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GEOSPACE

Annual Geo-ICT Magazine of GES

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ADVISOR

DR. SUBASH GHIMIRE

EDITOR IN CHIEF

SANDESH SHARMA

ADVISOR

DR. RESHMA SHRESTHA

EDITORS

RABI SHRESTHA

ASHOK THAKULLA

PUJA PUDASAINI

HRITIK BHATTARAI

DESIGNING TEAM

PRAYASH KOIRALA

BINOD PRASAD BHATTA

SAHIL SUNAR

MARKETING TEAM

YUKESH BYANJANKAR

PRAGYA PANT

JENISH CHAUHAN

SUJAN GHIMIRE

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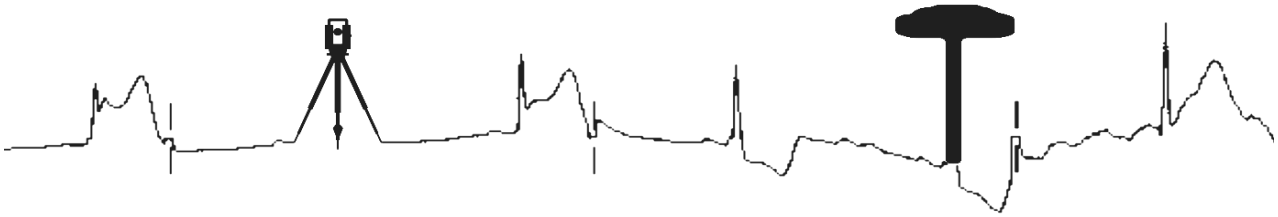

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Dhulikhel, Kavre

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EDITORIAL

Shedding light upon small things that can become a theory for big inventions has been a key role of the personalities who dedicate their life to certain and big changes in this world. A statement when said can flow up to thousands of ears, but when written can flow up to thousands of years. So, it is necessary that all the events, especially significant ones, be recorded in some meaningful writings. The dynamics and invention in today's world are based on the theories that were at some point in the past undermined, neglected, or not given equal importance. Keeping this fact straight, it is important to realize how a recorded piece of information is necessary as we don't know when it can become a turning point in any field.

"GeoSpace Volume VI" is an attempt of my team to record the findings and opinions of personalities related to the Geospatial domain. Since the scope and technology of this field are emerging, growing abruptly, and in high demand due to its diverse application, it is necessary to inform the world regarding the progress, findings, or even failures being encountered. This magazine, which is in the phase of being journalized, is a storehouse of the facts and opinions which integrates intra multidisciplinary subjects in it. We've tried to integrate the opinions and findings that were done by a student, a teacher, and a responsible officer. The diversity of the contributor can also show the prolific interest of research on this subject.

The success on completion of this magazine is not single-handed. I would firstly like to thank the Department of Geomatics Engineering for acknowledging the requirement of the GES, and this magazine as a part of the club. I would like to express my sincere gratitude to the entire faculty for their support and encouragement. Nevertheless, I would like to express my heartfelt thankfulness to all the authors who trusted us for getting their important research and opinions published. My team is thankful to all the personalities who are directly and indirectly involved in our works.

As Bruce Coville says, "Withholding information is the essence of tyranny", it is very important for us to realize the virtue of broadcasting information. Hopefully, all the materials published here be useful for all the readers. Any suggestions, opinions, and criticism are always welcome.

During this difficult time where the world is surrounded by fear and effects of the COVID-19 virus, me and my entire team wishes everyone be safe and away from this deadly foe.

Happy Reading!

Sandesh Sharma Dulal

Editor in Chief

GeoSpace Volume VI

Kathmandu University
Office of the Vice Chancellor

Message from the Vice Chancellor

I am delighted to see the sixth edition of annual Gro-ICT magazine *Geo-Space* published by Geomatics Engineering Society (GES), the Departmental club of Geomatics Engineering of Kathmandu University. This magazine adds to the knowledge of Geomatics Engineering in Nepal by creating and sharing new studies in Geo-Science. It equally complements the initiatives of our University in advancing our institutional identity and in creating impact in the communities and the country at large.

As our country moves to the era of decentralization that fuels development, the demand of expertise in Geomatics Engineering is increasing. I am hopeful that the team of Geomatics Engineering in KU will help fulfill this by providing locally suitable, applied skill and knowledge.

I congratulate GES, and the *GeoSpace* Team for this publication, extend my full support for your whole novel endeavors and wish for the continuity of the efforts.

Enjoy Reading!

Prof. Dr. Ram Kantha Makaju Shrestha, MD
Vice-Chancellor,
Kathmandu University
Website: www.ku.edu.np

Message from Head of Department

I am delighted to write a few words on the Sixth issue of annual Geo-ICT magazine **"Geo Space"** published by Departmental club, Geomatics Engineering Society (GES). First of all, I personally and on behalf of Department of Geomatics Engineering, would congratulate entire students, researchers, faculties and staff of the Department to bring out **"GeoSpace-VI"**. I am confident that this magazine is proficient not only to the surveying and mapping professionals, but also to others scientific community and researchers as well. I hope Geoinformation community will be benefitted at large by sharing scientific research and professional articles.

It is my pleasure to mention that Department of Geomatics Engineering, Youngest Department in School of Engineering, Kathmandu University, has been continuously contributing in the capacity building of Surveying, Mapping, Geoinformation Science and Earth Observation and Land Management. The Department has Diploma, Undergraduate, Graduate and PhD programs. It has Geospatial, Photogrammetry and Surveying lab and in the future Cartography lab will be established at the Department. The Department is working in line with silver jubilee initiatives such as Quality, Identity, Equality, Impact, Innovation and Global Engagement to achieve its vision. Finally, let me express my sincere appreciation to fellow colleagues, entire team of the editorial board to their invaluable contribution in "GeoSpace-VI". I would expect such kind of support and professional contribution in the upcoming issues too. I believe that this effort will boost networking among the students, researchers, faculties and professionals.

Thanking You!

Dr. Subash Ghimire

Assistant Professor and Head of Department

Department of Geomatics engineering

subash_ghimire@ku.edu.np

Message from Executive Director of LMTC

It is my pleasure to be a part of the 6th edition of GeoSpace, which is going to build one step ahead, spraying information and knowledge in sectors of surveying, mapping and geo-information technology. I am confident that, this publication will be fruitful to entire researchers, academia, students with concentrating, the land surveying and mapping technology.

Reminding that firstly, Surveying, Mapping and Geo-information Technology is an integral component related to land, water and environmental resources development, generally inclusion of civil engineers, municipal planners, environmental scientists, the construction industry manager and policy makers with inclusion of different lenses of land administration and geo-environmental issues.

And secondly, we cannot escape from latest knowledge, experience and technological development with the emerging issues of boundary management and control, geodetic framework, photogrammetric and engineering design surveys, cadastral mapping sector with demand of engineers, architects, municipalities, and real estate and land developers, along with three tier system: federal, state and local level of country. I am confident that this property will support on geomatics sectors for sharing data, information, knowledge and building wisdom.

Congratulation on getting your journal published! Precious views and ideas will encourage to booming the sectors of geo-information, land surveying and mapping technology. Of course, much of the subject reflects dedicated experience in the matter.

I honestly appreciate the effort and hardworking devoted by the Advisory Council, Editorial Board and Precious Authors to bring out the 6th Issue of "GeoSpace". Taking the opportunity, I would like to extend heartiest congratulation to the entire team for publication of the issue.

Thank you and enjoy reading.

Narayan Regmi

Executive Director

Land Management Training Center

Dhuikhel, Kavre.

Message from President of GES

Geomatics Engineering Society (GES), Departmental Club of Geomatics Engineering, Kathmandu University has been working for the overall development of students studying Geomatics Engineering in Kathmandu University. Having mindset of making geomatics students aware about geospatial techniques and technologies, GES organizes different talk shows, webinars, lecture sessions and other different programs with cooperation and collaboration with Department of Geomatics Engineering and other fellow clubs and organizations working in geospatial domain.

From organizing map literacy program in secondary and higher secondary level to collaborating with different renowned organizations for research and mapping projects, GES is always a step forward for making an impact in the society and individual with the direct involvement of it. GES involves students of Geomatics Engineering for accomplishment of its goals , which leads to capacity building, leadership capability building, cooperation, understanding about team work among the students of Geomatics Engineering.

"The greater the difficulty, the more glory in surmounting it. Skillful pilots gain their reputation from storms and tempests.". This line by Epictetus, I feel is said for the people like **Mr. Sharma and the team** who made this online publication of **"Annual Geo-ICT Magazine of GES, Volume VI"** possible in this hard time of pandemic. We are very much honored to get a fine working team, facilitators and the motivators who always stood by the side of GES in all our thick and thin and helped for the publication of this Magazine. I hope that the enthusiast of Geomatics Engineering as well as working professionals in the field of Geomatics engineering will surely be benefited from the articles and journal articles present in the magazine.

Finally, I would like to retire my statement stating that, **"This commendable work in this hard time of pandemic will surely be regarded as one of the finest deeds in the history of GES"**. I would also like to say everyone to stay safe, stay healthy, stay hydrated and we together will win over this pandemic soon.

Enjoy Reading!

Thank you!

Sudeep Kuikel

President

Geomatics Engineering Society

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टंकप्रसाद दाहाल
निर्देशक, नापी विभाग
tpdahal@gmail.com

परिचय

आमजनमानसको अचल सम्पत्तिको रुपमा रहेका जमिनको साँध सीमानाको नाप नक्सा गरि सोको विवरण प्रमाणित गरि राख्ने प्रकृयालाई कित्तानापी भनिन्छ । ऐतिहासिक कालमा कित्तानापी राज्यले कर उठाउन र जग्गा जमिनको लगत तयार गर्नका लागि संचालन गरिएको थियो । नेपालमा कित्तानापी विभिन्न कालखण्डमा विभिन्न किसिमका प्रविधिको प्रयोग गरि गरेको पाईन्छ तथापी वि.सं. २०१९ मा बनेको जग्गा नापजाँच ऐनका आधारमा गरिएको कित्तानापीलाई कानूनि रुपमा वैधानिक मानि सोहि ऐनमा अधारित भई तयार गरिएको नक्सा श्रेष्ता हाल सम्म प्रयोगमा रहेका छन । वि.स. २०२१ मा भूमि सम्वन्धि ऐन लागू भए पश्चात सो कानूनमा आधारित भूमिसुधार कार्यक्रमलाई सफल पार्नका लागि जग्गा जमिनको लगत संकलन गर्ने अभिप्रायवाट शुरु गरिएको कित्तानापी वि.सं. २०५५ मा एकसरो रुपमा सम्पन्न भएको देखिन्छ । यस क्रममा नक्सा तयार गर्ने प्रयोजनका लागि चेनदेखि टेलिस्कोपिक एलिडेड र प्लेन टेवल सम्म प्रयोग भएको थियो । त्यस्तै तत्कालिन ७५ जिल्लाहरु मध्ये ३८ वटा जिल्ला Local Control Network र ३७ वटा जिल्लाहरु National Control Network मा आधारित भएर नापी भएका थिए । यस लेखमा कित्तानापीको वर्तमान अवस्था र चुनौतीहरुको समिक्षा गर्नका साथै विद्यमान चुनौतीहरुको समाधानका उपायहरु वारेमा चर्चा गर्ने जमर्को गरिएको छ ।

कित्तानापीको वर्तमान अवस्था

कित्तानापी भन्नाले पृथ्वीको सतहमा रहेका जमिनका टुक्राहरुका साँध सीमानाहरुलाई स्वामित्व र किसिमका आधारमा नक्साङ्कन गरि सोको विवरण अध्यावधिक गरि राख्नु हो । नेपालमा लिच्छवी कालमा सुरु भएको कित्तानापीले विभिन्न चरणहरु पार गर्दै वि.सं. २०१४ सालमा नापी विभागको स्थापना र वि.सं. २०१९ मा जग्गा नापजाँच ऐन पारित भएपछि मात्र व्यवस्थित भएको पाईन्छ । वि.सं.२०२१ मा शुरु भएको कित्तानापी करीव ३४ वर्षको अवधि संचालन हुदा एकसरो रुपमा नापनक्सा सम्पन्न भएको भन्ने दावि नापी विभागको रहेको छ । तथापी वि.सं.२०५५ सम्म आई पुग्दा वीचमा केही क्षत्रमा पुन:नापीको प्रयास भएको र त्यसले सफलता पाऊँन नसकेको देखिन्छ । नापी बिभागले एकसरो नापी सम्पन्न गरेको दावि गरि रहदा देश भरिका सरकारी सार्वजनिक जग्गाहरुको कित्ता नापी भने भएको छैन । एकसरो नापी केवल आवाद गरिएको जमिन र त्यस भित्र पर्ने सर कारी सार्वजनिक जग्गाको मात्र भएको छ । नापी विभागले विधिवत रुपमा २०५२/५३ वाट पुन:नापीको सुरुवात गरेको पनि दुई दशक भन्दा वढि भई सक्यो तर पनि त्यति प्रभावकारी देखिएको छैन । पुन:नापी शुरु गर्दाको अवस्था देखि २०६५/११/०२ सम्म नापी गोश्वारालें कार्य गर्दा प्रगति वढि भएको देखिए पनि गोश्वारा विघटन पछि नापी कार्यलयहरुमा नापनक्शा र अध्यावधिक शाखा राखेर नापी गराउँदा त्यति प्रभावकारी भएको देखिदैन । अर्को तर्फ गाउँव्लक नापीको कार्यलाई सम्पन्न गर्ने लक्ष्यका साथ सुरु गरि एको नापी सम्पन्न हुने चरणमा छ ।

कुल १३१ नापी कार्यालय मध्ये केही कार्यालयहरुले डिजिटल प्रविधिको प्रयो गको अभ्यास गरेका छन । डिजिटल प्रविधिमा आधारित सेवा प्रवाहका लागि प्रयोग गरिएका डिजिटल डाटा तत्कालिन भू-सूचना तथा अभिलेख विभागले तयार गरेको हो । अर्को तर्फ फिल्डवाट सिधै Total Station प्रयोग गरि संकलन गरिएका coordinate data वाट तयार गरिएका नक्शा पनि केहि नापी कार्यालयहरुले प्रयोग गरिएको पाईन्छ । डिजिटल प्रविधि प्रयोगमा ल्यायका कार्यालयहरु मध्ये अधिकांश कार्यालयहरुले डिजिटल डाटाको प्रयोगवाट केवल नक्सा प्रिन्ट दिने कार्य मात्र गरेका छन । डिजिटल डाटाको प्रयोग गरि कित्ताकाटको सेवा उपलव्ध गराउँने कार्यालयहरुले पनि Hard Copy नक्शामा समेत कित्ता काट गर्ने कार्य छोडेका छैनन। यसले गर्दा Digital Data को प्रयोगवाट कार्य छिटोछरितो हुन सकेको छैन । यसले काममा दोहोरोपना भएको कारण कार्यवोझ मात्र थपिएको छ । अर्को तर्फ पुन:नापी कार्य स्पष्ट कार्य योजना विना अगाडी बढाईदा आसातित सफलता प्राप्त हुन सकेको छैन । बुदागत रुपमा कित्तानापीको वर्तमान अवस्थालाई देहाय वमोजिम उल्लेख गर्न सकिन्छ:

(क) एकसरो नापी सम्पन्न भएको दावि नापी विभाले गरे पनि गाऊँव्लक र सरकारी सार्वजनिक कित्ताहरुको नापी वाँकी रहेको ।

(ख) पुन:नापीको मार्ग चित्र र प्रविधि प्रयोगमा स्पष्टता नरहेको ।

(ग) Coordinate Cadastre गर्दा प्रयोग भएको Control Network भरपदो नरहेकाले कित्ता खप्टिने समस्या रहेको ।

(घ) नक्सा स्क्यान गरि digitized गरेका data पनि complete नरहेको र लामो समय सम्म प्रयोगमा नल्याउँदा outdate भएको ।

(ङ) कित्ता नक्साको अभिलेख व्यवस्थित नरहेको ।

(च) तयार भएका फाईल नक्सा original नक्सासंग नमिल्ने र Original नक्सा पनि च्यातिएका र कित्ताको लाईन मेटिएकाले सेवा प्रवाहमा जटिलता रहेको ।

(छ) Digitized data को गुणस्तर जाँच राम्रोसंग नभएकाले प्रयोगमा कर्मचारीहरु विश्वस्त नरहेको ।

(ज) Free sheet नक्साको integration गर्न नसकिएको ।

(झ) Data Securityको व्यवस्था नहुनु ।

(ञ) प्रविधि रुपान्तरको सन्दर्भमा जनशक्ति, कानूनि र संस्थागत समस्या रहेको ।

कित्तानापीमा वर्तमान चुनौतीहरु

कित्तानापी कार्य संचालनका क्रममा प्रसस्त चुनौतीहरु खडा भई राखेका छन, जसको कारण नापी पेशामा संलग्न प्राविधिक प्रति जनताको सकारात्मक दृष्टिकोण रहेको पाईदैन । समग्र नेपालको कित्तानापी कार्यमा वर्तमान अवस्थामा रहेका चुनौतीहरुलाई वुदागतरुमा देहाय वमोजिम प्रस्तुत गर्न सकिन्छ:

(क) मौजुदा नक्सा श्रेष्ता र डिजिटल डाटा

हाल प्रयोगमा रहेका नक्सा श्रेष्ताको अवस्था दयनिय रहेको छ । प्रयोगमा रहेका धेरैजसो नक्शाहरु नापीका क्रममा तयार भएका नक्शा नभई ट्रेस गरि तयार गरिएका नक्शा भएकाले ट्रेस गर्ने क्रममा भएका त्रुटीहरु समेत समाविष्ट रहेको पाईन्छ । कतिपय नापी कार्यालयहरुमा रहेका नक्साहरु Mounting Paper मा तयार गरिएकोमा ति नक्शा अति जिर्ण अवस्थाका र हाल प्रयोगमा ल्याउन नसकिने अवस्थाका छन । जुन क्षेत्रमा जग्गाको मूल्य वढेको छ र शहरिकरण पनि क्रमश वढेको छ, त्यस्ता ठाउँका नक्शा अति जिर्ण अवस्थामा छन । नक्सा च्यातिनु र मेटिनु सामान्य जस्तो भईसकेको छ ।

अर्को तर्फ तत्कालिन भू-सूचना तथा अभिलेख विभागवाट कित्तानापी नक्सा स्क्यान गरि तयार भएका डिजिटल डाटहरुको सन्दर्भमा कतिपय डाटाको स्क्यानिङ्गमा समस्या र कतिपयमा गलत digitization भएका कारण निर्धक्क साथ प्रयोग गर्न सकिने अवस्था रहेको देखिदैन । Digital data को प्रयोगवाट प्रदान गरिएका प्रिन्ट नक्साको आधारमा नापी प्राविधिकहरुले फिल्डमा गई निर्धक्क साथ नापी तथा रेखाङ्कन गर्न सकेका छैनन । कित्तानापी नक्साहरुको digitization गर्दाका समयमा उक्त डाटाको गुणस्तर जाँच नभएको होईन जति महत्वका गर्नं पथ्र्यो त्यति हुन सकेको थिएन केवल नाम मात्रको गुणस्तर जाँच भएको थियो । यसलाई अर्को शव्दमा भन्नु पर्दा केवल कागजी गुणस्तर जाँच भएको थियो, जुन कुरा हाल नापी कार्यालयहरुले digital data प्रयोगमा गरिरहेको आनाकानी र सेवा प्रवाहका क्रममा देखिएका समस्याहरुवाट घाम जतिकै छर्लङ्ग छ । डिजिटल डाटाहरुमा अर्को समस्याका रुपमा रहेको source नक्सामा भएको error का कारण Trig Sheet मा तयार गरिएका डिजिटल डाटाको integration गर्दा समस्याका रहेको छ, भने free Sheet data त्यसै पनि integrate गर्न सम्भव छैन । अतस मौजुदा digital data बाट विश्वासिलो भू-सूचना प्रणाली विकास हुने आशा गर्न सकिने अवस्था रहेको छैन ।

