer, GFM3
Mr. Narayan Kumar Shrestha, Survey Officer, GFM3
Mr. Bimal Prasad Gyanwali, Survey Officer, GFM3
1 year from September 2005, ITC, The Netherlands

Mr. Paban Khatri, Operator.GFM4
Mr. Sahadev Subedi , Surveyor,GFM4
9 month from January 2006,ITC, The Netherlands

The First Joint Team Meeting for Establishing a Disaster Risk Management System in the Asia Pacific Region
Mr. Durgendra Man Kayastha, Chief Survey Officer
2-3 Falgun, 2062(14-15 February 2006), Hanoi, Vietnam

Study Tour
Mr. Durgendra Man Kayastha, Chief Survey Officer 13-15 Baishak 2062 (26-28 April 2006) NRSA Hyderabad, India

Obituary

All the officials of Survey Department pray to the Almighty for eternal 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. Man Kaji Pradhan, Peon
2. Late Mr. Laxmi Shah, Peon

The Role of Mapping in Disaster Management

Kalyan Gopal Shrestha
Chief Survey Officer
Topographical, Survey Branch,
Survey Department

Abstract

Every year Nepal suffers from many kinds of disasters such as floods and landslides. In recent years, the increasing numbers of natural disasters in Asia like Tsunami and series of South Asian quakes are a matter of serious concern to us. At this crucial period, we should be conscious about our status of disaster management situation in Nepal. What will happen if a strong earthquake or any other natural disaster strikes Nepal, particularly in the capital city of Kathmandu? Though we cannot avoid disaster, but by implementing the effective prevention schemes, we can reduce damages from severity, if sufficient information for disaster forecasting is given timely. This paper attempts to evaluate the critical role of mapping for all stages of the disaster management cycle: prevention, mitigation, preparedness, response and recovery.

Introduction

Disaster is a sudden and accidental event that causes many deaths and injuries. Most disasters result in significant property damages. Common natural causes of disasters include earthquakes, floods, landslides, hurricanes, and tornadoes. Volcanic eruptions, fires, and avalanches rank among the other natural forces that sometimes create disasters.

Not all disasters are produced by the forces of nature. Many modern-day disasters involve accidents aboard passenger-carrying airplanes, ships, or railroads. Other "man-made" disasters can be traced to the collapse of buildings, bridges, tunnels, and mines, as well as to explosions and fires triggered by humans. War and terrorist events, which also cause death and destruction, are intentional rather than accidental, and therefore are not considered disasters.

In recent years, the increasing number of natural disasters in Asia that include Tsunami and series of South Asian quakes are a matter of serious concern to us. At this crucial stage, it is useful to make aware our status of Disaster Management situation in Nepal. What will happen if such a strong earthquake or any other natural disaster hits Nepal, particularly in the capital city of Kathmandu? Hundreds of thousands of people will be buried and yet other thousands and thousands of people will be killed because of poor post-Disaster Management. Country will face severe panics of road blockade, failure of water supply system, medical services and food supply failure and eventually upsurging epidemic so on.

Disasters in Nepal

Natural disaster is common in Nepal. The country is geologically young and still evolving. Therefore landslides and earthquakes are common and frequent. Given its mountainous topography and the fact that the country comes under the spell of the monsoon every summer, flash floods, regular floods and flood- and earthquake-triggered landslides are also quite common.

Tectonic-induced disasters (Earthquake disaster) could be most catastrophic. The earthquake of 1934, 1980, and 1988 were the most devastating natural disasters, which not only caused heavy losses of human lives and physical properties but also adversely affected the development process of the country as a whole. A massive earthquake registered 7.9 on the Richter scale struck Nepal in Jan 1934. Thousands of peoples were killed and hundreds of thousands were left homeless. A powerful earthquake is said to strike Nepal every 80 to 100 years. As Nepal falls in most vulnerable seismic zone, geologists have warned that a major earthquake may strike at any time.

Water-induced disasters, e.g. Flood, Landslides etc. are most common natural disasters in Nepal. Besides, heavy precipitation, high wetness and steepness of watersheds contribute to flood magnitudes. Mainly, the middle hills are prone to landslides and the Tarai to flood and fire. Thus, flood, landslide and fire are the most frequent natural disasters in Nepal. These disasters occur almost every year in one part of the country or the other causing loss of life and heavy damage to physical properties. In July 1993,

Nepal experienced the worst recorded natural disaster in history due to two days of torrential rainfall in central Nepal. More than 1300 lives lost and over millions of property and infrastructure were destroyed.

Apart from that, the region is also quite vulnerable to disastrous hazards due to glacial lake outburst floods. Since a few years, Tsho - Rolpa Glacial Lake has been a burning issue and becoming potentially dangerous. Among the 2323 glacial lakes of Nepal, 20 glacial lakes are identified as potentially dangerous. A monitoring system for lakes with outburst risk should be established to avoid flood hazards.

It is a great challenge to the nation to protect infrastructure and property from frequent landslide and floods. Each year flood, landslide, fire, epidemic, avalanche and various other natural and man made disasters cause the casualty of thousands of human lives and destruction of physical properties worth billions of rupees.

Disaster Management in Nepal

Immediate rescue and relief works as well as disaster preparedness mitigation activities are governed by the Natural Disaster Relief Act 1982 of His Majesty's Government of Nepal. The Natural Disaster and Floods Division of the Ministry of Home Affairs is the central unit responsible for managing/coordinating emergency response.

Disaster mitigation efforts of the government so far are confined to rescue operation and post-disaster recovery. In the absence of information about the nature of flood events, exposure of life and properties and capabilities to cope with disasters, it is difficult to prepare and implement pre-disaster activities. Lack of information is a major constraint in implementing and coordinating the rescue and post-disaster management activities effectively.

So far there are no established guidelines in Nepal that facilitates policy and program development in disaster reduction and efficient response. The efficient exchange mechanism of relevant information to establish a central database is the most important factor to be encouraged. There is an urgent need to prepare a consolidated Natural Disaster Management Policy. There are still several fundamental unanswered questions before us. How to do? When to do? Who will do?

Role of mapping

Maps have been used for centuries as tools for providing detail information about the area concerned. The remarkable developments in computer technology, space technology and GIS applications in mapping during the recent decades have enhanced the design, quality and utility of maps. Subsequently these developments provided important tools for change analysis, programming and monitoring for results and impacts, and policy making agencies to address issues related to sustainable development more effectively. The results obtained through the use of satellite data have stimulated major environmental policy decisions around the world.

