ISSN 2091-198X

Volume II, 2016

GeoSpace

Annual Geo-ICT Journal of GES

LIVELIHOODS OF SQUATTER SETTLEMENTS: ANALYSIS FROM TENURE PERSPECTIVE

-Mr. Ashok Kumar Shrestha

GEO ANDROID APPS IN DISASTER MANAGEMENT POST NEPAL EARTHQUAKE 2015

-Er. Dipesh Suwal

EDXL CAP BASED SAMBRO FOR PUBLIC WARNINGS AND ALERTING ACTIVITIES

-Mr. Biplov Bhandari

Published by: Geomatics Engineering Batch -2013, Kathmandu University

NAXA Pvt. Ltd.

PAN No: 602417000

location matters

WHO WE ARE

"Naxa" is a startup in the industry of Geo Informatics. Specializing in mapping, we provide services ranging from geodata collection, management and visualization to location based software development. Naxa is the intersection of Geomatics and Informatics, a domain that's unique and vital. We advocate for the optimum use of locational data, contribute to the mapping industry, try and innovate in the geospatial domain. That's who we are, pioneers in the Geo-informatics industry in Nepal.

WHAT WE DO

GEO SERVICES

- Surveying & Mapping
- Web Mapping / Mobile Mapping
- Location Based Software Development
- UAV/Drone Mapping & Consulting
- Trainings and Research
- 3D Modelling

IT SERVICES

- Web Design & Development
- Web Application Development
- Mobile Application Development
- Software Development
- SEO & Marketing
- Web Hosting

www.naxa.com.np | mail.naxa@gmail.com | 01-4416543 | Nagpokhari, Naxal, Kathmandu.

"Geo-Spatial Solution with Best Quality Results"

Rajdevi Engineering Consultant (P) Ltd.

We envision technological innovation in the geospatial sector to support neo-construction of Nepal.

- 2016 — UAV Photogrametry and Supply of ComNAV GNSS Receiver and OEM Board
- 2015 — Geo-Spatial Technologies for Disaster Management and Web GIS
- 2014 — Use of Super GIS in Public Infrastructure Projects
- 2013 — Supply of High Resolution Image, GIS and RS Software
- 2012 — Satellite Image Processing
- 2011 — Land use Mapping, Zoning & Planning
- 2010 — DGPS Surveying, GIS & Remote Sensing
- 2009 — Geo-database Design & Development
- 2008 — Surveying & Mapping
- 2007 — Engineering Project: Planning, Design & Implementation

Our Partners:
Authorized Re-Seller for product in Nepal

DigitalGlobe | ScanEx Research and Development Center | Supergeo | Satpalda Geospatial Services | ComNav

Members:

Address: P.O Box: 8647, Ganesh Marga, Sankhamul-34, Kathmandu, Nepal Tel/Fax: 01-4782643;
E-mail: info@rajdevi.com.np; rajdeviconsult@gmail.com Website: www.rajdevi.com.np

GeoSpace

Annual Geo-ICT Journal of GES

Volume II, 2016

Published by:
Geomatics Engineering – Batch 2013
Geomatics Engineering Society (GES)
Department of Civil and Geomatics Engineering,
Kathmandu University,
Dhulikhel, Kavre

Email: ges@ku.edu.np

ISSN: 2091-198X

GeoSpace

Annual Geo-ICT Journal of GES

Team of GeoSpace 2016

Editor-in-chief

Mr. Bibek Adhikari

Editors

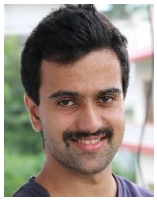
Mr. Utsav Dahal

Mr. Srijit Sharma

Ms. Nimisha Wagle

Mr. Kushal Kc

Technical Team



Mr. Srijit Sharma

Mr. Himal Chand Thakuri

Mr. Ashok Kumar Rimal

Ms. Ranju Pote

Marketing Team

Mrs. Rubina Shahi

Mr. Bijaya Aryal

Mr. Shaligram Lamsal

Mr. Sunil Bhandari

Editorial

'Geospace' has grown from its previous volume published four years ago, by a crop of enthusiastic Geomatics engineers who ventured into publishing a collection of articles marking the prevalence of geospatial technology in Nepal. This volume, an outcome of contribution of efforts from the professionals and the students from the geo-informatics realm encompasses the emergence of geomatics industry from its former not-so-prominent being into an eminent sector in the nation's context. The contents selectively included so as to cover this illustriously growing domain to the furthest embody the journey from its incubation to the contemporary scenario and includes the explorations, ambitions, evolution and accomplishments of the work-force behind the launch of this magazine who aim to address the ever-diversifying needs for the products of the geo-spatial industry.

The applications of this domain are in a rapid state of expansion, the manpower involved in the industry is increasing and the achievements are resounding. While this all sound impressive and it is, there is also room for lots more and we, the seventh batch who are just about to jump into this train of professionalism realize the need of a documented collection of the information available for everybody fascinated and everybody involved in this ever-evolving field. Above all, that is the reason for 'Geospace' to be published again.

The application of modern geospatial technology is a key theme in most of the papers published in this journal. The intent of this journal is to showcase new technologies which could bring about a fundamental change in achieving societal and consumer impact. These technologies could be very sophisticated to very elementary but in terms of impact they would be capable of being commercialized, scaled up and focus on real life challenges.

We would like to thank our well-wishers, faculties, seniors, authors and financial contributors who made this journal a reality.

Message from Vice Chancellor

It has always been our pleasure to see that the launching of new programs that the Kathmandu University has inititated has produced magnificent result in society and the community. When we first started Geomatics program we were quite confident about its relevancy but we were not so sure about how the society will take the Geomatics Engineers in their working group. The graduates of Geomatics Engineering from Kathmandu University has proved that they are indispensable engineering wings of scientific community through their hard work and dedication of the profession.

When we started this program, we understood it was first such program in entire South Asia so we were seeking support and collaboration from several related professionals both within and outside the country. We really appreciate the support and hard work that was rendered to us from all our stakeholders to make it one of the most sucessful programs at the School of Engineering.

I am very glad to see the students and faculty of Geomatics Engineering are publishing "Geo space" to disseminate their achievement and research to larger group of community in this form of Journal. I wish this could highligh and spread of research activities that Geomatics professional are doing and could bring together the Scientific community for further advancement of this discipline.

I firmly believe that this magazine the "Geo Space" that you are holding contains research articles that are published are true testimony of making Kathmandu University as Research cum Academic institutes, where the research finding are shared and discussed among its peers for its professional growth. Moreover the effort of bringing out this Journal, in spite of being new and emerging discipline in our context really gives inspiration and motivation for other areas of scientific community to follow such endeavors.

I thus wish you for the continuation of this journal for long run and get established as the most realible, universally acceptable and scholarly vehicle for Geomatics professionals to express their research finding thorugh their articles.

I wish all readers very happy and wonderful Happy New Year 2017 ahead.

Thanking you

Prof. Dr. Ram Kantha Makaju Shrestha

Vice Chancellor

Contents

IRRIGATED AREA DIFFERENTIATION AND WHEAT ACREAGE ESTIMATION USING REMOTE SENSING

Shushant Koirala, Rajeev Pathak, Shyam Sharan Nepal, Prekshan Prakash Subedi
Department of Civil and Geomatics Engineering, Kathmandu University

Remote sensing, these days has been emerged as an effective tool to monitor irrigated area over a variety of climatic condition and locations. Irrigation has been practiced in every country since long period of time. There are various ways of determining irrigated area, like the standard approach is to use supervised classification on multi spectral band, vegetation indices to the Principal Component along with the complex method and decision-tree based supervised classification have been proposed to differentiate irrigated areas. The project was completed using the alternative approach for differentiating irrigated area using the combination of logical operation and thresholding of Land Surface Temperature (LST) and Normalized Difference Vegetation Index (NDVI).

Three different Landsat Images for three different years are used. The irrigated area differentiation for all the images are done using the respective formulas for the irrigated area differentiation and land surface temperature. Landsat-5, Landsat-7 and Landsat-8 images are used, where the irrigated area are determined for the respective years. Bardiya is chosen as the project area. The image for the month of April is with the consideration that the irrigations are carried out during this month of the year and as according the wheat is selected as the crop for the acreage estimation as it is the harvesting month for wheat. With the consideration for the band designations and resolution for the thermal band, the procedures are carried out. After the irrigated area are determined, the wheat acreage estimation and crop differentiation are carried out on the irrigated area only.

The wheat acreage estimation is done on the basis of the data obtained from the land use which clearly elaborates the area for wheat production. The area of interest are defined by overlapping the shape file with the Landsat images. The pixels under the wheat area defined by the land use projects are used as area of interest. Maximum likelihood supervised classification is used for differentiating the wheat production areas. After this for crop water requirement the temperature data obtained from the meteorological stations are used. The crop water requirement depends on the crop factor and temperature, as per the equation used while carrying out this project. It is independent of the irrigated area and the wheat acreage.

LAND GOVERNANCE AND MARXISM

Sanjaya Manandhar
Survey Officer, Ministry of Land Reform and Management, Government of Nepal
Email: sanjayasurveyor@gmail.com, Mob: 9851018211

1 Land governance

Governance is the exercise of political, economic and administrative authority in the management of a country's affairs at all levels. Governance is a unbiased notion encompassing the complex mechanisms, processes and institutions through which people and groups to clear their interests, exercise their legal rights and commitments, and mediate their differences(Palmer, Fricska, & Wehrmann, 2009). Governance refers to the way in which power is applied by governments in managing a country's social, economic, and spatial resources. It simply means the processes of decision making and the processes by which decisions are executed(Williamson, Enemark, Wallace, & Rajabifard, 2010).

Land governance is a cross-cutting issue confronting all traditional silo-organized land administration systems(Grover, 2008). Land governance is about power and the political economy of land. The power structure of society is reflected in the rules of land tenure; at the same time, the quality of governance can affect the distribution of power in society(Palmer et al., 2009). Thus, land governance is very important issue in every country's political, social and environmental development.

Box 1: Some potentially interesting questions for reformers

Who benefits from the status quo and who is excluded?

Who sets the agenda for reform?

How do others influence this agenda?

What are the interests and objectives of different stakeholders and how do these play out in the reform process?

Why do reforms experience slippage during implementation?

How are the benefits of the reform distributed?

Who benefits; who does not and why?

2 Land tenure

Tenure is the relationship among people with respect to land and its resources. These rules define how access is granted to rights to use, control and transfer land, as well as associated responsibilities and restrictions. They develop in a manner that entrenches the power relations between and among individuals and social groups. It is no surprise, therefore, that the elites and even the middle classes have stronger forms of land tenure, while the poor and vulnerable

groups have weaker, more insecure forms of tenure.

Weak land governance is a cause of many tenure-related problems, and attempts to address tenure problems are affected by the quality of land governance. Improving land tenure arrangements often means improving land governance.

An understanding of land issues from a governance and political economy perspective can be derived through a three part framework that:

(i) Analyzes the broad country context, the types of tenure that exist, the operation of land markets and the institutions (rules and structures) that regulate both tenure and markets;

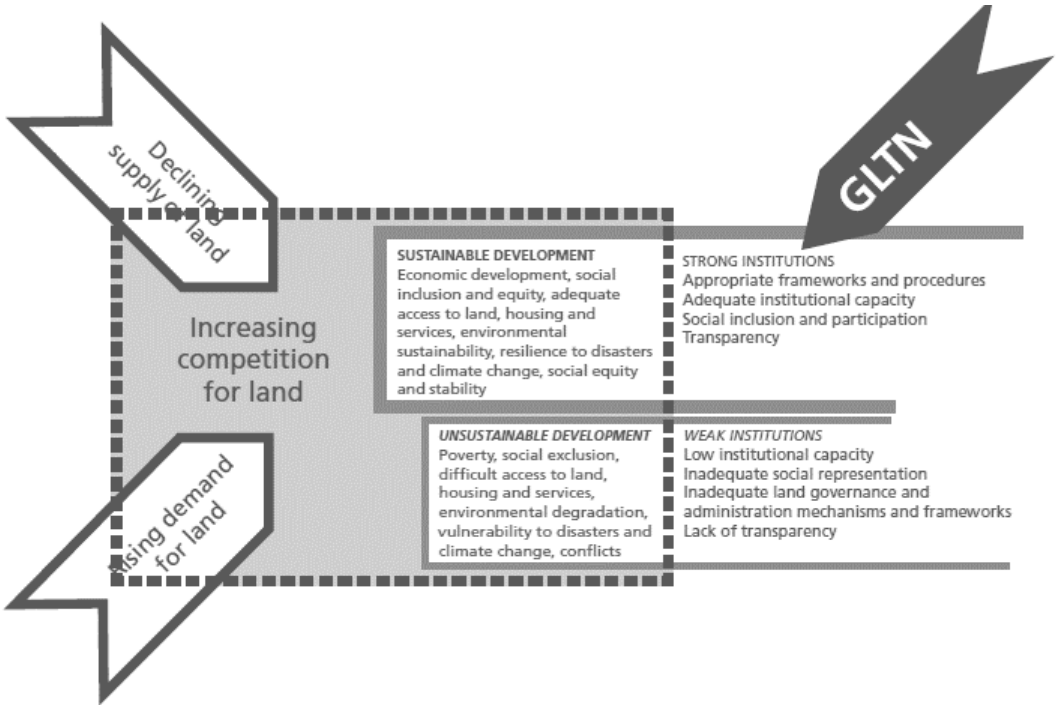
(ii) Examines how a governance and political economy perspective can be applied to a specific land issue or reform context, with emphasis on clarifying stakeholders, interests, influence, institutions and relationships; and (iii) Explores how to manage a reform process.

While the implementation of land sector reforms has been challenging, there is a significant body of experience on which to draw. The following land issues from a governance and political economy perspective: land policy formulation; land reform; security of tenure; women's land and property rights; forced evictions; natural resource management; informal settlements; land disputes and conflicts; and international cooperation are major issue of land governance in perspective of land administration(Palmer et al., 2009).

That's why, simply, land governance means implementation of laws, policies to manage land, property and natural resources. Land governance is the process by which decisions are made regarding the access to and use of land, the manner in which those decisions are implemented and the way that conflicting interests in land are reconciled (GLTN)[1].

[1] The Global Land Tool Network (GLTN) is an alliance of global regional and national partners contributing to poverty alleviation through land reform, improved land management and security of tenure particularly through the development and dissemination of pro-poor and gender-sensitive land tools. Secure land tenure and property rights are fundamental to shelter and livelihoods as well as the realization of human rights, poverty reduction, economic prosperity and sustainable development. The Global Land Tool Network (GLTN) main objective therefore is to contribute to poverty alleviation and the Millennium Development Goals through land reform, improved land management and security of tenure. UN-Habitat through GLTN continues to work towards this with partners who include international civil society organizations, international finance institutions, international research and training institutions, donors and professional bodies (http://www.gltn.net/index.php/about-us/about-gltn).

Box 2: The logic behind GLTN's work By developing institutions and providing them with pro-poor land tools, GLTN promotes sustainable development(UN-Habitat, 2012)



Some key elements embedded in the definition are focus on decision-making, implementation and conflict resolution, emphasis on both process and outcomes, need to understand both institutions (rules) and organisations (entities), recognize statutory as well as customary informal/extra-legal institutions and organisations and analyses stakeholders, interests, incentives constraints.

Box 3: Land policies will contribute to the realization of those development goals and commitments.

African states have subscribed to the principles and ideals of the NEPAD (New Economic Partnership for African Development) framework and are further committed to the attainment of the MDGs. These require governments to demonstrate commitment to:

1. achieving greater economic growth with equity, and reducing poverty;
2. promoting good governance and democracy;
3. reducing conflicts, enhancing political stability and consolidating peace and
4. ensuring the sustainable management of the environment. Land policies will contribute to the realization of those development goals and commitments(AUC, ECA, AfDB, & Consortium, 2010).

The eight MDGs form a plan approved to by all the world's countries and the world's leading development institutions. The first seven goals are mutually supporting and are directed at reducing poverty in all its systems. The last goal global partnership for development is about the means of attaining the first seven(Manandhar, 2015).

African states have subscribed to the principles that require governments to demonstrate commitment to significance of land policy is that it is estimated to improve i) financial growth by investments, credit, productivity, ii) poverty suppression by subsistence farming, market surplus, iii) governance by base democracy, devolution, no struggles, accountability and iv) environmental Sustainability by effective land use, inclusion externalities, state land management. Good land policy cannot be divorced from Good governance in land tenure and management(NUHU, 2008).

Access on land and the tenure security is major factor for productivity and social sustainability. Society grants the holders of social positions power to exercise coercive control over others. And property ownership, the legitimate right to coercively exclude others from one's property, is such power(Sanjaya Manandhar & Nepali, 2016).

3 Marx and class conflict

It is important to recognize that Marx viewed the structure of society in relation to its major classes, and the struggle between them as the engine of change in this structure. Conflict was not deviational within society's structure, nor were classes' functional elements maintaining the system. The structure itself was a derivative of and ingredient in the struggle of classes. The key to understanding Marx is his class definition, a class is defined by the ownership of property. Such ownership vests a person with the power to exclude others from the property and to use it for personal purposes.

3.1 Three Conflict Group

In relation to property there are three great classes of society:

a) the bourgeoisie[2] (who own the means of production such as machinery and factory buildings, and whose source of income is profit),
b) landowners (whose income is rent), and
c) the proletariat[3] (who own their labour and sell it for a wage).

Class thus is determined by property, not by income or status. These are determined by distribution and consumption, which itself ultimately reflects the production and

[2] bourgeoisie is meant the class of modern capitalists, owners of the means of social production and employers of wage labour. By proletariat, the class of modern wage labourers who, having no means of production of their own, are reduced to selling their labour power in order to live(Marx, 1848 #122).

[3] The proletariat is that class of society which lives exclusively by its labour and not on the profit from any kind of capital; that class whose weal and woe, whose life and death, therefore, depend on the alternation of times of good and bad business;. in a word, on the fluctuations of competition (Marx, 1848 #122).

power relations of classes. The social conditions of bourgeoisie production are de

fined by bourgeois property. Class is therefore a theoretical and formal relationship among individuals.

The force transforming latent class membership into a struggle of classes is class interest. Out of similar class situations, individuals come to act similarly. They develop a mutual dependence, a community, a shared interest interrelated with a common income of profit or of wages. From this common interest classes are formed, and for Marx, individuals form classes to the extent that their interests engage them in a struggle with the opposite class.

At first, the interests associated with land ownership and rent are different from those of the bourgeoisie. But as society matures, capital (i.e., the property of production) and land ownership merge, as do the interests of landowners and bourgeoisie. Finally, the relation of production, the natural opposition between proletariat and bourgeoisie, determines all other activities.

As Marx saw the development of class conflict, the struggle between classes was initially confined to individual factories. Eventually, given the maturing of capitalism, the growing disparity between life conditions of bourgeoisie and proletariat, and the increasing homogenization within each class, individual struggles become generalized to coalitions across factories. Increasingly class conflict is manifested at the societal level. Class consciousness is increased, common interests and policies are organized, and the use of and struggle for political power occurs. Classes become political forces.

The distribution of political power is determined by power over production (i.e., capital). Capital confers political power, which the bourgeois class uses to legitimatize and protect their property and consequent social relations. Class relations are political, and in the mature capitalist society, the state's business is that of the bourgeoisie. Moreover, the intellectual basis of state rule, the ideas justifying the use of state power and its distribution, are those of the ruling class. The intellectual-social culture is merely a superstructure resting on the relation of production, on ownership of the means of production.

Finally, the division between classes will widen and the condition of the exploited worker will deteriorate so badly that social structure collapses: the class struggle is transformed into a proletarian revolution. The workers' triumph will eliminate the basis of class division in property through public ownership of the means of production. With the basis of classes thus wiped away, a classless society will ensue (by definition), and since political power to protect the bourgeoisie against the workers is unnecessary, political authority and the state will wither away.

3.2 Six elements in Marx's view of class conflict.

a) Classes are authority relationships based on property ownership.
b) A class defines groupings of individuals with shared life situations, thus interests.
c) Classes are naturally antagonistic by virtue of their interests.
d) Imminent within modern society is the growth of two antagonistic

classes and their struggle, which eventually absorbs all social relations.

e) Political organization and Power is an instrumentality of class struggle, and reigning ideas are its reflection.
f) Structural change is a consequence of the class struggle.

(Marxism, Class Conflict, And the Conflict Helix, By R.J. Rummel)

4 Marxism and land governance concept

Marx shows the relation of property ownership with the social power. He debates on the equitable access of land on social status and production level. In the world of capitalism, for example, the nuclear cell of the capitalist system, the factory, is the prime locus of antagonism between classes--between exploiters and exploited, between buyers and sellers of labour power--rather than of functional collaboration. Class interests and the confrontations of power that they bring in their wake are to Marx the central determinant of social and historical process.

Marx's analysis continually centres on how the relationships between men are shaped by their relative positions in regard to the means of production, that is, by their differential access to scarce resources and scarce power. He notes that unequal access need not at all times and under all conditions lead to active class struggle. But he considered it axiomatic that the potential for class conflict is inherent in every differentiated society, since such a society systematically generates conflicts of interest between persons and groups differentially located within the social structure, and, more particularly, in relation to the means of production. Marx was concerned with the ways in which specific positions in the social structure tended to shape the social experiences of their incumbents and to predispose them to actions oriented to improve their collective fate.