अर्को चुनौतीका रुपमा रहेको फाईल नक्साको व्यवस्थापन छ । Graphical पद्धतिवाट तयार गरिएका फाईल नक्सा आफैमा original नक्सा भन्दा फरक आकार प्रकारका छन ती नक्साहरुको व्यवस्थापन छुट्टै फायल खडा गरि राखिएको छ, भने कतिपय कार्यालय हरुमा फाईल नक्शा हराउने गरेको गुनासो प्रसस्त सुन्न पाईन्छ । Original नक्शा भन्दा फरक आकार प्रकारका फाईल नक्शाहरुको digitized गरि मुख्य digital database मा integration गर्न सकिदैन त्यसकारण यसको छुट्टै database तयार गर्दा database को संख्या धेरै हुने र त्यसको व्यवस्थापनमा जटिलता समेत रहेको छ ।

कतिपय नापी कार्यालयहरुमा रहेका डिजिटल डाटाहरु digitized भएपछि पनि लामो समय सम्म प्रयोगमा नआउँनाले शहरि क्षेत्रका अधिकांश digital data outdated भई सकेका छन । अर्कोतिर ति डाटाको update गर्ने वा पुन scan गरि digitized गर्ने भन्ने प्रश्न खडा भएको छ ।

(ख) जनशक्ति व्यवस्थापन

नापी विभाग अन्तर्गत विभिन्न निकायमा कार्यरत जनशक्तिहरु मुलत Analogue प्रविधिमा अभ्यस्त रहेका पाईन्छ । मौजुदा जनशक्तिवाटै सम्पूर्ण digital data को quality assessment हुने र त्यसका आधारमा digital data शुद्ध वनाई प्रयोगमा ल्याउन सकिन अवस्था छैन ।केहि वर्ष देखि नविनतम प्रविधिको ज्ञान भएका प्राविधिकहरुको प्रवेश भएको पाईन्छ ति जनशक्तिहरुलाई analogue data का वारेमा विस्तृत ज्ञानको अभावले तत्काल सेवा प्रवाहमा सुधार आउँने आशा गर्न सकिने आधार देखिदैन । पुरानो प्रविधि र नयाँ प्रविधि दुवैको ज्ञान भएका र दुवै समुहलाई सहजिकरण गर्दै अगाडि वढाउन सक्ने जनशक्तिको संख्या ज्यादै न्यून रहेकाले तत्काल केहि समय जनशक्तिका सन्दर्भमा चुनौतीको सामना गर्नं पर्ने अवस्था छ ।

नापी गोश्वारा विघटन पछि नापी कार्यालय अन्तर्गत अध्यावधिक शाखा र नापनक्सा शाखा स्थापना गरि सोहि आधारमा जनशक्ति व्यवस्थापन गरि कार्य हुदै आएकोमा नापनक्शा शाखामा रहि कार्य गर्न ईच्छुक जनशक्ति ज्यादै न्यून देखिन्छ । कतिपय कार्यालयमा सवै कर्मचारी अध्यावधिक शाखामा वसेर काम गर्ने र कार्यालय प्रमुखलाई कर्मचारी खटाई काममा लगाउँन समेत समस्या रहेको छ ।

(ग) प्रविधि रुपान्तरण

हामीसंग अन्तराष्ट्रिय स्तरमा विकशित digital प्रविधिको प्रयोग गर्नंको विकल्प छैन । यस सन्दर्भमा एकातिर हामीले कागजमा आधारित नक्सालाई सेवा प्रवाहवाट हटाउन सकेका छैनौ भने अर्का तिर तयार भएको digital data लाई पनि विश्वास गर्न सकेका छैनौ । Digital Service Delivery का लागि ESRI को ArcGIS Platform मा आधारित SAEx र Parcel Editing Application प्रयोग गरिएको छ । ArcGIS मा तयार गरिएको Personnel Geodatabase का data storage capacity केवल 2GB मात्र भएकाले सो भन्दा वढि डाट यसमा handle गर्न सकिदैन । अर्का तर्फ Parcel Editing Application वा SAEx Application वाट तयार भएको databse होस दुवै data edit गर्दा concurrent editing facility नहुनुले गर्दा एउटै database मा दुई वा वढि प्रयोगकर्ताले एकै पटक काम गर्ने सकिदैन अत: सेवा प्रवाहमा समस्या पर्ने टडकारो देखिन्छ ।

(घ) विद्यमान कानुनी व्यवस्था

नाप नक्साका सन्दर्भमा प्रयोग भई रहेका कानुनहरु पुरानै परिपाटिका रहेको र समय सापेक्ष परिमार्जन नहुदा नविनतम प्रविधिको प्रयोगमा जटिलता प्रष्ट देखिएको छ । कतिपय नापनक्साका विषयहरु भिन्न कानुनमा फरक फरक व्यवस्था हुनुवाट पनि कार्य संचालनमा समस्या देखिन्छ । पुन: नापी कार्यका क्रममा हालसाविक गर्दा आउँने कतिपय विषयहरु समाधानका लागि मौजुदा कानुनमा स्पष्ट व्यवस्था नहुदा सेवा प्रवाहमा जटिलता रहेको छ ।

(ङ) वर्तमान संस्थागत संरचना

नापनक्साको सेवा प्रवाह गर्ने निकायको संस्थागत संरचना पनि त्यति प्रभावकारी देखिदैन। कतिपय जिल्लाहरुमा नापी कार्यालयहरुको संख्या धेरै र कतिपय जिल्लाहरुमा एक मात्र नापी कार्यालय रहेको छ । नापी कार्यालयहरु स्थापन गर्दा कार्य वोझको विश्लेशण गरेर सोही आधारमा स्थान चयन हुनु पर्नेमा भएको देखिदैन । कार्यालयहरुमा कर्मचारी दर्वन्दि पनि कार्यवोझको विश्लेषण नगरि राखिएको जस्तो देखिन्छ । कतिपय कार्यालयहरुमा नापनक्सा र अध्यावधिक शाखामा कार्य गर्ने कार्मचारीहरु वीच अध्यावधिक शाखामा रहेर काम गर्न हानथाप गर्ने गरेको पाईन्छ ।

(च) संधियतामा कित्तानापीको सेवा प्रवाह

संघ, प्रदेश र स्थानिय तह गरि तिन तहको राज्य संरचना स्थापना भइसके को सन्दर्भमा कित्तानापीको सेवा प्रवाह अर्को चुनौतीका रुपमा खडा भएकोछ। जनमानसको र स्थानिय जनप्रतिनिधिहरुको अपेक्षा नापनक्सा र जग्गा प्रशासनको कार्य स्थानिय निकायवाट सम्पादन हुनु पर्ने मनसाय देखिन्छ, मौजुदा डाटाको अवस्था तत्कालै स्थानिय निकायमा गई सेवा प्रवाह गरिहाल्न सक्ने अवस्था देखिदैन न त जनशक्तिको पर्याप्तता रहेको छ, जुन कुरा जग्गा प्रशासनको कार्यका सन्दर्भमा नेपालको संविधानमा जे उल्लेख भएको भए तापनि केही समयका लागि संघ अन्तर्गत राखिएवाट नै प्रष्ट हुन आउँछ ।

(छ) पुनस्नापी संचालन

नाप नक्साको क्षेत्रमा पुनस्नापी ठूलो चुनौतीका रुपमा खडा भएको छ । यसले नापनक्सा क्षेत्रलाई वदनाम समेत गराएको पाईन्छ किनकि कतिपय अवस्थामा मौजुदा व्यवस्थावाट नापनक्सा क्षेत्रमा कार्यरत प्राविधिकले जनताको काम गर्ने स्वच्छ मनसाय राख्दा राख्दै पनि हाल साविक गर्न सक्ने अवस्था विद्यमान छैन । हिजो सम्म कुनै समस्या नरहेको जग्गा पुनस्नापी भए पछि सुल्झाउँनै नसकिने समस्यहरु खडा हुने गरेकोले यसवाट नापी क्षेत्रलाई जस भन्दा वढि अपजसको भागिदार वनाएको छ । पून: नापीमा जनसहभागिता पनि न्यून हुदै गएको छ ।

(ज) नक्सा श्रेष्ता र डाटाको सुरक्षा

नक्सा श्रेष्ता र डिजिटल डाटाको सुरक्षा पनि विकराल चुनौतीका रुपमा देखा पर्न थालेको छ। विगतमा कागजी नक्शा प्रयोग गर्दा यसमा manipulation गर्ने त्यसवाट प्रतिलिपी तयार गर्ने कार्य गाह्रो थियो । Manipulation गरेको विषयहरु केही हद सम्म सजिलै पत्ता लगाउँन सकिन्थ्यो । तर हालका

दिनमा digitized गरि तयार गरिएको वा फिल्डवाट सिधै संकलन गरिएको digital data होस दुवैमा वदनियत भएका प्राविधिकले सजिलै manipulation गरेर नक्शा प्रिन्ट गर्न सक्ने र digital database मा नै manipulation समेत गर्न सक्ने र data security अभावमा digital data सजिलै copy गरि यसको unauthorized प्रयोग भई रहेको र हुने सम्भावना प्रसस्त छ ।

(झ) यन्त्र उपकरण व्यवस्थापन: नापनक्सा

कार्यमा प्रयोग भई रहेका उपकरणहरु समय सापेक्ष रुपमा standardization नगर्दा त्यसले राम्रो नतिजा दिन सक्दैन । भएका यन्त्र उपकरणहरु पनि कुन कार्यालयमा कति संख्यामा छन ? कति संख्यामा सहि अवस्थामा छन ? र कति संख्यामा सामान्य मर्मत गर्दा काम लाग्ने छन ? भनि रेकर्ड व्यवस्थापन समेत भएको छैन । कतिपय कार्यालयहरुले आवश्यक संख्यामा यन्त्र उपकरण नपाउँने र कतिपय कार्यालयहरुमा यन्त्र उपकरण त्यतिकै थन्किरहेको अवस्था छ ।

विद्यमान समस्याहरुको समाधानका उपायहरु

कित्तानापी क्षेत्रमा रहेका विविध समस्याहरुलाई समाधान गर्न नसकिने भने होईन यसका लागि सरोकारवाला पक्षहरुले आफ्ना काम, कर्तव्य र अधिकार को सहि सदुपयोग गरे मात्र पनि पुग्छ । यस सन्दर्भमा वर्तमान कित्तानापीमा रहेका चुनौतिहरुलाई समाधान गर्न देहाय वमोजिम सुझावहरु प्रस्तुत गरिएको छ:

क) कित्तानापी सम्वन्धि स्पष्ट कार्य योजना तयार गर्ने

कित्तानापी सम्वन्धमा विभागले स्पष्ट कार्य योजना तयार गर्नँ आवश्यक देखिन्छ । वर्तमान कित्तानापीको अवस्था गन्तव्य स्पष्ट नभएको सार्वजनिक यातायात चढेको भन्दा फरक देखिदैन । कम्तिमा कित्तानापीको संस्थागत कार्य योजना तयार गरि सोहि वमोजिम प्रविधि रुपान्तरण गर्दै जानु आवश्यक छ ।

ख) सरकारी सार्वजनिक जग्गाको कित्तानापी गर्ने

नेपालको एकसरो कित्तानापी सम्पन्न भएको दावि नापी विभागले गरि रहदा कतिपय गाउँ वस्तिको नापी, सरकारी जग्गाहरुको नापी वाँकी नै छ । जव सम्म कित्तानापी नक्शाको क्षेत्रफल जोड्दा नेपालको क्षेत्रफल आउँने अवस्था हुदैन तव सम्म एकसरो नापी सम्पन्न भएको मानिदै नायसका लागि सम्वन्धित निकायले उपयुक्त प्रविधिको प्रयोग गरि सरकारी सार्वजनिक जग्गाको कित्तानापी कार्य सम्पन्न गर्नँ जरुरी छायसवाट नेपालको क्षेत्रफल निकाल्न कित्तानापी नक्सा जोड्दा सम्भव हुन्छ र नेपालको क्षेत्रफल १,४७,१८१ वर्ग किलोमिटर हो वा त्यो भन्दा घटि वढि छ भन्ने सर्वसाधारणको प्रश्नको उत्तर सजिलै दिन सकिन्छ । नेपालको वन कति प्रतिशत छ भन्ने डाटा हचुवामा ४० % भन्नु पर्ने अवस्थाको अन्तय समेत हुन्छ ।

ग) पुन:नापीको परिष्करण र संगठन संरचनामा पुनर्विचार

नेपालमा पुनस्नापी संचालन भएको दुई दशक भन्दा वढि भईसक्दा पनि खासै उपलव्धि हुन सकेको छैन वरु यसले नापनक्साको क्षेत्रमा विकराल समस्याहरु खडा गरेको छ । अत पुन:नापी कार्यको समीक्षा गर्दै यसलाई परिष्करण गर्नँ जरुरी देखिन्छ । यसलाई अहिले कै परिपाटिमा अगाडि वढ्न दिने हो भने यसले भविष्यमा झन विकराल समस्या खडा गर्नँका अलावा नापी पेशाकर्मीहरु अझ आलोचित हुनु पर्नेछ भन्ने विषयमा दुईमत हुदैन । यसका लागि हालको मौजुदा नापी कार्यालयको नापनक्सा शाखालाई हटाई प्रत्येक प्रदेशमा ति जनशक्तिलाई राखि त्यसवाट वाँकी रहेको सरकारी सार्वजनिक जग्गाहरुको एकोहोरो नापी सम्पन्न गर्ने र प्रभावकारी रुपमा परिमार्जना सहित पुनर्सकित्तानापी गर्नँ जरुरि छ ।

घ) प्रविधि मैत्रि कानुन निर्माण र परिमार्जन

नेपाल संघिय संरचनामा प्रवेश गरिसकेको सन्दर्भमा मौजुदा कानुनी व्यवस्थालाई सोहि वमोजिम परिमार्जन गर्नँ जरुरि छ । कानून निर्माण गर्दा प्रविधि मैत्रि कानून निर्माण आजको आवश्यकता हो । यसरी कानून वनाउँदा भू-उपयोग सम्वन्धि व्यवस्थालाई समेत समेटि वर्तमानमा रहेको कित्ताकाट सम्वन्धि जटिलतालाई समाधान गर्नँ जरुरी छ ।

ङ) नापनक्सा सम्वन्धि अनुमतिपत्र

व्यवस्था गर्ने: वर्तमान जग्गा नापजाँच नियमावलीमा नापनक्साको अनुमतिपत्र सम्वन्धि व्यवस्था भएता पनि सो को प्रयोग हुन सकेको देखिदैन अत यसमा आवश्यक परिमार्जन गरि तहगत नापनक्सा अनुमतिपत्रको व्यवस्था गरि लागू गर्दा उपलव्धि मूलक हुने देखिन्छ ।

च) जग्गा प्रसाशन सेवा गठन गर्ने

नापनक्साको क्षेत्रलाई चुनौतीका रुपमा रहेको जग्गा प्रशासन गर्ने निकाय मालपोत कार्यालय र यसमा कार्यरत रहने जनशक्ति पनि हो । मालपोत कार्यालयमा पदस्थापन भई आउँने कार्मचारीहरु प्रसासन सेवा अन्तर्गतको सामान्य प्रशासन समूहका हुने गर्छन ति कर्मचारीहरुको जग्गा सम्वन्धि अध्ययन कार्यालयमा प्रवेश गरेवाट शुरु हुन्छ जसवाट सुधारको के आशा गर्न सकिन्छ? अत नापनक्साका अलावा जग्गा प्रशासनको क्षेत्रमा कार्य गर्ने जनशक्तिको छुट्टै जग्गा प्रशासन सेवा वा अन्य जुनसुकै नामको भए पनि सेवा गठन हुनु नितान्त आवश्यक देखिन्छ ।

छ) संघिय स्वरुपमा सेवाप्रवाहको व्यवस्था

वर्तमान संगठन संरचनालाई पनि संधिय स्वरुपलाई मध्ये नजर गर्दै परि मार्जन जरुरि छ । नाप नक्शाको कार्यलाई स्थानिय निकाय सम्म लग्न नसकिए पनि कम्तिमा कार्य वोझको आधारमा ३/४ स्थानिय निकाएका लागि एउटा नापी कार्यालयको स्थापना गरि सेवा प्रवाह गर्दा संघियताको मर्मलाई आत्मसात गरेको पनि ठहरिन्छ । अन्यथा स्थानिय निकायहरुले नापी र मालपोतलाई संविधानले स्पष्ट प्रदान गरेका सेवा सुविधा प्रदान गर्न अटेर गरेको आरोप लागाउँने सम्भावना देखिन्छ । यसरी संगठन संरचना निर्माण गर्दा नापी र मालपोत छुट्टाछुट्टै कार्यालय रहेकोमा एउटै कार्यालय वनाउँदा कार्य सहजिकरण समेत हुने देखिन्छ साथै जनताले एउटै कार्यका लागि दुई वटा निकाय धाउँनु पर्दैन । यसवाट सरकारको कार्यालय संचालन खर्च समेत मितव्ययी हुनेछ । नापनक्सा कार्य संचालनका लागि प्रदेश अन्तर्गत एउटा निकाय स्थापना गरि कार्य गराउँदा प्रभावकारि हुने सम्भावना छ ।

ज) Digital data को Quality जाँच गरेर मात्र सेवा प्रवाहमा प्रयोग गर्ने:

नापनक्शाको क्षेत्रमा अकी चुनौतीका रुपमा digitized data को quality assessment रहेको छ । प्रत्येक नापी कार्यालयले प्रयोग गरिरहेका digital data को quality प्रति सेवा प्रदायक नै विश्वस्त नभई रहेको अवस्थामा सर्वसाधारणले कसरी विश्वास गर्ने? अत digitized data को Parcel to Parcel गुणस्तर जाँच गरि विश्चस्त हुने र समस्या देखिएमा पुन original नक्सा scan गरि digitized गर्न लगाउँने । यसो गर्दा digitized data को गुणस्तर वढ्नुका साथै सेवा प्रवाहमा विश्वासनियता समेत वढ्ने देखिन्छ ।

झ) Control Network मा आधारित Voluntary कित्तानापी गर्ने:

Compulsory पुन:नापीलाई रुपान्तरण गरि **Voluntary** कित्तानापीलाई प्राथमिकता दिनु पर्ने देखिन्छ । यसका लागि देशभर **control point** को network प्रभावकारि रुपमा स्थापना गर्ने र व्यक्तिको जग्गा खरिद विक्रि गर्दा अनिवार्य रुपमा साँध सिमानामा स्मारक(Pillar) वा wall compound लागाउँनु पर्ने व्यवस्था गर्ने र सोको नापनक्सा Total

Station को प्रयोग गरि Coordinate मापन गरि गर्ने । जग्गा खरिद विक्रि संगै नापी कार्यालयले पुरानो नक्शालाई आधार मात्र लिई छुट्टै layer तयार गरि रेकर्ड राख्ने र सम्बन्धित जग्गाधनिलाई नक्शा जग्गाधनी प्रमाण पूर्जाका अलावा प्रत्येक कुनाको coordinate समेत उपलब्ध गराउँने । यसका लागि सबै भन्दा महत्वपूर्ण भनेको control point network हो जसको स्थापन गर्ने कार्य GPS प्रविधिको प्रयोगबाट सम्भव छ ।

त्र) नविनतम प्रविधिको प्रयोग र कर्मचारीको दक्षता वृद्धिमा जोडः कित्तानापी संचालन र सेवा प्रवाहमा मध्यष्तर्वा प्रविधिको प्रयोग गर्नंको विकल्प छैन । यसका लागि मौजुदा जनशक्तिलाई आवश्यक तालिम प्रदान गरि नापनक्सा बाँकी रहेका सरकारी सार्वजनिक जग्गाको नापी Remote Sensing प्रविधि वा अन्य उपयुक्त प्रविधिकोको प्रयोग गरि संचालन गर्नं सान्दर्भिक देखिन्छ । Digital प्रविधिको प्रयोगबाट सेवा प्रवाहका लागि ArcGIS वा अन्य कुनै Open Source Software प्रयोग गर्ने वा आफ्नै किसिमको Software निर्माण गरि अगाडी बढ्ने भन्ने विषयमा वृहत छलफल र विश्लेषण गरि समयमा नै निर्णय हुनु जरुरी छ ।