Maps are essential at all stages of the disaster management cycle: prevention, mitigation, preparedness, response and recovery. It is important to undertake a range of activities such as: risk assessment; scenario analysis or analysis of consequences; forecast and projection; dissemination of information; allocation of personnel, equipment and other resources; reaching relief personnel at various affected areas; damage assessment and so on. Maps play a critical role in all these activities. The role of mapping for disaster management can be analyzed with reference to the following phases:

Hazard assessment and vulnerability analysis

Hazard assessment and vulnerability analysis are fundamental to disaster management planning. It is necessary to identify geographical areas that are likely to be affected by hazards such as earthquakes, landslides and floods. Vulnerable and risky areas in the context of various types of disasters need to be identified and mapped with a view to planning of prevention, mitigation and emergency response measures. If we had geographical information systems, which link maps with database, it would be possible to have simulation models that can be useful at various stages. With the help of GIS, one can analyze disasters over time and space.

Mitigation and preparedness

Though we cannot avoid disaster, but by implementing effective prevention plans, its impact can be reduced through a proper disaster management, including disaster prevention (hazard and risk assessment, land use planning and legislation, building codes), disaster preparedness (forecasts, warning, prediction) and rapid & adequate disaster relief.

Mitigation measures will have to be taken in areas that are more prone to hazards like earthquake, cyclone, flood and drought. Maps and GIS can facilitate such activities. With the help of GIS, one can have a dynamic system of mapping. In other words, maps can be updated as soon as the linked database is updated. Based on the above analysis mitigation and preparedness activities can be planned.

Pre-disaster phase

During the pre-disaster phase (the period after a warning or an early warning of a disaster and before the actual occurrence of a disaster), scenarios can be analyzed and response measures can be planned with the help of maps and GIS. Evacuation routes can be planned and displayed for use by emergency managers. We take an example of a system of early warning of a flood. During the monsoon season, the rainfall situation is monitored closely. With the help of maps and GIS, it is possible to have a detailed assessment of areas with excess, normal and deficient rainfall.

Loss and damage assessment

The role of maps in loss and damage assessment does not need any emphasis. In the event of a disaster, the assessment of damage may have to be done in phases. Immediately after the disaster, questions are asked regarding the number of deaths, the number of injured persons, loss of property etc. With the help of GIS one can have broad and quick estimates of area, population and the vital installations affected. At a later stage when a detailed survey and damage assessment are carried out, the consistency and reliability of the data can be checked with the help of GIS based analysis.

Rehabilitation and reconstruction

Mapping is essential even during relief, rehabilitation and recovery phases after a disaster. In the event of a major disaster affecting vast areas and a large population, it is necessary to plan relief and rehabilitation activities with the help of maps. The task becomes easier and more systematic if maps are linked to database.

Roles of Remote Sensing and GIS as a Natural Hazard Management Tool

A complete strategy for disaster management is required to effectively reduce the impact of disaster, which is referred to as disaster management cycle. Disaster management consists of two phases that takes place before disaster occurs, disaster prevention and disaster preparedness, a three phases that happens after the occurrence of a disaster i.e. disaster Estimation, relief, rehabilitation and reconstruction.

Mapping has become an integral part of a modern decision support system. Remote sensing and GIS provides a data base from which the evidence left behind by disaster that have occurred before can be interpreted, and combine with the other information to arrive at hazard maps, indicating which area is potentially dangerous. Using remote sensing data, such as satellite imageries and aerial photos, allows us to map the variabilities of terrain properties, such as vegetation, water, geology, both in space and time. Satellite images give a synoptic overview and provide very useful environmental information, for a wide range of scales.

Dynamic use of **GIS** integrated with **RS** provides useful measures towards disaster preparedness and to provide warning for the people to take initiative to evacuate people to the safe places in time and also planning for operational activities, immediately before, during and after disaster.

Finally, the impact of the disaster event leaves behind an area of immense devastation. Remote Sensing can assists in damage assessment monitoring, providing a quantitative base for relief operation. After that it can be used to map the new situation and update the database used for the reconstruction of an area. It can help to prevent the occurrence of such disasters again in future.

The multidisciplinary approach of the study is fully benefited by application of remote sensing and GIS techniques combined with field studies. The current scenario of Base map and related records in disaster management is as follows:

Base Map Preparation

Survey Department of Nepal has already prepared the topographical base maps covering the entire country. The scale of the maps for mountainous and tarai area is 1:25,000 and the map scale for Himalayan region is 1:50,000. Survey Department has also prepared a set of digital topographical data base from the topographical base maps. The department has also initiated updating of topographical maps with the help of satellite images.

Hazard Mapping

Hazard map and disaster data play an important role to predict and foresee the possible trends of likely disasters. So, hazard map and reliable data is the need of the day. The lack of meteorological and hydrological records in the country makes accurate projection of possible flood damage beyond our target.

However, recognition of the past damages and potential hazards are one of the key elements to be studied. The primary stage is to plot out the exact location and degrees of damages in the previous major disasters are to be recorded through interviews and field surveys. This information will enable us to suggest particular locations, and human activities of significant vulnerableness, which are to be mapped and shared by the residents and researchers as a basis of discussion and learning toward strengthened protection of life and assets.

Nodal Point for Disaster Management

Survey Department is a member of Asia Pacific Regional Space Agency Forum (APRSAF). In 1995, APRSAF appointed the Survey Department as a nodal point for disaster management for Nepal. In this connection, Geoinformatics Center of Asian Institute of Technology (AIT), Thailand provided trainings to Staffs of Survey Department with the sponsor from Japanese Aerospace Exploration Agency (JAXA). The trainings so far provided are on study of Change in Urban Land use, Flood Disaster Mitigation and Earthquake Disaster Mitigation.

Concluding remarks

Persistent occurrences of earthquakes, floods, landslides and forest fires need to be studied using today's advanced technology to find effective preventive measures. Being a resource-poor country, Nepal faces a gigantic managerial task to provide adequate support to the natural disaster victims.

Nepal lacks organized data collection network, even though several governmental as well as non-governmental International agencies have been providing support for disaster victims from time to time. Despite all these provisions and assistance, there are many challenges for an effective disaster management system - such as system of hazard mapping, vulnerability assessment, risks analysis, low-level of public awareness, lack of cooperation and coordination, poor system of data collection and dissemination, remote and inaccessible topography.

There are no institutions that deal with hazard mapping for serious natural disaster threats in Nepal. Survey Department of Nepal, being a national mapping agency, should kick-off a disaster mapping unit to optimal utilization of its resources for the sake of enhancing country's disaster mitigation efforts. It could work as a coordinating agency for various other institutions dealing with various types of disasters in the country so as to produce disaster hazard maps. Investment towards making use of the space technology is worth because improvement in instrumentation and time prediction will bring about reduction in disaster damages; and improved decision making in planning stages.

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2005-2006 at a glance

Jagat Raj Paudel
Chief Survey Officer
Topographical Survey Branch

Radio Broadcasting on Surveying Mapping Activities of Survey Department

A Radio program *Hamro Jamin Hamro Napi* has been launched on air to aware the general public about surveying and mapping activities of Survey Department. The programme is broadcast from Radio Nepal since 2nd Ashadh 2062 on 1st and 3rd Thursday of every month at 8.15 PM-8.30 PM on different aspect of surveying and mapping.

