Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of System Engineering and Informatics

Diploma Thesis

Open data in Nepal: web-based disaster risk management

Author: Sajjan Ghimire

Supervisor: Ing. Miloš Ulman, Ph.D.

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DIPLOMA THESIS ASSIGNMENT

Sajjan Ghimire

Informatics

Thesis title

Open data in Nepal: web-based disaster risk management

Objectives of thesis

Main objective of the thesis is to improve the decision making under disaster risk management (such as earthquakes) using opendata for both government and public level in Nepal.
Partial goals of the thesis are as follows:
- to make literature review of open data on the international level and in Nepal,
- to understand the role and potential of open data in disaster risk management,
- to analyse the challenges of recent earthquakes,
- to design an web application for real-time earthquake data.

Methodology

First part of the thesis will be carrying information on open data on the international level and in Nepal. Current situation of Nepal data will be analysed. Second part of the thesis will be focused on 25th April 2015 Nepal earthquake. Roles of all important stakeholders will be described and their data collection methods identified. The practical part will consist of making a web application based on real-time earthquake data. Conclusion will be made based on the synthesis of theoretical knowledge and results of practical part.

The proposed extent of the thesis

60 – 80 pages

Keywords

Open data, Open Nepal, Information, Data, Web application, Data Suppliers, Users.

Recommended information sources

Bertot, J.C., & Choi, H. (2013). Big data and e-government: Issues, policies, and recommendations, 1-10.
Kitchin, Rob. The Data Revolution: Big Data, Open Data, Data Infrastructures & Their Consequences. SAGE
    Publications, 2014.
McDermott, P. (2010). Building open government. Government Information Quarterly, 27(4), 401–413.
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The Diploma Thesis Supervisor

Ing. Miloš Ulman, Ph.D.

Supervising department

Department of Information Technologies

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Ing. Jiří Vaněk, Ph.D.

Head of department

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Ing. Martin Pelikán, Ph.D.

Dean

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Declaration

I declare that I have worked on my diploma thesis titled " Open data in Nepal: web-based disaster risk management" by myself and I have used only the sources mentioned at the end of the diploma dissertation. As the author of the diploma thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 03/31/2016 _____

Sajjan Ghimire

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Souhrn

Pro každou vládu je klíčové shromažďování a vyhodnocování dat týkajících se zranitelnosti a výskytů rizik souvisejících s možnými katastrofami a pro vybudování efektivního systému při katastrofických scénářích. Na dnešním trhu jsou tato data velmi ceněna a vyhledávána pro účely porozumění rizik takových situací. Speciálně pro toto shromažďování dat byla vyvinuta internetová aplikace "Data.Open.NP", která poskytuje tyto informace nejen pro veřejnosti ale i pro všem zainteresovaným stranám. Tato aplikace a všechny veřejně přístupné informace zajistí lepší orientaci a urychlí rozhodování v nastalých rizikových situacích. Takto přístupná data jsou naprostou nutností pro každý stát a jeho orgány veřejné správy. Zároveň tato data usnadní informovanost občanů a zároveň je motivuje k většímu zapojení do děje v celé zemi a zajišťuje transparentnost a korektnost v rozhodování vlády.

Tato práce je založena na internetovém průzkumu zaměřeném na určení a poznání rizik v Nepálu, v zemi, která je nejčastěji postihována přírodními katastrofami. Díky tomuto průzkumu se zjistili závažné nedostatky ve způsobu jakým nepálská vláda informovala občany o rizikových situacích. Zvláště proto bylo nutno vyvinout volně přístupnou webovou aplikaci pro sdílení těchto dat s veřejností a všemi ostatními subjekty, které by tyto data dále využívaly. Tato aplikace byla postavena na nejnovějších webových technologiích a využívá například HTML5, CSS3, JavaScript, jQuerry a další. Aplikace poskytuje mezi jinými například funkci mapování zemětřesení v reálném čase, datové tabulky s možností stáhnout data ve standardních formátech a samozřejmě možnost přihlásit se k této aplikaci přes sociální média a poskytovat tímto způsobem zpětnou vazbu, či nová data správcům, pomocí přednastavených formulářů.