5 Conclusion

The Marx class theory debates on ownership of land on a society as perspective of access on property, with regarding the productivity factor. Access on land and the tenure security is major factor for productivity and social sustainability. Society grants the holders of social positions power to exercise coercive control over others. And property ownership, the legitimate right to coercively exclude others from one's property, is such power. Effective and democratised land governance is at the heart of delivering the global vision of our future laid out in the MDGs. However, the route to this vision is rapidly changing as a series of new environmental, economic and social challenges pervade and impact every aspect of our lives. Land Professionals have a vital role to play and we must understand and respond quickly to this on-going change. The key component of good land governance contains access to land and its use. Considering, major challenges of land governance as landlessness and inequalities, tenure insecurity and access to women and marginalized group, land ceiling, absentee landlords, land abandonment, land disputes and resolution, tenure security under common property resource, land administration, land records and taxation, land use plan, commercialization of land, transparency \and corruption in land transactions: so, national land administration and policies should try to overcome it.

6 References

AUC, ECA, AfDB, & Consortium. (2010). *Framework and guidelines on land policy in Africa Land Policy in Africa*.

Enemark, S., McLaren, R., & Molen, P. v. d. (2009). Land Governance in Support of The Millennium Development Goals.

Grover, R. (2008). State and Public Sector Land Management.

Manandhar, S. (2015). *State and public land management: Issues of encroachment and protection technique.* (Masters in Land Administration), Kathmandu University.

NUHU, M. B. (2008). *Public Land Policy, New Trends: Challenges in Nigerian Insititutional Frameowrks for State and Public Sector Land Management*. Paper presented at the FIG/FAO/CNG International Seminar on State and Public Sector Land Management, Verona, Italy.

Palmer, D., Fricska, S., & Wehrmann, B. (2009). *Towards Improved Land Governance*: FAO-Food and Agriculture Organization of the United Nations.

Sanjaya Manandhar, & Nepali, D. P. B. (2016). Community land governance and its conflicting theories. *Nepalese Journal on Geoinformatics*(14).

UN-Habitat. (2012). Handling Land: Innovative tools for land governance and secure tenure. *United Nations Human Settlements Programme*.

Williamson, Enemark, Wallace, & Rajabifard. (2010). Land Administration for Sustainable Development.

3D RECONSTRUCTION OF KATHMANDU UNIVERSITY USING UAV IMAGES

W.Nimisha[i] ,T.Shirisa[ii] ,P.Ranju[iii] ,S.Rubina[iv] ,G.Asmita[v]
Geomatics Batch -2013, Department of Civil and Geomatics Engineering, Kathmandu University

[i]wagle1996@gmail.com
[ii]shirisa123@gmail.com
[iii]ranz.rz2722@gmail.com
[iv]rubcroyal@gmail.com
[v]asmitagiri420@gmail.com

Supervisors:
Mr. Uma Shankhar Panday
Mr. Shangharsha Thapa
Mr. Sumesh K.C.

ABSTRACT

Nowadays, the techniques of 3D modeling have been changed from different measuring techniques to visualization. New technique of 3D modeling has created more accurate and photo realistic view of any structure. In this report, process of 3D modeling of Kathmandu University is given. This report includes the entire process involved while creating digital 3D model of Kathmandu University process and accuracy assessment of it. This project was done using UAV for taking images and DGPS for establishment of GCPs in the periphery of Kathmandu university premises.

Keywords: UAV, 3D reconstruction, SFM, GCPs

Introduction

Three dimensional reconstructions is assisted generation of a 3D model that is a precise copy of a real object. The information retrieved from the device must be processed in order to generate a 3D model using specific software (G., c, & C, 2012). This has created a lot of interest for image-based approaches. Applications can be found in e-commerce, real estate, games, etc. Three-dimensional models of real world scene can be widely used in a number of fields, such as simulation, navigation, walkthrough, culture protection, etc. (Zhang, 2013)

The project work of 3D reconstruction of Kathmandu University includes GCPs establishment using DGPS and image capturing by UAV.

Project area

The project area is the periphery of Kathmandu University. Every buildings and roads were modeled in the project.

GCPs establishment and measurement

GCPs for the project were established and measured using DGPS. After the measurement, raw data were converted from receiver into useable form with the help of GNSS solution software.

The raw data received from the device was downloaded into the software and converted them directly from the field and that download splits up into several files for GNSS solutions to process them. The data obtained from DGPS is in World Geodetic System(WGS).

Marker placement

Markers were placed over the GCPs so that they could be visible in the images.

Flight planning and Image acquisition

Flight planning was done using Dji Go and Pix4D capture android apps. Checklist was prepared to ensure that all the required parameters were in right condition. Compass was calibrated so that UAV can give right direction. By ensuring everything the UAV was ready for flight and it took overlapping images of KU premises.

Image processing

Image processing was done through pix4D mapper software. During image processing following steps were followed:

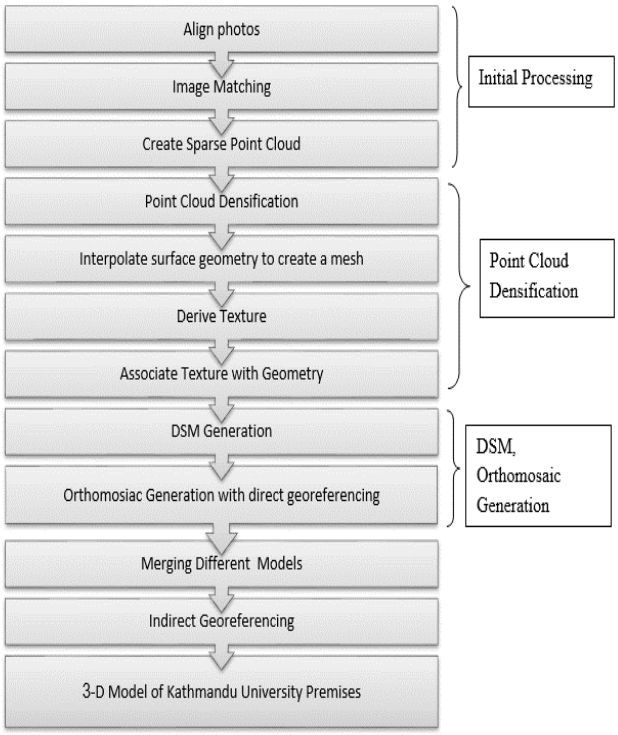


Figure: Process of image processing

The images were uploaded in pix 4D mapper software and image processing was done.

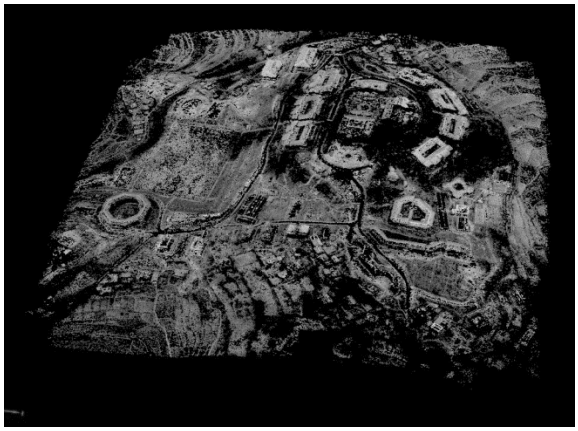


Figure: Sparse point cloud

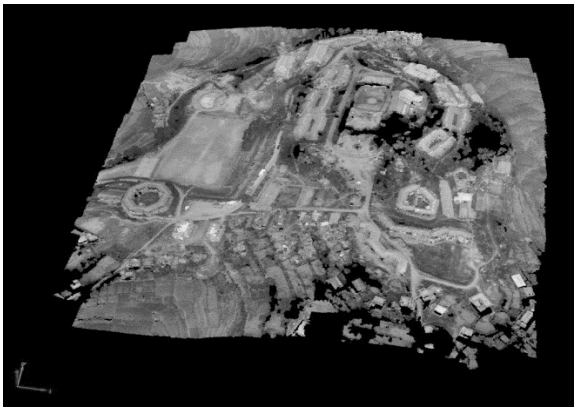


Figure: Dense point cloud

After creating dense point cloud orthomosaic of the area was created.

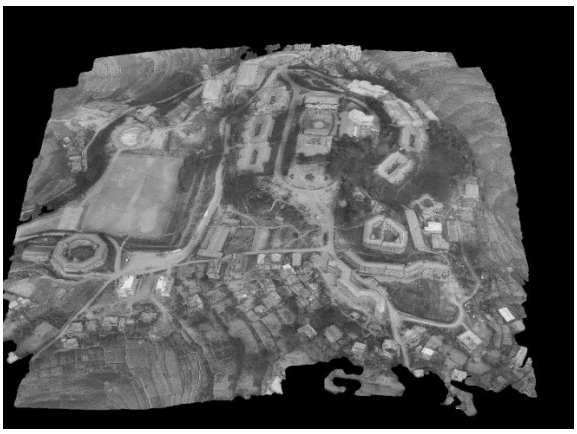


Figure: orthomosaic of Kathmandu University Premises

After image processing, the model obtained from the images captured in point of interest mode and nadir mode were merged using manual tie points.

Indirect Geo referencing:

Georeferencing of UAV images is a process where the image coordinate system gets transformed into ground coordinate system such that every object in the images now holds a coordinate belonging to standard reference frame. Here in this project indirect followed by direct was adopted for Georeferencing in which co-ordinates were manully inputed to obtain high accuracy.

Accuracy assessment

For spatial accuracy of the co-ordinate measured from DGPS, accuracy assessment was done and following result of assessment was obtained:

GCP Name	Accuracy XY/Z [m]	Error X [m]	Error Y [m]	Error Z [m]	Projection Error [pixel]	Verifie
2000 (3D)	0.020/ 0.020	-0.297	0.437	-0.064	0.608	5/5
1003 (3D)	0.020/ 0.020	-0.029	-0.005	0.004	0.781	5/5
1005 (3D)	0.020/ 0.020	0.117	-0.029	0.034	0.180	5/5
1008 (3D)	0.020/ 0.020	-0.062	0.090	-0.074	0.341	5/5
1011 (3D)	0.020/ 0.020	-0.107	-0.134	0.108	0.239	5/5
1012 (3D)	0.020/ 0.020	0.125	-0.163	0.063	0.293	5/5
1013 (3D)	0.020/ 0.020	0.097	0.041	-0.088	0.444	5/5
1014 (3D)	0.020/ 0.020	-0.459	0.658	-0.052	0.445	5/5
Mean [m]		-0.076806	0.111931	-0.008549		
Sigma [m]		0.195808	0.269022	0.067247		
RMS Error [m]		0.210333	0.291379	0.067788		

Localisation accuracy per GCP and mean errors in the three coordinate directions. The last column counts the number of images where the GCP has be automatically verified vs. manually marked.

Conclusion and Recommendation:

All the process that are involved in the 3D reconstruction of objects from its images, different algorithms involved, factors affecting the quality of 3D model and so on are overviewed. The conclusion drawn from the project is reconstruction from UAV can be the most economic, efficient and accurate as compared to other 3D modelling techniques. This may be the new trend on 3Dmodelling in Nepal.

References

G., A., c, t. j., & C, R. (2012). *3D digitization using Structure from motion.* Spain: Euro graphic Association.

Zhang, U. (2013). *3D construction of Yoshida Campus.* japan.

ANALYSIS OF ONLINE GEOCODING SERVICES IN CONTEXT OF BHAKTAPUR CITY

Suresh Shrestha[1], Amrit Karmacharya[2], Florencia Matina Tuladhar[3], Helina Shrestha[4]
shrestha.suress@gmail.com[1], akarmacharya8@gmail.com[2], ftuladhar@gmail.com[3]
[1,2] Land Management Training Centre, [3] Department of Civil and Geomatics Engineering, Kathmandu University

ABSTRACT

Geocoding is process of converting Street Address to geographical coordinates. It is being used extensively in disaster relief, health, business and everyday applications. The process involves sending a query to a Geocoding service like Google and the result is obtained in form of a coordinate pair (latitude and longitude). Till now we don't know how accurate the result of such services are. Accuracy of the services depend on the underlying database, the method used, the actual geographic location and also the actual query. Different methods yield different results. The objective of this study was to compare the positional difference between two common Geocoding methods i.e. Open Street Map (OSM) and Google Maps Geocoding Services. For reference, settlement data from NGIIP was used. Addresses were first geocoded to street level and positional difference in the results were calculated using havensire formula

Introduction

Geocoding is the processing of matching a description of a location to geographic coordinates. With the advances in web technologies and location based mapping, the traditional Geocoding tools provided in desktop GIS software are being increasingly replaced by online geocoding services (Roongpiboonsopit and Karimi, 2010b). The Web geocoding services from various providers offer users an easier way to geocode place names to location coordinates in multiple text formats like extensive Markup Language, JavaScript Object Notation, or Comma Separated Values.

Geocoding gives result in form of coordinate pair, usually latitude and longitudes pair. It may also give out extra information as to the shape and size of the features if the features were linear or areal. But mostly the result is in form of a point. The accuracy and completeness of a geocoding depends on the database used to perform the search and its hierarchical model.

Result of geocoding depends on the data used, Nepal government has published an Index of Geographical Names for the whole country. Google maps provides geocoding services but the sources of its data are unknown. OpenStreetMap mobilizes volunteers and local community to collect data directly on the field and provides free service for geocoding. In the current situation, the data from Nepal Government is not dense enough to locate places. The data from Google seem to be accurate but have not been verified. Also, Google deliberately uses Easter Eggs (false information mixed with original data to identify if data is being stolen) which compromises its accuracy. Google is the most popularly used geocoding service in Nepal.

OpenStreetMap data is unevenly distributed over the data, areas with active volunteers are better mapped whereas areas without volunteers are empty.

The assessment of accuracy and suitability of the geocoding services has not been conducted. Yet they are being used extensively.

Objective of the study

The objective of the study are as follows:

- To compare the positional difference in results provided by different services.
- To access the completeness of the services in study areas

Limitations of the Study

Limitation of the study is as follows

- Address in rural areas do not have precisely defined boundaries, so the assessment of accuracy is based on human interpretation.
- Due to unavailability of accurate reference data, the results are comparative analysis only.
- The study is limited to settlements only. Geocoding application in other sectors like house numbering, street level geocoding, point of interest matching, have not been conducted.

Methodology

Source of Data

The address data was collected from the Topographical Base Map Data. National Geographic Information Infrastructure Project (NGIIP) distributes the data. The data collected was of the Bhaktapur which lies in Sheet No 2785D. The other data of google and open street map are accessed from the web.

Data Preparation

The data from various sources are in various projection system. The data from NGIIP was from UTM system and the data from other geocoding services are in WGS 84 system. So, all of the data from NGIIP was converted to WGS 84 for uniformity.

All postal addresses were preprocessed before geocoding to improve standardization and quality. We reviewed the data for misspelled address information and remedied any incorrect home addresses (e.g. incorrect names). In addition, we removed all extraneous characteristics and standardized the spelling. We removed address which were inside the sheet but outside the study area.

Preparation of comparison table

Comparison table (shown below) was prepared to compare the discrepancies between the different systems. The table consists of location. Its coordinates as given by the 3 different providers. The distance range between the derived coordinates computed using havensire formula.

		NGIIP		OpenStreetMap				Google maps			
Sn	Name	Lon	Lat	Lon	Lat	discrepancy (km)	Remarks	Lon	Lat	discrepancy(km)	Remarks

Data Filing

For comparing the location information from three sources the location data from 3 sources are excelled. For this work, different sources have different system of acquiring the data.

Firstly, from NGIIP the data is available in GIS format which can be converted to different format and as we required, the latitude and longitude can be generated and exported to excel file.

For the Nominatim (free geocoding services which uses geographic data from free and Open Street Map project), we can enter the name of location in search box, then it will provide with the number of matches. There may be more matches, so for exact match we can input the location name with the higher-level address as well. It will then provide with the area and lat, long of the centroid.

In case of Google Geocoding service, it takes results in xml format and gives output in xml of json format but are not easily read by human. So, we use we a web application which help us to input and output data from google. Here it provides the single location. We use higher value addressing for fine tuning our search if the search area is found elsewhere from study area.

Data Analysis

In total, two hundred sixty seven (267) address were searched and matched using the above mentioned procedure. The distance between the locations provide by the two different services were compared using the havensire formula. Havensire formula gives distance between two set of coordinates which are in latitude longitude format and gives output in metric system. It takes into account for the distortion due to the curvature of earth and different scale factor at different latitude values. The values given by NGIIP were used as a standard data and discrepancy were calculated from other two sources. The discrepancy was then categorized into interval of 100m. There is no standard fixed value to specify how large an area is related to a location. it is big in village areas while small in crowded areas.

Completeness in Rural Areas

Bhaktapur and Madhyapur Thimi municipalities are considered as Urban Areas and others (Chandunarayan, Nagarkot, Suryabinayak, Anantalingeshwor) are considered as rural areas. The classification is based on Nepal Government's classification as Village and Municipality. The rural areas have recently been categorized as municipalities but for our study purpose we shall consider them as villages or rural areas. Table 2 shows the no of addresses in reference dataset and the results of query in the geocoding services. . Urban areas should have more address points. This is due to the limitation of the reference data set. Reference data set is based on homogenous distribution of addresses over spatial extent and since urban areas have smaller areas there is fewer address. The results show that there is 100% match in Bhaktapur Municipality in Nominatim and in Google and also around 50% match in Madhyapur Thimi Municipality in both the services. In the rural category Nominatim has shown more than 50% completeness in all municipalities while Google has less than 25% in 4 out of 6 areas.

SN	Municipality	NGIIP	OSM		Google	
		Settlement	Settlement	No result found	Settlement	No result found
1	Anantalingeswor	29	19	10	5	24
2	Bhaktapur	4	4	0	5	-1 (double match)
3	Changunarayan	46	24	22	8	38
4	MadhyapurThimi	11	7	4	5	6
5	Nagarkot	36	19	17	7	29
6	Suryabinayak	41	22	19	10	31

Table 1 : Completeness of results according to geographical regions

Municipality	OSM Completeness (%)	Google Completeness (%)
Anantalingeswor	**65.517241**	**17.241379**
Bhaktapur	**100**	**100**
MadhyapurThimi	**63.636364**	**45.454545**
Changunarayan	**52.173913**	**17.391304**
Nagarkot	**52.777778**	**19.444444**
Suryabinayak	**53.658537**	**24.390244**

Table 2: Completeness of results expressed in percentage

Result

Of the 267 addresses matched, OpenStreetMap found 118 results, whereas Google found 86 results. There is huge variation seen in between these matches. OpenStreetMap matched addressed in the range 100 m to 17 km. Google did the same with range of 70 m to 1034km. This huge difference is because google does not provide user interaction in searches. The high difference is obviously error but they cannot be identified correctly. The average discrepancy in OpenStreetMap is 175 m and the average discrepancy in Google is 1810 m.