NGIIP holds training programmes for stakeholders

National Geographic Information Infrastructure Project carried out three different training programmes on various technical aspects of NGIIP to participants from different stakeholder agencies from May 18 to June 22 2005. The training programmes included Basic Cartography and GIS training (Group I), Oracle training (Group II), Hardware, Network, System Administration, WAN, VPN training (Group III).

Workshop/Seminar on Geodetic activities and the use of Orthophoto for Cadastral Mapping

Geodetic Survey Branch, Survey Department, organized a one-day Workshop/Seminar on Geodetic activities and the use of Orthophoto for Cadastral Mapping on June 24, 2005. The following papers were presented:

- Paper on activities of Geodetic Survey Branch
- Study report on use of Orthophoto for Cadastral Mapping
- Report on preparation of Digital Map of the Geodetic Observatory, Nagarkot

EC project taken over by Government of Nepal

The Population and Housing Census 2001 Mapping Component project financed by the European Commission and implemented under the National Geographic Information Infrastructure Programme (NGIIP), Survey Department was completed successfully on June 30, 2005. The results and the assets of the project were taken over by the Director General of Survey Department, from the Charge' de Affaires of the European Commission Delegation to Nepal on June 27, 2005 amid a function held at the project premises in Survey Department.

Seminar on Space Technology application

Survey Department organized a one-day Seminar on Space Technology Application and Recent Development in Geo-spatial Products on 17th August, 2005.The aim of the seminar was to exchange of ideas amongst the professionals from Government organization, private sectors and academia. Prof. Dr.Michaeal Hahn, Vice President, Stuttgart University, Germany delivered a keynote speech on the topic "Recent Development and applications in Airborne Laser Scanning".

MOn this occasion Leica Geosystem Geospatial Imaging made two presentations on Geospatial Imaging Solution from Leica Geosystem and Leica Photommetry Suite and the following four technical papers presented were i) Space Technology Application in Nepal ii) Identification of informal settlement by integration of Cadastral Information and Remote Sensing Satellite Imagery iii) Land Resource Management and Human Resource in the context of Space Technology Application iv) Recent Development in RS Application in Hindu Kush Himalayan Regoin .

Discussion Program on Cadastral Survey

Cadastral Survey Branch, Survey Department organized a discussion program on 7-9 Bhadra, 2062 (23-25 August 2005). The progress of the fiscal year 2061\62 was reviewed and annual program to be conducted in the fiscal year 2062\63 was discussed.

Civil Servant Day Celebration

Survey Department organized a programme to celebrate Civil Servant Day on 7th September 2005.

Mini-project activities

Fieldwork of "RS/GIS for Earthquake Disaster Mitigation" was conducted in Kathmandu on 6th – 12th December 2005. Similarly fieldwork for "Flood Disaster Mitigation" was conducted in Sarlahi (Bagmati area) on 16th -21st December 2005. The final report of these studies was presented in AIT GAC on 24th February 2006. .

Interaction Programs

- 8 No. Survey Goswara, Pokhara organized an interaction program on 19th Paush, 2062(3rd Janauary, 2006). The interaction program was focused on the co-ordination between the organizations within the Ministry, effective service delivery to the stakeholders and to sort out the solution to the identified problems on land administration.

- Similarly 6 No. Survey Goswora, Kathmandu organized an interaction program on 26th Paush, 2062(10th January, 2006) concerning the problems in resurvey & to find out the solution to resolve the problems.

Training Course on Remote Sensing

An advanced training course on Remote Sensing was organized by Topographical Survey Branch on 28th Paush 2062 as the annual program of the fiscal year 2062\63.Five officials from Remote Sensing Section were participated in the training.

Computerized system started in District Survey Offices

District Survey Office Dilli Bazar Kathmandu started computerized system in service delivery .It started to provide copy of the cadastral maps and field book from the computer.

Consultative Meeting

National Geographic Information Infrastructure Programme organized a Consultative Meeting on Metadata Clearing House and National Geoinformation Infrastructure Networking on 31 March 2006. The effective and speedy service delivery using new technology was also discussed on the programme. The following two papers were presented:

- Status of building a National Geographic Information Infrastructure in Nepal with particular focus on the activities carried out by Survey Department

- Metadata clearinghouse developed by Survey Department

RS / GIS For Hazard Mapping & Vulnerability Assessment, Earthquake Disaster Management, Kathmandu, Nepal

Sudarshan Karki
Survey Department,
Ministry of Land Reform and Management
Pramod Karmacharya
Department of Urban Development and Building Construction,
Ministry of Physical Planning and Works

Background

This paper is part of the study conducted at Geoinformatics Centre of AIT, Bangkok for the Mini Project 2005-06. Two departments, namely, the Survey Department and the Department of Urban Development & Building Construction participated in the Mini-project. The study topic chosen was a joint decision of the two departments and reflects the current concern about disaster at the national and international level.

The Himalayas were formed due to the collision of the Indian plate with the Eurasian plate. The stress continues to build and is occasionally released through earthquakes. The earliest recorded earthquake in Kathmandu was in June 7, 1255 AD where one-third of the then population was killed including the King Abhaya Malla himself. Some assume the magnitude to be more than 8.0 in the Richter scale, taking into account of the extent of the damage. Another earthquake in 1934 AD, also known as the Great Bihar-Nepal earthquake was of magnitude of 8.4.

This paper aims to create hazard maps for a scenario earthquake of M=6.0, 7.0 & 8.0 for historical epicentres in the Kathmandu valley. This paper further performs assessments for vulnerability of buildings and population. This can aid in planning for mitigation and preparedness. Considerable part of the work has been done in RS/GIS environment and the results would be useful to planners who are looking for specific details for disaster preparedness. Finally risk assessment of a small part of the study area was done.

Objectives

The primary objective of the study is to assess the seismic hazard, vulnerability and risk for the Kathmandu valley, using Remote Sensing and GIS tools. To achieve this goal, the following secondary objectives are set forth.

- Preparation of seismic hazard maps
- Preparation of vulnerability maps
- Risk assessment of buildings

Methodology

The peak ground acceleration (PGA) was calculated using the Joyner – Boore (1981) attenuation formula adapted to local conditions, using a scenario earthquake of M=6.0, 7.0 & 8.0 and historical epicentres in Kathmandu. PGA amplification in soil was computed using soil amplification factors from engineering geological map. The liquefaction probability maps, lateral displacement maps and intensity hazard maps are prepared using the PGA maps. Using satellite imageries, land use classification was done to delineate settlement areas. Using other ancillary data, these are then grouped into public, residential, commercial or multipurpose housing types. Field verification of a sample area was done to collect training samples. From these residential types and population data, daytime and night-time population were calculated. From this population, intensity maps and building vulnerability curves, buildings and human vulnerability were calculated for each earthquake scenario. The prevailing depreciated building costs obtained from government agencies for calculating value of a house, risks assessment for the buildings in a small area was done.