ट) विभिन्न तहको भू-सूचना प्रणालि विकास गर्ने

Digital data को quality पूर्ण रुपमा विश्वासनिय भए पछि क्रमशः मालपोत कार्यालयले online system अवलम्बन गर्दा प्रयोग गरेको data संग integrate गरि स्थानिय, जिल्ला र प्रदेश तहको भू- सूचना प्रणालीको विकास गर्ने । यसरी विभिन्न तहको भू-सूचना प्रणालिको विकासबाट राष्ट्रिय स्तरको भू-सूचना प्रणालि निर्माण र सोको प्रयोग गरि जग्गा प्रशासनको सेवा प्रवाह सम्भव छ जुन आजको आवश्यकता हो । यसरी भू-सूचना प्रणालि विकाश भईसके पछि यि मबतब हरुको प्रयोग अन्य विकास निर्माणका कार्यको अलावा वैज्ञानिक भुमिसुधार कार्यक्रमलाई सफल गराउने कार्यमा प्रयोग गर्न सकिन्छ। यसरी राष्ट्रिय स्तरको भू-सूचना प्रणाली विकास भएमा हाल रहेका हदवन्दि सम्बन्धि विवरण र सुकुम्वासीहरुको पहिचान कार्य सहजै सम्पन्न गर्न सकिन्छ ।

निष्कर्ष

ऐतिहासिक कालबाट शुरू भएको नेपालको कित्तानापी वि.सं. २०१९ मा जग्गा नापजाँच ऐन बनेपछि मात्र व्यवस्थित रुपमा संचालन भई आएको देखिन्छ । वि.सं. २०२१ मा सरकारका तर्फबाट ल्याईएको भूमिसुधार कार्क्रमलाई सफल पार्न तथा राज्य संचालनका लागि आवश्यक कर उठाउने अभिप्रायबाट संचालन भएको कित्तानापी वर्तमान सम्म आईपुग्दा विभिन्न चुनौतिको सामना गर्नं परिराखेको छ । दिन प्रतिदिन नापीको सेवा जनमानसबाट आलोचित बन्दै गएकोमा यसको कार्यशैली परिमार्जन गरि जनभावना अनुशार सेवा प्रवाह गर्नं आजको आवश्यकता हो । यसका लागि संगठन संरचनाको परिमार्जन देखि मौजुदा मध्यष्तर्वा मबतब को गुणस्तर जाँच गरि स्थानिय, जिल्ला र प्रदेश स्तरको भू-सूचना प्रणालि विकाश गरि राष्ट्रिय स्तरको भूसूचना प्रणालिमा माध्यामबाट सेवा प्रावह गर्नं वर्तमानको आवश्यकता हो । यसका लागि वर्तमानमा रहेका जनशक्ति, प्रविधिको प्रयोग र उपलब्ध श्रोत साधनको समिक्षा गर्दै कित्तानापीको दुरगामी संस्थागत मार्गचित्र तयार गर्नं जरुरी छ । वर्तमानमा चालु रहेका पुनःनापी लाई परिष्करण गरि Control Network मा आधारित coordinate cadastre संचालन जनताको माग बमोजिम fixed boundary सिद्धान्तमा आधारित भई संचालन गर्दा मात्र वर्तमानका चुनौतिलाई समाधान गर्न सम्भव देखिन्छ ।

६. सन्दर्भ सामाग्रीहरु:

आचार्य, बाबुराम (२०६९) सेवाप्रवाह सरलीकरणका लागि जनतामुखी जग्गा प्रशासन पद्धति, प्रसाशन पत्रिका ।

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जग्गा नापजाँच ऐन २०१९

जग्गा नापजाँच तथा नक्सा श्रेस्ता अद्यावधिक सम्बन्धि निर्देशिका, २०७३, नापी विभाग, काठमाण्डौ ।

(यस लेखमा उल्लेख भएका धारणाहरु लेखकका नितान्त व्यक्तिगत धारणा हुन)

MODULAR GIS

Er. Suresh Shrestha
Survey Officer
Survey Department of Nepal
shrestha.suress@gmail.com

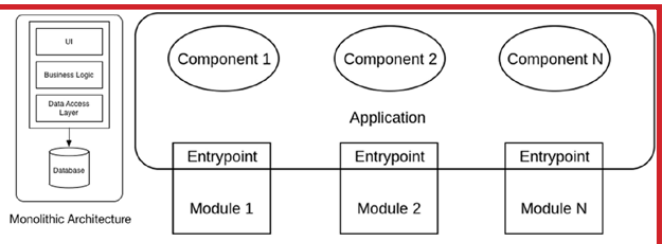
BACKGROUND

A modular system emerges from the concept of modular design. This approach consists of a structure to break the complexity of the problem into smaller manageable components called Modules. The design of the modules are considered as autonomous which can be created independently, configured easily and reconfigured into different systems (Modular Systems Design, 2019). When designing a system, one should decide about the architecture system as a homogenous or a modular system. Homogenous system concerning the whole problem solution in a single block as one overarching system and the modular system being the independent components loosely coupled together to create a configurable solution for the problem. Modular design has been implemented in a wide variety of industries such as computer and software engineering, car manu factu rin g, chemical processing.

A Geographic information system can be described as a system for input, analysis, management, and visualization of geospatial data. GIS applications are hence the tools to create interactive queries, manipulate, process and analyze spatial data and present the results of all these operations. Considering this definition, Modularity can be applied to the overall software architecture of the system as well as the individual GIS application that is installed on the system.

DEVELOPMENT OF SYSTEM ARCHITECTURE

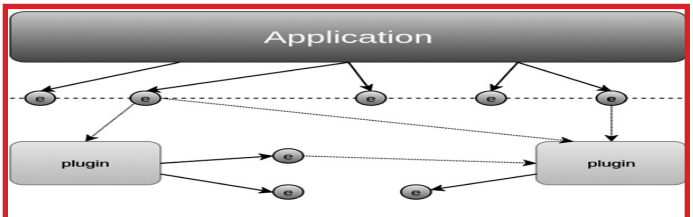
GIS was introduced to the world as a single monolithic system and there was no clear separation between client, application logic and the database. However, with the growing popularity and usefulness of GIS, it is required to improve the system and add more functionality to it. This proved to be difficult and time consuming for adding more services because the addition of new tools affected the whole code significantly and the entire structure of software required redevelopment. There was a need for reuse of code and its transferability between different systems. This demanded the separation of the software components into smaller chunks with different interfaces.



Source: (Microservices – Definition, Principles and Benefits, 2019) and (Modular Application Architecture-Intro, 2019)

When creating a modular system, as opposed to a monolithic system, several modules are written separately so that they construct the executable application program when composed together. Modularity is also concerned with communication between modules and core of the application, ways of accessing resources in the module as well as the extent to which the module can change system requirements of the core application. The application offers one or more interfaces that enable module to interact with the application core through entry points (Modular Application Architecture-Intro, 2019). Modules or Plugins can also interact with each other for the execution of specified tasks.

After successful registration of the module to the application, configuration is still possible through main application platform, otherwise, default configurations are used. After loading, application begins interacting with modules. Then, the application checks whether the module will be interested in interacting with the application core.



Source: (Modular Application Architecture Events, 2019)

It is now even possible for outside parties to develop tools, and plug them into existing GIS software to increase its functionality. Different people use different names for modules as plugins, bundles, add-ons, tools, extensions, etc. but the main idea is always the same, independent functionalities developed outside of the application.

As an example, ArcGIS software offers a number of modules known as tools that allow users to extend functionality of the core ArcGIS product. These modules are called as ArcGIS extensions. They include Spatial Analyst, 3D Analyst, Geostatistical Analyst, Network Analyst, Tracking Analyst, data interoperability and some more extensions for aeronautical, marine and defense sectors (ESRI, ArcMap, 2019). Apart from these designed extensions, it has also made a place for user-defined modules creation. Using third party modules can be implemented by configuring existing apps, extending the templates and apps and also by using web API and SDK. As a concept of modularity, there is a strategy to address business needs with minimal effort and unnecessary cost on development (ESRI, Architecting the ArcGIS Platform: Best Practices, 2018). QGIS also offers similar plugins for the extension of the functionality and most of which are developed by the user community. This has created the scenario for creating the optimum plugin for the desired function by various innovative developers.

BENEFITS AND CHALLENGES OF MODULAR ARCHITECTURE GIS

Modular Architecture helps to simplify development and maintenance of computer programs keeping the applications smaller. When software functions are in separate modules, the individual sections can be reused, developed and updated as well independently. It makes developer able to modify one section of code without having to make corresponding changes in other sections. This enables distributed collaboration and problem-solving. Working on even the large team, the development of certain modules can be easily distributed which makes the team member just to concentrate on their own assigned smaller task that they don't require an understanding of the whole system as well (Modular Systems Design, 2019).

This system will allow for a wide variety of customization of parent application and flexibility in design that will certainly lead to a reduction in cost and shorter learning time. Besides this, it also allows for augmentation that means the addition of a new solution by plugging in a new module to the system (Modular, Plug n play sortation, real or hype, 2019). Many plugins are developed for various GIS applications. AS the modules and application are independent, they can be developed by external developers independently and also sometimes possible with different technologies.

But the downside of the modularity can be taken as the cost of putting up interfaces between modules. Unless with less interaction, it will have a high burden on the system if too many modules will be required and created to perform a small job. High performance like a single system can be a challenge for this system. And as it has the possibility of frequent updates, there can be user problems getting to know with new versions. Besides, this system is mostly useful for combining the advantages of standardization of smaller components and improving reusability with the functionality of customization about aligning and using different tools.

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RE-ENGINEERING SURVEY OFFICES: ROLE OF YOUNG SURVEYORS

Er. Chandan Das
Survey Officer
Survey Department of Nepal
a1chandan@gmail.com

SUMMARY

Cadastre is one of the most important infrastructure of development in any country. Land is operated and administered through well established cadastre in Nepal. For many decades though survey and mapping has been developed and been continuously improving, yet there has been bottlenecks in service delivery by the survey offices. New generation of surveyors called Young Surveyors now have the challenge to restructure the service delivery and promise fast, efficient and quality service delivery. Young surveyors have ability to learn new concepts, excel in digital tools & techniques and incorporate best practices, yet there are several hindrances. So it is important to re-engineer the survey offices and young surveyors are expected to play major role in structuring cadastral SDI and making it operational.

KEYWORDS: Cadastre, young surveyor, SDI, service delivery

BACKGROUND

There are more than 100 survey offices spread over 75 districts all over Nepal. Survey office and Land Revenue Office (malpot office) are involved in carrying out cadastral activities in Nepal. Service to the public, in the form of facilitating land transfers and registrations, land measurements, updating and safekeeping of land records and cadastral plans etc. are the main jobs of these offices. The service delivery mechanism in offices are still paper based and analog. If we assess the institutional mechanism of land administration, technology adopted in cadastral surveying, political awareness about the essence of cadastre, and other various factors with the FIG Agenda of Cadastre 2014 it is out of reach for Nepalese context. (Bhatta, 2008)

A Young Surveyor is defined by FIG as a person 35 years old or younger or within 10 years of graduation with a Bachelors or Masters degree in surveying/ geomatics. So a young surveyor is a professional with sound academic knowledge of surveying and geomatics. As we have embarked on the technological age where information is available on f inger t ips with use of computers and internet, most of the disciplines and institutions have embraced the use of technology to provide efficient services and meet organizational goals. In Nepal private institutions have been successful in reaping benefits of modern tools and technologies but it has been equally difficult for the government offices due to traditional policies, acts, procedures etc. In many offices some part of components have been automated or computerized but not the whole process or entire workflow. It is a difficult process to redesign the system and functioning of the survey offices. We need a rational approach in reengineering the office which can be done by exploiting young surveyors.

Here we use reengineering in the form of Business Process Reengineering (BPR). Davenport and Short (1990) defines BPR as: The analysis and design of workflows and processes within and between organisations. Also Whereas Hammer and Champy (1993) defines it as The fundamental rethinking and radical re-design of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality,service and speed. Wikipedia states Business process re-engineering is a business management strategy, originally pioneered in the early 1990s, focusing on the analysis and design of workflows and business processes within an organization. BPR aimed to help organizations fundamentally rethink how they do their work in order to dramatically improve customer service, cut operational costs, and become world-class competitors.

It is important to view the survey offices as competent business organizations if we are to improve the efficiency and services to the service-seekers.

WORKING MECHANISM OF SURVEY OFFICES.

Survey offices perform regular activities related to land transactions and updating of land records. Apart from that it is also involved in carrying out cadastral surveys - In many part of the country digital equipments like total station are being used for surveys and use of computers are in place for mapping but still in many places paper and pencil cadastre is being practiced due to lack of trained manpower, instrumentation etc.

Parcel subdivision is one of the major activities performed in Survey Office. Whenever there is a land transaction that requires parcel subdivision the deed is prepared by Likhandaas which is brought to survey office and parcel subdivision is done by local surveyor called Ameen either on paper map or in computer. The land ownership information is updated in Land Revenue Office where such records Shresta are kept. Here two organizations are involved which takes time and workload to the service seekers. Most of the offices uses paper maps which are originally prepared from cadastral surveys done more than 30 years ago. The maps of urban areas in paper form are hard to read. In such areas where land transaction is quite high, maps are continuously folded which have eroded the linework and brough speckles. Department of Land Information and Archive(DOLIA) undertook the task of digitizing the land records and maps in form of digital geodatabase. But due to many inherent errors in maps, it cannot be used efficiently. Moreover, the database has not been spatially referenced to fit into national coordinate framework and integrated into a SDI. Digital cadastral database (DCDB) should be optimized and enhanced to act as a regional or national SDI, so that it can give complete situation of public, private ownership information and statistics of land important in policy making and development purpose.

Survey Department, the umbrella organization for survey offices has developed software to carry out parcel subdivisions and cadastral mapping called Parcel Editor. This software is not tailored enough to model all the mandatory paper processes. For example while registering a new parcel application has to be received by the landowner, the related documents, photographs, he/she needs to sign in the field- book, the authority has to sign off the ownership certificates which has not been automated. Therefore, still the mechanisms used are analogue.

Government has put efforts to digitize the workflow by piloting in some survey offices but still the processes has to be redesigned by careful study of all the parameters.

NEED FOR RE - ENGINEERING

As the population continues to grow sharply and rural areas convert to urban pressure on land also increases. Increasing pressure on land means increased workload on the survey offices. Though traditional thought has been to add the service centres or add the number of offices, but that is not the ultimate solution in the changing world. Banks in 80's have transformed significantly by use of modern techniques and are able to provide fast and efficient services by deploying ATMs, online banking etc. Database systems and softwares have developed to cater needs of large organizations. They have gone successful re-engineering with the help of state-of-art technology and modern systems.

In the sector of cadastre and land administration too, we have seen drastic developments in GIS, spatial databases, algorithms etc. It is important to reinforce the technological developments into the current practice in other words paradigm shift is needed in our offices.

If we take a scenario of a general govt. office paper and pen still continues to be workhorses in our offices, even if a piece of document is typed, it needs to be signed off by the related authority. Official communications are still paper based and whenever a document has to be searched pile of file has to be searched which takes lots of time and burden. This practice still continues though we have computers and internet almost everywhere. So there is a need of radical redesign of the core system and workflow. BPR in this context is needed as a sustainable solution.

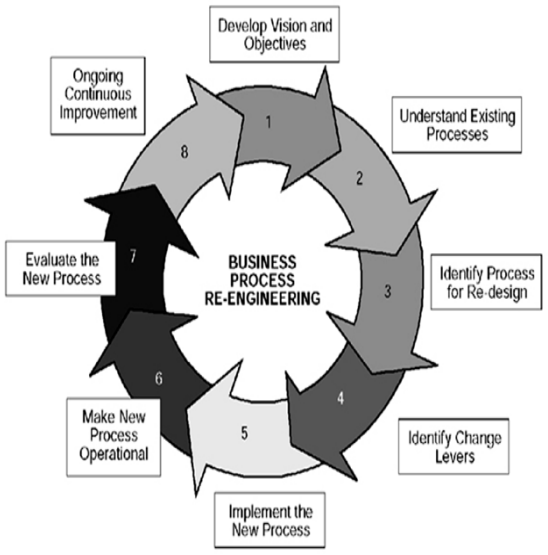

Figure 1. A generic model for business process re-engineering (Vakola et al, 1998)

The above process flow diagram depicts how a business process can be re-engineered. The procedures of survey office also can be considered as a business process with so many sub-processes which has to be carefully studied before redesign. Reengineering can be catastrophic to the organization if it cannot function well, particularly in govt. offices like survey office which are directly related to the people, there are millions of records and documents related to land parcels and owners. The reengineering should guarantee efficient, sustainable and accurate services incorporating all the parameters into the process.

PROBLEMS IN RE-ENGINEERING

The formulation and implementation of reengineering can be quite challenging. Careful attention must be devoted in a reengineering process design.
Potential problems faced can be as follows:

- Poor knowledge of know-how of functioning of survey offices.
- Interrelationship with line agencies and related institutions, change in system should go in harmony with the related agencies.
- Technical ability of human resources and their ability to respond to re-engineering.
- Digital divide prevalent in Nepalese society can pose problems.
- Loadshedding and frequent power outage.
- Traditional work-culture and red-taping.
- Corruption
- Failure to manage the system and inadequate qualified personnel.
- Need of rigorous and systematic research.
- Reengineering may demand amendments in acts, procedures, laws which in turn affects other institution workflows.
- Engage with national, regional networks like FIG YSN to share and learn from the practices used elsewhere.

ROLE OF YOUNG SURVEYORS

Young surveyors have the ability to learn new concepts, apply new tools and techniques to solve the problems. But when we are thinking of reengineering young surveyors alone cannot solve the issue there is a need of teamwork with other professionals however when the organization is equipped and optimized after reengineering young surveyors have the responsibility to keep offices up and running with new paradigm. In order to recognize the role of YS, SWOT analysis is performed here to have a better insight. This analysis has been performed based on interaction with several young surveyors in different survey offices of Nepal. Such analysis gives helpful information in guiding the reengineering efforts and avoids potential pitfalls while accepting inputs from a YS.

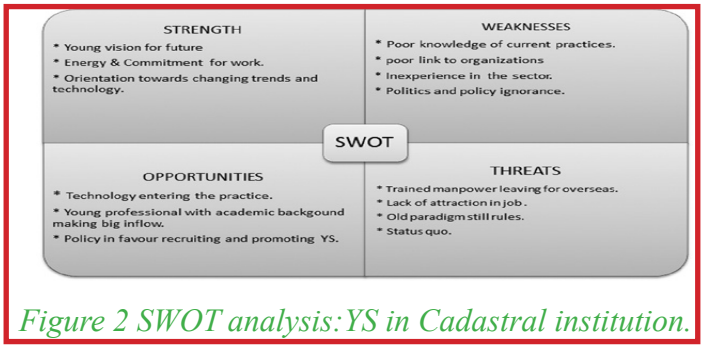

Figure 2 SWOT analysis: YS in Cadastral institution.

As YS have academic knowledge and competency in using modern tools they have the stake to bring principles to practice. When YS undertakes their responsibility in any survey office they are required to act and work according to established norms and practices, which is far from the concepts learned in the university. It is their responsibility to apply the knowledge in effective manner but working for a public institution is not an academic exercise so it is important to restructure the organization through re-engineering. A young surveyor can carry out following tasks to contribute towards it.

- Actively engage in workshops, seminars, group discussions.
- Engage with mentors and peers
- Be creative and try to enforce innovative practices.
- Organize meetings and endorse the practices carried out by each surveyor.
- Connect with higher officials and propose policy improvements.
- Be fluent with practices and workflows in place.
- Consider continuous learning environment.
- Be ready to take up responsibilities and be public-oriented.
- Think about automation.
- Able to communicate ideas effectively even to non-technical person.

In recent years there has been good influx of young surveyors in cadastral institution, and they are sure to get promoted to policy making levels. It is important to keep up with the passion and stay updated and informed of technological improvements and practices. GIS technology is being increasingly used to store parcel data, so they have the managerial role in acting as custodians of digital cadastral database(DCDB) and transforming the paper records like field books, plot registers, maps into spatial database. Such database design must be tailored towards fast & easy service delivery. YS must be involved in redesign

process which needs intervention from higher order officials and must be "thick skinned" to argue with the ideas.