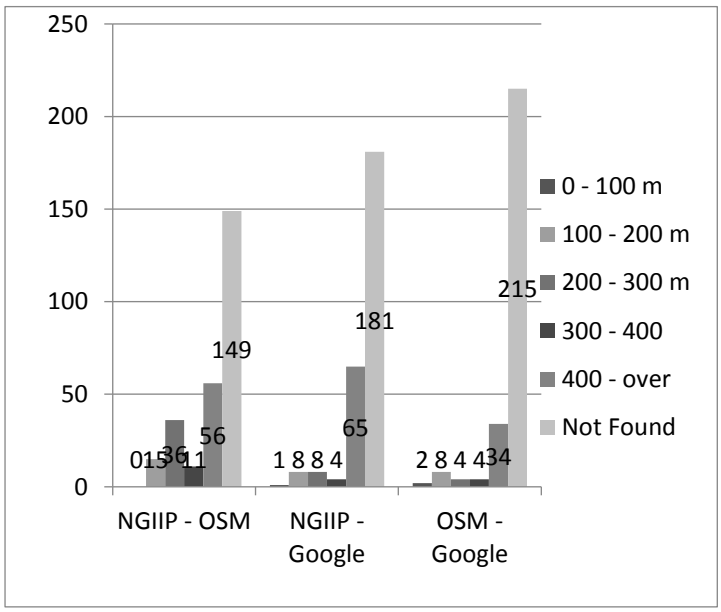


Figure 1.Simple Bar Diagram of Discrepancies

Discrepancy Between	0 - 100 m	100 - 200 m	200 - 300 m	300 – 400 m	400 – over	Total	Not Found
NGIIP - OSM	0	15	36	11	56	118	149
NGIIP - Google	1	8	8	4	65	86	181
OSM - Google	2	8	4	4	34	52	215

Table 3.Table of Discrepancies

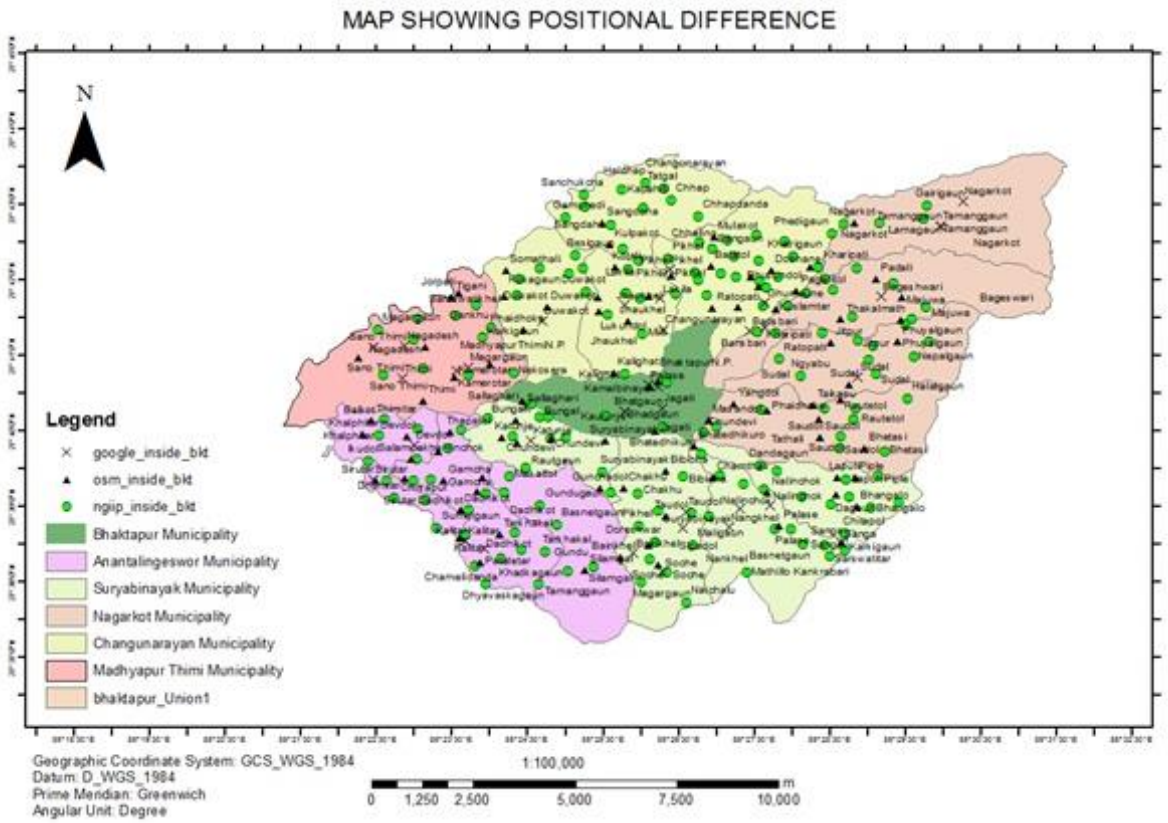


Figure 2: Map showing different search results of same name from NGIIP, OSM and Google

Among the Results found in both OSM and Google, the discrepancy chart below shows there is not a very good match in the results given by both services. Maximum error by OSM is below 20 km whereas Maximum error by Google is around 1000 km (this may be because of the service has found another place with same name). This is because, OSM results are hierarchical, i.e. it will give only results which match the hierarchy while google provides best match from all over the world. This means it will give results that will tend to match the search at least one of the word in the searched location.

Conclusion

This study has shown the comparison of online geocoding service. In this context, geocoding services are found to be incomplete to a large extent. Not even half of the addresses in reference dataset were found by the services. This shows a serious lack of data in Geocoding services.

Nominatim uses a hierarchical structure whereas Google tends to give more result. Use of hierarchical matching binds searches to a specific location and localizes the possibility of large discrepancy. Results from Google require some prior knowledge of location for verification. This may be because geocoding in Google is intended to be used with map interface that provides information on surrounding for verification. This does mean that nominatim is much more suitable for automated searches and Google is directed towards an interactive search.

Among the matched results, highest no of matches fall in discrepancy range of 400m and over; very few results are in the 0 to 100m range. From such result, it can be said that the geocoding provided can be used only for

general reference but not to pinpoint the location.

The quality and completeness varies by geographic region. Bhaktapur, an Urban area has 100% match and Madhyapur Thimi, a semi urban area has around 50% match. But the other rural areas are poorly matched. Nominatim is more complete in these areas with around 50% match than Google. Nominatim has better results than Google in rural areas.

References

Bonner MR, Han D, Nie J, Rogerson P, Vena JE, Freudenheim JL: Positional accuracy of geocoded addresses in epidemiologic research. Epidemiology 2003, 14(4):408-412.

Cayo MR, Talbot TO, 2003. Positional error in automated geocoding of residential addresses. Int J Health Geogr 2, 10.

Davis Jr, C.A. and R.O. Alencar. 2011. Evaluation of the quality of an online Geocoding resource in the context of a large Brazilian city. Transactions in GIS, 15(6): 851-868.

Dearwent SM, Jacobs RR, Halbert JB: Locational uncertainty in georeferencing public health datasets. J Expo Anal Environ Epidemiol 2001, 11(4):329-334.

Karimi HA, Durcik M, Rasdorf W: Evaluation of uncertainties associated with geocoding techniques. Computer-aided Civil and Infrastructure Engineering 2004, 19(3):170-185.

Krieger N, Waterman P, Lemieux K, Zierler S, Hogan JW, 2001.On the wrong side of the tracts? Evaluating the accuracy of geocoding in public health research. Am J Public Health 91,1114-1116.

Roongpiboonsopit, D., and H. A. Karimi. 2010a. Quality assessment of online street and rooftop geocoding services. Cartography and Geographic Information Science, 37(4):301–318.

Roongpiboonsopit, D., and H. A. Karimi. 2010b. Comparative evaluation and analysis of online geocoding services. International Journal of Geographical Information Science, 24(7): 1081-1100.

Ward MH, Nuckols JR, Giglierano J, Bonner MR, Wolter C,Airola M, Mix W, Colt JS, Hartge P, 2005. Positional accuracy of two methods of geocoding. Epidemiology 16, 542-547. Whitsel EA, Quibrera PM, Smith RL, Catellier DJ, Liao D,

Whitsel EA, Rose KM, Wood JL, Henley AC, Liao D, Heiss G,2004. Accuracy and repeatability of commercial geocoding.Am J Epidemiol 160, 1023-1029.

Yu L: Development and evaluation of a framework for assessing the efficiency and accuracy of street address Geocoding strategies. In PhD Thesis State University of New York at Albany, Rockefeller College of Public Affairs and Policy; 1996.

Zandbergen P.A., 2008. A comparison of address point, parcel and street geocoding techniques. Computers, Environment and Urban Systems 32, 214–232

Zhan FB, Brender JD, De Lima I, Suarez L, Langlois PH, 2006.Match rate and positional accuracy of two geocoding methods for epidemiologic research. Ann Epidemiol 16, 842-849.

GIS Database for Urban Planning

Er. Ashim Babu SHRESTHA, Nepal
MSc in GIS / BE in Geomatic Engineering / Diploma in Survey Engineering
Department of Mines and Geology (DMG), Lainchaur, Kathmandu, Nepal,
Tel: +977-01-4410141 (Off.), Fax: +977-01-4412056 (Off.), Mobile: +977-9851045361
Email: ashimbabu@gmail.com / Website: www.ashimbabu.com.np

Abstract

Geographical Information System (GIS) is capable of integrating geospatial data with various sources of information necessary for effective decision making in urban planning and sustainable urban development. GIS allows planners to perform spatial analysis using its geo-processing and cartographic modelling functions. The geo-processing functions, map overlay is the most useful tool for urban planning and sustainable urban development of land use activities. GIS database is the input to modelling and analysis programs together with data and other database for analysis and mapping. It has been used to information retrieve, development, control, mapping, site selection, urban planning, suitability analysis, monitoring and decision making.

Introduction

Geographical Information System (GIS) is a computer-based mapping tool that enables geographic or spatial data capture, storage, retrieval, manipulation, analysis, modeling and presentation of the real-world scenario. A database is a lot of information stored in a computer device, taking into account the existing technologies used to organize and structure the database, so we can easily manipulate the content. A database is collection of data organized in a structured way, so that; information can be retrieved quickly and reliably (Closa et al., 2010). The invention of information technology has led the database to be used in a management system, which is called database management system. A database management system is a set of programs that enables the management and access to a database. Geodatabase is an alternative way to store GIS information in one large file, which can contain multiple point, polyline, and polygon layers. Geodatabase is a collection of geographic datasets of various types of common file in single database. Urban Planning is the one of the main application of GIS. Urban planner use the GIS as well as spatial database and analysis tool. GIS increasingly an important component of planning support system. Recent advances in the database of GIS with planning models, visualization, and the internet will make GIS more useful tool for urban planning.

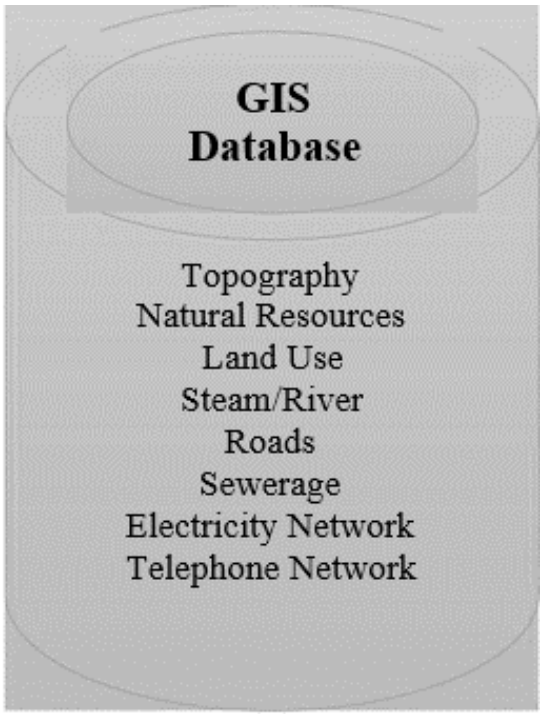


Figure 1: GIS Database

The GIS database for urban planning as below:

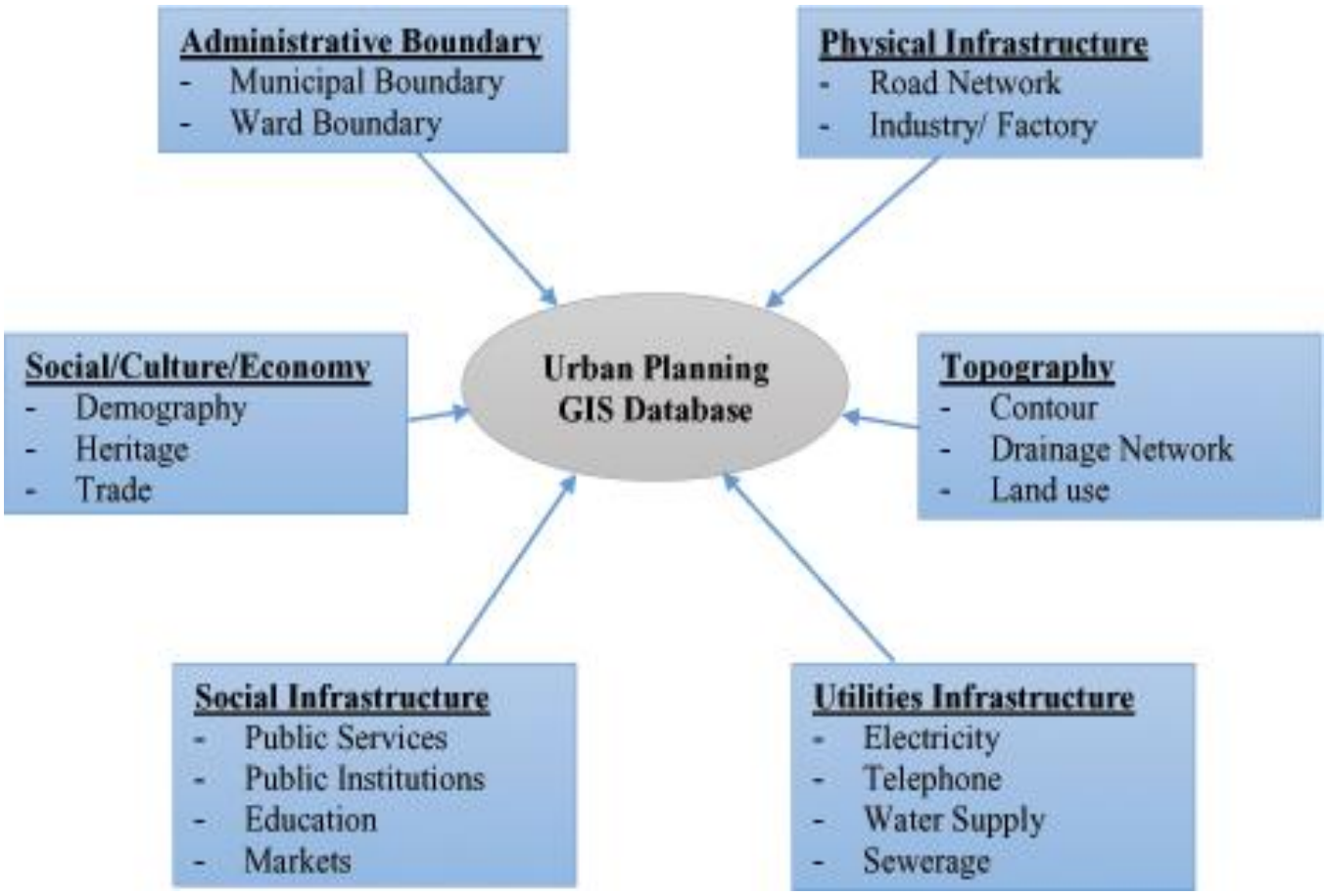


Figure 2: Data requirements for urban planning

Objectives

The main objective of this article is to preparation a GIS database for urban planning. The sub-objectives of this article as listed below;

1. To preparation of GIS database for urban planning
2. To play the vital role of GIS database for urban planning
3. To use GIS database for update and spatial analysis for urban activities
4. To support the decision-making process of urban activities.

Methodology

The methodology of preparation of GIS database form field survey and mapping (tabular data), Orthophoto generation from aerial photographs, satellite data from remote sensing and topography maps from aerial survey or field survey by total station. The GIS database collection and development methodology for urban planning as follows;

1. Field survey and mapping
2. Aerial survey
3. Satellite image
4. Topographic map

GIS database collection and development methodology for urban planning as below:

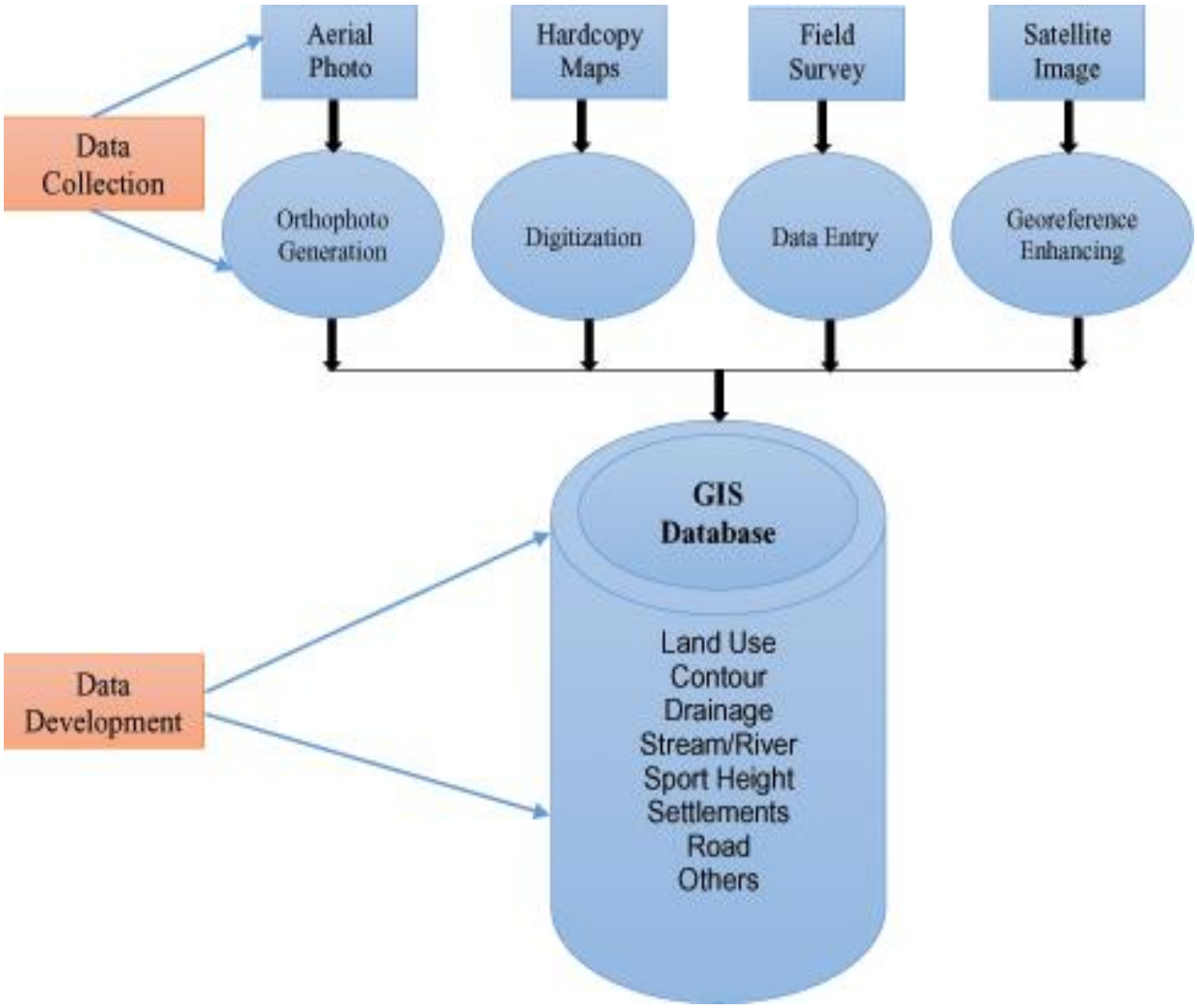


Figure 3: GIS database collection and development methodology for urban planning

Discussion

The VDCs and municipality of Nepal lack proper base map. They are mostly dependent on 1:25,000 or 1:50,000 scale topographic maps, land resources maps or other available analogue maps which is not sufficient or too coarse to use for urban level planning. The available maps are also not much useful for proper decision making process of the urban development activities. The lacking of digital geographic information in Nepal, particularly large scale, has resulted ineffective and inefficient planning activities in urban development. Thus, the GIS database mostly important for urban activities, decision making process, and urban planning. Department of Urban Development and Building Construction (DUDBC) should expedite the digital database, maps creation of all municipalities of Nepal including the new ones and urbanized settlements for sustainable development of municipalities. It is also required the updating existing topographical maps and GIS database preparation of large scale maps of the whole country from high resolution satellite images.

Conclusion

GIS is an important aspect for economic planning, sustainable urban development and urban planning. Geographic information

science is mapping and spatial analysis for both spatial and attribute data to support decision making process and activities. GIS providers decision makers, especially those concerned with the build environment, ways of creating enabling scenarios for making timely and information driven decisions to solve existing or identified spatial problems. GIS has emerged as a powerful tool in integrating and analyzing the various thematic layers along with attribute information to create and visualize various planning scenarios for decision making.

References

Bariar, A., Gupta, R. D., and Prasad, S. C., N/A, *Geospatial Database Development for Urban Planning Using Satellite Data Under GIS Environment*, Department of Civil Engineering, Motilal Nehru National Institute of Technology (MNNIT), Allahabad-211004, U.P., India.

Closa, D., Gardiner, A., Giemsa, F., and Machek, J., 2010, *Database and Database Management System,* Parent Law for Computer Scientists, Springer, Berlin, pp. 75-85.

Oli, P. P., 2014, *Preparation of Database for Urban Development*, FIG Congress 2014, Enhancing the Challenges - Enhancing the Relevance Kuala Lumpur, Malaysia.

Shrestha, A. B., 2016, *Identifying Suitable Areas for Urban Development in Rampur Municipality, Palpa District, Nepal*, Master Thesis on MSc in Geographical Information Science and Systems, MSc - (GISc), Department of Geoinformatics - Z_GIS, University of Salzburg, Austria.

Shrestha, B., Bajracharya, B., Pradhan, S., and Rajbhandari L., 2003, *GIS for Municipality Planning, A Case Study from Kirtipur Municipality*, International Centre for Integrated Mountain Development (ICIMOD), Mountain Environment and Natural Resources Information (MENRIS).