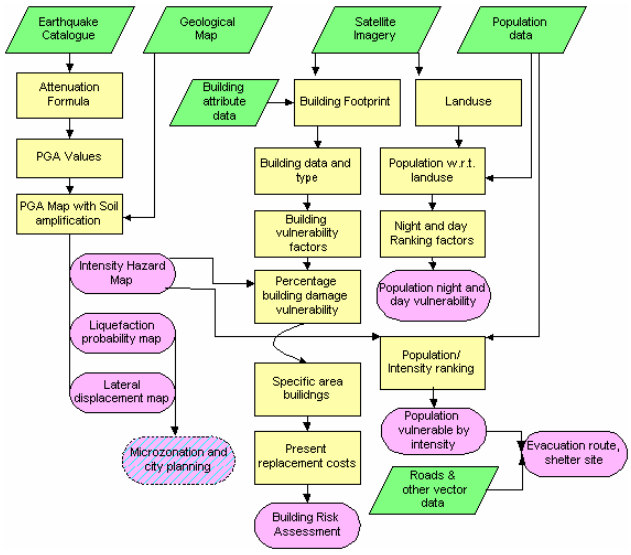

Figure 1: Methodology for the study

Study area

The study area, Kathmandu valley, comprises of three districts, Kathmandu, Lalitpur and Bhaktapur. Within these three districts are the municipalities of Kathmandu, Lalitpur, Bhaktapur, Thimi, Kirtipur and also other semi-urban and rural areas. The north and south of the study area is covered with forest and hills. The flat land in the middle of the valley is densely inhabited and is believed to be the bed of a pre-historic lake. Due to socio-economic and other factors, the growth rate has been immense, particularly in the past decade and a half. Thus, the population in the valley has become extremely vulnerable to multi-hazards and earthquakes in particular.

Data used

Vector data

Contour - (Survey Department, 1998), Administrative boundary, (Survey Department, 1998), Land use, (Kathmandu Valley Town Development Committee, 2001), Building polygons

Satellite images

Aster (Aug 24, 2005) Spatial Resolution 15 m., IKONOS (Dec 18, 2000) Spatial Resolution 4 m.

Hard Copy Maps

Topographic Map, 1995 (Survey Department, 1:25,000), Engineering & Geological Map, 1998 (Department of Mines and Geology, 1:50,000)

Other data

Population data, Census, 2001 (Central Bureau of Statistics), Earthquake catalogue 1255-2001 (Department of Mines and Geology)

Field Survey

The field survey was conducted in Chakupat area of Lalitpur district taking 55 GPS waypoints. Building types and attributes, for instance, the density of the buildings in the area, the number of stories, building material type, usage (residential, commercial, heritage etc.) were examined during the field survey. Landuse types were examined for evacuation or shelter purposes especially open space or school's football field etc.

The observed buildings varied by not only the construction materials but also by usage i.e. schools, residential, commercial and multipurpose use. Most of the buildings in the survey area are quite narrow and low in height. The average height of the buildings is approximately 3 stories and 3 meters at each floor. Buildings are remarkably congested and yet, new constructions are still going on.

Results and discussion

Hazard Maps

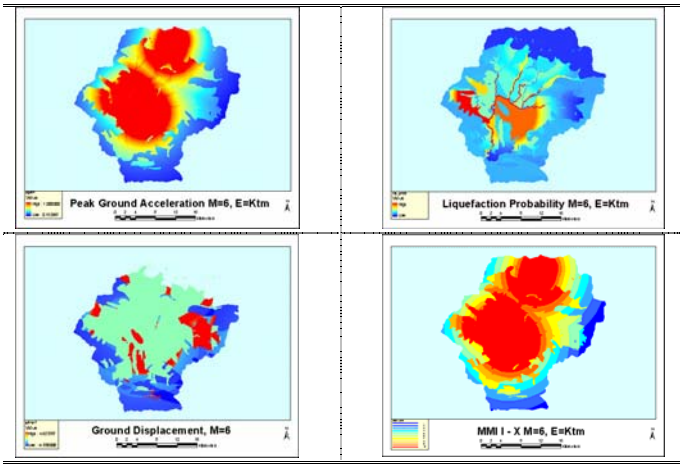

Table 1: Maps derived for M=6.0 and epicenter in Kathmandu

Peak ground acceleration maps were prepared using the Joyner Boore 1981 attenuation formula

Log PGA = 0.249 * M – Log (ÖD) – 0.00255 * (ÖD) – 0.8 (M=Magnitude, D=Epicentre distance).

Liquefaction probability maps and Ground Displacement maps were prepared using conditional probability from PGA maps as set out by the Hazard US (HAZUS) manual of Federal Emergency Management Agency (FEMA). The intensity hazard maps were prepared using the Trifunac & Brady 1975 formula.

Peak ground acceleration maps were prepared considering earthquakes of magnitude 6, 7 and 8 in Richter scale for epicentres in Kathmandu using historical earthquake catalogue. This was used to prepare (1) Liquefaction probability maps, (2) Lateral displacement maps and (3) Intensity hazard maps. The Intensity hazard map was reclassified from MMI I to XII as Low: MMI d" 5, Medium: 6 d" MMI d" 7 and High: 8 d" MMI. For magnitude 6, 7 & 8 with epicentre in Kathmandu the percentage of hazardous areas are shown in Table 2:

Magnitude	Intensity	Hazard Area (%)
M=6	Low (0 - 5)	31
	Medium (6 - 7)	14
	High (8 - 12)	55
M=7	Low (0 - 5)	15
	Medium (6 - 7)	9
	High (8 - 12)	76
M=8	Low (0 - 5)	15
	Medium (6 - 7)	9
	High (8 - 12)	76

Table 2: Percentage of hazard area

For an earthquake of magnitude M=6, 55% of the whole Kathmandu valley is under high hazard area and will experience considerable damage. The value reaches 76% for M=7 and 8. Thus, for an earthquake with epicentre in Kathmandu, the extent of damage expected for a magnitude of M=7 is as high as for M=8. So precautionary measures taken for M=7 will be sufficient for M=8 as well. However, since much of the valley is under hazardous areas, immediate steps must be taken for mitigation and preparedness.

Vulnerability assessment

Vulnerability assessment was done for buildings. Five building types namely 1) Stone-Adobe, 2) Brick with mud mortar, 3) Brick with cement mortar, 4) RCC with 3 or less stories and 5) RCC with 4 or more stories were considered and their vulnerability was assessed from fragility curves prepared by JICA, from intensities VI to >IX.