CONCLUSION

Survey offices have increasing public pressure of service-seekers. Traditionally professionals without adequate academic background have been working in such offices due to which the systems and structure continue to be analogue and time- consuming leading to red taping and slow inefficient services. With time it is imperative to reinforce the working mechanism with digital tools and techniques. Efforts to make improvements have either aimed to develop only part of service with limited success. Reengineering in this context seems to be a promising tool to bring paradigm shift towards modeling the current work processes and shall bring about promising changes to the structures of service delivery. Human resources must be knowledgeable, technically oriented to handle the role of redesigning and implementation of new models. Young surveyors now have that role and must take up the responsibility in making survey offices a new generation service- hub. National and international organization must provide mentorship and opportunities to young surveyors to handle this challenge and make surveying profession more people oriented.

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GROWTH PATTERN ANALYSIS OF WATER HYACINTH IN GHODAGHODI LAKE AND KHASTE LAKE USING REMOTE SENSING TECHNIQUES

S. S. Thakuri[1], P. Shrestha, M. Deuba, P. Shah, O. P. Bhandari, S. Shrestha
1. Teaching Assistant
Himalayan College of Geomatics Engineering
sumanthakuri24@gmail.com

ABSTRACT

Invasive Alien Plant Species are spreading outside of their natural geographic range where they are not naturally present. Water hyacinth (Eichhornia crassipes) is one of the most widely and rapidly spreading Invasive Plant Species which was introduced in Nepal as a result of trade and transport of woods and ornamental plants that then establish themselves into the wild and spread throughout the tropical and subtropical regions of the Nepal. In the last decade, water hyacinth has become a chronic problem in many major lakes of Nepal which have affected the habitat of aquatic plants and animals. Our study has focus on using remote sensing technique for determining growth pattern analysis of Water hyacinth along with other floating aquatic macrophytes in Ghodaghodi and Khaste lake. Normalized Differential Vegetation Index were calculated from Landsat imageries of year 2008-2015 to determine growth pattern of vegetation area (Water hyacinth with other floating aquatic macrophytes) over two lakes. After completion of this project, we can conclude that growth pattern over Ghodaghodi lake and Khaste lake is going on increasing rapidly every year. But trend line shows sudden decrease in these two lakes, it might be due to human intervention.

INTRODUCTION

Biological invasion has been considered as an important component of global environmental changes and a leading cause of decline and/or loss of native and ecosystem services. Due to the increase in human movement and global trade, the intensity of biological invasion has been increasing in all ecosystems and landscapes. The problem of invasive species is prevalent both in developed as well as developing countries, but their impact is likely to be higher in developing countries like Nepal due to lack of expertise and limited resources available for their management (Shrestha, 2016). This paper encompasses water hyacinth (Eichhornia Crassipes) which is world's worst invasive aquatic plant species. Water hyacinth (Eichhornia Crassipes) is an erect, free-floating, stoloniferous, perennial herb. Water hyacinth is originally from South America and one of the world's most prevalent invasive aquatic plants. Water hyacinth has invaded freshwater systems in over 50 countries on five continents. In the last decade, water hyacinth has become a chronic problem in many major lakes of Nepal such as Phewa lake, Khaste Lake, Ghodaghodi Lake, Bis hazari Lake, etc. Literature shows that invasive water hyacinth species can cause severe ecological and economic impacts (Kgabo Humphrey Thamaga, 2018). It has dramatic negative impacts on fisheries and boat traffic. The growth of these species is very rapid; if uncontrolled it eventually blankets the entire water surface which affects the habitat of aquatic plants and animals. So, the major objective of our project was to analysis growth pattern of Water hyacinth over different time series (2008-2015) using remote sensing techniques.

STUDY AREA

A. Ghodaghodi Lake

Ghodaghodi lake is a Ramsar site in western Nepal. Ghodaghodi is a natural freshwater oxbow lake which covers an area of 2,563 ha (6,330 acres) in Kailali District at an altitude of 205 m (673 ft) on the lower slopes of the churia Hills. It is a large and shallow lake, having finger-like projections, with associated marshes and meadows surrounded by tropical deciduous forest. There are thirteen associated lakes and ponds, and some streams separated by hillocks situated on the periphery of Ghodaghodi. The forest and wetlands are wildlife corridor between the low

land (Terai) and the churia.

B. Khaste Lake

Khaste Lake is a freshwater lake located in the Pokhara Lekhnath metropolitan city at Kharanephant of Nepal. The lake is located in Ward No Lekhnath 3, 4 and 6. It covers an area of 24.8030 hectares (61.290 acres) and the water area is 13.7370 hectares (33.945 acres). The area, known as 'Bird Wetland' is best suited as a bird watching lake, as the Siberian, Indian and Afghani birds come here to protect themselves from the cold. This area is a potential Research center for the birds of different species.

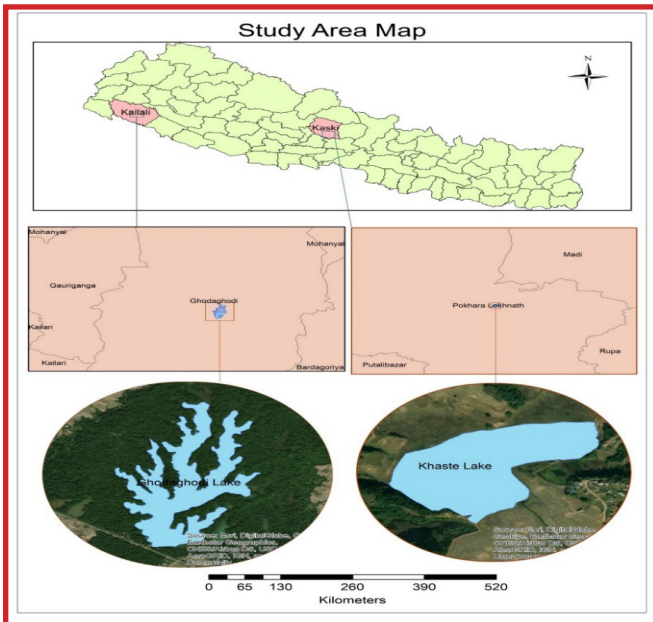

Figure 1: Study Area for Growth Assessment

METHODOLOGY

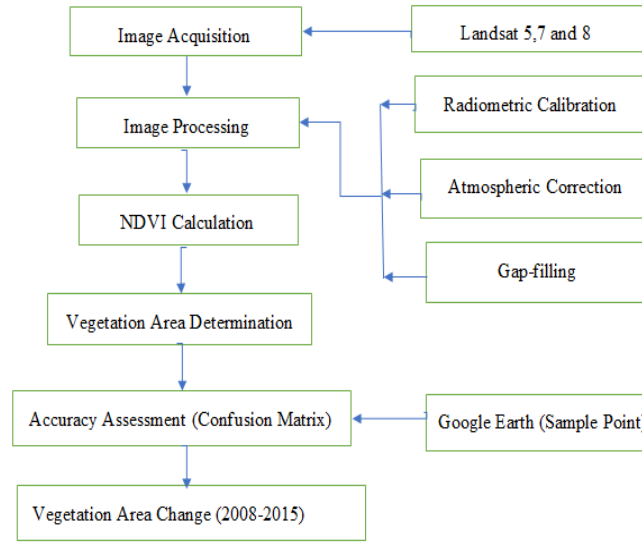

Figure 2: Workflow diagram growth pattern assessment of Water hyacinth along with other floating aquatic macrophytes

A. Image Acquisition

Landsat 7, Landsat 5 and Landsat 8 image of the study area over different time series (2008-2015) were downloaded from USGS earth-explorer website (https://earthexplorer.usgs.gov). Images were collected of month (May -July) because on these months, Water hyacinth along with aquatic macrophytes have high excessive growth over the lake.

B. Digital Image Processing

a. Radiometric Correction

Radiometric correction is needed because the appearance of the same image varies with angle of view and illumination conditions i.e. observed energy does not match with the energy emitted from the same object. Radiometric correction of Landsat image over different time series (2008-2015) was done using ENVI 5.1 software. In this method, ENVI uses image's gains, offsets, solar irradiance, sun elevation and acquisition time defined in the metadata to calibrate the data to Top-of-atmosphere (TOA) reflectance (L3harris Geospatial Solution, 2019). This is appropriate and easy method to work with as most of the data required for the calibration are provided with in metadata.

b. Atmospheric Correction

Atmospheric correction removes the scattering and absorption effects from the atmosphere to obtain the surface reflectance characterizing (surface properties). For this purpose, dark subtraction method was adopted using ENVI 5.1 software. This method is found to be data dependent and well accepted by the geospatial community to correct light scattering in remote sensing data. Dark object subtraction (DOS) is perhaps the simplest yet most widely used image-based absolute atmospheric correction approach for classification and change detection applications (D. L. Peterson, 1986). The minimum DN value in the histogram from the entire scene is thus attributed to the effect of the atmosphere and is subtracted from all the pixels (Jr., 1989).

c. Gap-filling

This an additional step, adopted when landsat 7 imageries were used i.e. for year 2012. Gap filling was done in ENVI software. This step removed the strip lines of imageries by histogram matching techniques.

d. Sub-setting

Sub-setting is the process of retrieving just the parts of large files which are of interest for a specific

purpose. Within our project, subset of Khaste lake and Ghodaghodi lake were extracted from the large tile of Landsat images.

C. Calculation of Normalized Differential Vegetation Index (NDVI)

NDVI helps to distinguish the vegetative and non-vegetative features from image based on reflectance on red and NIR band. In our project, NDVI was used to distinguish water hyacinth and water with in the Khaste and Ghodaghodi lake. NDVI is mostly used index for identification and classification of different vegetation as NDVI value for different plant species can be found easily in literatures. NDVI will be calculated using formula:

NDVI=(NIR-RED)/(NIR+RED)…….. (i)

D. Image Classification

Image classification was done by assigning land cover classes to pixels. After calculation of NDVI, two classes were assigned to the pixels of NDVI calculated images in order to distinguish water and water hyacinth. The image pixels of NDVI values from range 0.47-0.50 (Peter Odoyo Agutu, 2018) were classified as Water hyacinth class and rest of the image pixels where classified as water.

E. Vegetation Area Determination

Classification divided pixels of whole image in two classes. Calculation of NDVI and Classification of image was done for images from year 2008-2015. After classification, the classified raster image was converted to vector format where each single class represents individual polygon. Then area of polygon containing pixel of water hyacinth was calculated using ArcGIS 10.2.2.

F. Accuracy Assessment

Statistical approach was adopted for accuracy assessment of our result i.e. vegetation area over Khaste and Ghodaghodi lake. Independent sample of ground validation points were collected from Google earth over the lakes as Google earth provides images of different time period with sufficient resolution to distinguish vegetation from water. Based on those sample points, confusion matrix was established to determine kappa coefficient and overall accuracy of the classification. Accuracy assessment was done on the images available in google earth within the time period of 2008-2015.

G. Vegetation Area Change

After computing the area of all images for year 2008 to 2015 and validating from the available images in google earth, vegetation area change map was prepared. Moreover, trend lines were introduced to determine characteristics vegetation area change.

RESULT

The major objective was the assessment of growth pattern of Water hyacinth along with other floating aquatic macrophytes in Ghodaghodi and Khaste lake from year 2008 - 2015. Preparation growth pattern map of Water hyacinth along with other floating aquatic macrophytes was done in Ghodaghodi and Khaste Lake using Landsat imageries.

A. Growth pattern map of Water hyacinth along with other floating aquatic macrophytes of Ghodaghodi lake

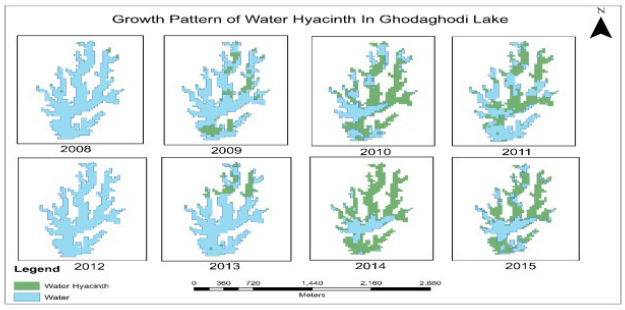

Figure 3: Growth Pattern of Water hyacinth in Ghodaghodi lake

B. Growth pattern map of Water hyacinth along with other floating aquatic macrophytes of Khaste lake

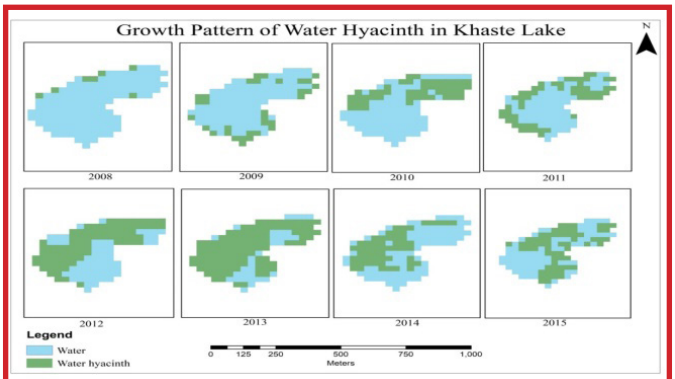

Figure 4: Growth Pattern of Water hyacinth in Khaste lake

C. Accuracy assessment of growth pattern map

Table 1: Accuracy assessment of Ghodaghodi lake (Top) and Khaste lake (Bottom)

Ghodaghodi Lake		
Year	Kappa Coefficient	Overall Accuracy
2011	0.7836	89.24%
2013	0.7162	86.93%
2014	0.8111	90.47%

Khaste Lake		
Year	Kappa Coefficient	Overall Accuracy
2008	0.7931	88.57%
2011	0.7854	91.65%
2012	0.7312	87.23%
2013	0.7094	86.79%
2014	0.7836	89.24%
2015	0.7283	85.97%

The table 1 shows the kappa coefficient and overall accuracy of the classified images of Ghodaghodi lake and Khaste Lake which was based on the sample points collected from google earth. Values of kappa coefficient and overall accuracy derived below fulfill the sufficient requirement for our project. The kappa coefficient is rated as substantial and hence the classified image found to be fit for further research (Sophia S. Rwanga, 2017).

D. Growth pattern change of Ghodaghodi lake and Khaste lake

Figure 5 and Figure 6 below shows the growth pattern change of Water hyacinth along with other floating aquatic macrophytes in Ghodaghodi lake and Khaste lake. In the initial year of growth assessment, growth pattern goes on increasing. In year 2012 in Ghodaghodi lake, in year 2010 and 2014 in Khaste lake, there was sudden decrease in the area cover of Water hyacinth. And it goes on increasing in following year. This is probably due to human intervention as every year many governmental and non-governmental programs are conducted to clean and protect major lakes of Nepal.

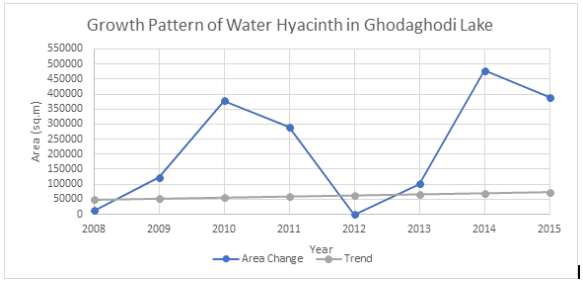

Figure 5: Graph showing growth pattern of Water Hyacinth in Ghodaghodi Lake

Figure 5 shows that the growth trend of Water hyacinth along with other floating aquatic macrophytes in Ghodaghodi lake is increasing gradually. Though, there is rapid growth of Water hyacinth every year but the trend line shows moderate growth. This is due to sudden reduction of presence of Water hyacinth in year 2012.

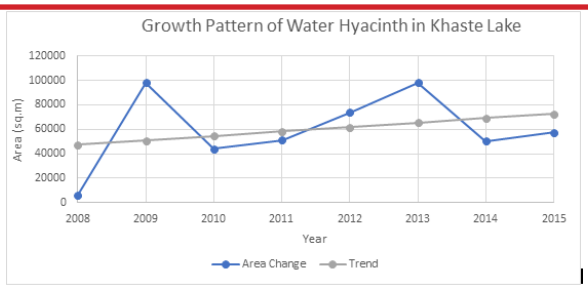

Figure 6: Graph showing growth pattern of Water hyacinth in Khaste Lake

Figure 6 shows growth trend of Water hyacinth along with other floating aquatic macrophytes in Khaste lake is rapid. There is sudden decline in the area extent of vegetation in year 2010 and 2014 but overall trend shows rapid growth.

CONCLUSION

This study discussed the use of remote sensing for analyzing the growth pattern of water hyacinth and other floating macrophytes over different time series.

The result shows that the growth pattern of water hyacinth is very rapid and if uncontrolled it eventually blankets the water surface and cause adverse effects to aquatic flora and fauna. So, remote sensing is the effective tool for monitoring, mapping and analyzing the changes and distribution of species over different time series on large scale at low cost.

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A PROTOTYPE FOR INTERACTIVE WEB MAP

Er. Pawan Thapa[1]
Lecturer
Department of Geomatics Engineering
Kathmandu University
pawan.thapa@ku.edu.np
1. orcid id: https://orcid.org/0000-0002-4331-5315

ABSTRACT

Around two decades have seen the rapid evolvement of web map services throughout the world. It will deliver up to date information. This study designed a web map prototype consisting of layers such as roads, land use, that includes residential, agricultural, and industrial areas, and provides the stakeholders who will be helpful for decision making. Such research provides a platform for simple and easy ways to visualize spatial and non-spatial data over the web.

KEYWORDS: Web map, Interoperability, Interactive, Municipality

INTRODUCTION

Web map is a process of delivering maps on the World Wide Web (Neumann, 2008). The use of web maps improves sharing information of spatial and non-spatial on social aspects (Maseleno, A., & Hasan, M. M. 2012). Web GIS is similar to web mapping but with an emphasis on analysis, processing of project specific geo data and exploratory aspects (P. Fu, et al., 2010). With the Advancement of technology of internet, the data management and service for various purpose of work has been reliable with the storage, security, and sharing and dissemination aspects. When the concept of Internet draws attention towards the World Wide Web then there arises a topic on web map services. In Nepal, the attention of people towards the Internet has provided the possibility of proper web mapping works. Almost all spatial information records reside in the form of paper files and hard copy format. The situation of such records is so poor and the way of their management and storage is further pitiful. By consequences if these records get fire or tear out we do not have backup storage. The map update and reproduction is cumbersome and expensive. Thus, this system must be partially eradicated by the Web Mapping technology for secure, efficient, portable and effective services. The digital environment of managing the spatial data in desktop has been completed in many government offices but as the Internet is affecting GIS in three major areas: GIS data access, spatial information dissemination, and GIS modeling/processing.

STUDY AREA

The study area is Dhulikhel Municipality of Kavreplanchowk District, Nepal. It lies in the Central part of Nepal of geographical coordinates are 27° 36' 992 North, 85° 33' East. Dhulikhel is southeastern 30 km away from Kathmandu with an approximate area of 54.62 km²; the Municipality lies at an altitude of 1550 meters (GoN, 2019).

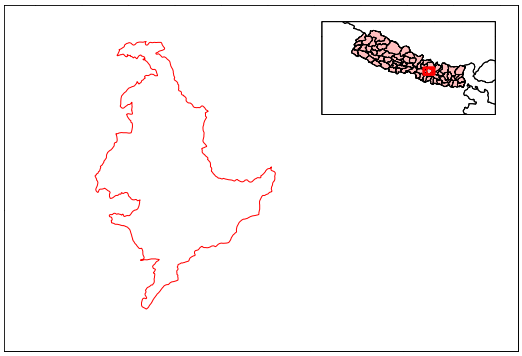

Figure 1: Map of Study Area Dhulikhel Municipality

METHODOLOGY

Prototype Development Model applied for system development method (Figure 2). The Prototype development model is that where a prototype estimates the final output. A prototype begins with a requirement analysis for design, after proper analysis of the requirement, coded, tested, and then reworked until an acceptable prototype. The complete prototype develops the system. The significant actions performed, as listed below.