V této práci najdete také srovnání aplikace "Data.Open.NP" s dvěma podobnými webovými aplikacemi. A přesto, že by se dala tato aplikace v porovnání s ostatními weby hodně rozšířit, má velmi skvělé vlastnosti, díky kterým se "Data.Open.NP", s průběžnou údržbou a aktualizacemi, může zařadit mezi vysoce hodnocené a užitečné webové aplikace, které jsou závislé na zpětné vazbě od uživatelů a hostů.

Klíčová slova: Otevřený Nepál, Informace, HTML5, CSS3, JavaScript, uživatelé, zemětřesení, Informační technologie

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Summary

The government is the key player to collect, curate and analyse data about the vulnerability, exposure and other relevant sets of evidence for making effective disaster risk management. Such data is being highly demanded in the market on today's date to be open for the purpose of understanding the disaster risks. In this paper, a web application "Data.Open.NP" has been developed which provides open data for the public and stakeholders regarding the disaster risk management. The data that are fully open helps the decision makers across the country in decision making. Open data is being an urge for every nation on various levels of public administration. The encouragement for the release of open data rises from the hope of massive involvement of public in government which has thoroughly increased transparency and improved decision-making and thus makes a smarter government through data provision.

In this paper, an online survey was done to find the relevant information about the disaster risks in Nepal, a country that is mostly affected by the natural disasters and hazards. Through the survey, it was found that government of Nepal has been failing to provide information to the public and stakeholders. So, it was urged to develop a web-based application that would facilitate the public and stakeholders with the relevant sets of data as desired by them. The web application was built using the latest web technologies like HTML5, CSS3, JavaScript, jQuerry and so on. This application provides the features like real time earthquake map with markers, data table and an option to download the data in standard formats. Also, it connects the user through social media, and administrator can receive feedbacks, data and so on through the online forms.

Furthermore, this thesis compares the features of Data.Open.NP with other two web applications and Data.Open.NP was found to be a scalable web application compared with others. However, it still holds great features as the other web application do. With regular updates and maintenance, Data.Open.NP can be a highly rated web application which depends on the user feedback and rating.

Keywords: Open Nepal, Information, HTML5, CSS3, JavaScript, Users, Earthquakes, Web Technologies

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1 Introduction

This thesis aims to reduce the impacts of disasters by providing better information to the stakeholders, policy makers and the civil society in Nepal. The idea of better information means the use of open data as useful tools for a significant and enhanced decision-making process regarding the vulnerability and risks due to disasters. A web application based on open data will be built to share the information with the public on ongoing and future disaster risks. All the data in this web application will be free to use under a particular license that will allow the end users to reuse and to redistribute the data for commercial or non-commercial uses in a legal way. Open data are data which are available on the web at a particular address that can be filtered, viewed, downloaded or accessed through an application programming interface in structured or unstructured formats. Over a decade, there have been dramatic changes in the release of open data or open government data. Today in many countries, datasets ranging from weather statistics to economic data, health to transport data and hazards to disasters data has been placed on the internet with particular formats of data depending on that country.

On 25th April 2015 (1), a powerful earthquake rocked Nepal with an epicentre 77km northwest of the capital city (Kathmandu) in Barak, Gorkha district. According to United Nations, eight million people have been affected, over 9000 people was killed, and many houses, historic buildings and hospitals fell to the ground due to the devastating earthquake. The government of Nepal had a terrible time handling the situation since the bridges, roads and houses were damaged, and rescue and relief work was taking much longer than it should take. The government of Nepal has faced many disasters like this time to time. Nepal is known to have variable climatic conditions, rugged topography and complex geological structure that makes it more vulnerable to the disaster every year. This thesis will provide relevant information regarding the disasters that are being unreached to the public through a web application.