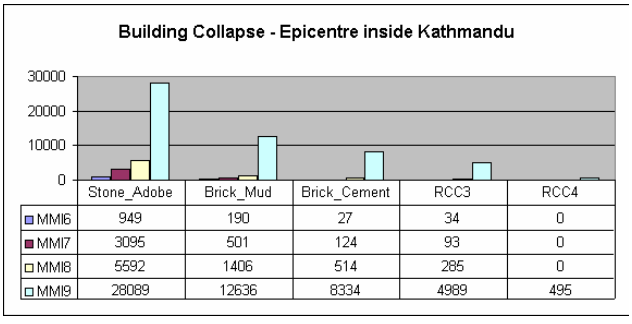

Figure 2: Building collapse for each building type per intensity

Figure 2 indicates that the population living in Stone_Adobe buildings are highly vulnerable to an earthquake in Kathmandu. Nearly all Stone_Adobe buildings will be collapsed at an intensity of MMI IX. There is an urgent need to fortify these buildings to prevent from immediate collapse to minimize casualties of people living in these buildings. Brick_Mud, Brick_Cement and even reinforced cement concrete buildings of 3 or less stories (RCC3) buildings are vulnerable to an earthquake of intensity MMI IX or more. The last earthquake of magnitude 8.4 was in 1934. From historical records in Table 3, we see that the approximate recurrence interval for an earthquake of magnitude 7.5-8 Richter scale is 40 years, so an earthquake of this magnitude would be highly devastating for Kathmandu, so building reinforcement should be undertaken without delay. New buildings should be built with earthquake resistant technology.

Richter Magnitude	No. Of Events	Approximate Recurrence Interval (Year)
5-6	41	2
6-7	17	5
7-7.5	10	8
7.5-8	2	40
>8	1	81

Table 3: Magnitude-Frequency Data on Earthquakes in Nepal and the Surrounding Region (1911-1991)

Source: http://www.geohaz.org/contents/projects/kathmandu.html

Risk assessment

Risk assessment was done on the Chakupat area of Lalitpur district, the field study area where high-resolution satellite image was available. The average height and building type was RCC3. The prevailing rates of construction and depreciated rates used by government agencies were used to calculate value of a house. The damage percentage was calculated using the fragility curves for RCC3 type for the 1493 buildings in the area.

Present construction cost rate (NRs./sq.ft.)	1,000
Depreciated cost rate (NRs./sq.ft.)	750
Total number of buildings	1,493
Total built area (sq.ft.)	6,617,321
Total present cost (NRs.)	6,617,321,000
Total depreciated cost (NRs.)	4,962,990,750
Average building cost (NRs.)	3,324,175
Number of collapsed buildings	448
Damage costs (NRs.)	1,489,230,400
Remarks: US$1 = NRs. 70	US$ 21,274,720

Table 4: Risk Assessment

Table 4 shows that for the buildings alone, without taking into account the valuables and commodities inside a house or other collateral damage to infrastructure, the estimated damage amounts to US$ 21 million. This can be extended to other similar areas for an estimate of expected damage costs using high-resolution satellite imagery.

Conclusion

Remote sensing and GIS was extensively used in the study for earthquake vulnerability and risk assessment in Kathmandu valley. Extraction of building information from IKONOS image was relatively easy but the image covered only a small part of the study area. High-resolution stereo satellite images could be used not only to generate precise DEM but also to extract information like building footprints, building area, building height and building density etc. With the use of high-resolution images the risk assessment could be extended to the whole study area easily, which is currently limited to approximately 10 hectares only. Better landuse maps can be prepared from high-resolution images to incorporate landuse patterns for vulnerability assessments and also for seismic microzonation. The hazard maps and vulnerability maps helped to estimate population and building vulnerability, potential losses and areas at risk. The results obtained can be useful for strategy formulation for mitigation and planning, creating awareness about earthquake disaster and as guidelines for future urban planning and zoning.

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An Overview of the 26th Asian Conference on Remote Sensing

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Background

Asian Association on Remote Sensing (AARS), Vietnam Association of Geodesy, Cartography and Remote Sensing (VGCR) and Association of Vietnamese Geographers (AVG) jointly organized the annual event of the AARS, the 26th Asian Conference on Remote Sensing (ACRS) form November 7-11, 2005 at Hanoi, Vietnam.

Nepal is one of the member countries of AARS and Survey Department is representing as the member organization of Nepal since 1999 AD. There were 6 participants from Nepal: One each from Ministry of Land Reform and Management, Land Management Training Centre, ICIMOD and National Development and Research Institute and two from Survey Department. Moreover, the conference was attended by 624 participants; it includes 376 foreign participants, 143 local participants and 105 observers from 37 countries of the world including Vietnam.

Objectives

The objectives of the conference are as follows:

1. To discuss problems in Remote Sensing and GIS in Asia
2. To exchange academic, technical information and applications
3. To promote regional cooperation amongst member countries
4. To promote operational applications of Remote Sensing and Space Technology

Programme

The programme of the conference consisted of the following activities:

- **Registration** : Each participants has to make registration with Registration Fee of US $ 100 and the participants were provided with a conference kit. The fee includes: attendance to the conferences, one CD-ROM Proceedings, a Conference souvenir, participation in the opening and closing ceremonies, Lunches and Coffee breaks, participation in two Banquets and the Exhibition.

- **Opening Ceremony :** The Session of the Opening Ceremony was chaired by Dr. Le Quy Thuc, President, Vietnam Association of Geodesy, Cartography and Remote Sensing. The session was addressed by Prof. Shunji Murai, General Secretary, AARS, Honorary Chairman Prof. Dr. Scientist Dang Hung Vo, Deputy Minister, Ministry of Natural Resources and Environment (MONRE) and Prof. Ian Dowman, President, ISPRS. The messages delivered by the speakers are available in the Programme Book of the conference.

- **Keynote Addresses** : There are three presentations on this session and are the following:
  1. Mr. Kaoru Mamiya, Vice President JAXA, Japan : Maximizing Space Benefits for the Society
  2. Mr. Jorg Hermann, Managing Director INFOTERA, GmBH, Germany : Terra SAR-X mission: The new generation in High Resolution Satellites
  3. Dr. Suvit Vibulsresth, GISTDA, Executive Board, Thailand : Indian Ocean Tsunami and Remote Sensing.

- **Commercial Technical Sessions** : SPOT Asia, ERSDAC, VidaGIS, SuperMap, EADS and Department of Survey and Mapping, MONRE delivered their corresponding commercial presentations in two sessions.

- **Technical Sessions** : From 8th November, Tuesday to 11th November, Friday, technical sessions were conducted in 59 parallel sessions. Out of 395

Abstracts submitted, only 280 technical papers were presented. Three papers from Nepal: Registration of 3rd Dimension : the context of Nepalese Cadastre by Rabin K. Sharma, Land Management Training centre : Journey of Surveying and Mapping Studies in Nepal by Sri Prakash Mahara and Socio-economic and Environmental Change in Pokhara Valley : a Study using Satellite Remote Sensing and other Information by Dr. Krishna Pahari were presented.