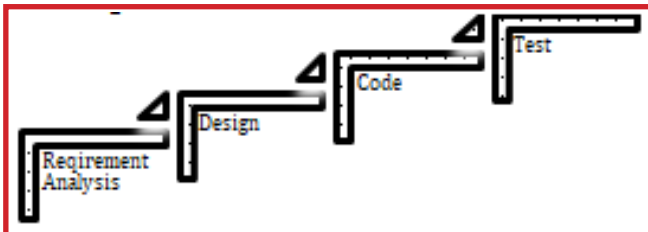

Figure 2: Approach for Prototype Development Model

Initially, the requirement of the proposed system was collected. By studying relevant research papers and reports on web-based systems, this process started and performed until the final stage. From this analysis, it will provide guidance and planning to achieve an outcome. The first designed, several modifications were implemented to achieve the requirement. The database prepared using this Entity-Relationship model. It is an Abstract way to describe a database by using entity and a set of attributes describing the entity. The design of the website is done in (HTML) Hyper Text Markup Language. Openlayers is used to display different features, layers, and visualization tools. Community Style Sheet (CSS) and Styler used to style website and map. PostgreSQL, along with its spatial extension PostGIS and Geoserver, were selected for database preparation. PostGIS is used to import shapefile, and Geoserver performs store, publish layers in (WMS) Web Map Service, and (WFS) Web Feature Service. Database with a scheme of two different tables, one spatial and other non-spatial. Geoserver was used for spatial data hosting, then connected to the PostGIS database. Apache server performs web hosting. During this process, the prototype continuously checked and rechecked to design the final output. Also, the design prototype refines and corrected numerous times. This phase helped to achieve our purpose goal.

RESULT

XAMPP server used to host in web server, Geoserver and Apache had been used to build system. These two servers are configuring a proxy to bypass XML. ArcGIS 9.3 transform the coordinate system to the WGS-84 system. During transformation in Geoserver, declare it in EPSG format. Apply the OpenGeo suite Dashboard (v2.5) to import data in the PostGIS database. Also, import shapefile using Shapile DB loader to the PostGIS database. This suite contains Geoserver, PostGIS, and others Function as an inbuilt system.

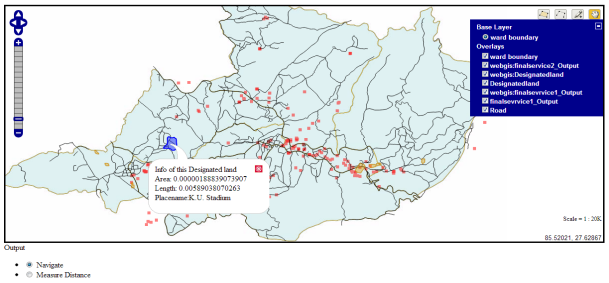

Figure 3: Web Map of Dhulikhel Municipality

CONCLUSION

This is a prototype of the web map and its application. Similarly, this web map visualizes spatial and non-spatial data on the web. Similarly, people can view, update, and use some functions like popup, distance measurement, and layer switching to acquire information about the land use type. Successfully, the prototype has been developed and performed user test. However, different areas still need to be addressed and explored for the betterment of this system—this system posse's great potential in upcoming days. Due to increasing internet service users, people are more attracted to their accessibility, sharing, interoperability, and faster service. It will increase access of data, storage, and management, not in big paper files but web and application (apps).

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LAND POOLING "CONSIDERED BY MANY EXPERTS AS A GAME CHANGER"

Aman Manandhar[1], Sagar Bayalkoti[2]
Diploma in Geomatics Engineering
Land Management Training Centre
1. aman.manandharr@gmail.com
2. bayalkotisagar535@gmail.com

ABSTRACT

Land pooling is a development technique where a number of small holdings are pooled together and a part of the pooled land is utilized for developing physical & social infrastructure. The remaining land is returned to original land owners with development rights. One of the requirements of land pooling in that area is because of small and irregular shaped parcels. The other was to use systematic approach of sustainable development, help in planned and systematic urbanization, infrastructural developments and therefore increase the living standard of people. Our project had its main objective to perform land re-adjustment providing roads, open spaces, parks, drainages and other facilities; then returning corresponding proportion of adjusted regular shaped land to the owners in a systematic way and was located at Dhulikhel municipality at ward no 04, 200m due east of the Land Management Training Centre. Existing cadastral and topographical map was used during the process. UAV was used for capturing the photographs, DGPS was used to determine the co-ordinates of the proposed stations and PIX4D mapper was used to stitch those images into one. GIS was used for further processing of data such as creation of contours, creation of slope map, water flow pattern. Similarly, AutoCAD was used for fragmentation of regular shaped parcels after separating developmental features. Not to mention that the old documents and existing laws are considered and followed during the whole process. After land pooling, we created systematic planned area and we can analyse that the development in this area will bloom in the near future.

KEYWORDS: Pooling, Consolidation, Sustainable, Game Changing Technique, Public Private Participation

INTRODUCTION

A. Background

Urban resilience is a city's ability to withstand and recover from unexpected shocks associated with natural hazards (ADB, 2013). Densely populated urban core areas are understandably at greater risks to hazards such as earthquakes and fire. However, even the newly developed urban areas are falling prey to disorganized spatial pattern because of the fragmentation of land parcels into irregular shapes and sizes. As a result, efficiency in terms of mobility is being compromised. Functional open spaces are becoming rarer with each new building constructed with little or no harmony with the existing buildings or infrastructure in the neighbourhood. To correct this, the National Urban Development Strategy 2015 (draft) has aimed to get half of the new residential area developed through land readjustment (land pooling) process by 2031 A.D. Land readjustment is a land assembly process that is used for developing and redeveloping real estate. The process is also known as land pooling or land consolidation.

In the context of Nepal, Land Pooling mechanism was introduced in 1998 by the Town Development Act, with the goal to provide basic urban infrastructure through contribution and participation of the owners. The land pooling method is the only programme which will assist on sustainable urban development with appropriate infrastructures, and land consolidation without financial assistance of the government, most of land litigation will be solved and nobody will be evicted from their areas. The concept of land pooling can, therefore, be explained with the help of two key words – 'unification' and 'partnership'. Unification implies consolidation of separate land parcels, the unified design, infrastructure provision and subdivision of these parcels and a unified preparation and implementation of the scheme under a single management. 'Partnership' indicates the partnership between government, private and community for urban land development.

Land pooling, simply is a development technique

where a number of small holdings are pooled together, a part of the pooled land is utilized for developing physical & social infrastructure, open spaces, parks and the remaining portion is returned back to the owners. Land Pooling is simply an assembly of small rural lands being converted into large parcels through readjustment. The infrastructure development is planned on this large land with around more than half the land given back to the land owners which makes it a very fair practice. Simply put, in land pooling a number of small holdings are pooled together and a part of the pooled land is utilized for developing physical & social infrastructure. The remaining land is returned to original land owners with development rights. Basically, the parcels, being most of them irregular; is merged together as one and later systematically divided into regular patterns including services such as roads, drainages, open space, parks, hospitals etc. It can be further explained by this figure below:

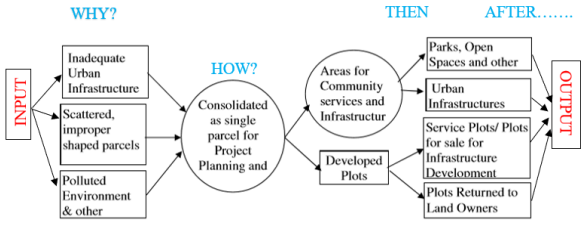

Figure 1 P. P. Oli Land Pooling / Readjustment Programmes in Nepal (4553)

B. Objectives of Land Pooling:

Most of the semi-urban areas of Nepal are unplanned where housing and infrastructures situation are worst. The government does not have enough resources to develop these infrastructures. It is also striving to achieve minimum development goals (MDG). Similarly, irregular parcel shapes, fragmentation of land into smaller pieces, etc. are the major problems regarding land in semi-urban areas. Hence, we performed this project to address these problems, re-adjust parcels into regular shapes, perform planned urbanization while introducing roads, drainages, electricity, drinking water, parks, open spaces and other plots for development.

METHODOLOGY

The concept of land adjustment is to accumulate small sized rural parcels of land into a large-sized land parcel. It also includes providing the land with good set-up in a systematic way and give back the re-formed land to its owners after taking out the cost of provision of the setup and the public areas by sale of few serviced lands. During our project, UAV was used for capturing the images, DGPS was used for establishing control points, Pix4D was used for image processing, Trimble Business Centre was used to process the DGPS data afterwards, GIS and AutoCAD were used to analyse and re-divide the parcels and different recent land pooling programmes in Nepal were studied and the land pooling parameters were categorized accordingly. The detailed information on each of them is shown below:

A. Specifications:

Table 1 General Specifications

S.N.	Particulars	Description
Instruments Used		
1. DGPS 2.Drone		3 sets, to establish control points 1 set, to capture aerial photographs
Data Used		
3.	Cadastral Map	Scanned Map (1:2500, 157-1366)
Software used		
4.	Pix4D Mapper	For processing images
5.	GNSS Solution & Trimble Business Centre	For computing co-ordinates
6.	AutoCAD	For parcel sub-division
7.	ArcGIS	Datum transformations, creating layers, layouts and templates

Table 2 DGPS specifications

S.N.	Particulars	Description
B.	**DGPS**	Trimble R8s
1.	Observation Time	30 – 60 minutes
2.	Max PDOP value	5
3.	Cut-off Angle	15°
4.	Epoch Time	10 sec
5.	**Datum transformation Parameters**	UTM to MUTM
	Translation x-axis	124.3813
	Translation y-axis	-521.6700
	Translation z-axis	-764.5137
	Rotation x-axis	-17.1488
	Rotation y-axis	8.11536
	Rotation z-axis	-11.1842
	Scale factor (ppm)	-2.1105

The parameters used in various land pooling projects varied in some extent. So, we studied various recent completed land pooling projects of Nepal and decided our parameters accordingly.

Table 3 Land Pooling Parameters

S. N	Land Pooling Parameters	Averaged of some recent land pooling programmes
1.	Road 1st plot depth 2nd plot depth	Max. 8m, Min 6m 15% 25%
2.	Sales Plot	8.1%
3.	Open Spaces	4.8%
4.	Drainage	2%
5.	Total land contribution	29.9% - 39.9%
6.	Total land returned back	60.1% - 70.1 %
7.	Minimum Plot Size	80m² (0-2-2-0)

Table 4 UAV specifications

S.No.	Particulars	Description
Instruments		
A.	**Drone**	DJI PHANTOM
1.	Camera Model	FC330_3_6_4000*3000(RCB)
2.	Flying Height	63.00m
3.	Flight duration and speed	~20 min, 5.51 m/s
4.	Average ground sampling distance	2.46 cm / 0.97 inch
5.	Area covered	0.163 km^2/ 16.296 ha/ 0.06 sq. mi.
6.	Image captured and Overlap	227 images, 80%
7.	Image Co-ordinate System Ground Co-ordinate System	WGS84 (EGM 96 Geoid) WGS84/UTMZone45N (ECM96Geoid)

B. Study Area

Dhulikhel is located at the Eastern rim of Kathmandu Valley, south of the Himalayas at 1550m above sea level and is situated 30 km southeast of Kathmandu and 74 km southwest of Kodari. This city lies on the intersection of the Araniko Highway to Tibet and B.P. highway to the Eastern Terai.

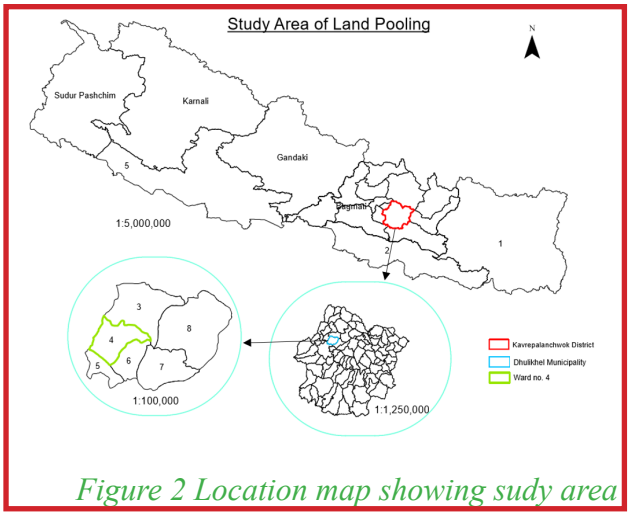

Figure 2 Location map showing sudy area

In our context, the study area was located at 28 kilo, Dhulikhel-04, Kavre. The area covered during land pooling was 0.163 km2/ 16.296 hectares. The study area was at altitude of around 1465m with geographic co-ordinates 27°37'10" N and 85°32'46" E. It is situated around 200m due east from the LMTC and around 500m southeast from the junction of Kathmandu University and the LMTC. We selected this area as we had very limited project time and it was very close to the LMTC (our working place). Also, the area was almost open so flying UAV was not a problem and surface was fairly levelled with uniform slopes and hence proper DTM will be extracted. The area where we performed land pooling consists not only plain areas but also have uniform slopes and the gradient can be clearly seen in the DEM produced.

PROCEDURE

Land pooling is a rural-to-urban development technique in which every newly created parcel is facilitated by basic infrastructures such as roads, drainages, water supply, electricity with hospitals, parks, playgrounds, parking and other re-creational areas in necessary areas. We completed our project going parallelly with office work and field work. The procedures we followed are briefly explained.

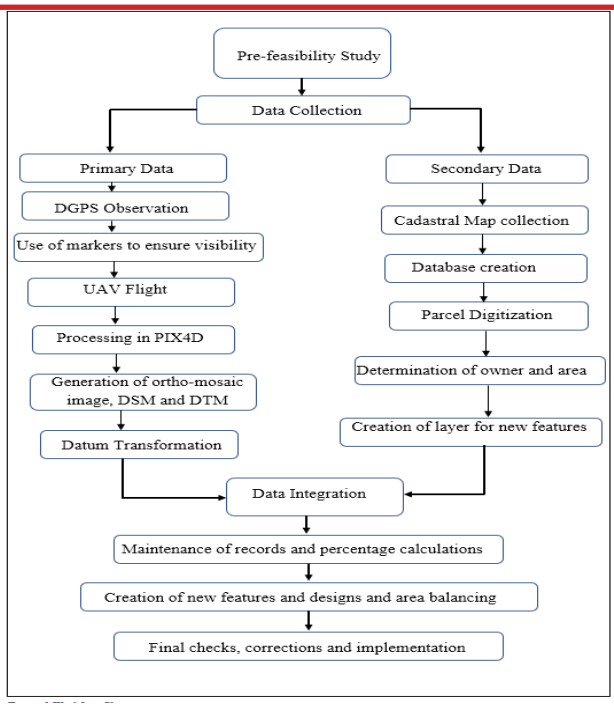

Figure 3 Workflow

A. Pre-feasibility Study:

A good planning is considered half-work done. Hence, we had selected the area for the project, various methods to be used, the instruments, hardware, software and created specifications in every process following the standards. Cadastral map was primarily collected for the visualization of study area. Topographical map was also collected for studying the terrain structure.

We went on field visit to select our study area and visualized various parameters such as existing roads, forest areas, drainages, buildings, electric poles etc. We took wooden pegs and created around 11 stations, well distributed in the area, where there was high visibility. They were established neither too close to the boundary of our study area nor too close within other stations. Wooden pegs were driven in the ground half visible with additional marks and pins in the top to precisely locate the point for later observation.

B. Field Work:

a. DGPS Observation:

On those ground-driven pegs, DGPS (of Trimble brand) was set for observation for about 30-60 minutes in each station. A base was set inside LMTC and two rovers were used simultaneously. It was made sure that the base was operating until the very end until we finished our observation. Considerations such as visibility, uniform distribution and stability were strictly followed.

Altogether, 11 stations were studied, which tentatively covered the whole study area. The weather was clear and the location was very open, so the PDOP values were very low and stuck between 1 and 1.5 respectively. Co-ordinate system was set to WGS84 and at the end of the day, all the stations were successfully observed following the above-mentioned specifications.

b. UAV Flight

Markers of size 30*30cm were used to mark the stations in the ground exactly above the wooden pegs. Flying height was set at 63.00m and the flight duration was around 20 minutes. Performing UAV flight was easy as all we had to was to provide it with the flying path and its configurations. After the study area was covered, the drone itself came back to the starting position. The images were synced and data was stored in micro SD-card. We performed several test flights to check the clarity and quality of images. After determining all the required configurations, we selected a sunny day and successfully captured our strip at around noon and the number of pictures counted 280.

C. Office Work

a. Data Processing:

For DGPS, first of all data download was performed from all devices using USB or Bluetooth and then was opened in Trimble Business Centre in the presence of license. All the observed data was also imported in the TBC. The base data was sufficient so we didn't need the CORS data of KU. In the TBC, the base lines were processed, network adjustments were performed, reports were generated and co-ordinates were extracted.

For UAV, first of all, PIX4D was installed and a project was created. Steps to be followed during processing was easy. We provided the strips of images, imported the GCPs and addressed the GCPs in those images and the software did the rest. Ortho-mosaic image, DSM, DTM and contours were created automatically by the software. It took some time though.

After this, required portion of cadastral map was digitized after geo-referencing. The layer was converted into WGS84 through datum transformation. The digitized layer was overlayed with the ortho-mosaic image and was compared with the present ground structure. Slope and contours were generated from the DTM. On the other hand, database was created in Excel sheet regarding the land owner, its parcel number, its present area, various parameters for deduction in various attributes such as road, sales plot, drainages, open spaces etc. and the final deducted area with new parcel number was also included. Numerous land pooling projects were studied and the percentage calculations was performed based on them. Some of the provisions for land pooling were:

- The roads must touch each plot and the road must be parallel and perpendicular to each other if road is developed or run across.
- The plots side must be perpendicular to road touching on it.
- The area for the open space must be in such a place that it should be accessible to every peoples of the area.
- The plots should be re-distributed at the same place as before as much as possible.
- The area covered by road, open space, greenery was as per the specification.
- The drainage should be created in such a way that the water doesn't gets stored in-between the plots and the flow of water directly goes to the drainage. First plot depth was considered 18.5 m from the existing road and 15% deduction was done to those area whereas 25% deduction was performed on remaining plots.
- Fair and transparent procedure with participatory approach and parallel provision of infrastructure.

We mostly used AutoCAD to design the new plots and developmental features. The procedure was lengthy and consumed a lot of time. Then, used GIS afterwards to create various layers and sub-types between each layer, performed topological checks, applied suitable colour, labelled new parcel numbers, created templates for various sizes, included scale, co-ordinate system, symbols, legends, and other marginal information and printed them.

OUTCOMES

After all the computations, calculations and analysis, we came up with similar output as planned. Most of the planning was performed in AutoCAD with iterative process. All the basic requirements we listed above were considered and fulfilled. Each of the parcels were connected through road and were

modified into regular shapes, mostly rectangles and squares. The table shown here represents the details in each field, i.e. roads, drainages etc.

Table 3 Outcomes in terms of area

SN	Particulars	Description	Percentage (%)
1	Total Project area	99864.186 m^2	100
2	Area covered by Road	19825.561m 2	19.85
4	Area covered by Open spaces	6039.788m^2	6.04
5	Area covered by Sales Plot	8250.078m^2	8.26
6	Area covered by Drainage	4765.943	4.77
7	Area of plot: Smallest Largest	 80m^2 (0-2-2-0) 1881.41m^2 (3-11-0-3)	 0.080 1.183
8	Total no of developed plots	148	
9	No. of land owners	121	
10	Road length	6361.037m	
11	Slope of area Minimum Maximum	 0.06 degree 31.84 degree	

A. Output in terms of Perspective

a. Land Owner's Perspective:

- Regular shaped of plots which can be useful for proper housing.
- Developed area so higher standard of living.
- Roads, drinking water, electricity and other facilities all around the area.
- Sky rocket in price of parcels after pooling, i.e. increase in land valuation.
- Higher motives of investment in banks and other financial institutions which promotes in more investment, that increases the life style and living standard of the locals.

b. Developmental Perspective:

- Sustainable development, a best approach for development.
- Establishment of basic infrastructures in very short period of time, which would have taken decades.
- Roads touches every parcel, so enormous possibility and higher rates of development.
- With analysis, natural disasters such as landslides, floods, can be minimized.
- A new perspective of development, which can be a game changer considering its unlimited possibilities and impact in the development of that place.

c. Governmental Perspective

- With the use of new technologies and analysis on various aspects such as drainages and slopes, this technique becomes a game changer.
- Roads reached in and around and agricultural land converted into residential and commercial area, so more revenue and more tax collection in a long run.
- With the creation of parks and open spaces, eco-friendly environment is created which enhances healthier life and hence promotes the living standard.