This thesis will be more focused on open formats data for geospatial data that uses CSV, ShapeFile and GeoTiff or Open Geospatial Consortium (OGC) standard web services. The motive to use geospatial data is to locate the impact area of disaster in the maps and visualize the valuable information by analysing and designing the trend of disaster. An online survey will be made to know what kind of data are needed to be made

available to public and stakeholders so that it could lead to providing relevant information through a web application. At last, the possible benefits, the general overview of a web application and technologies used will be described in detail.

2 Objectives and Methodology

2.1 Objectives

This diploma thesis focuses on sorting out the communication gap between the government and the public by developing a web application based on open data. The primary aim of this thesis is to improve the decision making under disaster risk management (such as earthquakes) using Open data for both government and public level in Nepal. Partial goals of the thesis are as follows:

- To make literature review of open data on the international level and in Nepal,

- To understand the role and potential of open data in disaster risk management,

- To analyse the challenges of recent earthquakes,

- To design a web application for real-time earthquake data.

2.2 Methodology

The different methods will be applied to know the needs of the public based on the necessity of information to be provided during disaster risk. The first part of the thesis will be carrying information on open data on the international level and in Nepal. The Facts and Figures considering the impacts and effects of disasters will be presented in the literature section, and a brief description of the involvement of organisations or community will be provided to show how the situation can be handled before, during and after the disaster. The second part of the thesis will be followed by a survey and questionnaire which will focus on to find the actual needs of public and stakeholder regarding getting relevant information and data of disasters in Nepal. Roles of all relevant stakeholders will be described and their data collection methods identified. After the analysis of survey and questionnaire, it will be followed by actual design and development of a web application which uses a dataset related to disaster risk management. Relevant information about disaster will be loaded into the database. Then, the application will present that data in an understandable way to be interpreted by the user, from which he or she can get desired Facts and Figures. The conclusion will be made based on the synthesis of theoretical knowledge and results of the practical work.

3 Literature Review

3.1 Concept of Open Data

The rapid and expanding growth in technology has increased the computing power and storage capacity. The purpose and use of data have been changed with time. Once data was utilized in a particular research, it was considered as of no importance in further studies. Now, data has become right for everything and raw material for business, an input for vital economic to lead a new kind of economic value. Furthermore, the concept of reusing of data has grown for creating new ideas, innovation and services (2). In this 21st century, more than an average population do have a mobile device in their pockets or notebook in their backpack or back in their houses or offices. The need for information and access to information have become the priority in people's day to day life. The person who is in need to find a new location, he/she just navigates the maps in their mobile or computer devices and can locate their destination in no time unless the data in the map is complete, accurate and updated. If the data is open and updated time to time, people will be aware of what's going on right now and will be able to follow the pattern in that time. However, all data or information are not accessed or open to all public in most cases. The reasons might be different in different areas related to data quality, legal or business case, technical or organisational issue and uncertainty or risk.

Open data can be defined as accessible public data that people, companies, and organizations can use to launch new ventures, analyse patterns and trends, make data –driven decisions, and solve complex problems (3). The source is open data. It is simple: the data is public, generated from the government or other sources and is available for the business process or to any sector/individual, to solve simple or complex scenario or needs by analysing deviations and trends of data. Anyone who has searched for public transportation routines, used natural disaster alerts applications, or booked a hotel online has used open data. Nowadays you even don't notice that you have just used open data because the daily activities look very convenient and common with the use of more powerful computers, smartphones, etc.

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If people put data onto the Web-government data, scientific data, community data, whatever it is – it will be used by the other people to do wonderful things in ways that they never imagined (4).

According to Tim Berners-Lee (4), 2010 was a year to observe the coming of a "worldwide open data movement." The talks and debates continued since that time whether open data would be a good source to make information available to everyone. The talks and discussions for using open data were moved forward by some particular events and programs such the Organisation for Economic Co-operation and Development Committee for Scientific and Technological Policy's Declaration and initiative of U.S. President Barack Obama's Open Government in 2009 (4). However, initiation of open data played a significant role in relief efforts when the magnitude of 7.0 Rector scaled earthquake rocked the Haiti in 2010. This time, open data was applied to provide real-time information to generate real-time streets maps finding the place of hazards, aid stations and refugees and also can be used by volunteers, related organisations, evacuation team and others.