- **Poster Sessions** : These sessions were conducted from Tuesday to Thursday and 115 papers were displayed and presented.

- **Exhibition** : The Exhibition was inaugurated jointly by Prof. Shunji Murai, General Secretary, AARS; AARS Dr. Le Quy Thuc, President, Vietnam Association of Geodesy, Cartography and Remote Sensing and Prof. Vu Tuyen Hoang. There were 29 stalls from 27 different organizations related with Remote Sensing, Space Technology and Geographical Information System. The exhibition lasted from Monday to Thursday. The exhibitors displayed their recent products and demonstrated its strengths, functions and provisions of their hardware and software.

- **National Delegates Meeting** : National delegates meetings were held on November 8 and 10, 2005. The meetings were chaired by Dr. Le Quy Thuc, President, Vietnam Association of Geodesy, Cartography and Remote Sensing. General Secretary presented the report on AARS and the financial status. Prof. Shunji Murai and Manu Omakupt are once again unanimously reelected as General Secretary and Deputy General Secretary of AARS respectively. Prof. Ryutaro Tateishi presented the report on Asian Journal of Geoinformatics. Dr. Guo Hua Dong, China presented the concept on launching of a Ricesat. Finally, AARS decided to provide recommendations in Remote Sensing Development to host country Vietnam from the conference which is a first time in its History.

- **Closing Ceremony** : The closing ceremony was conducted under the Chairmanship of Mr. Manu Omakupt, Deputy General Secretary of AARS on November 11, 2005. Prof. Dr. Scientist Dang Hung Vo, Deputy Minister, Ministry of Natural Resources and Environment, Vietnam gave a Keynote speech on "The need of cooperation on formulation of an open spatial database for Asia". Prof. Emeritus Shunji Murai, General Secretary, AARS presented the report of the National Delegates meeting along with the recommendations in Remote Sensing Development to host country, Vietnam. Dr. Nguyen Dinh Duong, ACRS Organizing Secretary presented the statistics of the conference.

Prof. Ryutaro Tatieshi announced the Japan Society of Remote Sensing and Photogrammetry (JSPRS) Award for the young presenters in which 5 of them were from the oral presenters and 1 from the poster presenters. Prof. Murai gave away award to the winners. Prof. Murai also handed over gifts to the Deputy Minister and some of the other Local Organizing Committee members.

Vote of thanks was offered by **Rabin K. Sharma, Nepal**. Mr. Sharma considered the decision of Local Organizing Committee to give vote of thanks from the representative of Nepal is a glory to Nepal and felt very much honoured to get opportunity to deliver vote of thanks in such an international forum.

The date for the 27th ACRS was decided to be held from October 9-13, 2006 in Ulaanbatar, Mongolia. So, the Chairman of the 27th ACRS, Dr. M. Saandaar invited all the delegates to participate the 27th ACRS. He also provided some information of Mongolia and about the conference important dates.

Deadline for submission of Abstract : July 15, 2006
Notification on Abstract Acceptance : August 15, 2006
Deadline for paper submission : September 15, 2006.

Additional Event

In conjunction with the conference the following additional events were also organized as the special sessions of the conference:

1) 2nd Asian Space Conference : The 2nd Asian Space Conference (ASC) was organized by International Institute for Air Space Law (IIASL) and was held from November 8-11, 2005. The theme of the conference was **"Satellites, Applications, Socio-economics and Regulatory Regimes"**. The conference was conducted with 9 Sessions with number of parallel sessions, each with high quality presentations and speakers. The details of the conference are available in the proceedings of the conference.

2) Workshop on Capacity Building in Asia : The workshop on capacity building in Asia was jointly organized by Japan Aerospace Exploration Agency (JAXA) and Geoinformatics Centre of Asian Institute of Technology (GAC/AIT) and was held on November 8, 2005. This workshop attempted to share the results of the Mini projects with other Asian participating countries in the Mini project conducted by JAXA and GAC/AIT in the past. The participating countries are Bangladesh, Cambodia, Nepal, Philippines, Sri Lanka and Vietnam. During the workshop, the representative of the participating countries presented the results of the Mini-project. Mr. Sudarshan Karki from Survey Department, Nepal presented the results of the project with the title "Utilization of Space Technology : Urban Planning for Earthquake Disaster Mitigation". The details of the workshop are available in the proceedings of the workshop.

3) Innovative problem solving methodologies for less developed countries : The special session on this topic was chaired by John Van Genderen and 4 technical papers were presented in this session.

4) Tsunami : The special session on the topic of Tsunami was chaired by Dr. Suvit Vibulsreth and 11 technical papers were presented in 2 sessions.

5) **Ricesat** : The special session on the topic of Ricesat was chaired by Gua Hua Dong and 5 technical papers were presented in this session.

6) Strengthening International Partnership for Education : The special session on this topic was chaired by Kohei Cho and 5 technical papers were presented in this session

Receptions

a) The Local Organizing Committee of the 26th ACRS provided the following receptions:

1. Welcome Dinner : A welcome dinner was offered in honour of the ACRS participants on November 7, 2005. During the dinner time, participating countries were requested to perform cultural item in which 8 member countries took part in the event. The participant countries were: Vietnam, India, Nepal, China, Japan, China Taipei, Thailand and The Netherlands. As per the tradition of AARS, it is a competition event and accordingly, Japan was awarded with second prize and there was a tie between China and Vietnam for the first place. Due to the tie in the first place the third place was not declared.

2. Farewell Dinner : A farewell dinner was offered to the participants on November 10, 2005 and on that evening professional artists performed the various types of Vietnamese dances and sang songs.

b) AARS provided a dinner for the national delegates on the first day of the national delegates meeting on November 8, 2005.

Conclusion

The conference completed with a grand success. General Secretary of AARS expressed his satisfaction for the participation from more Asian countries than the past and appreciated to receive such a large number of technical papers in this 26th ACRS. It was believed that the participants of this conference able to update their knowledge on the recent developments in the field of Remote Sensing and Geographical Information System and also able to acquire information, to some extent, on the present status of the technological development in the participant countries.

As the next conference, 27th ACRS is going to hold from October 9-13, 2006 in Ulaanbaatar, Mongolia. The professionals in the field of Remote Sensing and Geographical Information System of Nepal should grab opportunity by participating the event to present international level technical papers to share ideas and views with the international professionals so that the corresponding institutions could improve its available technology or even to introduce the feasible technology for the betterment of the society of Nepal.