Yeh, A., G-O., N/A, *Urban Planning and GIS*, pp. 887

GEOMATICS EDUCATION IN NEPAL

SCHOOL OF GEOMATICS

- A College of Geomatics Engineering
(Affiliated to CTEVT)

A pioneer Institute of Surveying and Geo Information in Nepal providing educational services since 1999. The courses offered include:

Regular Courses

- T-SLC in Survey Engineering (15 Months Training Course: eligibility: SLC Passed)
- Diploma in Geomatics Engineering

(Three years academic Course: eligibility: SLC Passed)

Short Term Training

1. Customized Training for layers, land managers, bankers and corporate staffs on land surveying, equipment handling and land management.
2. Professional Training on:
   - Geographical Information System(GIS)
   - Autodesk Land Development
   - Total Station Operation Training

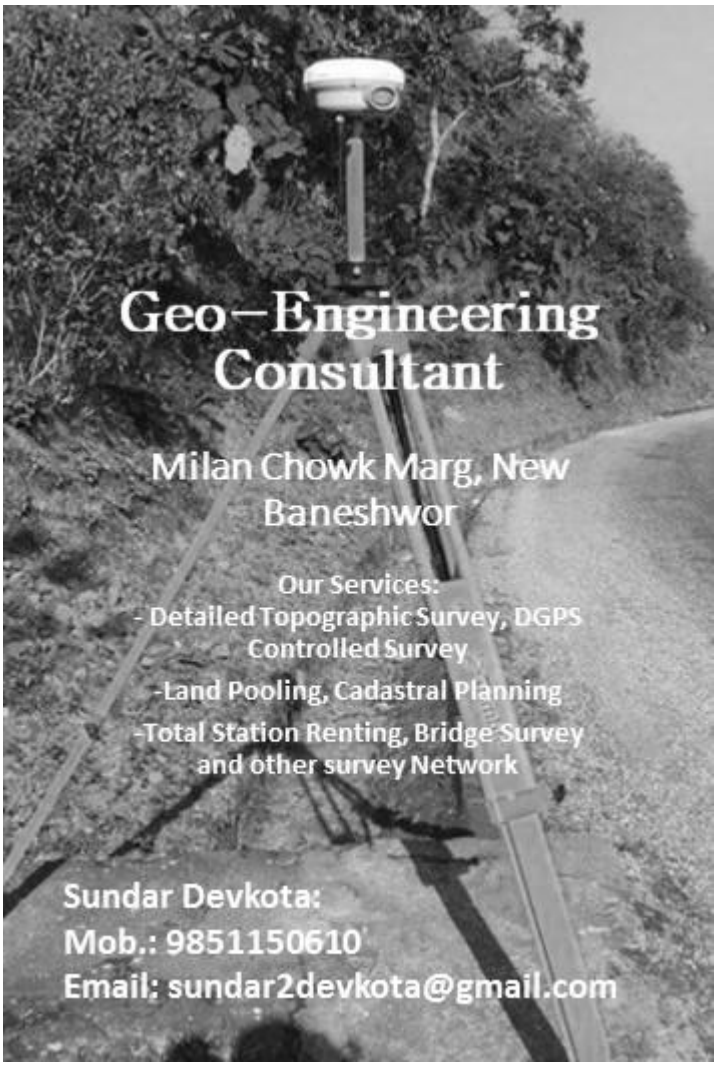
SCHOOL OF GEOMATICS
Basuki Marg, Mid Baneshwar P.O Box: 13177,
House No: 121/55
Phone: 4116177,016202651,
Email: sog@geomatics.edu.np
Web Address: geomatics@edu.np

Mir Consult

Lalitpur-15, Satdobato

Remember us for feasibility studies, construction supervision, EIA studies, planning and other engineering services

Contact No.: 015203114, 9851222822



Through

Geo-Information

Training

Survey

Land Administation

To Produce

Qualified Geo-Professionals

"We have been producing Qualified Geo-Professionals since 1968."

Government of Nepal
Ministry of Land Reform and Management
Land Management Training Center
Dhulikhel, Kavre

For more information visit us at:
Website:- www.lmtc.gov.np
Email us at info@lmtc.gov.np
Phone No:- +977-011-661455
Fax No:- +977-011-662078

SURVEY DEPARTMENT

NATIONAL MAPPING ORGANIZATION

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

Available Services

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

Available Maps and Data

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

Contact Address:
SURVEY DEPARTMENT
Min Bhawan, Kathmandu, Nepal
Phone: +977-1-4622719
Fax: +977-1-4622957
E-mail: info@dos.gov.np
website: www.dos.gov.np

SHREE RS ENGINEERING SOLUTION PVT. LTD.

SRSES For Comprehensive Solution

About us

SRSES is a premier multi-disciplinary engineering Consulting Company, established in 2003, visions to be the leading company in the country in providing innovative, reliable, and professional services. SRSES is uniquely positioned to deliver end-to-end multi-disciplinary Services.

We have our experience working with various clients including government organizations, INGOs, NGOs, Hydropower, Private Organizations and other providing wide range of IT related services.

Why choose us

We provide services for:

- Information and Technology
- Geospatial Sector
- Road,Highways and Bridges
- Water Supply and Sanitation
- Irrigation and Water Use
- Urban Planning
- Environment management
- Project support

Contact

Bhat Bhateni, Kathmandu, Nepal

www.srses.com.np

info@srses.com.np

Call Us: +977-1-4416063
+977-9851216290

International Partners

HEXAGON · GEOMAX · kt · pwc · Louis Berger · KIP · INFOTECH · Ernst & Young · CyberSWIFT

Cube Info Company Pvt. Ltd.

Bishalnagar, Kathmandu, Nepal

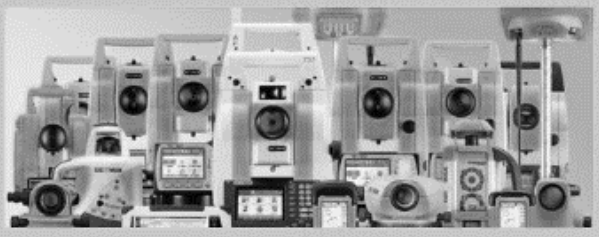
Our Services:

CONSULTING SERVICES

- ☐ Enterprises Web GIS solution
- ☐ Preparation of Land Resource Maps
- ☐ Digitization & preparation of geo-database
- ☐ Impact Study and Evaluation of Irrigation project
- ☐ Topographic survey
- ☐ Civil Engineering and Water Resources
- ☐ Hydropower feasibility study
- ☐ General and applied geology including slope stability problems
- ☐ Socio-economic studies
- ☐ Environmental and bio-engineering studies
- ☐ GIS, Remote Sensing and Photogrammetry applications
- ☐ Natural Hazards: Flood, Landslide, Debris flow, Earthquake, Glacier Lake etc.

SALES SERVICES

- ☐ Authorised Sales and services provider of Surveying Instrument for GeoMax
- ☐ Total Station,
- ☐ GPS/GNSS instrument,
- ☐ Softwares
- ☐ Lasers
- ☐ Optical and Digital Levels and Accessories
- ☐ Supplier of Satellite Imagery



Contact Us:
Email: info@cubeinfo.com.np
cubeconsultant.nepal@gmail.com
Office No.: +977-1-4423194
Cell No.: +977-9851131374

EDXL CAP Based SAMBRO for Public Warnings and Alerting Activities

Biplov Bhandari
Research Associate, Asian Institute of Technology,
Member and Software Developer, Sahana Software Foundation,
International Coordination Council Member, Asta-Ja Research Center.
W: https://np.linkedin.com/in/geomatbiplov; B: https://biplovbhandari.wordpress.com/

ABSTRACT

Sendai Framework on Disaster Risk Reduction emphasis on the implementation of the Early Warning System in the member countries to save life and reduce loss. However, most countries in Asia have the manual system and significant amount of time and resources are required for the public warnings to reach the last mile. To add more, the disparate systems implemented by different stakeholders makes it harder for the government to integrate all the public warnings and stakeholders. In the paper, the discussion on how Location Based CAP-enabled SAMBRO has realized the gaps and tried to address the problem is presented. The paper discusses various features of the system, the user perspective and acceptance towards the system. The system is implemented by the government of the Philippines, Maldives, and Myanmar. The system is used for public alerting activities along with recipients like IFRC, Google Public Alerting as subscribers of the system.

Introduction

Disasters are increasingly taking a heavy toll of life and property with each passing year around the world. Unfortunately, the forces of urbanization, unplanned growth, and extreme climatic events make the situations worse. According to various UN study, the Asia-Pacific region is one of the most risk-prone areas for disasters, based on disaster occurrences since 1995.

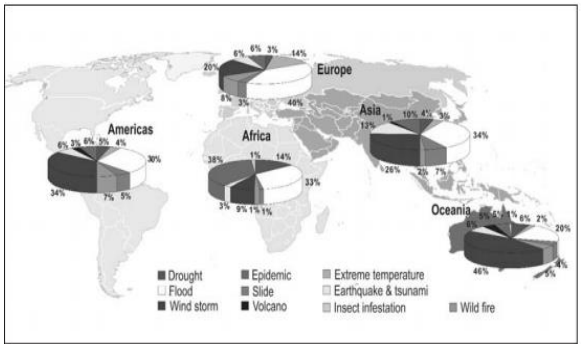


Fig 1. Regional Distribution of Disasters: By Triggering Hazards, 1995–2004. Source: (base map): UNEP/DEWA/GRID-Europe, November 2004

One of the key reason for this is the implementation of effective disaster management systems and evacuation procedures in the developed countries. The modern ICT tools provide different Free and Open Source solution to address the similar problem. Sahana Alerting and Messaging Broker (SAMBRO) is the Location Based Early Warning Broker aimed at providing timely, accurate warnings to stakeholders and interoperability between various heterogeneous systems. SAMBRO integrate different data stream and various stakeholders under a common platform. The technology provides the ease of use, open source solution and with little effort can be tweaked and customized for different use-cases.

Goals and Objectives

The long-term goal of the project is to operationalize a CAP-enabled Multi-

Agency Situational Awareness (MASA) platform, SAMBRO, in each beneficiary country in order to provide location-specific alerts/warnings and integrate all the stakeholders through a common information exchange hub for better coordination at the time of a disaster. For achieving this goal the following objectives are set forth:

- To improve the national capacities for providing hazard and location specific alerts/warnings according to risk levels.
- To improve the national capacities for maintaining a register of alerting/warnings authorities for creating, authorizing, issuing, auditing, and receiving MASA alerts.
- To help national agencies to share situational-awareness information with the responders, line-agencies, and NGOs to consolidate their efforts and operate as one entity to minimize the duplication of efforts.
- To develop a group of master trainers (Technology Stewards) in each country equipped with training materials in the countries.

Study Area and Target Group

The Location Based SAMBRO was implemented for the Government of Philippines, Maldives, and Myanmar. Various Target Audience and groups are summarized in the table below.

Maldives National Warning Center (NWC): Maldives Meteorological Service (MMS)	**Maldives National Disaster Management Office (NDMO)**: National Disaster Management Center (NDMC)
Maldives Response Organizations: Maldives National Defense Force (Coast Guard and Fire Search and Rescue Department); Maldives Red Crescent Society; Local Atoll Councils; Local Island Councils; Maldives Police; Maldives Red Crescent Society; Department of Health; Ministry of Tourism Arts and Culture; Ministry of Education	
Myanmar NWC: Department of Meteorology and Hydrology	**Myanmar NDMOs**: Relief and Resettlement Department; General Administration Department;
Myanmar Response Organizations: Department of Irrigation; Department of Health; Department of Agriculture; Department of Fisheries; Department of Inland Transportation; Fire Services Department; Myanmar Red Cross Society	
Philippines NWC: PAGASA; Philippines Institute of Volcanology and Seismology	**Philippines NDMO**: Office of the Civil Defense (OCD)
Philippines Response Organizations: Department of Social Welfare and	

Development; Local Government Units, Disaster Risk Reduction and Management Councils

Table 1: Stakeholders and Target Audiences

Methodology and Discussion

The MASA platform SAMBRO is Common Alerting Protocol (CAP) enabled Broker. CAP is the Emergency Data Exchange Language (EDXL) intended for all kind of media and all kind of hazard. CAP can use from Dam-warning, Child Abduction to Biological/Infectious Diseases Hazards as well as various Hydrological, Meteorological and other hazards and disaster.

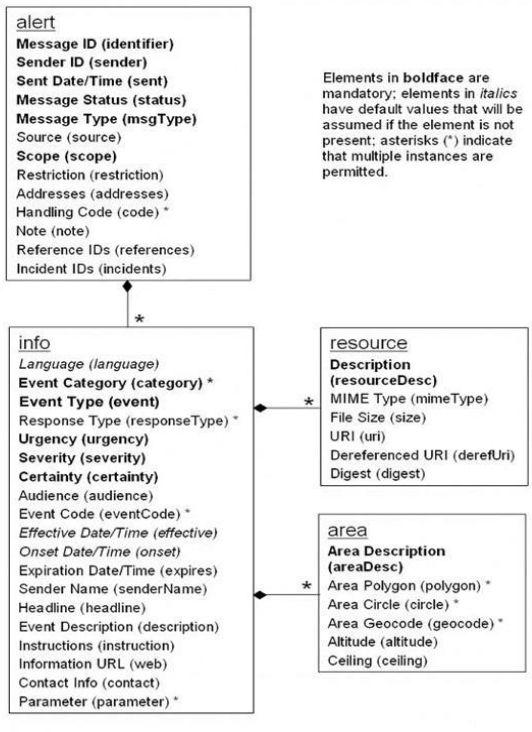


Fig 2: CAP Data Model

Web-based system as well as mobile (Android/IOS) platform was developed, designed and implemented. The web-based system is more redundant and complete entire workflow from creating the alert to alert update, cancel, error etc. The mobile app is mostly for the first responders in the field to complete the Standard Operating Procedures (SOP) and issue the warning.

Various other features of the system include Multi-Agency Situational Awareness (MASA) platform which brings various organizations under a common umbrella; inclusion of all kind of audiences - Subscribers (Alert Recipients), Publishers (Alert Issuers), Implementer (Super Users) as well as Map Admin (GIS personnel); ability for the first responders to be able to reply back to the system as acknowledgement; dissemination of warnings through Email, SMS (Short Message Service), Google Cloud Messaging (GCM), FTP (File Transfer Protocol), RSS (Really Simple Syndication) Feeds, TV Scrolling, Cell Broadcasting, social media like Facebook, Twitter, etc. and download the bulletin etc.; supports self-subscriptions and admin based subscriptions. Since some personals are compulsory to receive the alerts on the ground in order to perform the SOP, the admin can forcefully subscribe them to receive the alerts. The subscriptions can be filtered as well. Also, SAMBRO provides answer to Who issued the alert, What's the status and Where it was issued - 3W information; allows easy import and export of the external CAP files as well as CSV, XML etc.; allows complete customization to make everything in local language as well as receive Email, SMS in local language; synchronization of various instances and many more.

SAMBRO can act as an alert hub for the National Level where feeds, alerts, and

warnings can aggregate providing an overall situational overview and warning.

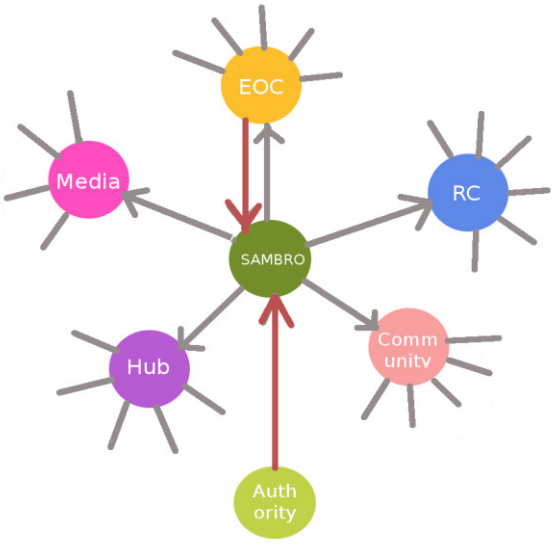


Fig. 3: SAMBRO as a hub broking the messages from various agencies and sectors

The system was designed and developed using the modern methodologies, techniques, and technologies. We identified four related areas of study and practice within the broad field of information system design. These four areas are (1) User-Centered Design (UCD); (2) rapid prototyping; (3) agile software design (SCRUM); and (4) action research.

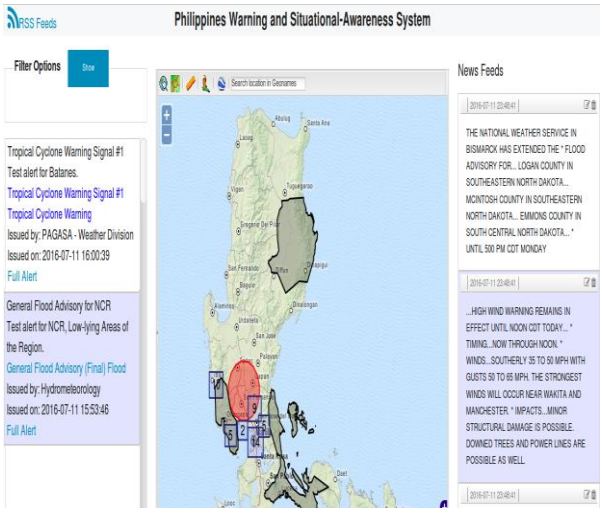


Fig 4: Web Based SAMBRO

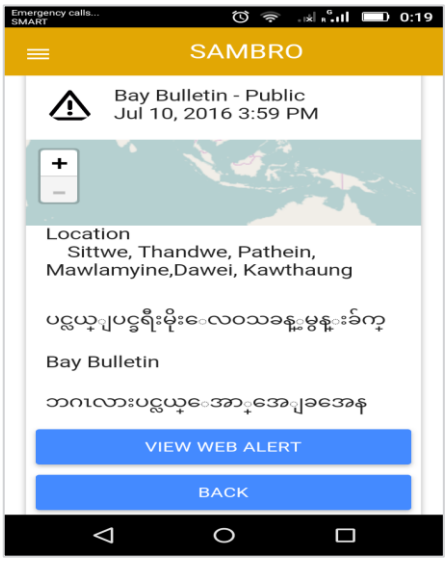


Fig 5. Mobile App for First Responders

Drills, Simulations and Results

One of the most important activities of the project was to perform the drills and simulations in each beneficiary countries by simulating their common scenario for an event of interest. The participants performed according to their existing workflow following the existing SOP and then tried to simulate the same condition using SAMBRO following the existing SOP. The result was incredible. The simulation was performed as Table Top Exercise (TTX), Technology Acceptance Model (TAM), real time scenarios use-cases, and added flavor with Human Computer Interactions (HCI) Interaction usability (UI/UX) Evaluation and observer based exercises.

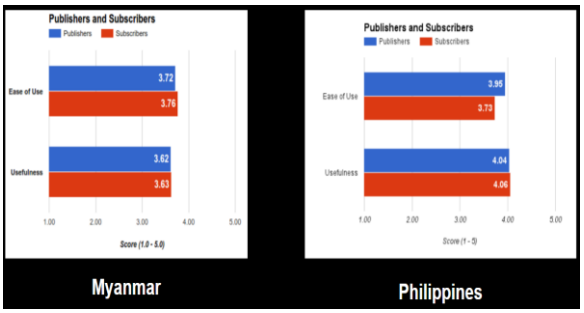


Fig 6: User Perspective of SAMBRO usability

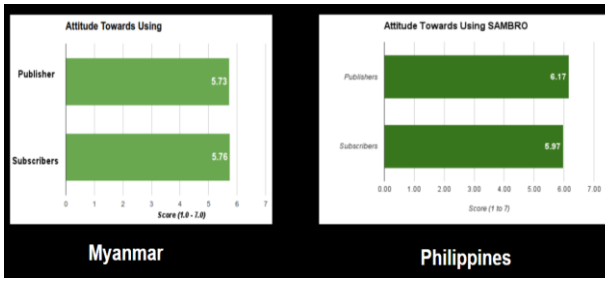


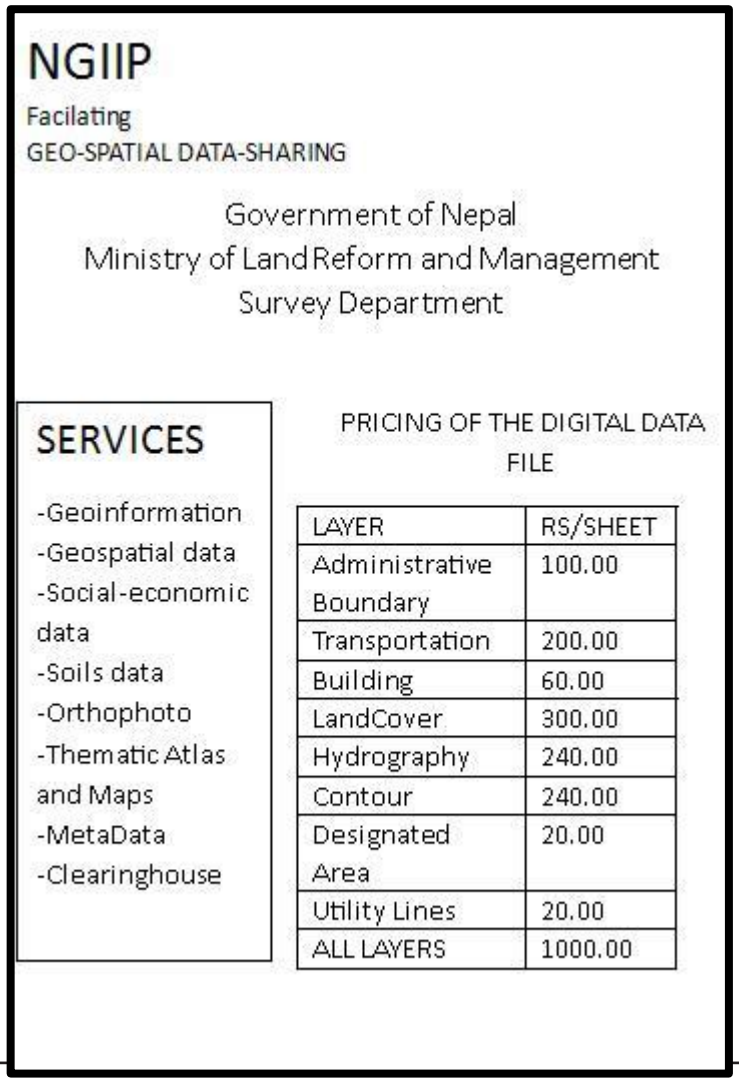
Fig. 7: User attitude towards SAMBRO

Among many, Technology Acceptance scores for the users' perception of ease-of-use and usefulness of SAMBRO is shown in Figure 6 and the users' attitude towards using SAMBRO in their workflows is shown in Figure 7. The ease-of-use and usefulness were given a score based on the Likert scale 1 = strongly disagree, 2 = disagree, 3 = partial, 4= agree, and 5 = strongly agree. The attitude towards using was given a score based on the Likert scale 1 = extremely, 2 = quite, 3 = somewhat bad / harmful / foolish / negative; 4 = neither nor; 5 = somewhat, 6 = quite, 7 = extremely good / beneficial / wise / positive.