Figure 4 Graphical view of output

Table 5 Detailed calculation of individual parcels

		Open Space		Sales Plot			Road			Drainage					
arcel_Numbe	Owners_Name	_Area (square m	Percentage(%)	Area (sq. m	Percentage(%)	Area(m2	Plot Depth	Area	Percentage	Reduced Area	Percentage	Area	Total Area Deducted	Total Returned	New Parcel Numbe
							1st depth	80.439	15%	12.066					
85	Roshan Khadka	394.841	4.800	16.188	8.100	31.982	2nd depth	314.402	25%	47.160	2%	7.897	115.294	279.547	326
							1st depth	1017.106	15%	152.566					
90	Uddhav Khadka	1077.000	4.800	44.157	8.100	87.237	2nd depth	59.893	25%	8.984	2%	21.540	314.484	762.516	331
							1st depth	734.141	15%	110.121					
25	Sisan Baniya	1294.808	4.800	53.087	8.100	104.879	2nd depth	560.667	25%	84.100	2%	25.896	378.084	916.724	332
							1st depth	954.745	15%	143.212					
7	Krishal Manandha	1788.898	4.800	73.345	8.100	144.901	2nd depth	834.153	25%	125.123	2%	35.778	522.358	1266.540	317
							1st depth	4.743	15%	0.711					
2	Anil Khatiwoda	722.723	4.800	29.632	8.100	58.541	2nd depth	717.979	25%	107.697	2%	14.454	211.035	511.688	323
							1st depth	504.536	15%	75.680					
98	Sheetal Kc	2083.225	4.800	85.412	8.100	168.741	2nd depth	1578.689	25%	236.803	2%	41.665	608.302	1474.923	320
							1st depth	2.176	15%	0.326					
93	Aadarsha Pote	223.258	4.800	9.154	8.100	18.084	2nd depth	221.082	25%	33.162	2%	4.465	65.191	158.067	338
							1st depth	883.725	15%	132.559					
110	Pramod Dahal	1274.735	4.800	52.264	8.100	103.254	2nd depth	391.01	25%	58.652	2%	25.495	372.223	902.512	327
							1st depth	214.349	15%	32.152					
113	Himal Subedi	782.333	4.800	32.076	8.100	63.369	2nd depth	567.984	25%	85.198	2%	15.647	228.441	553.892	329
							1st depth	172.149	15%	25.822					
92	irinkhala Khatiwac	194.572	4.800	7.977	8.100	15.760	2nd depth	22.422	25%	3.363	2%	3.891	56.815	137.757	339
							1st depth	167.695	15%	25.154					
24	Sundar Yadav	430.080	4.800	17.633	8.100	34.836	2nd depth	262.385	25%	39.358	2%	8.602	125.583	304.497	315
1											2%				
3	Abhishek Badal	2224.974	4.800	91.224	8.100	180.223			25%	556.244	2%	44.499	872.190	1352.784	249
4	Aashman Basnet	332.119	4.800	13.617	8.100	26.902			25%	83.030	2%	6.642	130.191	201.929	275
5	Aayush Regmi	143.046	4.800	5.865	8.100	11.587			25%	35.762	2%	2.861	56.074	86.972	286
6	Roshan Khadka	187.034	4.800	7.668	8.100	15.150			25%	46.758	2%	3.741	73.317	113.717	288
8	Kunjan Shrestha	858.082	4.800	35.181	8.100	69.505			25%	214.520	2%	17.162	336.368	521.714	342
9	Ramesh Oli	421.421	4.800	17.278	8.100	34.135			25%	105.355	2%	8.428	165.197	256.224	341

Figure 5 Merged aerial photographs of study area with image resolution 24733 x 16975(280 images merged)

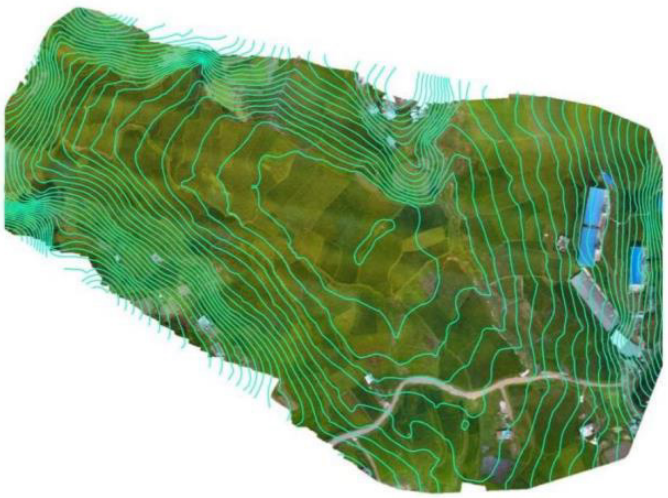

Figure 6 Contours of study area

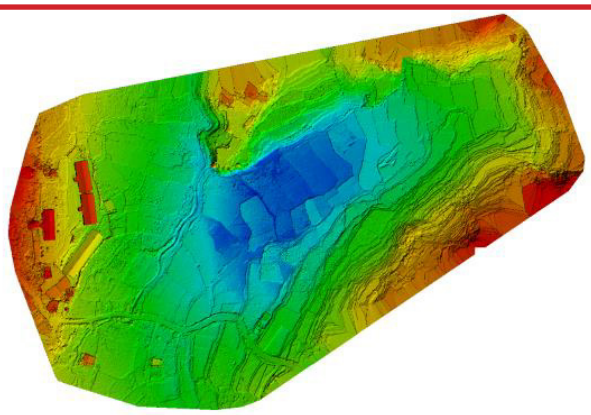

Figure 7 DSM of study area

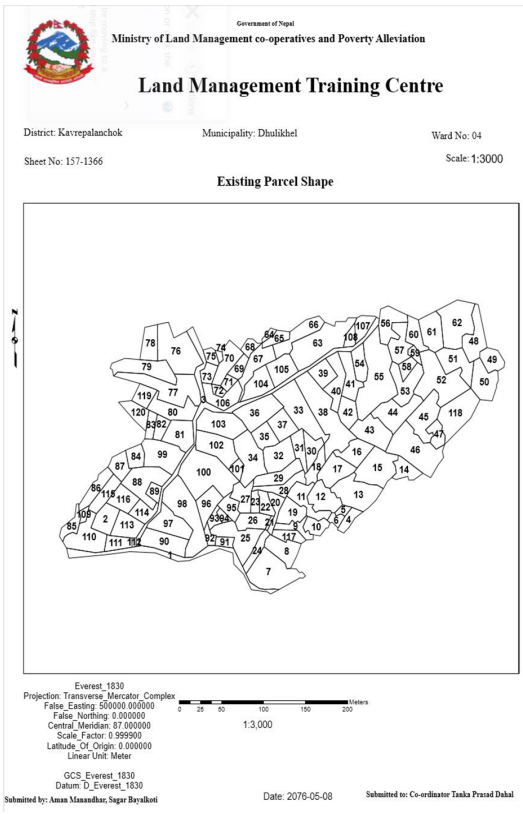

Figure 8 Existing Parcel Shape

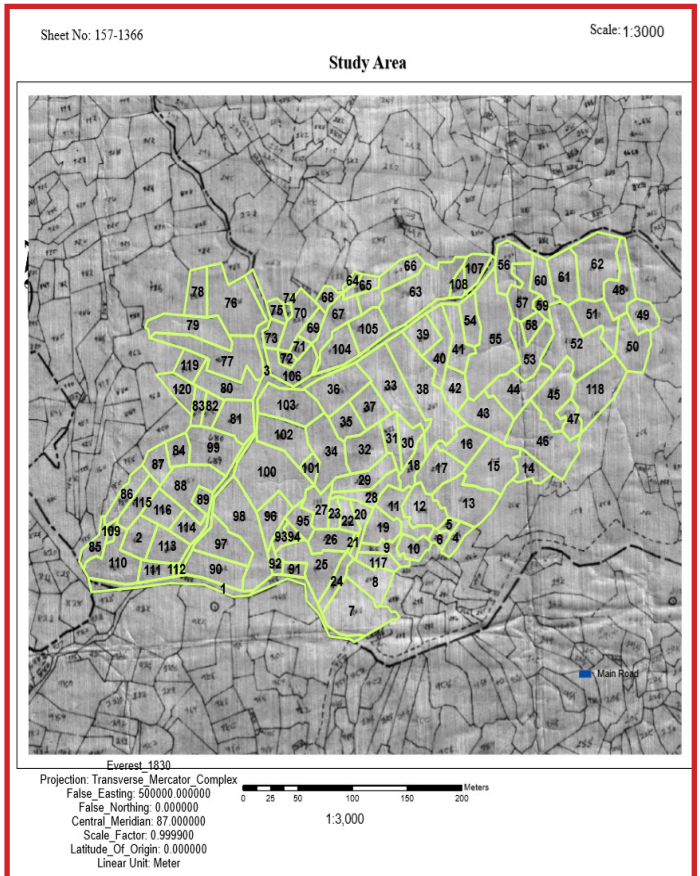

Figure 9 Digitized layer of study area

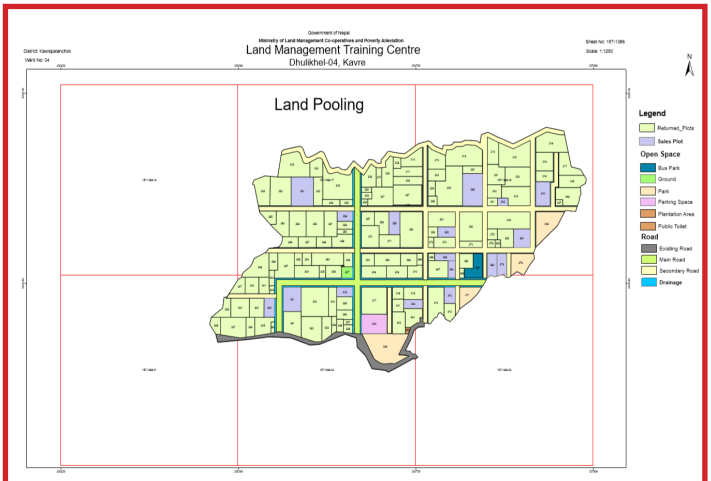

Figure 10 Study area after the completion of Land Pooling

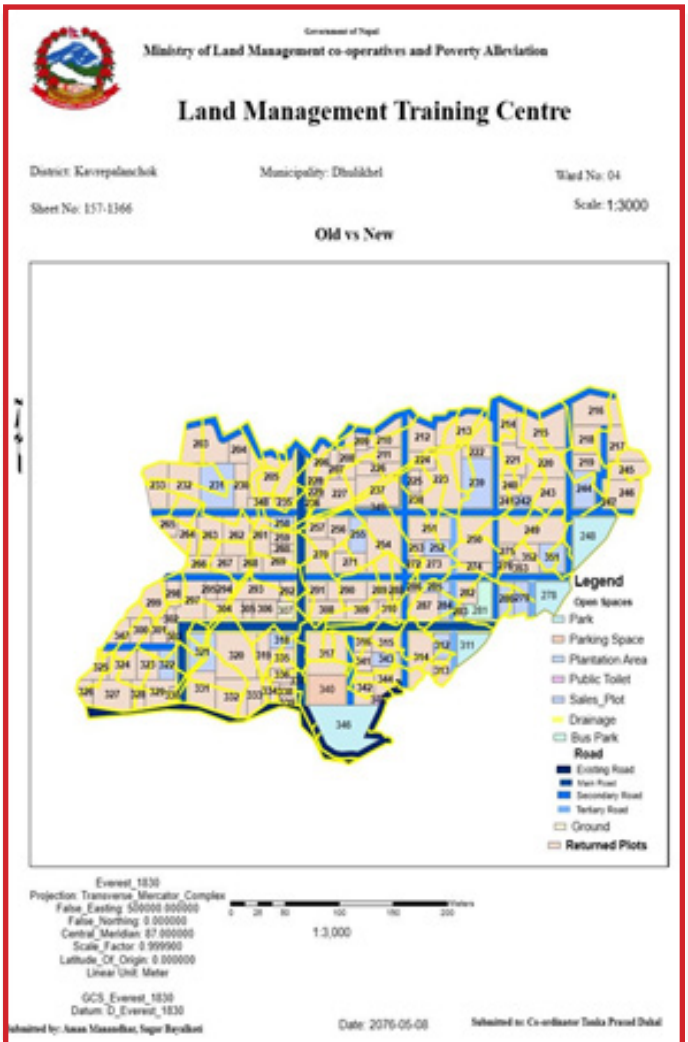

Figure 10 Existing data overlayed with the Pooled data

ANALYSIS

Hence, after the completion of this project we realized the potential of land pooling. Most of the semi-urban areas of Nepal are unplanned where housing and infrastructures situation are worst. The government does not have enough resources to develop these infrastructures. It is also striving to achieve minimum development goals (MDG). Similarly, irregular parcel shapes, fragmentation of land into smaller pieces, etc. are the major problems regarding land in semi-urban areas. On the other hand, land pooling provide infrastructure like road, water supply, sewerage and drainage facilities. The projects also provide open spaces for breathing, relaxation and recreation such as for playgrounds and children parks. In addition to that, the land pooling technique leads to an arrangement of irregular plots into regular plots which are suitable for housing and for accessibility. Because land pooling projects are designed as self-financing projects, the burden on government or local governments to provide infrastructure and services is lessened to a significant degree. Although landowners lose some portion of their lands, they get serviced plots in return which are more valuable than before. In short, a land pooling project is a win-win scheme for both people and government. The rapid infrastructural developments during the process and rapid planned urbanization after the land pooling makes it one of the best and a game changing development technique for country like Nepal. The only concern is the will of the owners to perform land pooling. If majority of owners agrees, then it can be a game changer. But, if the majority of owner dis-agrees, it can be a problem and conflicts may occur frequently. So, there should be enough amount of negotiations with the owners (>50%), agencies and stake-holders and forceful acquisition of land should be avoided as much as we can during this process. Hence, government can implement these kinds of game changing techniques with tri-partnership (between public-agencies-government) for the effective development of country in a systematic way.

CONCLUSION AND RECOMMENDATION

The land pooling is one of best solution of solving problems of provision of comfortable housing and infrastructure development without external funds. Despite the hardship during the implementation phase, generally residences are always happy after implementation. The land records are updated, tenancy secured and comfortable shelter developed. Land pooling is a tool that can support sustainable urban development by allowing for planned and managed urban extension and densification. For land readjustment to be successful, it is necessary to have favourable economic conditions, along with procedural and regulatory rules in place to guide the process. Land readjustment requires intensive voluntary participation and cooperation by the property owners. It must be obvious to the property owners that the final profits will be greater than they would receive otherwise, without land readjustment and is worth, negotiating time that will be devoted to the project implementation. We learned a lot about this technique of development and its procedure and theoretically fulfilled all our objectives and now consider ourselves able to handle these kinds of projects in real-life scenario.

As for the recommendations, these developmental procedures should be focused more as we all know its endless benefits. We performed land pooling in open area without any analysis with no houses within, but the urban growth rate should be determined and land pooling should be done in such areas so that the

place can actually be benefited. Also, land pooling techniques should be linked with environment and climate change concerns (such as provision of green infrastructure, rainwater harvesting, sustainable designs, and energy efficiency), to frame a whole new mode of development.

ACKNOWLEDGEMENT

With great honour, I would like to thank Dr. Pradeep Sapkota, Er.Sanjeevan Shrestha, Er. Govinda Ghimire and Er. Bhuwam Ranjit for their valuable time and support during this project, without whom it would be incomplete.

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OVERVIEW ON OPEN GLOBAL DIGITAL ELEVATION MODELS (DEMS)

Er. Shankar Kc
Survey Officer
Survey Department of Nepal
shanker01@gmail.com

ABSTRACT

DEM is an elevation dataset required for many GIS based applications. Out of various DEM data acquisition methods, satellite based stereo- photogrammetry with image matching technique is cost efficient, timely and provides reliable data with moderate accuracy and has been used for global level elevation modelling. Adavanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), ALOS World 3D (AW3D), CartoDEM are the global scale spaceborne photogrammetry to produce the Orthorectified images (ORI) and DEM. Shuttle Radar Topography Mission (SRTM) produced global level DEM using radar interferometry principle. DEM from these mission is available to user communities freely. The characteristics of each mission and DEM produced, reported vertical accuracy, website to access the dataset is presented in this review paper with summary of studies of vertical accuracy assessment.

KEYWORDS: DEM, ASTER, stereo-photogrammetry, SRTM

INTRODUCTION

High resolution orthorectified imageries and digital elevation model (DEM) are very crucial input to several GIS analysis. Especially large scale mapping and terrain modellingapplications demands the High Resolution Satellite Imageries (HRSI) and DEM. Several GIS analysis such as contour generation, derivation of slope, aspect, watershed, and viewshed, road design and cut- fill volume calculation, reservoir volume computation, soil erosion analysis, design of hydraulic structures, landslide zonation, fly-through visualization demands the quality DEM. Various DEM creation techniques have been used such as digital aerial and terrestrial photogrammetry, airborne and laser scanning, GPS with different measurement approach, active and passive remote sensing, with optical satellite imagery system. The satellite based stereo-photogrammetry produces efficient, timely, regional and global coverage DEM and has become most popular data acquisition method. Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), ALOS World 3D (AW3D) project, Cartosat-1 and CartoDEM, Shuttle Radar Transmission (SRTM) DEM, are the global level DEM project and freely available to user communities.ASTER,AW3D,and CartoDEM are based on satellite stereo-photogrammetry while SRTM is based on Interferometric Synthetic Aperture Radar (InSAR) principle. Overview of these four projects is presented in this paper. A summary chart of specifications of each DEM is shown too.

Cartosat-1 and CartoDEM

Cartosat-1 is endeavor of (ISRO) Indian Space Research Organiztion, has stereo viewing capability, carries two panchromatic camera, and provides high resolution near-instantaneous stereo data with spatial resolution of 2.5m. Cartsat-1 has following characteristics:

Parameters	Specifications	Parameters	Specifications
Orbit	Polar Sun Synchronous	Local time	10:30AM
Orbit altitude	618km	Revisit	5 days
Orbits/cycle	1867	Repetition	126 days
Semi major axis	6996.14km	Orbits/day	14
Eccentricity	0.001	Orbital period	97 minutes
Inclination			

The two camera, one forward looking (FORE) at +26° and another backward looking (AFT) at -5° , acquire stereoscopic images in 52 seconds interval. Radiometric parameters are almost identical between stereopairs. The swath of stereo pairs is 26km and B/H ratio is 0.62. Below is the payload specifications of Cartosat-1:

Parameters	ations	Parameters	Specifications
Swath	29.49km	No of Detectors	12k
	26.24km	Pixel size	7*7 micron
IGFOV	2.452m (Across track)	Integration time	0.336s
		Focal length	1945mm
GSD	2.54 (Along track)	Data rate per camera	336Mbps
Spectral Band	0.5 - 0.85 microns	Data Compression ratio	3.22:1
Quantization	10 bits	Type of compression	JPEG

Data is transmitted from spherical phased array antenna at the satellite at the rate of 105Mpbs *f* camera to the ground. Cartosat−1 provides two kind of products: radiometrically corrected, georeferenced images and orthorectified images.

CartoDEM:

The stereopairs with 2.5m spatial resolution acquired from Cartosat−1 are used to generate DEM using ASST (Augmented Stereo Strip Triangulation) soGware. The generated DEM and Orthoimages are decomposed to 7.5'X7.5' tiles, each tile's quality is checked and improved by Quality Verification (QV) system. The water body irregularities, hill−top distortions, plain area sinks and residual mosaics are corrected using Tile Editing (TE) system. Finally qualified DEM tiles are archived and distributed through Dissemination System (DS).