Price of Maps

S.No	Description	Coverage	No. of shees	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 Capability 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	Western Nepal	7	40.00
8	1:125 000 Districts Maps (Nepali)	Whole Nepal	76	50.00
9	1:250 000 Zonal Maps (Nepali)	Whole Nepal	14	50.00
10	1:500 000 Regional Maps (Nepali)	Whole Nepal	5	50.00
11	1:500 000 Regional 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	Orthophoto Map	Urban Area (1: 5 000) and Semi Urban Area (1: 10 000)	-	1 000.00
20	Administrative Map	Nepal		5.00

Price of Control Points

Type	Control Points	Price per point
Trig. point	First Order	Rs 2 000.00
Trig. point	Second Order	Rs 1 500.00
Trig. point	Third Order	Rs 800.00
Trig. point	Fourth Order	Rs 100.00
Bench Mark	High Precision	Rs 500.00
Bench Mark	Third Order	Rs 100.00
Gravity Point	High Precision	Rs 500.00
Gravity Point	Lower Precision	Rs 100.00

Let Us Give A Thought

Special Contribution From
Suresh Man Shrestha
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Change has been a Universal Truth since the very begininning of the human civilization, The requirements of the human society have called upon changes in every field of society, philosophy, politics, economy, social structure and so on Most of the times such changes have proved to be beneficical to the society and have added fuel to modernize and facilitate livelihood of human beings. This is the way we have come through the road of time, And our today is a part on never ending journey of such changes.

The surveying profession has not been left aside by such changes and during the course of time surveying became much improved and indispensable scientific field. Developments in the field of Physics, Chemistry, Photogrammetry, Remote Sensing, Photography, Computing Technologies, Industrialization, Mechanics, Communication Sciences and so on have played a great role in bringing Survey Science to the state as we perceive it today.

Basically, the principles of surveying have remained unchanged. But the requirments imposed on the products of surveying for different disciplines are changing to fulfill the demands of the time. And the methodology of surveying has been refined to meet the challenges of the present day's requirments, The methodology, universally accepted today, may be not suitable in the days to come. Looking at the global trend of using digital technologies and products, we should take necessary steps to move in par with this trend otherwise we will have to stop our works just because there are no more instruments and materials we are using today. Hopefully, in near future, surveyors will not be using instruments with eye-piece for field measurements. Instead, they will be using very handy devices for such purposes. I even dare to say that, the next generation surveyors will see field books, field maps, drafting equipment and materials etc. only in the museums.

Surveying for mapping is done in different environments and for different purposes. The accuracy of measurements is dictated by the requirements of different mapping objectives. To fulfill such requirements, apart from the knowledge and skill of handling of contemporary techonology, surveyors should have basic knowledge of the field for which survey is being done, For example, cadastral maps are one of the very important documents and are directly related to the people's property. Apart from the knowledge of modern Survey Science, a surveyor involved in cadastral mapping must have sound knowledge of social behavior, religious and moral values, administrative procedures, legal issues and so on. Similarly, surveying of border, surveying for base map production etcetera require specific knowledge of the related fields.

Having up-to-date technology and manpower is not sufficient for an organization to provide necessary services to people. Well designed and flexible organizational structure is a must for this purpose, The current organization structure of Survey Department needs to be re-engineered to provide people oriented services using the boon of modern technological development. In doing this the department should create posts which can be fulfilled with right person. Special arrangements should be done to make sure that the institution structure is sustainable in a long run. This may demand vital changes in the current acts related to survey profession of even we may need to create a new one.

Apart from up-to-date technology, manpower and well-structured institution, the basic infrastructure like electricity supply, communication network, educational institutions in the field of surveying and mapping is necessary to further the survey profession.

In the present situation, in Nepal, any Surveyor can go to measure the land for any type of mapping purpose. Seriously speaking, this trend is ridiculous and may create serious problems in the future. It is high time to give a thought on developing appropriate manpower, institutional and legal structure for such purposes. We should be bold enough to develop new wings, integrate or disintegrate existing work loads in the field of surveying to meet the present and future challenges. And the professionals involved in Survey profession must have capability to put the things to get the whole picture and have a clear vision of what their work means to their country. We should be clear, what we do today will shape the way how survey profession will look like in future. So let us keep survey professionals changed at all times and motivate them to take on present and future challenges. It is time to give thought on these issues.

Consultative Meeting on Metadata Clearinghouse and National Geoinformation Infrastructure Networking: A Report

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Mahendra Prasad Sigdel
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Dev Raj Paudyal
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Introduction

The long term policy of the land reform and management sector in tenth plan (2002-2007) is to bring about social justice and good governance and contribute in achieving the national goals of poverty alleviation through the development of an effective, reliable and qualitative land utilization and management system in Nepal. One of the key sectoral strategies related on it is the development of an infrastructure for sharing geoinformation in order to make easy access to geographical information. The National Geographic Information Infrastructure (NGII) Programme of Government of Nepal has launched and developed a portal for GI networking for both data producers and data users. A wider networking and interaction between data producers and data users was realized and a Consultative Meeting on Metadata Clearinghouse and National Geoinformation Infrastructure Networking was organized by Survey Department (SD), Ministry of Land Reform and Management (MOLRM) in Kathmandu, Nepal on March 31, 2006. A total of 74 participants, top Govt. officials of Government of Nepal were invited from 13 Ministries and 28 Governmental Departments.

Objective of the Programme

The main objective of the meeting was to develop a strategy for populating their metadata in the NGIIP metadata clearinghouse and building up a networking arrangement between data producers and data users for furthering NGII in Nepal. To fulfill this main objective the following three sub objectives were outlined for the meeting:

- To present the philosophy and status of the NGII and the structure and importance of the metadata clearinghouse developed at the Survey Department.
- To develop a strategy for populating the metadata clearinghouse with available information.
- To build consensus on how to build up a networking at institutional and technical level for the optimal use of geoinformation resources in Nepal.

Session of the programme

There were two sessions: inauguration session and discussion session. The event was inaugurated by lighting an auspicious lamp. The then officiating Secretary of MOLRM chaired the first session.

Toya Nath Baral, Director General of Survey Department welcomed to the participants and distinguished guest. He expressed that National Geographic Information Infrastructure (NGII) under Survey Department has developed a core foundation for last four years to reduce the duplication efforts, optimal utilization of available information and to strengthen the geoinformation network throughout the country. He hoped that this meeting would help in developing a strategy to strengthen NGI network and to populate the metadata in the NGI clearinghouse.