The Technology Acceptance Model (TAM) results, in Figures 6 and 7, indicate that on average both the Publishers and the Subscribers are closer to agreeing that the SAMBRO warning dissemination technology is easy-to-use and agree that it is useful. All things considered, their attitude towards adopting SAMBRO, is closer to being "quite good, beneficial, wise, and positive".

Conclusion

We found that in many countries most of the Early Warnings are top-down approach. A break in between can cause the system to collapse. From the implementation of SAMBRO, we realized that a broker like system can help gain efficiency as well as effectiveness and save time and resources. Most existing system in countries are more manual than automatic. And many sensor-based platforms are available for aggregating the data. And hence manual effort to create alert using those data. SAMBRO can be used with sensor-based platform or without it behaving autonomously. Also, we experience that experts are involved with Early Warning as day-to-day activities but may not understand the intricacies of data standard, which was quite of the challenge in the project. SCRUM methodology turned out quite useful. Similarly, various bureaucratic process may cause delay or can hinder some salient features. Like obtaining SMS gateway was much challenging than thought etc.



Structure from Motion (SfM)

Sumesh K.C.[1*], Shangharsha Thapa[2*], Sristi Baidar[3*], Manoj Shah[4*], Uma Shankar Panday[5*], Ganesh Prasad Dhakal[6*]

**** Department of Civil and Geomatics Engineering, Kathmandu University***
1 sumesh.kc@ku.edu.np ***2 shangharsha.thapa@ku.edu.np*** ***3 preeti_sristi@yahoo.com***

4 me.manojshah111@gmail.com ***5 uspanday@ku.edu.np*** ***6 iamanjaanster@gmail.com***

Abstract

In recent years, the emphasis for applications of 3D modelling has shifted from measurements to visualization. New communication and visualization technology have created an important demand for photo-realistic 3D content. In most cases, virtual models of existing scenes are desired. In this paper, an approach is presented that obtains virtual 3D models from number of images through the use of simple hand-held consumer graded camera captured from ground platform (terrestrial photogrammetry) – the entire process involved in reconstructing the structure, the algorithms for feature detection and image matching, 3D point cloud reconstruction, texturing filtering and textured model generation. This paper also compares the effectiveness of 3D reconstruction through the use of different available desktop and web applications – Agisoft Photoscan, VisualSFM and Microsoft Photosynth, scaling and validation of generated model and also the comparison of SfM over laser scanning techniques.

Keywords: *3D, photogrammetry, consumer camera, SfM, feature detection, image matching, point cloud reconstruction*

1. Introduction

World is rapidly changing itself through the rapid progress in science and technology. Maps are also one of the sector that also have changed its appearance from 2D paper maps to 3D interactive model representation of real world. In recent years, the emphasis for applications of 3D modeling has shifted from measurements to photo-realistic visualization. This has created a lot of interest for image-based approach, photogrammetry. These days, 3D has been mandatory, which plays a key role for fostering tourism industry. Different methods are being employed such as laser scanning, photogrammetry and so on. Laser scanning techniques is mostly being used for 3D reflection and visualization of real world in accordance with the higher accuracy provided by it. The accuracy provided by it is not comparable to any other measures of producing 3D models. However, this method is expensive and is not affordable. Photogrammetry have a great potential in many applications such as large scale mapping, true orthophoto generation, archaeology, 3D city modelling, e-commerce, real estate, games and especially emergency response. This paper outlines a revolutionary, low cost, user friendly technique, terrestrial photogrammetry for 3D modelling of archaeological structure and its documentation, technically known as Structure from Motion (SfM).

SfM is a method of creating dense point clouds from sets of overlapping images where the point cloud scene (Structure) is created by the rectification of the images from multiple camera locations and orientation (from Motion). The SfM method solves the camera pose and scene geometry simultaneously and automatically, using a highly redundant bundle adjustment based on matching features in multiple overlapping, offset images. This technique combines the theory behind photogrammetric principles with advanced computer vision and images processing techniques to extract features. This combination provides a simple, easy and rapid form of data collection with a simple digital camera. Some of the benefits of SfM technology are: ease of data collection, low/no cost, semi or fully automated processing, good color mapping and point cloud is visually appealing after little or no manual cleaning. SfM reconstructs the structure with the same accuracy as that of laser scanning techniques. Hence, the application of SfM for 3D reconstruction project can play a vital role for modelling the real world physical as well as natural objects in a lower cost with the higher accuracy.

2. Methods

2.1 Test Site and Field Measurements

Panauti Municipality is one of the tourist destination, rich in cultural and historical aspects. It is approximately 4 km south of Kathmandu University. Shree Pashupati temple, located in the heart of city, was selected for modelling.

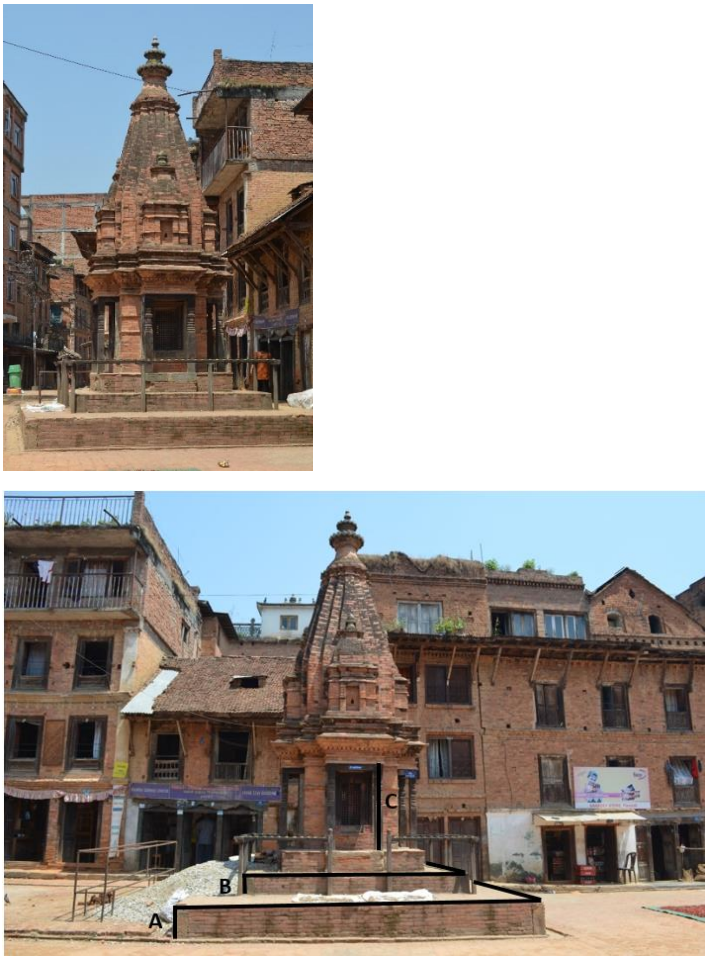


Fig 1: Test Site, Shree Pashupati Temple (up), field data measurement – A, B, C (down)

2.2 Image Acquisition and Field Measurements

Two cameras, SONY DSC-310 and NIKON D5100, were used to capture images of the same temple. The objective of using two different cameras is to study the effect of resolution of image in the overall reconstruction of the structure and quality (geometrical, texture) of the model. SONY DSC-310 is a 12 MP camera with focal length 5mm and sensor size 6.17mm×4.55mm, whereas NIKON D5100 is a 16 MP camera having focal length 18 mm and sensor size 23.6mm×15.7mm. 95 images were captured from SONY and 192

images from NIKON, from different location and height, so that there is enough overlap between images and no part of the structure is occluded.

The field measurements including the length, breadth and height, whichever is possible had been measured (represented as A, B, C in Fig 1). The measurements were later used to scale the model and assess the accuracy.

Measurements	Length (cm)	Width (cm)	Height (cm)	Remark
A	556	551	45.5	First step of the temple
B	375	375	30	Second step of the temple
C	14.1	14.0	150.5	Supporting pillar of the temple

2.3 Software

2.3.1 VisualSFM

VisualSFM is a visual 3D reconstruction system that integrates SiftGPU and Multicore Bundle Adjustment. It is easy to use with a feature-packed GUI and runs fast by exploiting multicore parallelism for feature detection, feature matching and bundle adjustment. Keypoint generation and matching among the overlapping images is based on Scale Invariant Feature Transform (SIFT) algorithm and thus relative camera position is estimated and sparse point cloud is generated. The generated points, camera positions and image planes in 3D can be viewed in the user interface. The densification of point cloud is based on Clustered Multi-View Stereo (CMVS) algorithm. The underlying concept of VisualSFM began in 2006 and was led by Changchang Wu.

2.3.2 Agisoft PhotoScan

Agisoft PhotoScan is an advanced, commercial image-based 3D modeling solution aimed at creating professional quality 3D content from still images. Based on the latest multi-view 3D reconstruction technology, it operates with arbitrary images and is efficient in both controlled and uncontrolled conditions. Photos can be taken from any position, providing that the object to be reconstructed is visible on at least two photos. Both image alignment and 3D model reconstruction are fully automated. Generally, the final goal of photographs processing with PhotoScan is to build a textured 3D model. The procedure of photographs processing and 3D model construction comprises four main stages:

- Camera Alignment: At this stage, PhotoScan searches for common points on photographs and matches them, as well as it finds the position of the camera for each pictures and refines camera calibration parameters. As a result, a sparse point cloud and a set of camera positions are formed.
- Build Dense Point Cloud: Based on the estimated camera positions and pictures themselves, a dense point cloud is built by PhotoScan. Dense point cloud may be edited and classified prior to export or

proceeding to 3D mesh model generation.

- Build Mesh: PhotoScan reconstructs a 3D polygonal mesh representing the object surface based on the dense or sparse point cloud according to the user's choice
- Build Texture: After geometry i.e. mesh is reconstructed, it can be textured and/or used for orthomosaic generation.

2.3.3 Microsoft Photosynth

Microsoft Photosynth was originally created at University of Washington and further developed by Microsoft. Photosynth is a combination of technologies that solves for the common features between photos and how each of the photos is oriented with respect to one another in 3D space. This software provides the platform for the user to load up to 20GB of data after signing into account. The first thing required to run this software on users' PC is to download and install the local Photosynth application on the computer that ties into the Photosynth server to process the data. This local application helps the user to load the images. Depending upon the number of photographs and internet connection speed, the time to make the synths of the images varies from minutes to hours. Once completed, one is able to view the 3D view as well as point clouds by signing into the Photosynth account. Microsoft Photosynth, will not produce the textured model. For exporting these point clouds supporting software called Synth Export is used to export the generated 3D point clouds into different format PLY, OBJ and so on.

2.4 Processing Workflow

A study about the camera and its settings – resolution, ISO, aperture, shutter speed etc., is the most. As well, a good planning is required to capture quality, sharp images with less or no occlusion.

After planning, images were captured using two different cameras, SONY and NIKON, in noontime to minimize shadow content in the images. Images were captured from different location and height so that there will be enough overlap between the images and every part of the temple is visible in at least two images.

The captured images were processed separately using Agisoft PhotoScan, VisualSFM and Microsoft Photosynth. The processing time, number of point clouds, quality of mesh and textured model were noted for comparison. The general process is explained here.

The first step in 3D reconstruction from images is keypoint detection in images. The first stage of keypoint detection is to identify locations and scales that can be repeatedly assigned under different views of the same object.

Detecting locations that are invariant to scale change of the image can be accomplished by searching for stable features across all possible scales using a continuous function of scale known as scale space. Neighborhood analysis is carried out to find out the magnitude and orientation of the descriptor, keypoint.

Keypoints in the overlapping set of images are matched based on the descriptor and thus the camera position and 3D location of matched keypoints is estimated. This process is known as Bundle Adjustment.

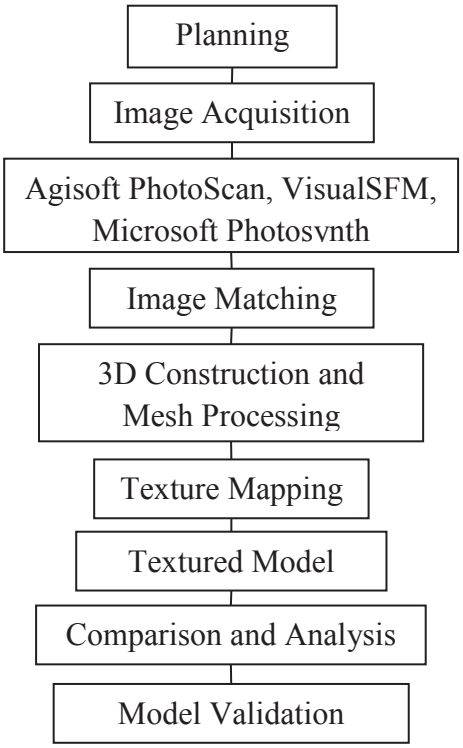
Based on the initial approximations, the densification algorithm enters to pixel and sub-pixel level of the images to create a dense point cloud. Then a surface is fitted passing through the dense point cloud and texture is embedded to the surface from the images used for 3D reconstruction.

The textured model generated was in the model coordinate system, which was scaled to ground measurements. A scale constraint was defined by a line connecting two vertices in the model. The assessment of the scaled model was carried out by comparing the corresponding linear measurements of model and in situ data from field.

3. Results

The figure shows the direct effect of number of images and its resolution in the 3D reconstruction. The model on the left is generated from 95 images from SONY (12 MP) which has many holes, incomplete reconstruction as well as irregular rough walls and edges. Whereas, model on the right, generated from 192 images from NIKON (16 MP) camera, has very few and small holes, a complete reconstruction as well as the walls and edges are more smooth than in the left model.

Thus, more the number of images, larger is the processing time and a more enhanced output. And there is a direct relationship of resolution of the image with the quality of the model.



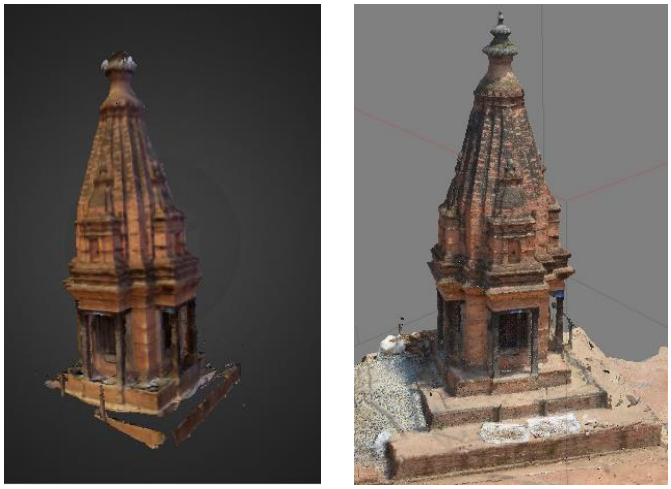


Fig 2: Textured model generated using Agisoft PhotoScan from images captured from SONY (left) and NIKON (right)

Fig 3: Textured Model generated from NIKON images using VisulSFM (left), Agisoft PhotoScan (middle) and point cloud generated from Microsoft Photosynth (right)

The three models shown above are generated from 192 images from NIKON. The model on the left, generated from VisualSFM has some problem in point cloud estimation and reconstruction, many small hoes can be detected and the quality of texture embedded in the 3D mesh is not of good resolution/quality. The model obtained from Agisoft Photoscan for same set of images has good overall reconstruction and pleasing textured model. Microsoft Photosynth gives only the colored point cloud, which can be exported to other 3D processing software. The perception of temple and different architectural structures can be perceived from 3D point cloud.

Software	Processing time	3D Points	Mesh Quality	Texture
VisualSFM	7 hr 40 min	81,861	Coarse reconstruction, many small holes	Low resolution
Agisoft PhotoScan	6hr 15 min	2,86,677	Good reconstruction, few holes	Good quality
Microsoft Photosynth	Approx. 3 hr for uploading images, 1 day to get the output	1,27,543	-	-

4. Conclusion

Nepal is rich in cultural heritage, which reflects the history. Many of the historical structures are vulnerable due to aging, earthquake or other factors. But the proper documentation of such structures do not exist. Conservation and preservation of those structure is most, to pass to offspring as well as to foster the tourism industry. SFM can be most economic, efficient and accurate as other 3D modelling techniques, for documentation of the historic structures, to assess the changes within structure and also during restoration. The model generated can also be used for creating virtual reality for educational purpose or for advertisement.

5. Acknowledgement

We are very grateful to all the faculties of Geomatics Engineering for their support.

We would like to heartily thank Dr. Rijan Bhakta Kayastha, Coordinator, Himalayan Cryosphere, Climate and Disaster Research Center (HiCCDRC), Department of Environment Science and Engineering, who provided licensed 3D Reconstruction software, Agisoft Photoscan (Professional Edition) and permitted us for image processing (8 GB RAM, processor: Intel® Core™ i7 CPU Q740@1.73GHz, 4 GB Graphics, 64 bit operating system) in a sound environment.

6. References

1. Agisoft PhotoScan User Manual, Standard Edition, Version1.0.0 http://downloads.agisoft.ru/pdf/photoscan_1_0_0_en.pdf
2. Bailey, D. G. (2003, November). *"Sub-pixel estimation of local extrema"*. In *Proceeding of Image and Vision Computing New Zealand* (pp. 414-419).
3. Eid, A., Rashad, S., & Farag, A. (2002). *"Validation of 3-D Reconstruction from Sequence of Images"*. In Proceedings of the International Conference on Signal Processing, Pattern Recognition, and Applications (SSPRA'02) (pp. 25-28).
4. Frueh, C., Sammon, R., & Zakhor, A. (2004, September). *"Automated texture mapping of 3D city models with oblique aerial imagery."* In 3D Data Processing, Visualization and Transmission, 2004. 3DPVT 2004. Proceedings. 2nd International Symposium on (pp. 396-403). IEEE.
5. González-Aguilera, D., Fernández-Hernández, J., Mancera-Taboada, J., Rodríguez-Gonzálvez, P., Hernández-López, D., Felipe-García, B. & Arias-Perez, B. (2012). *"3D Modelling and accuracy assessment of granite quarry using unmanned aerial vehicle."* ISPRS Annals of Photogrammetry, Remote Sensing and Spatial Information Sciences, 1, 37-42.
6. Hartley, R., & Zisserman, A. (2003). "*Multiple view geometry in computer vision*." Cambridge university press.
7. Hollsten, F. (2013, February). *"The effect of image Quality on the reconstruction of 3D geometry from photographs"*. Master Thesis, Aalto University.
8. http://lidarnews.com/emag/2013/vol3no6/43-48 (retrieved on : 27th March, 2014)
9. Iwaszczuk, D., & Stilla, U. (2010). *"Quality measure for textures extracted from airborne IR image sequences."* In Proceedings of the ISPRS Technical Commission III Symposium PCV (pp. 79-84).
10. Lowe, D. G. (2004). *"Distinctive image features from scale-invariant keypoints."* International journal of computer vision 60(2): 91-110.
11. Manferdini, A. M. and M. Galassi (2013). *"Assessments for 3d reconstructions of cultural heritage using digital technologies."* The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XL-5 W **1**: 167-174.
12. Snavely, N., et al. (2006). *"Photo tourism: exploring photo collections in 3D."* ACM transactions on graphics (TOG) 25(3): 835-846.

LIVELIHOODS OF SQUATTER SETTLEMENTS: ANALYSIS FROM TENURE PERSPECTIVE

Ashok Kumar Shrestha, MLA, Dissertation Work, 2015,
Dr. Purna Nepali, Research Supervisor (KU)
Department of Civil and Geomatics Engineering, Kathmandu University, Nepal

ABSTRACT

Squatter settlements are inevitable in most of the urban areas. Livelihood situation of squatter settlements seem poor, vulnerable and miserable. Living condition in these settlements suffered from overcrowding, inadequate accommodation, limited access to clean water and sanitation, lack of proper waste disposal system and degraded air quality.

The research aims to study the livelihood of squatter settlements and analyze from tenure security perspective in the selected study area. Moreover, this research basically attempts to understand and analyze livelihood situations of the squatter settlements with reference to tenure security. Specifically, it includes the importance and the role of tenure security in squatter settlement with regard to livelihood, as well as to analyze improvement of it over the past 10 years. Data for the research were collected from both primary and secondary sources.

The research has successfully evaluated and analyses livelihood situations of the squatter settlements with reference to tenure security. The analysis result shows that the improvement level in TSS is negative in regard to key dimensions of the slums and squatters. Relatively, SSS has improved. Being the resettlement, KSR is achieving the key dimensions of the slums and squatters. In the continuum of land rights, TSS is found in the condition of perceived land tenure. Unlike it, SSS has the condition of De-facto land tenure and KSR is in the condition of legal tenure.

The findings of the study show that practice by the government and fear of eviction are the main causes of the squatters' planning of the physical structure of their houses .Specific policies are to be applied by the government both for the betterment of the squatters and for prevention of the formation of squatter settlements. It is recommended that identification and categorization of genuine squatters at local level can be the better way of studying them.