The new concepts of open data have been developing since then and has been widely praised by public and grabbed their attention too. The decision-making has been more transparent with the available facts and Figures. The Internet, today, has made publicly accessible of both historical and real-time data. Every day a massive amount of data is being generated, and the storage of these data are readily available either in cloud or server's storage (2). If someone needs a massive amount of data, it can be accessed through anywhere, anytime and in a convenient way through the Internet. After the access to data, it can be managed, stored, manipulated, processed, analysed and presented to create reports and dashboards to generate the information, patterns or trends of data.

The publicly available data sets reflect certain patterns that can be used to extract the information. The use of visual analytics and visualization of data helps to deal with the compound data sets using mathematical or statistical tools (5). The Different analyst uses various techniques. However, the primary goals are to find the patterns, analyse clusters and outline gaps or outliers within such massive and huge data sets. The computer displays extensive data sets both web and storage based and

the user can modify or manipulate with the highest refresh rate of the screen, use colours or markers to identify data quickly, use different analysis tools with relevant to data and so on. The logical formulas and functions play an important role to split the large set of data into some useful information. Thus, this information is critical to public and plays vital role in making a decision by figuring out data that are open publicly. The formats how to publish a data also plays an important role making it more visual, readable, and usable.

3.1.1 5 ★ Open Data

Tim Berners-Lee, the inventor of the World Wide Web and the Web and Linked data initiator, suggested a 5-star deployment scheme for Open Data (6). For each level of Tim's 5-star Open Data plan, follows the particular restriction on availability and visibility of the data format. They are as follows (6):

★ – whatever the format is, make the data available on the web under an open license. However, it is hard to extract the data from the document since the data gets locked in a document.

★★ – use of excel instead of image scan of Facts and Figures i.e. structured data. In this, data can be extracted only in case of available proprietary software. The data is machine-readable and is structured.

★★★ – available in a non-proprietary open format i.e. CSV as well as of Excel. It means you can take out the data from the document, and anyone can use the data efficiently.

★★★★ – using of URIs to show things, which points their stuff. The data contains URI and is ready to be shared on the web. The most common way to represent the data is with RDF and another format like Atom.

★★★★★ – connects data link to link to provide more context. Finally, the data is on the web and linked to other data.

The comparison between the 5 ★ data has been made to address how the user gets benefits through the type of data (Table 1).

Table 1. Benefits of using data format on the open data standards as a user

Benefits / Data Format	★	★★	★★★	★★★★	★★★★★
View, Print, Store, Extract, Modify, Share	✓	✓	✓	✓	✓
Direct Process	✗	✓	✓	✓	✓
Direct export to another format	✗	✓	✓	✓	✓
Manipulate without owning software package	✗	✗	✓	✓	✓
Bookmark, Reuse, Use of RDF, can combine with other data	✗	✗	✗	✓	✓
Data scheme	✗	✗	✗	✗	✓
More related data	✗	✗	✗	✗	✓
Broken data links	✗	✗	✗	✗	✓
Presenting data from an arbitrary link	✗	✗	✗	✗	✓

(★- star, ✗ - not supported, ✓ - supported)

(Source: (6))

The comparison between the 5 ★ data has been made to address how the publisher gets benefits through the type of data (Table 2).