Two working papers were presented during the occasion. The objective of the presentation was to provide a status report of NGII in Nepal and provide the agenda for the discussion. R.R. Chhatkuli presented the first paper entitled "Status of Building a National Geoinformation Infrastructure in Nepal with particular focus on the activities carried out by Survey Department". He started his presentation with a query from a GI user quoting an email from one of the professors (user) of Lund University/ Cardiff University. This conveys the message to the participants

that NGIIP is practically becoming the focal point for geoinformation/ data users on Nepal. He explained about the institutional (organizational aspect, capacity building, pricing and commercialization), legal (data ownership/ custodianship, copyrights/IPR, confidentiality/privacy, liability) and technological (data quality, interoperability, data custodianship/ownership, data pricing policy, data sharing) issues about NGII. He concluded that to work on the partnership (network) is the answer to make operational NGII. Durgendra Man Kayastha presented the second paper entitled "Metadata Clearinghouse developed at the Survey Department: How it helps in addressing geoinformation needs for decision makers." He demonstrated the interface of NGII clearinghouse as well as metadata developed by NGIIP and showed various metadata search options (through theme, place, geographical location, organization's name etc.) to the participants. He concluded his presentation providing the ground for discussion agenda to the participants.

The then Minister addressed that in spite of being in a very low profile comparing to the other ministries, he found MOLRM an important ministry which can play a pivotal role for national building and peace keeping by providing useful information to the government on national issues. He added that in this ICT age; the government should rationalize its service delivery system incorporating technological development and people's need. People are expecting the prompt service delivery though the application of IT and related technology. He explained the importance of national level networking for sharing not only to geoinformation but other types of information as well. The provision of national level networking and accessibility of reliable information will help policy makers to formulate different policies to achieve the national objectives of the country. He thanked all the participants and hoped that this meeting will come out with very positive outcomes.

Yub Raj Bhusal, the then officiating Secretary. MOLRM closed the first session. In his closing remarks, he expressed that this is IT age and according to the demand of the age, MOLRM has initiated to use IT for effective service delivery. He added that, there is a need to revise IT policy to handle geoinformation. He opined that NGIIP of Survey Department could play the focal role, especially in the case of framework data, in Nepal including the 13 ministries and 27 departments represented in this meeting. He suggested that there should be more free-downloading facility of certain products provided by Survey Department through clearinghouse, as per user's need, He quoted 'several minds are better than few minds' hoping that this gathering would work as a bridge between data producers and data users. At last, he thanked to all the participants for their active participation and closed the first session.

The Special Guest for the second session was the then Honorable Member of the National Planning Commission (NPC) Dr. Ram Prasad Chaudhary. Director General of Survey Department Toya Nath Baral chaired the session. R.R. Chhatkuli facilitated the discussion programme. He raised seven questions to for the participants to concentrate upon, mentioning however that the discussions may not be limited on these issues only. Each of the participants expressed their individual views and actively participated on the discussion programme. The seven guideline questions were as followings.

1. Whether the GI networking is necessary or not? If yes how?
2. How to build up a networking arrangement between data users and producers?
3. What will be the role of Survey Department for development of NGII?
4. What will be the organizational structure of NGII? What will be the organizational mandate?
5. What strategy should be developed to make operational NGII ?
6. What strategy should be adopted to populate the metadata on the clearinghouse?
7. How to make the metadata clearinghouse operational?

Dr. Chaudhary expressed that his views would not be different than the views expressed by this forum regarding the GI networking. He added that National Planning Commission needs reliable and updated information to formulate policy hence NGII is the GI portal to get valuable information for policy makers. The analysis of data is equally important for decision makers. We have to make the use of collected data and make them easily accessible and affordable to the users. There is a need to setup Monitoring and Information Centre at each of the Ministry. For solving various research issues in GI domain, he recommended to make collaborative joint research activities with academia especially with foreign universities. He assured to the participants that NPC is ready to execute the findings recommended by this forum. Finally, Toya Nath Baral from the chair summarized the findings and answered most of the unclear questions raised by the participants. He thanked

to all the participants for their valuable contribution and closed the discussion programme.

Findings from the Discussions

Each of the participants was actively involved in the discussion programme. The following are the main findings from the discussion.

1. It was realized that GI networking is necessary for data producers and data users. For startup the process, at least physical networking and available data sharing mechanism should be developed. There should be at least a focal point at every organization to initiate for GI networking. A coordinating committee should be formulated for GI networking. The sharing of resources is equally important for GI networking.

2. The level of understanding of NGII concept was found different from each participant. Hence, there is a need of classification of data producers and data users. The GI networking should be developed according to the classification.

3. Survey Department should play a leading role with open mind. In the case of spatial datasets, the custodianship of framework data should be with Survey Department. The custodianship of other thematic data should be with other related organizations. In the case of attribute data, Central Bureau of Statistics should have the custodianship of census data and other organizations should have the custodianship of their related datasets.

4. It was realized that some mechanism for pacing NGII under National Planning Commission (NPC) umbrella for inter agency coordination should be realized. The GIS Steering Committee should be reactivated and made operational. The proposed three tier organizational structure comprising of policy level, management level and the operational level with cross- sectoral representation need to be executed. The National Mapping Committee and Census Council should be made activate for data standardization.

5. It was realized that more interaction and discussion among the stakeholders is necessary to make operational NGII. All producers and users of geoinformation need to work together.

6. For populating metadata on the clearinghouse, the Excel based metadata editor developed by NGIIP is good. Still there is a need to provide training to the operational level staffs to prepare their metadata. The concept of a decentralized database system and a centralized metadata clearinghouse was realized as a rational strategy in the present scenario.

7. It was realized that to make operational NGII, interagency networking is a must. The data should be accessible, affordable and interoperable.

Besides the main findings, the following are the other issues and results from the discussion programme.

1. There is a need to define framework data again. For urban mapping cadastral maps and high resolution imagery should be taken as a foundation data layer in GIS. Hence, they should also be taken into account for framework data.

2. We can use the resources of organizations that are working at the local level for networking and data collection. The local authority can play a leading for GI development at local level. Equally, the concept of local SDI should come for effective NGII networking.

3. The pricing of SD products is very high. Since the SD framework data are foundation for practically all GIS applications in Nepal, it is very much necessary that the prices of SD products need to be reviewed.

4. Survey Department should acknowledge the work done by other agency. But the quality of data should be verified and standardized.

5. There is a need for adopting a National Geoinformation Policy for inter-agency networking. Also there is a need to define a comprehensive legislative framework to cope with latest issues like copyright, intellectual property rights (IPR), rights of information, digital signature, liability for miss-information etc.

6. About the data format and contents we need to support all the user's needs. If users are asking for the products in settlement-wise, ward-wise or district-wise, we have to provide them.

Conclusions

The meeting has given an opportunity to understand the views of top executives of ministries and departments who are representatives from main stakeholder agencies of NGIIP. The participants showed great interest on NGII, actively participated in the discussion programme and provided valuable guidelines and suggestions for building up a networking arrangement between data users and data producers. The notion that Survey Department should play a leading role for the development of NGII in Nepal was reconfirmed from this meeting. It was realized from the meeting that interagency networking and more interaction between stakeholders is necessary to make operational NGII. The meeting Programme concluded successfully and was able to achieve its defined objectives.