Genuine squatters should be resettled and vulnerable ones should be relocated or eliminated. Consequently, participatory resettlement of squatter settlement is suggested for betterment of their livelihood and ensures their land tenure security.

Keywords: *Livelihoods, Tenure Security, Squatter Settlements*

1. INTRODUCTION

Land is a cross-cutting issue. Along with the development works, there are different types of settlements in different areas. Basically, in the urban areas, there are slums and squatters developed simultaneously with urbanization. These settlements have affected the status of life of those people because there are less facilities and services; and the settlements are deprived of land tenure rights. In the recent years, migration has led to population growth in many cities especially in developing countries (Nandi, S. and Gamkhar,S., 2013). According to the studies, in the early 1990s, 40% of the people were living in the urban area whereas the number increased by 10% (WHO, 2013) at the end of the year 2010. It is predicted that the increment is unstoppable.

There are many haphazard residential settlements and built up areas which have brought serious problems like continuity of informal settlements, increased gap between rich and poor people, lack of tenure security, and unsustainable land use (Kotter, 2009). There is always conflict between unplanned urban growth and limited accessibility of land in the urban areas (Ying, S. *et al.*, 2011). Similar to other countries, there is rapid growth of urbanization in Nepal in the recent years. Especially in Kathmandu Valley, the population increased from 1,645,091 to 2,517,023 within 10 years (CBSN, 2011). Due to the scarcity of land, settling in the public land has brought numerous problems such as environmental degradation, conflict between the residents and the government, and loss of open space in Kathmandu Valley (Haack, B.N. and Rafter, A., 2006). Without access to land many people find themselves in a situation of great economically insecurity. Due to searching better livelihoods, better opportunities, poor people are migrated to cities. Consequently, Rural–urban migration for better jobs, health, education and other facilities; rapid escalation of the cost of land, housing units and rents; government's failure to supply adequate land and affordable housing; increasing poverty; unemployment; and low wages have required poor and unskilled migrants to squat and build their shelters on public land

and other environmentally sensitive areas like riverbanks or flood plains, steep slopes and vacant spaces under high-voltage electrical transmission line in the Kathmandu Valley. The failure of the rural economy and displacement of people for various reasons, including natural disasters and conflict, are the two major causes for the increase of slums and squatter settlements in the valley (UN-HABITAT, 2010).

2. CASE STUDY AREAS

The study areas are well known all over the country. The three different case study areas are selected, namely: Shankhamul Squatter Settlement (SSS), Thapathali Squatter Settlement (TSS) and Kirtipur Squatter Resettlement (KSR).

3. METHODOLOGY

The study is based on qualitative method of data collection and analysis. Qualitative research methodology aims to explore people's feelings, perception and experiences of particular events and phenomenon more closely (Limb, M. and Dwyer, C., 2001). The researcher has used interpretive paradigm to analyze the data obtained from the field. Three phases are conducted during the research as follows;

3.1 Pre-field work

The research starts with the preliminary survey of squatter living people in SSS, TSS and KSR for making concept of research proposal which makes easy to formulate research objectives and research questions. Research questionnaire and sampling procedure are prepared for the respondents. Out of 105 HHs in SSS, 127HHs in TSS and 44 HHs in KSR, 35 respondents from each study area were selected using purposive non-random sampling method. This phase contains the literature review with respect to the research objectives and preparation for the field work. This phase is concerned with the desk study.

3.2 Field work

Both primary and secondary data are used for this study. Sample of the respondents is taken using purposive non-random sampling method. First, the respondents are selected from the study area on the basis of the objectives developed in this study. Data collection includes personal information, condition of physical infrastructure, socio-economic situation of dwellers and their views on improving settlements and on land tenure security. Numerous formal and informal meetings and discussions were also held with the concerned stakeholders working at public organizations, private organizations and NGOs. The local squatters, Local NGOs (such as Lumanti,

Nepal Basobas Basti Samrakchan Samaj, Nepal Mahila Yekta Samaj etc.) and professionals of concerned organizations are interviewed to obtain information for fulfillment of the research objectives as well as, observed the livelihood condition of squatters. Secondary data are collected from books, journals, policy review, scientific literatures, conference paper and other published material which help to find out the appropriate way of improving the livelihoods of squatter people in SSS, TSS and KSR.

3.3 Post field work

This phase of the study is for data management, data processing and data analysis which are carried out for the final conclusion and recommendation. Qualitative data aims to achieve respondent's understanding from. In it, interpretation of the meanings of people's experiences, behavior, practices and actions are focused. In the present study, he researcher has analyzed the data collected from primary sources; basically, interview with the respondents and observation of the study area. Similarly, secondary sources are also used to locate the study in livelihood framework in regard to tenure security and livelihood.

4. RESULT AND DISCUSSIONS

This research basically attempts to understand and analyze livelihood situations of the squatter settlements with reference to tenure security. Specifically, it includes the importance and the role of tenure security in squatter settlement with regard to livelihood, as well as to analyze improvement of it over the past 10 years. The research mainly focuses on livelihoods based on five key dimensions for improvements according to UN-HABITAT in *Guide to Monitoring Target 11: Improving the lives of 100 million slum dwellers* and tenure security in terms of continuum of land rights. According to UN-HABITAT, the five key dimensions for improving slums and squatters are: "access to safe water, access to sanitation, secure tenure, and durability of housing and sufficient living area".

4.1 Tenure Security and Livelihood of Squatters

Various researches have been increasing positive outlook towards the slums and squatters in the world, there has been a lot of growing realization of the need to provide secure tenure to these inhabitants. At present, security of tenure is considered as the main component of the right to housing. Having known that secure tenure provides the authority to reside in a place without threat of forceful removal or eviction (UN-HABITAT, 2003). Legal title

is the best way of assure tenure security (De Soto, 2000). Thus, Land tenure security is found important in upgrading livelihood of the individuals. There is always the fear of eviction in study areas. Government's eviction policy and fear of eviction are the main causes of the squatters' planning of the physical structure of their houses. The squatters are afraid of eviction anytime. So, they are not willing to make the permanent structure for living. After the resettlement, respondents in KSR are happier than in other squatters. SSS and TSS are weak about future plan of their house and properties for improvement. The study has showed that they are unsecured from the fear of eviction. No one was found willing to improve their settlement due to fear of eviction (Figure: 1).

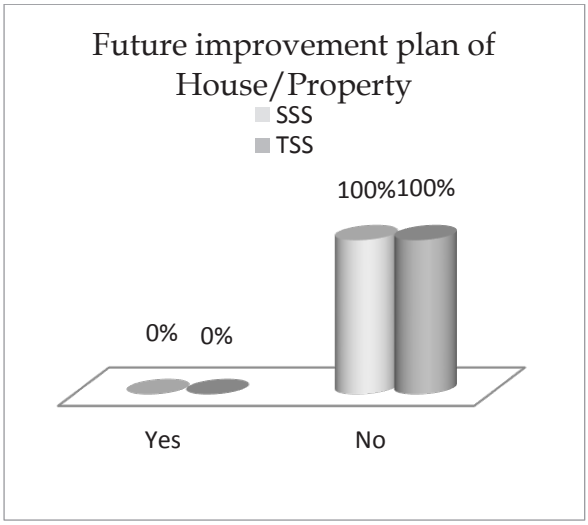
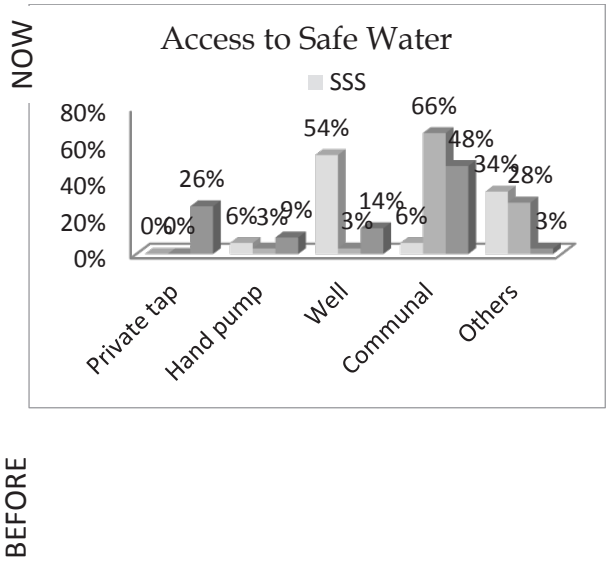


Figure 1: Future improvement plan of House/Property in SSS and TSS
(Source: Household Survey 2015)

Secured land tenure has improved living standard of the respondents. The settlements without land tenure security are less developed and people are reluctant to construct permanent physical structures on that land. The respondents are in tension of basic services to them. But KSR is achieving the key dimensions of the slums and squatters. The living standard of people in KSR is better than SSS and TSS because they have legal tenure security. Most of the squatters living at SSS have a perceived high level of 'de facto land tenure' but only 'perceived land tenure' in TSS.

Most of the households depend on a variety of sources for water. Major sources are Private tap water, hand pump, well and communal. The numbers and percentage of households using different type of sources for water are shown in following Figure: 2;



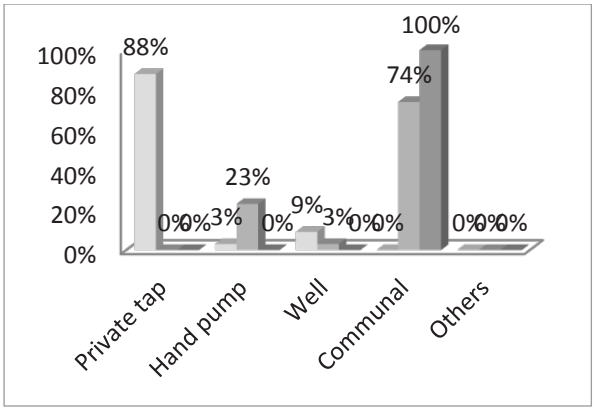


Figure 2: Source of Water among SSS, TSS and KSS

(Source: Household Survey 2015)

Sources of water vary in different squatters. SSS has better water supply because there are many respondents using private tap for water. TSS has not proper access of water. KSR squatter has only communal source of water. There is also communal rain water harvesting system from the assistance of Water Aid Nepal. The quality of water in KSR is better and fresh in comparison to other study areas.

The condition of access to sanitation and its use by the respondents is found better because they are more aware about their health at present. The Figure shows that the respondents in SSS and KSR are more conscious about their health.

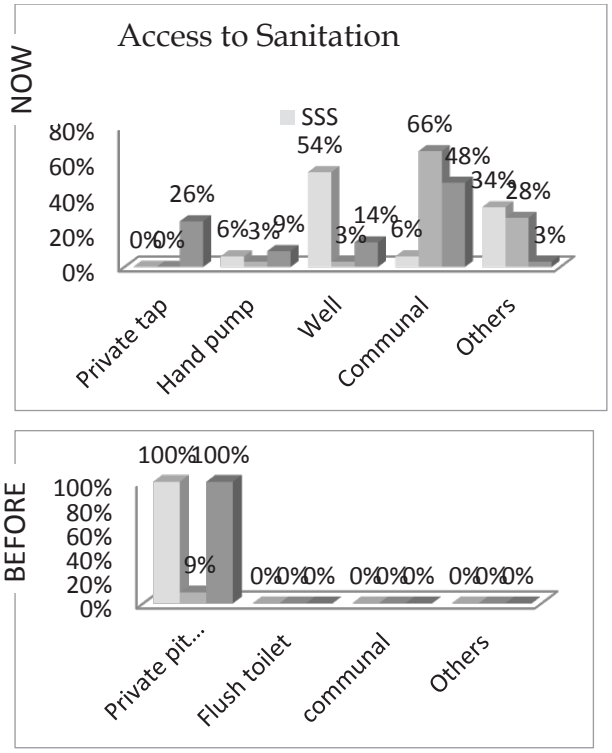


Figure 3: Source of Sanitation among SSS, TSS and KSS

(Source: Household Survey 2015)

But in TSS, the respondents are reluctant towards their access to sanitation due to the fear of eviction because the government forcefully evicted them several times.

TSS has poor living area, poor economic condition, fear of eviction and insufficient living area. TSS was evicted by the government on May 8, 2012 so that they are not willing to construct any permanent structure there. The Figure shows that Living area of the squatters is found not satisfactory in TSS and SSS. SSS is more developed in comparison to TSS where many of the squatters have multiple rooms for living though there are varieties in the number of rooms each family possesses. In

KSR, there are all facilities for living, sufficient living area and planned sizes of the rooms.

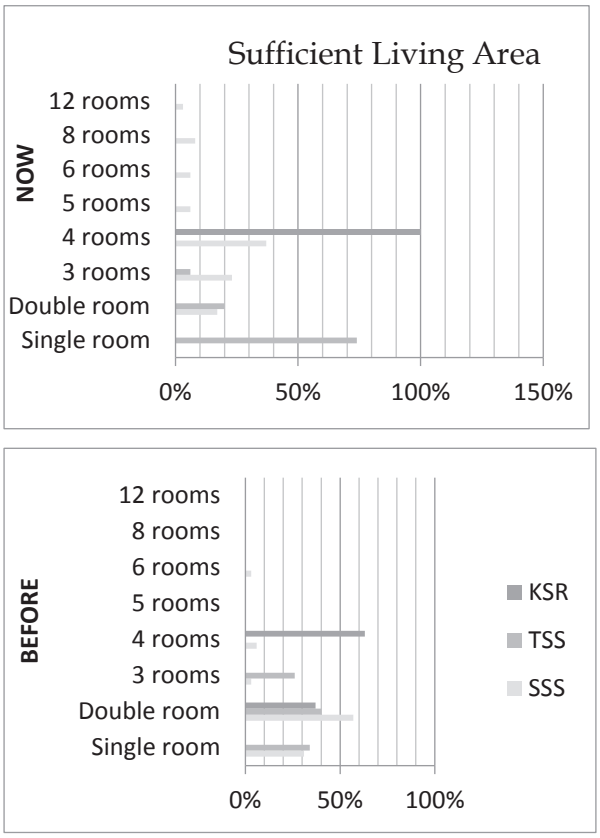


Figure 4: Sufficient Living Area among SSS, TSS and KSR

(Source: Household Survey 2015)

Living area gives the picture of how the squatters are passing their lives. To compare all three squatters, TSS has poor condition of living area. It reflects that the squatters in this area have poor economic condition, fear of eviction and problem of sufficient living area. In comparison to it, SSS is more developed where many of the squatters have multiple rooms for living. But still, there are varieties in the number of rooms each family possesses. KSR is resettled as per the government's aid and decision. So, there are all facilities for living, sufficient living area and planned sizes of the rooms.

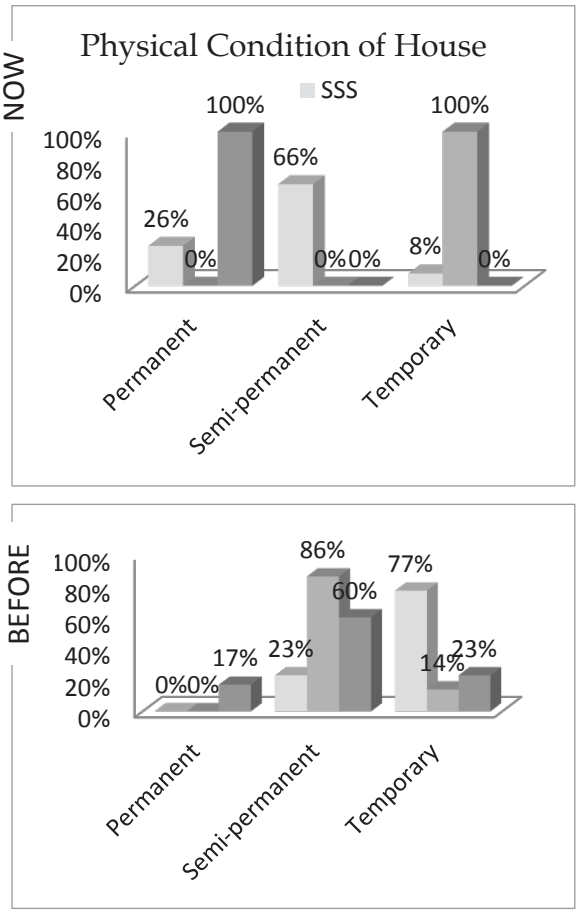


Figure 5: Physical Condition of House among SSS, TSS and KSR

(Source: Household Survey 2015)

The Figure shows that practice by the government and fear of eviction are the main causes of the squatters planning of the physical structure of their houses. In TSS, the government tried to evict the area, so the squatters are not willing to construct permanent structure. Similarly, in SSS, there is the support of several agencies and the government has also not tried to evict them. So, there are more semi-permanent structures. In comparison to these

squatters, KSR is more developed in the matter of physical condition of the houses. After the resettlement, respondents in KSR are found happy and comfortable. They don't need to worry about the condition of their houses.

Being the resettlement by the government, income status of the respondents in KSR is better than in other two study areas over the past ten years. The squatters running self-business and office works are increased in all three study squatters. The study shows that they are earning more and engaged in many income generating activities. But still, the respondents having of daily wages are more than the manual workers or job holders.

5. CONCLUSIONS AND RECOMMENDATIONS

There are both 'push' and 'pull' factors that contributed to migration in different squatters in Kathmandu Valley. In one hand, they had poor economic status, they were deprived of modern facilities in the rural areas, they could not educate their children in better schools and there were not modern health facilities in their rural villages. These factors worked as the push factor of migration of the squatters. Similarly, the respondents are found coming to the study area in search of better jobs, services, education for the children and opportunities. These worked as the pull factor of migration. But, their migration could not satisfy them. It is so because of high living costs in the cities, unemployment and low wages jobs, high demands and expectations have given chance to the formation of slums and squatters in the city areas. The squatters in the study area are found with several problems. They are facing the problems of their access to financial markets, fear of eviction, lack of proper physical facilities and services; and several physical-psychological problems.

Land tenure security is found more important for the improvement of livelihood of squatters in comparison to other physical aspects. Similarly, the respondents' living standard is found improved in the past ten years. The squatters there want to live near the city, but are having several economic, health and social problems too. The case is different in SSS. They are living there for more than 40 years. So, they are not afraid of the eviction. But still, they do not have tenure right. So, they do not dare to construct permanent structure in the land they have occupied. Consequently, this study shows that tenure right plays vital role in the livelihood of the squatters.

In the past ten years, the squatter settlements are found improved along with their several problems. The improvement level in TSS is negative in regard to key dimensions of the slums and squatters. Relatively, SSS has improved record of the squatters' living standard, physical facilities, and sources of income, monthly income and access to the other factors of livelihood. Being the resettlement, KSR is achieving the key dimensions of the slums and squatters. The squatters have access to safe water, access to sanitation, secure tenure, and durability of housing and sufficient living area. Consequently, The KSR was evicted from Bishnumati river bank's squatter settlement as a result of Bishnumati Link Road project in Kathmandu which is the successful story of resettlement approach in Nepal.

In the squatter settlements selected as the study areas, legalization of the tenure security and thorough study of the settlers' activities and practices are needed. Participatory Resettlement approach is found better in comparison to other settlements in regard of basic facilities and tenure security. So, Participatory Resettlement is recommended as the better way for improving settlements and their lives near the urban areas because tenure security is found the burning problem of squatters. Furthermore, STDM can be a better way for squatter settlement along with resettlement and providing an opportunity to live a dignified life of them.

7 BIBLIOGRAPHY

CBSN. (2011). *Priliminary Census Report 2011*. Kathmandu: Central Beureau of Statistics.

De Soto, H. (2000). *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*. London: Black Swan Books.

Haack, B.N. and Rafter, A. (2006). *Urban Growth Analysis and Modeling in the Kathmandu Valley*. Kathmandu, Nepal: Habitat International.

Kotter, T. &. (2009). Developing urban Indicators for Managing Mega Cities, Land Governance in Support of The Millennium Development Goals: A New Agenda for Land Professionals. *International Federation of Surveyors (FIG)*. Washington DC.

Limb, M. and Dwyer, C. (2001). *Qualitative Methodologies for Geographers: Issues and Debates*. London.

Lumanti. (2008). *Status of Squatter Communities along Bagmati River Squatter and its Tributaries in Kathmandu valley*. Lumanti, Kathmandu.

Nandi, S. and Gamkhar,S. (2013). *Urban challenges in : A Review of recent policy measures*. Habitat International.

Shrestha, R. (2014). *Decades of Struggle for Space: About the Legitimacy of*

Informal Settlements in Urban Areas, (7095), FIG Congress, KualaLumpur, Malaysia 16 – 21 June 2014

UN-HABITAT. (2003). *Improving the lives of 100 million slum dwellers: Progress towards the Millennium Development Goals.* Nairobi: UN-HABITAT.

UN-HABITAT. (2010). *Nepal Urban Housing Sector Profile.* Nairobi: UN-HABITAT.

WHO. (2013). *Urban population growth.* World Health Organization.