Table 2. Benefits of using data format on the open data standards as a publisher

Benefits / Data Format	★	★★	★★★	★★★★	★★★★★
Simple, open license	✓	✓	✓	✓	✓
Need converters or plug-ins	✗		✓	✓	✓
Load balancing, caching	✗	✗	✗	✓	✓
Others can link the data	✗		✗	✓	✓
Need of slicing and dicing of data, assign URIs, find existing pattern to reuse	✗	✗	✗	✓	✓
Making data discoverable, increase value of data, gain from links, invest resources to link, repair of broken links	✗	✗	✗	✗	✓

(★- star, ✗ - not supported, ✓ - supported)

(Source: (6))

3.2 Open Government Data

The government is facing enormous challenges as we are stepping into the future. Most governments still show the industrial age behaviour with the same command and control process. The use of computers came in handy for solving and building data to create elaborate procedures, methods, controls and structure. The government had to cope with the inconsistent database, non-unified data, data anomalies and duelling spreadsheets. back in 20th century. The government started to participate in broad with citizens and other stakeholders with the launch of e-government in 2006 (7). It brought more facility to the public to use government services and information however it was only an online-based version of the existing process. Back in 2010, after open government concepts emerged, most governments opened its door to share its resources that were protected and hidden, involved with the public to make transparent system making itself an integrated and networked organisation.

The general requirement of open government data (OGD) is that the data is accessible through the web i.e. online, is in standard and re-useable formats and under given licenses that data can be re-used in different contexts. The use of mashups and web 2.0 gave more life to the government to make data available, transparent and accessible. The data portals have been created by government and public organisation to list their data under the open data provision. OGD has become a political objective and a big commitment for many countries (8). It has shown a roadmap to support government objective to bring a change in the economy and improve public services. Most of the developed country have already been the success in launching OGD however there are many governments making plans to initialize or still unknown about the benefit of OGD. The reasons that are hindering OGD in different government level might be cost factors for collecting and processing of public data, security reasons, lack of technical equipment or skilled manpower. OGD is all about bringing a positive impact on an economy, social and good governance value and other positive values.

The government has put forward the concept and process on how to deal with data that makes them open. Given below are some distinct process of OGD that government uses: (9)

1. About facts: In most cases, it is often underestimated that data are for developers and their uses. However, this concept goes back long ago. Now, data means for all, all those individuals who are seeking out facts and Figures for their individual or organisational needs. It helps them to solve, analyse and process the data to get required pattern, values or trends of data. Facts can be accessed online through different web interfaces and can be downloaded in the form of spreadsheets, CSV, and other visual applications.

2. Providing Information: Raw data are the source of information. It can be used and analysed through different mathematical functions, statistical tools and visual applications as per need. The conventional methods are interpreting data, making reports and dashboards using graphs, Figure and trends.

3. Creating of the interface: The smooth, clean, and user-friendly sources of datasets are more likely to be accessed and explored by the users. The custom manipulation for searching or filtering data using a certain mash-up for a

massive data sets, a tool for browsing and creating source feedback provides a better interface. Often interface includes the ability to the interpretation of data i.e. summary statistics.

4. Sharing: This means sharing an existing or new datasets either in the same format or another, combined datasets or already manipulated datasets. Any datasets can be shared regarding its size, location of storage using applications through web or applications and hardware. It is important to make datasets easily downloadable.

5. Service oriented: Most data are needed to service oriented. For, e.g., OGD does play its role in making services available online or offline. It may also create a boundary to use data for specific users for some confidential datasets.

The different government do have their implementations and strategies and are using multiple processes based on their purpose. Still the use of OGD is exploratory and experimental. The rapid growth in the technology and changes in government acts and views has made a change in OGD concepts and its uses. The questions may raise about how current OGD will cope with the updates to original datasets, how secure it may be by publishing open and how to optimise the costs on doing so.

For various reasons, there is involvement of people for putting OGD to work out. Many research and initiatives are continuously taking OGD to a new level. The engagement of people working in private sector, local and national public sector institutions and data suppliers, volunteers working in many projects and research, academic institution and many other known and unknown sources are using OGD and helping out to bring OGD in public level. It can be categorised in following sets of drivers who uses OGD (10).

1. The Government focused: These category wants to understand the norms and values of government and gives anything that could enhance and promote efficiency and accountability.