Several vertical accuracy assessment and quality check studies reveal that the achieved height accuracy is better than the specified accuracy 8m in plain and undulating region. The versioning of CartoDEM is version 1, version 1.1, R1, version 2 R1, version 3 R1 and available through open data archive of bhuvan portal, http:*ff*bhuvan.nrsc.gov.in

ASTER Sensor

Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) is a sensor onboard NASA's earth orbiting terra satellite since 1999. ASTER sensor was built by METI, Japan. It has 3 optical subsystems: visible and near infrared (VNIR) radiometer acquiring images in 3 bands with 15m IFOV and additional backward looking band for stereo, shortwave infrared (SWIR) radiometer, acquiring images in 5 bands with 30m IFOV, thermal infrared (TIR) radiometer, acquiring images in 5 bands with 90m IFOV. ASTER acquires images in all bands with a swath width of 60km and revolves in sun− synchronous near polar orbit. VNIR 3 band nadir−looking sensor and backward−looking sensor separation is 28˚, with B*f*H ratio 0.6m, operates in 0.76 − 0.86 µm spectral range, acquires stereopairs at each acquisition. The 30m posting scene models were produced using standard stereocorrelaltion methods, cloud screening, and averaging elevations on a per pixel basis. The resulting data were partitioned into 22600, 1X1 degree tiles.

ASTER GDEM

The stereopairs collected from ASTER are processed and compiled by SILC (Sensor Information Laboratory Corporation) to produce DEM, the coverage is 83˚S to 83˚N. NASA and METI released ASTER GDEM version 1 in June 29, 2009 using 1.7millions of scenes out of 2million collected scenes. The ASTER GDEM version 2 is released in October 2011 with additional 260000 scenes. Version 3 is released in 2016 adding data from additional 350000 additional scenes. DEM is referenced to WGS84*f* EGM96. The elevation value at each post is the unweighted average of the accepted scenes in the stack of repeated observations of that pixel. Oceans and sea elevations are set to zero. The reported vertical accuracy is 20m vertical error and 30m horizontal error at 95% confidence interval. It's a DSM for which the observations may refer to bare earth, vegetation, or man−made structures. A quality assurance file is provided with each tile giving the actual number of scenes that were averaged to generate the elevation value at each post. The quality assurance file also indicates if a post was corrected using a reference DEM or if it contains an interpolated value. The GDEM is available for download from NASA Earthdata and LP DAAC Global Data Explorer. Cloud screening, stacking from overlappingscenes, removing outlier values, and averaging elevation values improved the GDEM Version 3. Each file contain DEM file and NUM file. NUM file reports the number of scenes used for each pixel and identifying the source for fill−in data. The additional dataset is ASTER Water Body Dataset (AWBD). AWBD is a raster dataset, encodes every pixel as either lake, river or ocean. The water body was identified from spectral analysis algorithm and manual editing. The quality of AWBD is checked against SRTM Water Body Dataset (SWBD) and Landsat based global inland water (GIW) product.

ALOS World 3D

JAXA developed the PRISM (Panchromatic Remote Sensing Instrument for Mapping) and put it onboard ALOS (Advanced Land Observing Satellite), collected the data from 2006 to 2011 and generated DEMƒDSM and ORI. PRISM consists of three panchromatic radiometers: nadir looking (NDR), forward looking (FWD), and backward looking (BWD) acquired along track stereo images with spatial resolution of 2.5m in nadir−looking radiometer in 35km swath width. It is capable of triplet observing mode (OB1) and stereo observing mode (OB2). AW3D archived approx.

6.5 millions of scenes, produced precise global DSM and ORI, and made available to users. DSM of 0.15" resolution (approx. 5m) and ORI of 2.5m are produced

.PRISM specifications:

Parameters	Specifications	Parame-ters	Specifica-tions
Number of bands	1 (Panchro-matic)	Posting angles	−1.2ƒ+1.2 degrees (OB1,NDR)
Wavelength	0.52−0.77 micrometers	Bit length	8 bitƒpixel
Number of optics	3 (NDR, FWD, BWD)	Data rate	960Mbps (OB1,OB2)
BƒH ratio	1. 0 (b etween FWD & BWD)	Data compres-sion	Loss y, JPEG extension
Spatial resolution	2.5m (NDR)	Data downlink rate	240 Mbps
Swath width	35km (OB1) & 70km(OB2)		

AW3D dataset provides: Precise DSM dataset, ORI dataset, and Correlation coeficient image (CCI). Precise DSM dataset contains DSM file (DSM), Mask file, Stack number file (STK), Header information (HDR), Scene list (LST) and Quality assurance information (QAI). ORI dataset contains Orthorectified images (ORI) and Header file (OHR).

The DSM is available in 1X1 degree tile GeoTiff format signed 16 bit raster data, referenced to GRS80ƒITRF97 and EGM 96, horizontal spacing of approx. 5m and with RMSE of 5m in height and 5m in geolocation. The ORI with horizontal spacing of approx. 2.5m and the geolocation accuracy is of RMSE 5m. Various vertical accuracy test of DSM is carried in comparison with GCPs, LIDAR DSM, ICESat, SRTM and height accuracy less than 5m (RMSE) is obtained. The low resolution DSM of 30m spacing resampled from 5m resolution mesh with height accuracy RMSE 5m is available to users free through http://www.eorc.jaxa. jp/ALOS/en/aw3d30/data/index. htm

SRTM

NASA's Shuttle Radar Topography Mission (SRTM) launched in February 11, 2000 on space shuttle endeavor to collect interferometric data, generated global coverage 60˚N latitude to 56˚S latitude (80% of landmass) elevation dataset using radar interferometry. Synthetic Aperture Radar (SAR) is side looking instrument acquires data along swaths extending from about 30˚ off−nadir to about 58˚ off−nadir from an altitude of 233km, and thus are about 255km.

SRTM DEM

The SRTM collected radar images were processed using the SRTM Ground Data Processing System (GDPS) super computer by NASA JPL. This processor transformed the radar echoes into strips of digital elevation data. The strips were each mosaicked into at least 14,549 − 1X1 degree tiles. This elevation dataset is arranged SRTM format, with spatial resolution of 1 arc−second (SRTM1) and made available online from USGS as Version 1.0 in 2003. The 1arc−second SRTM1 dataset is resampled to 3 arc− second resolution (called SRTM3) in two ways: one 3 arc−second cell value is generated by selecting center value of 3X3 window of 1 arc−second distributed from NASA LPDAAC, another 3 arc−second cell value is the average of nine (3X3) 1 arc−second data distributed through NGA EROS LTA. SRTM1 dataset is made available to the US only and SRTM3 dataset is made available to worldwide from the USGS EROS Data Center.

NGA flatten and delineate water bodies, define coastlines, remove spikes and wells, and small void filling via interpolation of surrounding elevations of SRTM1 version 1.0 and gave to NASA for distribution. This dataset is then became SRTM Version 2.0 in 2005. Some minor errors found in the original 3 arc−second Version 2.0 were corrected and released as SRTM Version 2.1. The gaps and voids of version 2.0 were eliminated with ASTER GDEM2 and USGS GMTED2010 or USGS NED and released as Version 3.0 in 2006. In 2008, CGIAR−CSI released SRTM3 version 4.0. It used new spatial interpolation method and used more high resolution auxiliary DEMs such as Canadian Digital Elevation data and SRTM1 DEM. SRTM version 3.0 Global 1 arc−second named as SRTMGL1 with spatial resolution approx. 30m is released for the first time outside of US region. In past only 90m resolution SRTM DEM was available outside US

regions. SRTMGL1 is void filled elevation data from ASTER GDEM2, GMTED 2010, and USGS NED.

Individual tile of SRTM DEM is named using lat*f*long of southwest corner of the tile. The unit of elevation is meters, the horizontal datum is WGS84 and vertical datum is EGM96. The DEM data is provided as 16−bit signed integer raster data.

SRTM Image Data:

Another kind of SRTM data is image swath data. There are two types of SRTM data: Swath Image Data and Combined Image Data. For swath image data, every data take that crossed a tile was saved as a separate file (no mosaicking or combining) so that some files contain only partial data. Every image pixel acquired by SRTM is included in swath image dataset while combined image dataset is produced by averaging all image data in a 1X1 degree tile. This produced a single, smoother, uncalibrated image for each tile.

CONCLUSION AND RECOMMENDATIONS

Above global elevation modelling mission provides DEM freely with 30m resolution. ASTER and SRTM data were collected in during 1999−2000, Cartosat and AW3D acquired images during 2006−2011. According to reported vertical accuracy, AW3D DEM is more accurate (5m RMSE), then CartoDEM (8m LE90), then SRTM (16m 95% at confidence interval) and ASTER GDEM (20m at 95% confidence interval). The vertical accuracy of open global DEM is assessed in various part of the planet with GCPs, local level high accuracy DEM, LiDAR, ICEsat and found within the specified accuracy. There is no study of assessment of vertical accuracy of those DEM in Nepal's terrain. How much accurately open global DEM performs in our complex terrain should be analyzed to use such DEM in further applications.

APPPENDIX(COMPARISON TABLE)

Parameters	CartoDEM	ASTER GDEM	AW3D30 DEM	SRTM DEM
PlaVorm	Cartosat−1	NASA's Terra Satellite	ALOS	
Data acquisition methods	Stereophotogrammetry	Stereophotogrammetry	Stereophotogrammetry	InSAR
Wavelength	0.5 – 0.85 µm	0.78 – 0.86 µm	0.52 – 0.77 µm	5.66 cm
Coverage	Global	83°N to 83°S	82° N to 82°S	60°N to 56°S
Format	GeoTiff	GeoTiff	GeoTiff	
Data type	16 bit signed integer	16 bit signed integer	16 bit signed integer	16 bit signed integer
Datum – Horizontal	WGS84	WGS84	WGS84	WGS84
Datum – Vertical	WGS84	EGM96	EGM96	EGM96
Projection	Geographic	Geographic	Geographic	Geographic
Resolution	30m	30m	30m	30m
DEM Type	DSM	DSM	DSM	Mixed
Absolute planimetric accuracy	15m (CEP90)	30m 95% confidence interval	5m (RMSE)	20 m
Absolute vertical accuracy	8m (LE90)	20m 95% confidence interval	5m (RMSE)	16 m
Height units	Meters	Meters	Meters	Meters
Tile size	1°X1° tile	1°X1° tile	1°X1° tile	1°X1° tile
Producer	NRSC/ISRO	NASA/METI	JAXA	NASA
Versioning	Version 1 (Sept, 2011)	ASTER GDEM1 (June,2009)	Version 1 (April 2016)	Version 1.0 (2003)
	Version 2 (Sept, 2014)	ASTER GDEM2 (Octo, 2011)	Version 1.1 (May 2016)	Version 2.0 (2005)
	Version 3 (March, 2015)	Version 3 (2016)	Version 2.1 (April, 2018)	Version 3.0 (2006)
				SRTMGL1 (2015)
Website	http://bhuvan.nrsc.gov.in	https://search.earthdata.nasa.gov https://gdex.cr.usgs.gov/gdex/	http://www.eorc.jaxa.jp/ALOS/en/aw3d30/data/index.htm	https://earthexplorer.usgs.gov/ https://lta.cr.usgs.gov/SRTM1Arc
Release date	September, 2011	June, 2009	2016	2003

A REVIEW OF THE ARTICLE TITLED: BIO - INSPIRED CADASTRAL BOUNDARY DESIGN

Sandesh Sharma Dulal
Student
Department of Geomatics Engineering, Kathmandu University
sharmadulals@gmail.com

ABSTRACT

The development of geospatial technology is hitting a new milestone every day. But it hasn't been able to model down the integration of environmental parameters as its subsystem. So, it is an issue of importance and interest that study on this topic must be done. This review outlines the major issues present in the traditional boundary delineation methods and introduces the unmarked concept of Biomimicry. This concept is based on adopting nature's way of performing activities, hence delineating the boundaries also. The review explicates the theoretical approaches of modeling environmental parameters in the geospatial domain, and how the model can be effective. It concludes that the paper is a proper document to the question of why of bio-inspired cadastral boundary design, but now how.

INTRODUCTION

The world today is based on the crude science of any matter for defining its existence, as well as for the establishment of new theories. Due to this, many things have been perfectly modeled out for now, but whether these so-called well-visioned sciences focus on sustainability or not is the burning question. Being specific on the field of cadaster boundary delineation, it is solely based on the principle of the geodetic science, which primarily includes the distance measurement, bearing calculations, and other geodetic methods. Though this geodetic science has helped in rigorous boundary delineation, the natural phenomenon isn't taken into account. Hence, this isn't a well- visioned concept. So, to establish methods that are economically, socially, and environmentally well effective, the process of biomimicry or any environmental parameter must be integrated into the domain of the geodetic modeling. Nevertheless, it is equally important to integrate the parameter in all the other sciences as everything is interconnected. So, this paper introduces three major problems in the current system of boundary delineation: economic, social, and environmental, and majorly focuses on how bio-inspired methods that can solve all these problems. The concept of biomimicry is sustainable, but this paper fails to outline rational ideas about how biomimicry can practically be implemented to develop a Bio-inspired cadastral boundarydesign.

DISCUSSION

This paper mentions that the use of the cadastral boundaries was done previously to estrange and protect crops from evaders. Hence this concept generalizes the major use of cadastral boundary for proving and protecting the ownership of the land property. With the economical revolution, 'systems' have been developed for everything, also for boundary demarcation. The 'fixed' system is where the boundary is accurately demarcated by a huge of high precision technology, and the 'general' system is where the approximate definitions are used. The latter is considered to be economical and advised to be used in most of the regions. Irrespective of the systems, the major principle used is the geodetic principle for boundary determination and demarcation. But, the principle of the ecological and biological conservation is undermined here, which are the necessary concepts to be integrated. So, being based on the sustainability objectives, geospatial technologies must be redefined in such a way that they can delineate, survey, and record natural phenomena as well as the geodetic ones.

The major problem of the existing conventional boundary delineation principles as per this paper are Ecological ignorance, economic expense, and specific social norms. The Ecological ignorance is done as the human delineated space are mono-cultured, which violates the natural trend of the gradual transition, and diversity. We can see that nature tends to gradually bring out the changes in its components and integrate the major of its components for all the places, but human activities don't favor such. Example: Forests include varieties of trees and plants and the specificity of the forest changes with altitude which is a natural

diversity. But humans tend to break that diversity and try to implant single specie of plants important for them in all the places and ignore all others. The Economical expense is also a problem as the utilization of the monetary, technological, and human resources is maximum in the boundary demarcation system which can be reduced by adopting bio-friendly technologies. And another is that there is major involvement of specific social norms in the demarcation. These norms are now present in forms of ground markers, maps, and registers. These things create a conflict between people and their relation to nature. Hence, to solve these major issues, and also integrate the environmental parameter, the concept of "Biomimicry" has been introduced in thispaper.

Biomimicry is a design approach, specifically a design philosophy, which outlines how the biotic life works, and finally analyzes where all components fit in. It is simply a process that is used to analyze how all the beings sustain, mimic the strategies used by them, and adopt them in the systems that have now become inseparable components of life. The main principle of it is that natural processes should be mimicked and that must be used in the formation of the design of any project. The major process involved is, identification of the problems or function be taken into account, 'Biologizing' it, finding the nature's best practice and translating the practices into buildable forms. Being specific in the context of boundary demarcation, this concept urges the use of geospatial technologies for demarcating the boundary but according to how nature tends to demarcate it. For example, can various bands like thermal, NIR be able to delineate boundary based on the tendency suitable per nature? Can geospatial tools support fixing the areas where marine movement is unhindered? Is the trend of indigenous settlement a way of sustainability? So, these are the concepts that try to integrate the natural phenomenon of human-based demarcation. The nature-based demarcation implies that how nature has or had separated various areas for their purposes. It is a complex statement. It can be explained by the following example, the land has its capabilities, as some lands are best for agriculture, some for grazing, some are barren, and many others. This is the natural boundary delineation and the tendency that nature has chosen. But humans tend to encroach the land use type and develop a structure based on their needs without analyzing nature's tendency. This is the conflict and this must be solved. Hence, biomimicry integrates nature's tendency of diversity and classification. But the major drawback of this paper is that it doesn't answer 'how' can these all things be integrated into the geospatial domain. It just explains'why'. There have been modalities and institutions developed to solve the major three problems mentioned.

To solve the economical problems, rapid and low-cost boundary delineation technique can be used. To solve the problem of specific social norms, various organizations mediate between the people, develop a singular rule for all called law, bring laws into effect, and maintain discipline in people. But the environmental problem doesn't have a solution for it. Hence, the concept of biomimicry can be adopted to integrally solve all three problems which reduce the diversity in approaches. As this concept hasn't come into effect in the geospatial field, it is necessary to burrow and integrate the ideas and methodologies from the fields that have considered environmental factors in their design any problem,and also correlate to the geodetic science. For example, architecture which integrates nature in its design. To develop the new set of boundaries that viably integrate the ecological and biological components, there is the necessity of identification of the ecological and biological phenomenon in the area of the study, and select geospatial technology that fuses biological, ecological, and geospatial subsystems.

By adopting the principle, the economical problem can be solved as this process tends to use fewer resources. The social problems can be solved as this method seems suitable in those rare where land holdings are based on indigenous groupings, i.e customary tenure. We can see that the distribution of the people is based on the geographic features which are nature's way of diversity and sustainability. For example, Sub-Saharan African regions have native people in stay and these people are well adapted for surviving in that region. This is a proper environmental distribution. And the Environmental problems can be solved as it can help to reconcile nature policies, better implant land useplanning.

CONCLUSION

This paper aims to remind people that it is necessary to respect nature's way of delineating the boundary of all things, even cadastral parcels. So, it is necessary to adopt and develop the technology that can solve all the problems in the present cadastral boundary system integrating the environmental parameters. For that, this paper suggests the concept of Biomimicry that involves "Biologizing". The main principle of it is that natural processes should be mimicked and that must be used in the formation of the design of any project. The concept of biomimicry is sustainable,

but this paper fails to outline rational ideas about how biomimicry can practically be implemented to develop Bio-inspired cadastral boundary design. Hence, the study must be done on how biomimicry can be integrated as part of the geospatial domain and the answer to why is clear. Hence, this paper suggests an important concept of the major issue, sustainability, which is required but scarce.

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PRESCRIPTION TO ESTABLISHING FACILITY FOR TESTING OF GEODETIC AND SURVEYING INSTRUMENTS IN NEPAL

Er. Mahesh Thapa[1], Er. Bigyan Banjara[2]
Survey Officer
Survey Department of Nepal
1. mahesh100thapa@gmail.com
2. bigyanbanjara@gmail.com

ABSTRACT

Surveying and mapping tasks utilizing geodetic and surveying instruments must ensure that the instruments comply to the prescribed precision. In order to determine and evaluate the precision of such instruments, there is a need of an accredited institution with a facility to test precision compliance of geodetic and surveying instruments. Depending upon the geodetic and surveying instruments, laboratory as well as field based testing is necessary to assess the precision of the instruments. These testings have to be done using procedures that are rigorously preparedbyexpertsinordertoensurethereliabilityofsuchtests. This article emphasizes on the need of such a testing facility and discusses on standards prepared by International Organization of Standards (ISO) as prescription to establish such a testing facility.

KEYWORDS—ISO Standards, Testing, Geodetic Instruments

INTRODUCTION

The accuracy with which a surveying and mapping project can be accomplished depends upon the precision of surveying and mapping instruments employed. In order to ensure the compliance of these instruments to the necessary precision, it is mandatory to be tested using procedures that are rigorously prepared by experts and in general has universal acceptance. In addition, it is important to have a testing facility where these instruments can be reliably tested such that the facility supports the implementation of standard procedures for testing.

A large number of geodetic instruments are used in Nepal for surveying and mapping activities, including the establishment of control points. Use of these instruments without periodic testing can potentially introduce errors in surveying work. In addition, it is important to ascertain the precision specifications provided by the manufacturers of geodetic in- struments while purchasing.

In this article, firstly, we highlight the importance of establishing a testing facility for geodetic instruments in Nepal. Then we review international standards that would guide the establishment of such a facility. Finally, we conclude with way forward to establish such a facility.