Ying, S. et al. (2011). 3D Cadastre in China: a case study in Shenzhen City. *2nd International Workshop on 3D Cadastre Delft.*

नेपाल सरकार
भूमिसुधार तथा व्यवस्था मन्त्रालय
नापी विभाग
खगोल तथा भू-मापन महाशाखाको

सुचना

१. कुनै पनि विकास आयोजनामा नक्साहरु राष्ट्रिय आधार संरचनासंग आवद्ध गर्न कानुनत: आवश्यक छ। शुद्ध नाप नक्साको लागि आधिकारिक नापी नियन्त्रण विन्दुहरु प्रयोग गरौ।

नापी नियन्त्रण विन्दुको किसिम र सोको दर रेट तालिका		भाडामा उपलब्ध गराउन सकिने यन्त्र उपकरणको विवरण
विन्दुको किसिम	प्रतिविन्दुको मुल्य	
प्रथम दजाको ट्रिग विन्दु	रु. ३०००।-	- wild T3 थियोडोलाइटहरु - wild N3,N2, Level यन्त्र - inver Staff - GPS Receiver - Worden Gravimeter - Drum Plotter
द्वितिय दर्जाको ट्रिग विन्दु	रु. २५००।	
तृतिय दर्जाको ट्रिग विन्दु	रु. १५००।-	
चौथो दर्जाको ट्रिग विन्दु	रु. २५०।	
उच्च दर्जाको उचाइ विन्दु(B.M)	रु. १०००।-	
निम्न दर्जाको उचाइ विन्दु (B.M)	रु. २५०।	
भू- आकर्षण विन्दु	रु. १०००।	

नगद जम्मा गरी रसिद प्राप्त गर्ने तालिका :
- आइतवार देखि विहिवारसम्म (विदाको दिन बाहेक) : विहान १०:०० बजे देखि दिनको २:०० बजे सम्म मात्र
-शुक्रवार (विदाको दिन बाहेक) : विहान १०:०० बजे देखि मध्यान्ह १२:०० बजे सम्म मात्र।

- विकास निमार्ण कार्य(सडक, पुल, सिंचाई, जलविद्युत) आदी कार्यको लागि मेरुदण्डको रुपमा रहेका यस्ता विन्दुहरु कित्तानापी, स्थलरुप नक्सा बनाउने, कित्ता सिमांकन लगायतका कार्यहरुमा समेत प्रयोग हुने हुदाँ यस्ता नियन्त्रण विन्दुको अभावमा त्यस क्षेत्रको नाप नक्साको कार्य समेत प्रभावित हुन जान्छ। तसर्थ यस्ता नापी नियन्त्रण विन्दुहरुको संरक्षण गर्न हामी सबैको दायित्व हो। यि विन्दुहरुलाई नष्ट हुनबाट जोगाऔ।

नापी विभाग
(खगोल तथा भूमापन महाशाखा)
मीनभवन,काठमाण्डौ।
फो.न. ०१-४६२२३१४

GEO ANDROID APPs in DISASTER MANAGEMENT POST NEPAL EARTHQUAKE 2015

Er. Dipesh Suwal, Geomatics Engineer

dipeshsuwal@gmail.com

Nepal, ranked as one of the most vulnerable country to disasters in the world, the country is prone to frequent and heavy loss of life and property due to earthquake, flood, landslides. The scenario compared to other countries in a post disaster case is much worse due to the lack of properly coordinated disaster information management system which include stages of mitigation, preparedness, relief, response and recovery. Nepal Government coordinating with different NGO and INGO are collaboratively trying to build effective disaster management systems. But, at the current context, the existing applications, tools and systems we have at the national level have not been enough to address all issues of disaster management. The market and reach of mobile phones to people is increasing day by day and mostly the popularity of smartphones is very high and increasing. Mobile phone could be an effective tool in communicating, sharing information and sending and receiving alerts quickly and effectively in a post disaster scenario system. Android has been the long leading smartphones in the market, the use of android smartphones would be an effective medium of communication, sharing information and sending and receiving alerts in a disaster scenario. The android's penetration to users is increasing so rapidly that it could be a quick information sharing tool. Realizing the fact, using android smart phones as a tool of communication in post disaster scenario could come handy and effective.

Geo Android apps by here means all those applications that run-on Android OS (latest version or older) and have some kind of geo abilities in the form of map, coordinates, bearing, compass etc. Nowadays, most of the smartphones having Android OS or ioS have inbuilt GPS or GLONASS by which anyone with the smartphone has the ability to get his/ her position in latitudes and longitudes. Also, freely available common mapping apps like GOOGLE Maps, OSMmaps, maps.me etc provide the user to view where they are located using these apps and simply their inbuilt GPS. It's very rare that a smartphone with internet abilities have no inbuilt GPS. But if this is the case still the user can locate himself using GPRS/internet abilities of the smartphone.

Talking about Geo Android apps, Google Map is the most popular and most widely used app that uses geo information. Most android phone user know this app because it is inbuilt in android OS phones and helps them to visualize themselves where they stand in the world map with the help of inbuilt GPS. Many people use this app to route paths, to find the exact location of places they want to go, to search for nearby hotels, banks, schools, hospitals, parking etc. This mapping app may be the most advanced form of android app that

uses geo information. Other such mapping apps include OSMAND, OSM tracker of similar purpose.

In the field of disaster management, the need of effective disaster management system and the capacity of smartphones to reach to people make an interesting scenario to invest people's time and money in developing android based systems that at least help in reducing deaths and damages caused due to disasters by reaching to more number of people at ease. The android apps can address any one phase of disaster including from preparedness, recovery, relief and rescue to all of the phase. Regarding this aspect, many organizations have developed some useful android applications that are available in the market today for disaster management. Mentioning some top android apps used worldwide for disaster management are FEMA, Disaster Alert, ubAlert, Natural Disaster Monitor etc.

1. *FEMA*

FEMA is an android app developed by Federal Emergency Management System (FEMA) under Department of Homeland Security, United States whose mission is to support US citizens and first responders to ensure that US is capable to prepare for, protect against, respond to, recover from and mitigate all hazards including from drought, earthquakes, floods to even terrorism before, during and after disaster strikes.

2. *Disaster Alert*

Disaster Alert app is another android app developed by PDC-Pacific Disaster Centre which provide real time alerts, collected from authoritative sources with details such as potential threats to people, property or assets due to potential disasters which covers global Earthquake, floods, Tsunami, Volcano, Storm, Marine and even manmade disasters that may occur around worldwide and shows on an interactive map.

Other such leading geo android apps include Natural Disaster Monitor and UbAlert-Disaster Alert

The penetration of communication technologies is getting stronger in Nepal. In Nepal, internet penetration has reached 44.89 percent of the total population as per the Nepal Telecom Authority's report of mid-October, 2015 and another report suggest there could be 19.1 million android phone users in Nepal. Smartphones are growing in popularity even in Nepal. Be it students, professionals or retired people, everybody wants to own a smart handset. The main reason for the popularity of smart phones is the addiction of people towards social media sites. People want to use social networks any time it is possible and nowadays every smart phone is equipped with integrated support for social networking sites. On this context, putting two things in mind, Nepal a disaster-prone country and Nepalese trend of using smart phone, many organizations like NSET, Kathmandu University, Kathmandu Living Labs, ICIMOD realizes that the use of geo android as to address post disaster management issues could come handy. After the Earthquake 2015, the work on developing geo android apps increased significantly. Many organizations build their own geo app for data collection as well as visualization of spatial data. Here I have mentioned two such apps build by developers from Nepal for disaster management:

1. ***Disaster Reporting***: ICIMOD and Kathmandu University, Nepal, developed 'Disaster Reporting', an android application that enables users to report disaster events along with essential information, such as impact and immediate relief requirements.

2. ***D-Fencing App***: Developed by students of Kathmandu University as a final year project. The app uses the user's location and compares with the existing geofence (designated virtual perimeter on map which could be frequent and possible disaster site like frequent landslides or flood site) in the system to find if the user is inside or outside the geofence. The app users can receive alerts/notifications on their mobile screen based on the location of the device (which consequently is their location if they are carrying it), and given that their location is within or inside a defined geofence.

Nepal is a disaster-prone country. Use of android smartphones application is becoming popular day by day. Many people are connected with one another through the use of android apps like Facebook, twitter, messenger, what's app etc. So, it is evident that if android apps are used as medium in disaster management than many people and victims can be connected to one another. Many foreign organization like US, Department of Homeland Security and others have developed android apps for pre and post disaster management. Realizing the need of effective application for disaster management in case of Nepal or globally, android application can be useful medium of communication in a post disaster situation in the response phase. Users can get alerts and notifications on their smartphones based on their location. Android inbuilt GPS or the internet is used to retrieve the location of device and these coordinates, in latitudes and longitudes in WGS coordinate system, are then sent to the central database through the medium of internet. The Geo android apps as uses both GPS and maps which may drain battery of the device due to load on processor of the device and also these geo android apps may require good internet connectivity. These may be some drawbacks of geo android apps but looking at what they offer to save life and property in a post disaster scenario, all its drawbacks can be neglected. I conclude Geo Android apps can be and is a revolutionary tool in a post disaster scenario.

The impact of Land Use Land Cover Change on Water Quality in the Big Sioux River: 2010-2015

Dinesh Shrestha
Graduate Student, Department of Geography, South Dakota State University

Abstract

The conversion of grassland into cropland in the Western Corn Belt Plains Ecoregion during the early twenty-first century has led to an increased amount of nitrate runoff from agricultural land (particularly from the corn cropland) to river. The river transports the nitrates downstream leading to an increased nitrogen proportion from the headwaters to the lower basin. Nitrate increases in the Big Sioux River (BSR) may be associated with increased areas and intensities of agriculture in the watershed. High concentrations (10ppm) are associated with human health issues and regulated by EPA. My research used NASS Cropland Data Layer to characterize and determine the rates of LULC change, and ArcSWAT model in ArcGIS to calibrate and validate the nitrate data from 2010 to 2015. The SWAT model calibrated the water flow and water quality parameters from the years 2010 to 2015. My research illustrates that there was an increase of 65,000 acres of corn cropland and 46,000 acres of soybean cropland, while a decrease of 119,000 acres of grassland and 42,000 acres of other crops from 2010 to 2015. Additionally, it shows the increasing trend of nitrogen leaching from cropland to river; the year of 2012 and 2015 having high amount of nitrogen leaching of 210,000 kg and 370,000 kg, respectively. This concludes that there is a direct correlation with an increase in converted croplands and increased nitrogen levels in the Big Sioux River.

Keywords: Big Sioux River basin, water quality, Soil and Water Assessment Tool (SWAT), land use/land cover

Introduction

Land use land cover changed significantly in Westen Corn Belt Plains Ecoreigion during last 30 years (Waisanen 2003). Wright and Wimberly, 2013 stated that the annual rate of grassland to cropland in this ecoregion was 1.0-5.4%. Intensive cropping dominated all other uses of land cover in the region. Reitsma et.al 2015 stated that there was a conversion of 1.8 million acres of grassland to cropland, from 2006 to 2012 in South Dakota (SD). Most of the conversion took place in eastern SD. With the increase in cropland, the use of industrial fertilizers also increased to support production and yield increases, but resulted in the nutrient rich soils which when leached to river enrich water with nutrients. Nutrient leaching, particularly nitrates, potentially degrades water quality and endangers human health. Conversion of lands to cropland and use of fertilizer for increasing the productivity have led to an increased quantity of nitrates in the soil which dissolve and infiltrate through the soil to river system; which is tranported to thousands of kilometers to the ocean and lead to ocean eutrophication. The Big Sioux River transports nitrates to the Missouri River which then enters the Mississippi River and flows to the Gulf of Mexico.

Generally, the sources of nitrates pollutant in the Big Sioux River is point source such as municipal waste treatment units. According to East Dakota Water Development District (EDWDD), the gauge stations WQM67 near Alcestor, R16 near 20th Avenue, and LBSRM on Military Road at North Sioux City showed

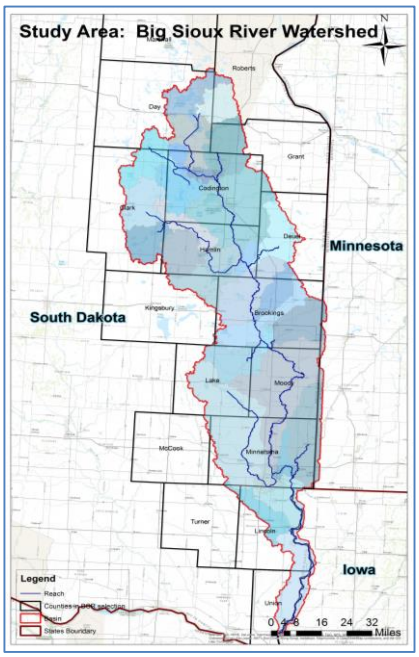


Figure 1: Study area, the Big Sioux River Basin that covers 5799 sq. Miles of eastern South Dakota

the highest nitrate concentrations of 9.1, 8.9, and 8.4 ppm respectively. The bump in nitrogen level was because of the municipal waste treatment plant. Guage station—WQM32 near Richland had 9 ppm, where the nitrate pollutant come from non-points source—cropland.

High concentrations (>10 ppm) are associated with human health and regulated by EPA. High concentration of nitrates in drinking water causes methemoglobinemia to infants and carries a potential cancer risk to adults. The nitrogen problem can be limited by good farmland management, therefore, farmers should pay special attention when choosing the proper N-fertilizer to avoid acidification and degradation of soils and, at the same time, to limit the nitrate pollution of the ground waters (Assimakopoulos, 2003, 19).

Objectives

The objectives of my research were to determine (1) LULC in the CBSR, (2) spatial and temporal trends of nitrogen concentration in the CBSR, and (3) determine whether there is a correlation between LULC and trend of nitrogen levels in the basin. I used the NASS Cropland Data Layer from year 2010 to 2015 to determine the rates of land use land cover change. I used the Soil and Water Assessment Tool (SWAT) model in Geographic Information System (GIS) to delineate the watershed and to calibrate simulations from 2010 to 2015.

Material and methods

Study Area

My study area covers approximately 15 billion acres (5799 sq. miles) of Big Sioux River basin that lie in east South Dakota (figure 1). The Big Sioux River is 420 miles long river that begins in Robert County, SD and flows south until it meets up with the Missouri River in Sioux City, Iowa (eastdakota.org 2016).

Table 1: Reclassification table

Classes	Categories
Corn	Corn, Sweet Corn
Soybean	Soybeans
Other Crops	Wheat, Alfalfa, Cotton, Rice, Potato, and other crops.
Water	Water, Perennial Ice/Snow, and Wetlands
Developed	Open/low/mid/high density developed
Grassland and Forest	Forest, Fruit Trees, Shrub land, Barren, and others

Eastern South Dakota is largely drained by the Big Sioux River, a tributary of the Missouri. Farmers rely upon Big Sioux River for irrigation. Agriculture has historically been a key component of the South Dakota economy (Reitsma et al. 2015, 2364). The five most valuable agricultural products in South Dakota are cattle, corn, soybeans, wheat, and hogs (Reitsma et al. 2015, 2363). There is an evidence of high conversion rate of grassland to cropland i.e. 1.8 million acres in South Dakota, from 2006 to 2012 (Reitsma et.al 2014, 1). The region has been encountering the water pollution problem for more than two decades. It is the most populated and most polluted river basin in the state (Press 2012).

Data Collection

Land Use Land Cover Change

For the purpose of LULC, National Agricultural Statistics Service's (NASS) CropScape-Cropland Data Layer from 2010-2015 were used. The data were available online (https://nassgeodata.gmu.edu/CropScape/). The CDL is a raster, geo-referenced, crop-specific land cover data layer created annually for the continental United States using moderate resolution satellite imagery and extensive agricultural ground truth. CDL Data Layer

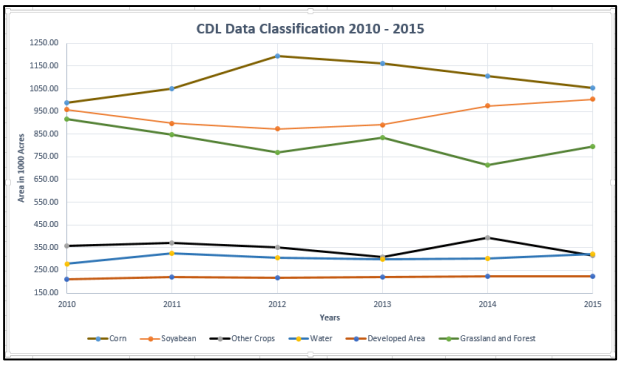
Table 2: CDL Data Reclassification into 6 major class types, area in 1000 of acres, from 2010 to 2015.

Value	Class Type/Year	2010	2011	2012	2013	2014	2015	Difference	% Change
1	Corn	989.17	1050.30	1192.44	1159.67	1106.49	1054.32	65.15	**6.18**
2	Soyabean	957.09	897.84	872.49	891.18	974.63	1002.96	45.88	**4.57**
3	Other Crops	356.94	369.64	352.41	308.53	392.12	314.73	-42.21	**-13.41**
4	Water	278.63	324.62	306.04	298.45	300.95	320.46	41.83	**13.05**
5	Developed Area	209.22	219.88	218.45	219.51	222.57	222.01	12.79	**5.76**
6	Grassland and Forest	915.43	848.68	769.18	833.53	714.01	796.29	-119.14	**-14.96**

has 225 different classes. These classes were reclassified into six broad groups: (1) Corn, (2) Soybean, (3) Other Crops, (4) Water/Wetland, (5) Developed, and (6) Grassland and others (table1).

There was an increase in corn cropland that increased from 989,000 acres to 1054,000 acres from 2010 to 2015. There was a gain of 65,000 acres of corn cropland which sums up to a change of 6.18%. Soybean cropland increased too. It had a gain of 45,800 acres which is 4.57% increase. The developed land remained constant while water/wetland had a gain of 41,000 acres of land. Grassland and others, and other crops significantly loss their acre area, 119,000 and 42,000 respectively.

Corn cropland has an increasing trend from early 2010 to 2012 when it reached to a peak, 1192,000 acres. The corn cropland gradually began to decrease from 2012 until 2015 (graph 1). Conversely, soybean cropland decreased has a decreasing trend from 2010 until 2012 and an increasing trend from 2012 to 2015. Grassland and forests and other crops seem to increasing and decreasing trend.



Graph 1: Land cover land use change in the Big Sioux River from 2010-15.

SWAT Analysis:

Soil and Water Assessment Tool (SWAT) model in Geographic Information System (GIS) was used to delineate the watershed and to calibrate and validate the nitrate data from 2000 to 2015. The datasets required were: Arc Grid representing a DEM for the Big Sioux River Valley (Quad 1:24,000), topographic map sheet from USGS (30m x 30m cell size; heights in meters). Also, the land use/land cover dataset was obtained from National Land Cover Department, Soil Data from Geospatial Data Gateway.

The SWAT model involved basically three steps: Watershed Delineation, HRU Definition and Weather Data input. After all these steps are completed, some parameters are input from the SWAT database and finally SWAT Model is run. There were 29 sub-basins created for my watershed. The total area of the basin is 5977 sq. miles. The model was set to run from 01/01/2010 to 12/31/2015, in daily basis.

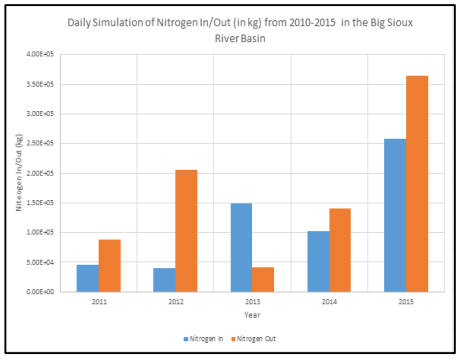
Results and discussion

Land use land cover change

From the total area acres of land (3710000 acres), 27% and 26% of corn and soybean increased to 28% and 27% from 2010 to 2015, squeezing other crops and grassland and forest from 10% and 25% to 8% and 21%, respectively (Figure 1a and 1b). Change in corn cropland and soybean cropland made a mirror image, meaning that when corn cropland increased soybean cropland decreased and vice versa. From 2010 to 2015, 15.62% of corn cropland is converted to soybean while 16.11% of soybean cropland is converted to corn cropland. However, there were increased acres of land for both the corn and soybean cropland. Where did the land come from? Yes, they came from the other crops and grassland and forests. 2.17% and 2.32% of other crops (= 80,000 acres, and 86,000 acres) were converted to corn and soybean, respectively (table 3). Similarly, 1.94% and 2.13% of grassland and forest (= 69151 acres and 72142 acres) were converted to corn and soybean cropland. But there fewer acres of corn and soybean cropland converted to other crops and grassland and forest.

SWAT analysis

The Watershed delineation categorized the basin into 29 sub-basins. I was able to simulate the nitrogen flow from 2010-2015 with the help of SWAT model. The graph below gives us the idea of the amount of nitrogen flowing in the soil and flowing out from the soil. There was high amount of nitrogen leached from soil in 2012 and 2015 (graph 2).



Graph 2: Daily simulation of nitrogen in and out (in kg) from 2010-2015 in the Big Sioux River Basin.

Table 3: A contingency table for land change is a FROM-TO table. In this example it shows land covers in 2010 and what they changed to in 2015.