NECESSITY OF A TESTING FACILITY

A national testing facility for geodetic and surveying instru- ments is necessary for the following reasons:

- Geodetic and surveying instruments are manufactured by a large number of companies from several nations.These manufacturers provide the specifications concerning pre- cision of such instruments. In order to ensure the claimed precision specifications are indeed true, it is necessary to test these instruments.
- Geodetic instruments suffer wear and tear during use as well as during transportation which is likely to degrade its precision. Periodic testing is necessary to ensure the reliability of suchinstruments.
- Some of the projects are highly sensitive to accuracy re- quirements. In such projects, it is important to ensure that the geodetic and surveying instruments used are reliable and meet the accuracy requirements of the project. In these

cases, it is necessary to test the instruments before these are deployed into surveying activities.

STANDARDS FOR TESTING SURVEYING AND GEODETIC INSTRUMENTS

A. Standards

Although a complex and time consuming process, developing standards is essential to ensure safety, quality, interchange- ability of parts or systems, consistency across international international borders [1].Standards not only streamline the transaction, it also has considerable impact to the economy [2]. There are both national as well as international bodies that are responsible for developing standards. The International Organization for Standardization (ISO) is the most important international organization for developing standards with has membership of 165 national standard bodies. It has published 23512 standards pertaining to various areas [3].

B. Structure of ISO

ISO has Technical Committes (ISO-TC) and Subcommittess (ISO—SC) to decentralize and streamline the development of standards. The ISO-TC and ISO-SC have Working Groups (ISO-WC) which actually develop the standards.

The standards for Geodetic and surveying instruments are under the jurisdiction of ISO Technical Committee 172 Sub- committee 6 hereafter referred as (ISO/TC 172/SC 6). The ISO/TC 172 is responsible for developing overall standards pertaining to Optics and photonics. The SC 6 under TC 172 is responsible for developing standards particular to Geodetic and surveying instruments. The SC 6 has two Working Groups (WG): WG 3 and WG 4. The WG 3 is responsible for developing standards relevant to Laboratory procedures for testingsurveyingandconstructioninstruments. Similarly,the WG 4 is responsible for developing standards relevant to Field procedures and ancillary devices.

C. ISO Standards for Geodetic and surveying instruments

The ISO/TC 172/SC 6 has published 14 standards related to Geodetic and surveying instruments. The preview of the published standards can be accessed from the official website of ISO at https://www.iso.org/committee/53732.html. The complete standard documents have to be purchased.

The standards published by ISO/TC 172/SC 6 can be classified into four categories:

a. Geodetic and surveying instruments — Vocabulary — ISO 9849Series

b. Ancillary devices for geodetic instruments — ISO 12858 Series

c. Laboratory procedures for testing surveying and con- structioninstruments—ISO16331Series

d. Field procedures for testing geodetic and surveying instruments — ISO 17123Series

a. Geodetic and surveying instruments — Vocabulary — ISO 9849 Series: The ISO 9849 Series has only one standard at the time of writing this article — ISO 9849:2017 as pre- sented in the Table I. The ISO 9849:2017 standard defines the terms relating to geodetic field instruments and components essential to functioning of these instruments.

TABLE I
ISO STANDARDS IN 9849 SERIES

	Standard Code	Standard Name
	ISO 9849:2017	Optics and optical instruments - Geodetic and surveying instruments - Vocabulary

b. Ancillary devices for geodetic instruments — ISO 12858 Series: The ISO 12858 series has three parts which is pre- sented in Table II.The three parts specifies the most important requirements of the three ancillary devices — Invar levelling staffs, Tripods &Tribrachs.

TABLE II
ISO STANDARDS IN 12858 SERIES

	Standard Code	Standard Name
	ISO 12858-1:2014	Optics and optical instruments - Ancillary devices for geodetic instruments - Part 1:Invar levelling staffs
	ISO 12858-2:2020	Optics and optical instruments - Ancillary devices for geodetic instruments - Part 2:Tripods
	ISO 12858-3:2005	Optics and optical instruments - Ancillary devices for geodetic instruments - Part 3:Tribrachs

c. Laboratory procedures for testing surveying and con- struction instruments — ISO 16331 Series: The ISO 16331 series has only a single part —ISO 16331-1:2017 which is presented in Table III. This standard specifies procedures in order to assure the compliance of handheld laser distance meters with the performance specifications.

TABLE III
ISO STANDARDS IN 16331 SERIES

	Standard Code	Standard Name
	ISO 16331-1:2017	Optics and optical instruments - Laboratory procedures for testing surveying and construction instruments - Part 1: Performance of handheld laser distance meters

d. Field procedures for testing geodetic and surveying instruments — ISO 17123 Series: The ISO 17123 series has 9 published parts which are presented in Table IV. These standards specify the procedures that is conducted in field to determine and evaluate the precision of geodetic and surveying instruments.

TABLE IV
ISO STANDARDS IN 17123 SERIES

	Standard Code	Standard Name
	ISO 17123-1:2014	Optics and optical instruments - Field procedures for testing geodetic and surveying instruments - Part 1:Theory
	ISO 17123-2:2001	Optics and optical instruments - Field procedures for testing geodetic and surveying instruments - Part 2:Levels
	ISO 17123-3:2001	Optics and optical instruments - Field procedures for testing geodetic and surveying instruments - Part 3:Theodolites
	ISO 17123-4:2012	Optics and optical instruments-Field procedures for testing geodetic and surveying in- struments - Part 4:Electro-optical distance meters (EDM measurements to reflectors)
	ISO 17123-5:2018	Optics and optical instruments-Field procedures for testing geodetic and surveying instruments - Part 5: Total stations
	ISO 17123-6:2012	Optics and optical instruments - Field procedures for testing geodetic and surveying instruments - Part 6: Rotating lasers
	ISO 17123-7:2005	Optics and optical instruments - Field procedures for testing geodetic and surveying instruments - Part 7:Optical plumbing instruments
	ISO 17123-8:2015	Optics and optical instruments - Field procedures for testing geodetic and surveying instruments - Part 8: GNSS field measurements-Part 8: GNSS field measurement systems in real-time kinematic (RTK)
	ISO 17123-9:2018	Optics and optical instruments - Field procedures for testing geodetic and surveying instruments - Part 9:Terrestrial laser scan- ners

TESTING OF GEODETIC AND SURVEYING INSTRUMENTS IN NEPAL

A. Current Practices

While there are practices of testing geodetic and surveying instruments in Nepal, systematic approaches to do so are lacking. One of the prime reasons to this is failure to timely update existing standards and come up with new standards. The existing standards have been outdated with introduction of digital geodetic and surveying instruments. There have been efforts to update the standards but these are not sufficient. A consolidated standard for testing the instruments is needed.

B. Way Forward

The void in national standards for testing of geodetic and surveying instruments can be sufficiently fullfilled by ISO standards. Since, ISO standards are prepared by rigorous process involving experts, it is much more advisable to adopt such standards. If ISO standards already exist pertaining to specific issues, it makes little sense to prepare new standards from ground up. Henceforth, the first step in establishing a testing facility is to adopt the ISO standards as national standards with necessary amendments and refinements where necessary to fit the national context. The next step is to estab- lish a testing facility preferably under the jurisdiction of the National Mapping Agency — Survey Department. Laboratory based testing facility can be established in collaboration with universities which already have similar facilities. While it is important to establish both laboratory and field based facilities, it is advisable to start with establishing a facility to conduct field based testing as this could potentially have less logistical challenges. Premises of Survey Department at Nagarkot and the premises of Land Management Training Center and Kath- mandu University can be potential location for establishment of field based facility. Once built, guidelines to periodically test geodetic and surveying instruments must be prepared and implemented to ensure the reliability of surveying and mapping works conducted throughout the nation.

CONCLUSION

An authoritative testing facility is an immediate necessity for testing geodetic and surveying instruments. In this paper, we have discussed on the ISO standards that would guide the establishment of such a facility. In addition, we havepresented the way forward to establishing such a facility.

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MAPPING AND CONSERVATION NEEDS OF TRAILS

Why the lifelines of rural Nepal need to be protected amidst aggressive accessibility development?

Er. Arun Bhandari
Co-founder, NAXA
arun@naxa.com.np

I was eight when a roaring excavator opened the first motorable track to connect us to the national roads network. It was a big day for the whole village and the operator of the machine was toured around in shoulders with garlands and tika. After a few years, the first bus reached the village. With that, local markets boomed, commodities were no longer to be carried through the trails, medical supplies became convenient, traveling to and from the capital became convenient and a lot of people migrated to cities for seasonal employment. About a decade later, the village was electrified. Now in my early 30's- a proper health post is being constructed. The development has been slow, gradual, and visibly unsatisfactory however.

Accessibility has been the primary factor behind all the other aspects of development. It would have been nearly impossible to carry those electric poles to each settlement and every effort of progress would have been costly. Thanks to the dusty rural roads, infinite opportunities have opened up. My grandfather who is turning a century-old next year says it was out of his imagination that a motor would roll through the village someday. This is in Kavre, an adjoining district to Kathmandu. Accessibility is still a far-fetched ambition to a lot of geographies especially in the upper parts of Sudurpaschim and Karnali Province. Keeping the optimism high that the federalism empowered local governments will very soon make their geographies accessible, I want to discuss a rather different aspect on the agenda of accessibility- Trails.

Downside of Roads observed around the country, some facts and figures then significance of trail would be relevant.

SIGNIFICANCE OF TRAILS

Having been brought up in a rural part of a fairly urban district, trails have been parts of my life. Unlike the hiking trails that are fascinating routes for weekend trips to urban dwellers, trails are like arteries and veins to the rural communities. From non-local food commodities to medical supplies, everything needs to be carried through trails. Students travel to and fro from their schools through trails. Patients are carried on stretchers to the health facilities. All aspects of rural life depend on trails.

Picture: Rural livelihood is deeply rooted in the trails.
Photo Credit: Muskan Dangal

Most of these trails are likely to become vestigial soon. When motorable roads become available, trails will be less preferable, It is definitely not going to be practical any more in using trails when convenient alternatives are available. But, there are a few advantages trails offer that will be gone with them;

- **Ancient heritage**

Trails have existed for centuries. They have been walked from generation to generation. Efforts to strengthen, revise, and safeguard these trails must have been made constantly. So trails are not just reminiscences of the past but carry information about the ancient world. They can depict the geographic setup for social, economic, and cultural activities of rural Nepal.

Trails also reflect the science of the ancient times that should have some rationale behind how trails cross rivers and ridges or how to make sure that drinking water sources and safe resting spots are available on the trails. Trails carry the opportunities for researchers to dig deep into anthropology, ancient livelihoods and socio-economic history of the country.

- **Time effectiveness**

Trail networks spread like a cobweb in rural areas connect villages in the most time-effective manner. Unlike vehicular roads, trails do not have to take long turns or maintain grades. These are thus short-cuts,

diagonals. Walking through trails can often take the same time as driving through the tracks in the hills.

- **Cost-effectiveness**

Trails are cost-effective in two aspects: land coverage and mode of transportation. Trails are by nature narrow and short. They do not require land acquisition on a large scale as is required for road construction and widening. And the trails that exist today have already been classified as public land areas. Hence no further acquisition of land is necessary. Maintenance, strengthening, and widening costs for the trails are also negligible compared to motorable roads. The other aspect is that using trails is free of cost and clean for the environment.

- **Great alternative**

Even though there are very few alternatives to vehicular roads for the transportation of goods, trails can still be the alternatives for travel. Ropeways and trains may be the future but trails are still going to be relevant because they will be free, fast, and terrestrial alternatives. In the transitional period when we are on the verge switching completely to travel-on-wheels from travel-by-foot, we are faced with some serious chaos. Primarily because the new tracks have not stabilized in the terrain due to constant occurrence landslides and flash floods (induced by the construction activity itself), our new routes of travel are seasonal and more risky. Most of the hilly roads are not operational during the monsoon season and require a lot of time and cost for maintenance every year. Trails are the alternatives being used, and they can be the alternatives during inevitable disturbances in road networks in the future as well.

- **Resilience**

The resilience of trails to natural disasters is higher than that of roads. This is again subject to various other factors like geography, quality of construction, and measures taken to avoid damage. But, fine trails that have existed for centuries have adapted to nature especially flow directions in the watershed. Constructed roads change how water flows in the terrain often leading to damage on the terrain where water in the side canal is let out. In the rural tracks that have been opened everywhere, landslides induced by changed water flow channels are frequent. We have seen in recent years the damage that has caused.

Even though it is not the finding of a scientifically backed research work, an observation I made during a recent field activity for trail mapping is that disaster occurrence is higher in areas that have seen more road construction than areas that still rely on trails. There are less landslides, less erosion of soil masses and calamities due to natural disasters tend to be low. In fact, in the case of Bajura district that suffered heavily from flooding of Budiganga River this year, construction of tracks parallel to the river hence leading to blockade of the river by slumped soil masses during monsoon is considered as the primary factor for the floods.

Images: Unlike trails that cause minimal damage to the terrain, roads that are haphazardly constructed are not just damaging the terrain but also leading to calamities on human lives and properties.
Photo Credit: Arun Bhandari

- **Health benefits**

While it may sound absurd of an idea that continuing to use trails can be a practical means of staying fit, it is not undeniable that the use of trails in everyday life contributes to an overall physical wellbeing. With vehicles carrying us everywhere, the culture (or rather the need) of walking is also fading. Modern society resorts to gyms and indoor fitness activities to be healthy while the lifestyle of having to walk through the ups and downs of trails is gone. With vanishing trails, fitness emerges as a requirement to fulfil rather than naturally assured by the lifestyle.

- **Harmony with nature**

As the point made with resilience, trails have existed for a long time in harmony with nature. They have adapted with nature, or perhaps nature has molded trails within itself. This harmony is what makes trails resilient and sustainable.

- **Trails may soon vanish**

With modern motorable roads connecting all corners of the country, trails will start becoming useless. Let us predict what might happen when people stop using trails. Trails exist because of the feet that walk them. With footmarks, traces of where trails existed will also be gone. Soon, grasses start covering the trails, and bushes hide them ultimately. Since we do not have signs or marks to guide through trails, no evidence will remain that trails used to exist there except the minds that remember them and the cadastral maps that

may contain the information. While the reality of our maps cannot give us confidence that the information can actually be derived out, the minds that remember the trails will also be gone someday. Decades later, we will most probably have no clue where the lifelines of our rural geographies exist. With that, we will lose the alternative, efficient, and resilient routes that backed our ancient livelihoods. And the opportunities to utilize these trails in the modern context will also be gone.

Image: A trail that is on the verge of disappearance. Photo Credit: Arun Bhandari

EFFORTS TO PRESERVE TRAILS

While it is quite difficult to convince local governments to invest in the conservation of trails (it sounds like a waste of resources or a backward-facing effort), it is an urgent issue. Trails tend to fade away in a couple of years if not months when people stop using them. Soon, efforts to preserve trails will have to start with finding them first. There are a few things we can start with though:

- **Identify and map trails**

The first step would be to find out where these trails are while they are in use. This can be done by consultation with and mobilization of local community members in the identification process. Some level of prioritization should be done based on the significance of the trails and this can be done by engaging a more research-driven approach too. But once the trails have been identified, mapping them is the most important step. Important because it documents what would otherwise be a list of abstract routes. And all the steps of preservation will be based on the blueprints, the maps.

Trails and Local Infrastructure Mapping Project

Identification and mapping of rural trails have been components of an ongoing project of World Food Programme Nepal for the Ministry of Home Affairs. Under the emergency preparedness and response (EPR) project, WFP Nepal has engaged consulting firms in the prioritization of the most remote districts of Nepal on the basis of the gap in data availability. The gap analysis report, the earliest output of the project, lists the districts where trail identification and mapping is required. Since 2018, WFP has been identifying and mapping the trails that connect the most remote locations of some of these districts. The project has already been implemented in Jumla, Humla and Mugu districts whereas it is ongoing in four other districts; Bajhang and Bajura of Sudurpaschim Province and Dolpa and Kalikot of Karnali Province.

The project has not just identified and mapped trails, it has also mapped the local resources and community infrastructure along the trails mapped. In order to achieve the goal of generating map data and filling the gap, the project's approach has been to sensitize local leaders about the significance of mapping in emergency preparedness and to capacitate the local community members to do the same. So far, the project has mapped more than 3500 Kms of trails altogether, sensitized more than 400 local stakeholders and developed mapping capacity of more than 150 local youths.

Image: Hands on training on mapping tools and technology to local youths and technical manpower in Bajura before field mapping activity. Photo credit: Aashish Dotel

All the map data has been uploaded to OpenStreetMap to be made available for wider use in humanitarian and development projects. Consolidation of collected data was done to develop geodatabases at the district level and profiles at municipal level. These geodatabases contain geotagged photos that were taken to capture the constraints and hazards along the trails during data collection. The outputs of the project can be huge assets to respective districts and local governments to be utilized for effective emergency preparedness and development planning.

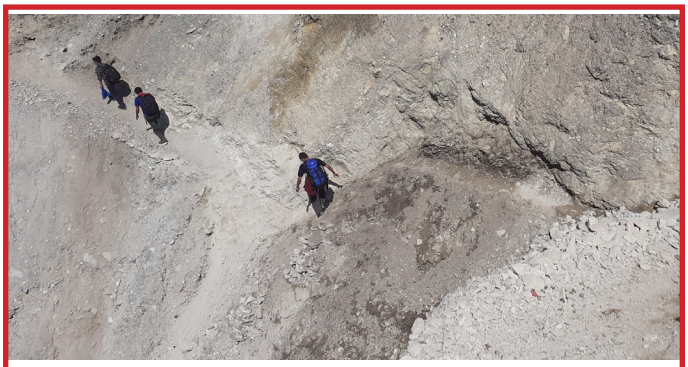

Image : Walking through a narrow landslide-affected trail section during data collection in Bajura District.
Photo credit: Arun Bhandari

- **Spend on strengthening the trails**

Despite resilience and natural adaptation, trails do need to be strengthened in order to be protected. Strengthening here means working to make the trails more walkable by widening very narrow sections, building stairs in steep sections, paving stones in slippery sections and installing fences where necessary. These efforts do require an adequate amount of financial and human resources, but with proper sensitization of the local community, this can be done as yearly programs by either in-kind contribution of the community or by providing employment opportunities to the community members.

An example of this is the Simkhet to Pokhara trail section in Bajura that was strengthened under the Prime Minister Employment Program recently.

Image: A trail section in Gaumul Rural Municipality, Bajura that was strengthened under the Prime Minister Employment Program by providing employment opportunities to local community members.
Photo credit: Arun Bhandari

- **Install route signs**

I remember getting lost in the midst of Shivapuri National Park while hiking to Chisapani from Budhanilkantha in 2011 when no signs were installed. We had a narrow escape from having to stay in the forest all night by losing a few hours walking the wrong trails that led only to the thickness of the national park. Relying on pure judgement about which may be the most walked trail, there have been several cases of lost travellers, some of whom have never returned.

Installing signs on the trails is a very urgent task to do, perhaps the immediate after identification and mapping. It can be coupled with mapping initiatives because installing map boards that can visualize the traveller's current location aids in ensuring safety. These signs preserve the trails as well because they serve as physical pegs on the ground, somewhat like d-cards if the search for trails are needed someday.

- **Convert trails into trekking/hiking routes**

Perhaps this is the most relevant use case of trails that most of us can think of immediately in the rapidly urbanizing world. Trails that were like arteries and veins can be turned into neurons of adventure and bliss. For a country like ours, tourism can be a huge contributor to the national economy and can transform rural lives. If the trails that mostly lead to somewhere beautiful and unique can be converted into routes for adventure, it is a win-win to everyone. Trails should be preserved and they deserve to stay not because they are the reminiscences of our ancestors but also because they carry potentials to shape our future generations too.

While utilization of trails as means of adventure is a great prospect, coupling that idea with protection initiatives like encouraging travellers to map them and keeping a digital database of trails in the country can give genuinely advantageous results.

This article is backed by observations and interactions on the community level rather than structured scientific research and factual support. The objective is largely to develop awareness on the needs to protect trails and encourage for initiatives to do the same.

UNG. BATCH-WISE PHOTOS

GE BATCH-2019

GE BATCH-2018

UNG. BATCH-WISE PHOTOS

GE BATCH-2017

GE BATCH-2016

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STILL ON TOP!!!

8848.86 m

is the new height of the Mt. Everest published on December 8, 2020.

GeoSpace congratulates the Nepalese Survey Team and celebrates the success of the Joint venture between Nepal and China to measure the world's highest peak.