A contingency table for land change is a FROM-TO table. In this example it shows land covers in 2010 and what they changed to in 2015								
		2015						
		Corn	Soybean	Other Crops	Water/ Wetlands	Developed	Grassland and Forest	Total
2010	Corn	8.10	15.62	2.15	0.22	0.05	0.54	26.69
	Soybean	16.11	7.03	2.17	0.08	0.06	0.37	25.82
	Other Crops	2.17	2.32	2.57	0.56	0.05	1.96	9.63
	Water/ Wetlands	0.15	0.11	0.23	6.59	0.01	0.42	7.52
	Developed	0.03	0.02	0.01	0.01	5.56	0.02	5.65
	Grassland and Forest	1.87	1.95	1.35	1.17	0.26	18.10	24.70
	Total	28.44	27.05	8.49	8.62	5.99	21.42	100.00

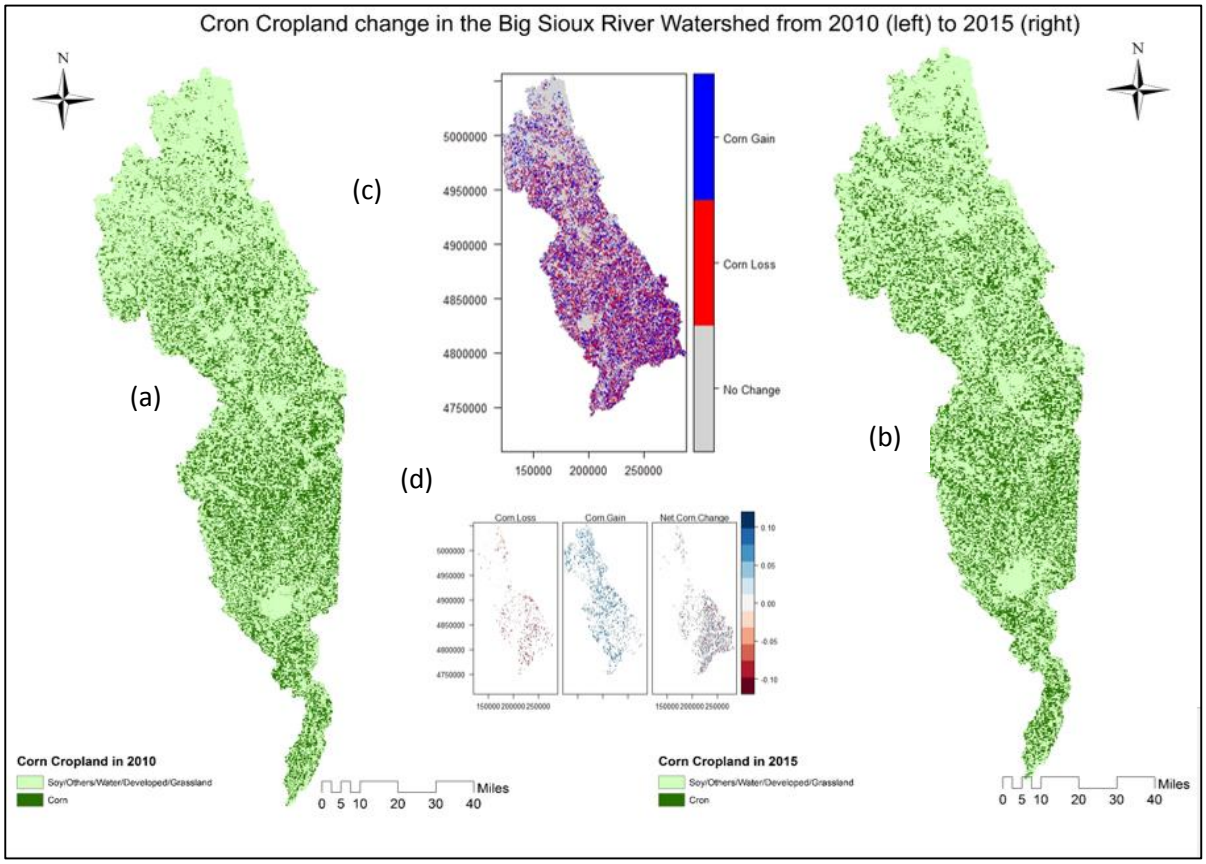


Figure 2: Net change in Corn Cropland in the Big Sioux River Watershed from 2010 to 2015: (a) Map showing the corn cropland vs other class in 2010, (b) Map showing the corn cropland vs other class in 2015, (c) Map showing the corn gain and corn loss from 2010 to 2015, and (d) Graph showing the corn gain and loss, and net change from 2010 to 2015.

Conclusion

High nitrates concentration in the river waters has always been a major problem in the rivers of the USA. Eutrophication in Gulf of Mexico and Chesapeake Lake are the examples. This issue has become one of the major concerns of public and federal water authorities (Kreiling 2016). Nitrate increase in the river water are associated with increased cropland and intensities of fertilizer use because with an increase in cropland, the use of industrial fertilizers increases; which bolsters the production yield, but also results in nutrients rich soil which when washed away to river enriches water with nutrients. Nutrients leaching, particularly nitrates have potential threats to degrade the water quality, and lead

to diseases such as methemoglobinemia. The lawsuit in Iowa about this issue has elicited attention of water authorities in South Dakota. A good farmland management can limit the intensity of nitrates leaching to the rivers. Removing nitrates from water is expensive, therefore, it could be a wise choice if farmers pay special attention when choosing the proper N-fertilizer to avoid acidification and degradation of soils and, at the same time, to limit the nitrate pollution of the ground waters (Assimakopoulos, 2003, 19).

This research used NASS-Cropscape CDL data layer to look at temporal and spatial change in LULC in the Big Sioux River form 2010-2015. Use of Landsat images to look at the changes for longer period of time may give a better trend and conclusions regarding the LULC. Similarly, the SWAT analysis for longer period of time may give a better picture of nitrate trends in the river.

References

Assessment, ME. 2005. "Ecosystems and Human Well-Being." *Washington.*

Assimakopoulos J. H, D.P. Kalivas, V.J. Kollias. 2003. "A GIS Based Fuzzy Clissification for mapping the Agricultural Soils for N-Fertilizers use." *the Science of the Total Environment* 19-33. www.elsevier.com/locate/sciotenv.

Chin, David A. 2012. Sources of Water Plooution. In *Water-Quality Engineering in Natural Systems: Fate and Transport Processes in the Water Environment*, by David A. Chin, 1-22. John Wiley & Sons.

Corwin, Dennis L., Keith Loague, and Timothy R. Ellsworth. 1999. "Introduction." In *Assessing Non-Point Source Pollution in the Vadose Zone with Advanced Information*, by Dennis L., Keith Loague, and Timothy R. Ellsworth Corwin. American Geophysical Union.

eastdakota.org. 2016. *...more about the Big Sioux Riverr.* April 20. Accessed April 25, 2016. http://eastdakota.org/bsrwatershed/More%20About%20Watersheds.html.

Gangolli, Sharat D., Piet A. Van Den Brandt, Victor J. Feron, Christine Janzowsky, Jan H. Koeman, Gerrit JA Speijers, Berthold Spiegelhalder, Ronald Walker, and John S. Wishnok. 1194. "Nitrate, nitrite and N-nitroso compounds." *European Journal of Pharmacology: Environmental Toxicology and Pharmacology* 292 (1): 1-38.

Gries, John Paul. 1996. *Roadside Geology of South Dakota.* Mountain Press.

Kreiling, Rebecca M., and Jeffrey N. Houser. 2016. "Long-term decreases in phosphorus and suspended solids, but not nitrogen, in six upper Mississippi River tributaries, 1991–2014." *Environmental monitoring and assessment 188* 1-19.

Leaver, JD. 1991. "The role of fertilizer nitrogen in the 1990s. Management Issues for the Grassland Farmer in the 1990's." *Proceedings of the British Grassland Society* 140-147.

National Water Quality Monitoring Council, NWQMC. 2007. Glossary of water-quality monitoring terms: Advisory Committee on Water Information. Accessed April 3, 2016.

Press, The Associated. 2012. *Rapid City Journal.* May 7. Accessed April 29, 2016. http://rapidcityjournal.com/news/south-dakota-s-big-sioux-among-dirtiest-rivers-in-nation/article_26094a6e-984c-11e1-a46d-001a4bcf887a.html.

Reitsma, K. D., B. H. Dunn, U. Mishra, S. A. Clay, T. DeSutter, and D. E. Clay. 2015. "Land-use change impact on soil sustainability in a climate and vegetation transition zone." *Agronomy Journal* 107 (6): 2263-2372.

Rothrock, Edgar Paul. 1943. *A geology of South Dakota. Vol. 1. State of South Dakota.* Vol. 1.

Schwarzenbach, René P., Thomas Egli, Thomas B. Hofstetter, Urs Von Gunten, and Bernhard Wehrli. 2010. "Global Water Pollution and Human Health." *Annual Review of Environment and Resources* (35) 109-136.

Waisanen, Pamela J. 2003. "Land USe and Land Cover Change in the Western Corn Belt Plains Ecoregion, 1970 to 2000." July 26: 1-124.

Wright, Christopher K., and Michael C. Wimberly. 2013. Recent land use change in the Western Corn Belt threatens grasslands and wetlands. *Proceedings of the National Academy of Sciences*

W. R. Raun, G. V. Johnson, and R. L. Westerman. 1999. Fertilizer nitrogen recovery in long-term continuous winter wheat. *Soil Science Society of America Journal* 63 (3): 645-650.

नेपाल सरकार
भूमिसुधार तथा व्यवस्थामन्त्रालय
नापी विभाग
(कित्ता नापी महाशाखा)

सर्वसाधारण जग्गाधनीहरुको लागि जारी गरिएको सार्वजनिक सूचना

विभिन्न नापी कार्यालयवाट कित्ता नापी कार्यक्रम संचालनमा रहेको व्यहोरा जानकारीको लागि अनुरोध गरिन्छ । नापनक्सा संचालन गरिएको विशेष नापीकार्यालयहरु मध्ये अछाम, अर्घाखाँची पाल्पा र सिराहा अन्तर्गत द्वन्द्वबाट क्षतिग्रस्त भूमिलगत पुनर्स्थापना गर्ने कार्य भैरहेको छ भने विशेष नापीकार्यालय झापाबाट जिल्ला भित्रका समस्याग्रस्त क्षेत्रको नापनक्सा कार्य संचालन भैरहेको छ । नापी कार्यालय बाँके, कपिलवस्तु, रुपन्देही, नवलपरासी, कावासोती, सर्लाही, धनुषा, महोत्तरी, सिराहा, लाहान, उदयपुर, सप्तरी, सुर्खेत, सुनसरी, धनकुटा र इलाम अन्तरगतबाट गाउँब्लक नापी संचालनमा रहेको अवस्था छ । कैलाली (धनगढी), दाङ्ग, चितवन, मकवानपुर, पर्सा, विराटनगर, वेलवारी, दमक, चन्द्रगढी, काठमाडौं, चावहिल, कलंकी, भक्तपुर, ललितपुर नापी कार्यालयहरुबाट पुनःनापी कार्य भैरहेको छ । त्यसैगरी डिजिटल नापी कार्यालय बनेपाबाट पनौती नगरपालिका डिजिटल प्रविधिबाट नापनक्सा भै रहेको छ । नापी हुँदा जग्गाधनीले आफ्नो हकभोगको प्रमाण सहित साँध सिमाना देखाई नापजाँच गराएमा भविष्यमा सिमाना सम्वन्धी कुनै किसिमको विवाद झेल्नु पर्ने अवस्था आउँदैन । तसर्थ अन्य जग्गाधनीहरुलाई समेत यस कुराको जानकारी गराइ दिनु भई नापीकार्यलाई प्रभावकारी बनाउने यस महाशाखाको अभियानमा सहयोग पुऱ्याइदिनु हुनसाथै थप जानकारीको लागि सम्बन्धित नापीकार्यालयमा सम्पर्क गर्नुहुन सर्वसाधारण सबैमा हार्दिक अनुरोध गरिन्छ ।

Acknowledgement

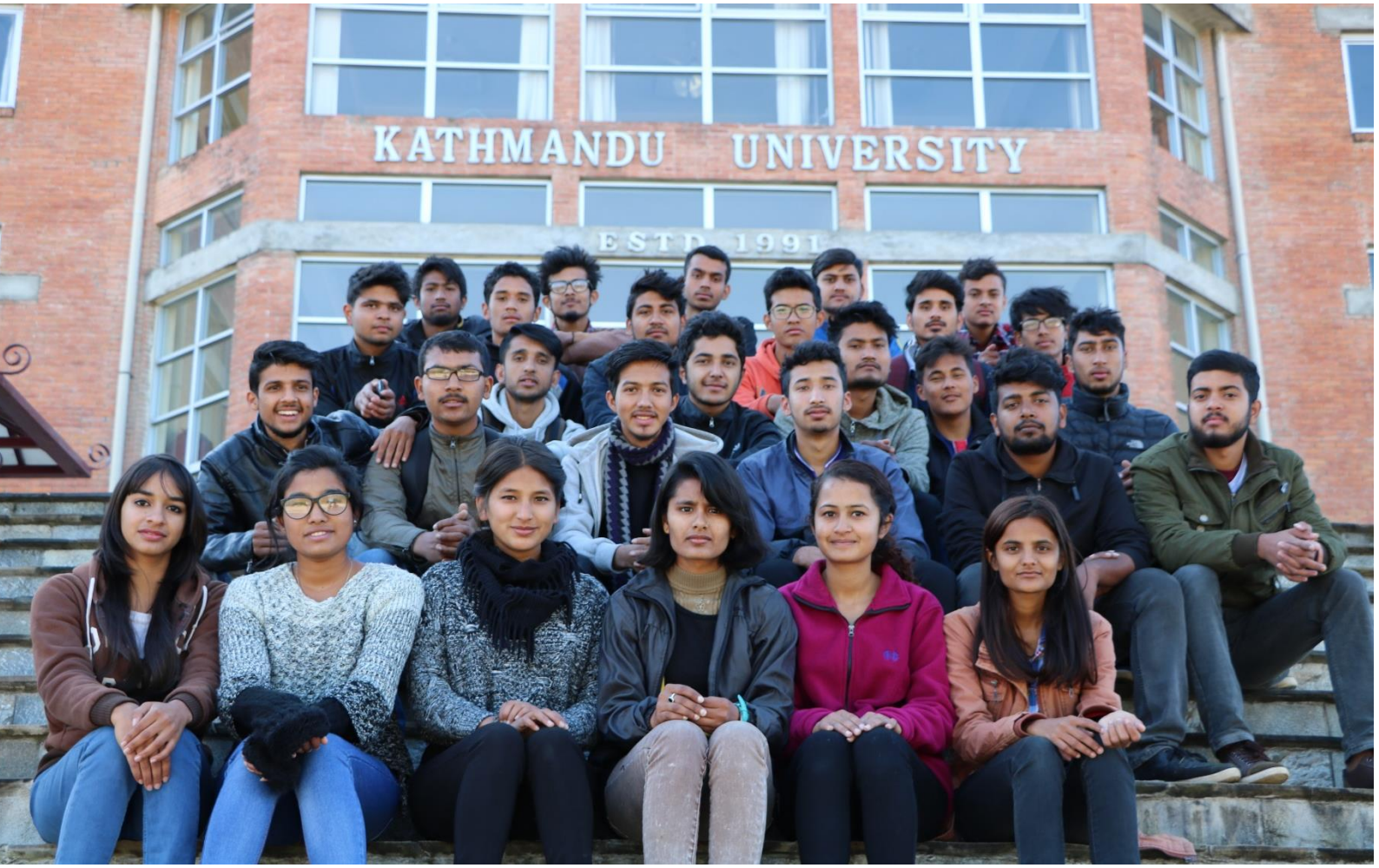
We would like to thank Kathmandu University for providing Geomatics Engineering Society such a great opportunity to publish this Journal. We would also like to show our gratitude to the Dr. Prachand Man Pradhan (Head of Department) and Prof. Dr. Ramesh Kumar Maskey for sharing their pearls of wisdom and untiring support with us during each step while publishing this journal. We are also grateful to all the people who have provided their articles and shared valuable ideas.

We appreciate the effort of following people who have financially supported us for this magazine:

1. Mr. Suresh Man Shrestha
2. Mr. Krishna Sapkota
3. Mr. Susheel Dangol
4. Mr. Ram Kumar Sapkota
5. Mr. Ramesh Gyawali
6. Mr. Arjun Thapa
7. Mr. Ashok Kumar Shrestha
8. Mr. Rabin Prajapati
9. Mr. Hem Raj K.C.
10. Er. Dipesh Suwal
11. Er. Bibek Nepal
12. Er. Eliza Shrestha
13. Er. Laxmi Thapa
14. Er. Shrijana Sharma
15. Ms. Roshani Sharma
16. Ms. Florencia Matina Tuladhar
17. Er. Bipul Neupane

Nevertheless, we would also like to thank our seniors, whose inspiration was the gateway to our success.

Geomatics Engineering, Batch 2016

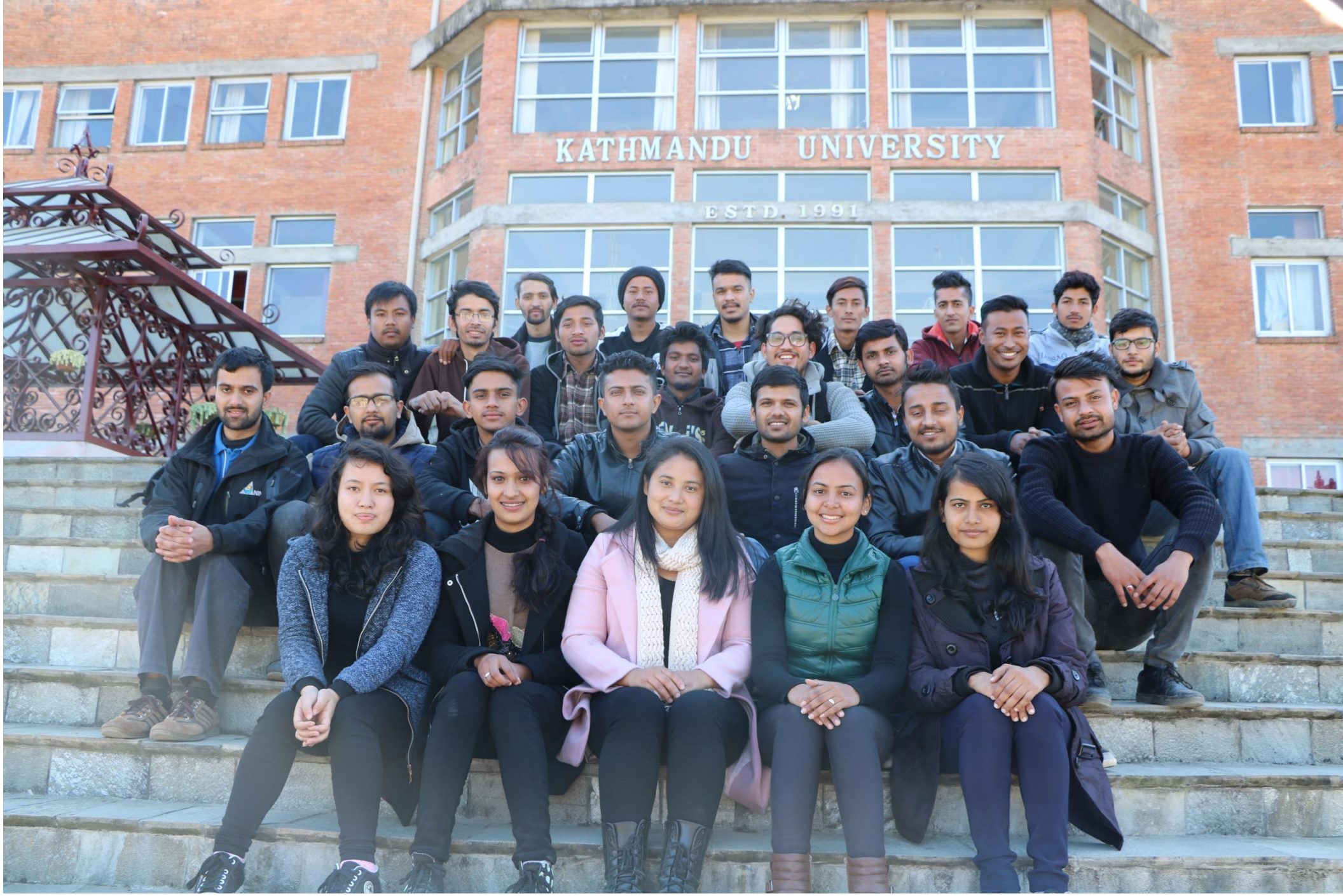


Geomatics Engineering, Batch 2015

Geomatics Engineering, Batch 2014

Geomatics Engineering, Department of Civil and Geomatics Engineering

Faculty



Geomatics Engineering, Batch 2013

Trimble

Transforming the way the world works

R10 GNSS SYSTEM
- Smallest and lightest GNSS Receiver
- First in the market to use HD-GNSS engine
- Trimble SurePoint compensates for pole tilt

UX-5 UNMANNED AIRCRAFT SYSTEM
- 36MP, Full-frame, Hi-Res Camera
- Orthomosaics resolution of 1 cm
- 3-D models with up to 1000 pts/m2

SX-10 SCANNING TOTAL STATION
- Surveying, Imaging & High-speed scanning
- Scans up to 26,600 points per second
- Scanning range up to 600m

V10 IMAGING ROVER
- Capture 60MP Panorama of the site
- Survey, GIS or Mapping accuracy from images
- Create 3-D models and point clouds from pictures

M3 MECHANICAL TOTAL STATION
- Best selling total station in Nepal
- Compact, light-weight and rugged
- Renowned Nikon optics
- Dual Hot-swappable battries
- Best features in an affordable price

tsstt

TOTAL SCIENTIFIC SURVEYING TECHNOLOGY TRADERS

KUMARISHTAN, KUPONDOLE, LALITPUR

01-5541722, 9801124013, 9851036650

tssttraders@gmail.com

Trimble
Authorized Distribution Partner