2. Enhancing Technology: These seekers are interested in providing and creating a new platform, tools and applications where all the needs to solve problems can be resolved in an easy and convenient way.

3. Seeking Reward: For getting beneficiary or rewards, these types are motivated to deliver maximum outputs for the desired goals. They use OGD as a source to find real usability and patterns of data that would lead some new ideas.

4. Problem solver: The use of OGD helps to meet desired outputs or solves problem. Looking into the chunks of datasets, anyone can use it and manipulate it according to the need and necessity. The analysis of data may lead to useful information that can be helpful for individual entities for solving the arising problems. It also helps in enhancing the decision-making process.

5. Public/social sector enterprise: These users uses OGD to provide services to the public and social sector. Informing public on specific problems or activities, informing public citizens about certain events, telling about support campaign and movement are some purposes of using OGD.

6. Digitizing Government: The process to manage files, creation and delivery of images using the modern equipment of digitizing are essential in any offices. Government seeking technology wants to improve efficiency and functioning of its activities.

OGD is being used to inform and practice within the OGD from various users. The most developed concept on this is that data is not just for developers but is for anyone who intends to use and access it. OGD is successful in delivering its data to all citizens, media, organisations and different government authorities. The new trend to develop and offer the public services through the use of OGD has been increasing day by day. With the development of OGD infrastructure, there could be a threat to politics and power of the nation due to publicly available of data and digitization of government.

3.2.1 Open Data and RTI in Nepal

There are many instances that the government authority often feels not to share information upon request with public. However, there are many cases and successful stories of public empowerment brought by the right to information (RTI) act. With the emerging of open data in Nepal, the goal to achieve transparency and accountability of

public sectors has a demand to improve and move ahead with time. Even though both RTI and open data come from different origins and community, it does share some common goals.

According to Nepal's interim constitution, RTI can be defined as a right given to citizens to know information of public concern. Further, it states, 'every citizen shall have the right to demand and receive information on any matter of his or her interest of public interest' (11). The right to information rule, 2009 and the Right to Information Act, 2007 provides public agencies to issue proactively information on 21 types of information, maintain updated information and appointment of an information officer (11).

With the increase in the use of the internet, open data is gradually receiving a significant attention as an initiation to make open government. The collective work of the Aid Management Platform and CSO-led initiation has opened a path for the development of open data in Nepal (11). The involvement of the stakeholders and initiatives has brought different audiences together i.e. researchers, CSOs, government authorities and journalists to improve the impact of public budget and aid data, increase the availability and accessibility of budget information and other related data. Despite the work was done, there is still a lot to be done to bring disclosed data in an open and shareable format. The government of Nepal has not addressed any such bilateral agreements for issuing standard level of open data.

3.2.2 Current Status of OGD in Nepal and Solutions

After viewing some important websites of the government of Nepal, some drawbacks and solutions based on it are made of how OGD can be used further to enhance its level:

E-government data framework: Most of the data are stored electronically, normally in pdf or scan format. This tendency of government to release data leads to an unclear and unreadable data. These files are only accessible in one office and cannot be manipulated or updated from other departments. So, certain standards must be used by the government of Nepal for the accessibility, modification and re-use of data. The use of CSV and excels file would give a far better result than this (12).

1. Open data policy: A limited use of open data is not sufficient to represent a transparent and accountable public sectors. A good amount of data must be

made despite storing data for private use. Open data helps to create an opportunity for economy growth and making of effective economic policies. The initiators of open Nepal like CSO and Aid Management Platform must be encouraged both from private and public sectors.

2. The Machine Readable: The use of pdf, Figures and pictures are very common among the websites in Nepal. Even though the provided data are human readable, it is not a machine readable. The data is a source of information which under analysis would benefit the users. These data must be machine readable so the user can manipulate, redesign, reprocess and analysed to extract desired information. The well-defined XML, standards like search capability, mash-ups and browsing are the important component of open data.

3. Accessibility of data: The main question is who can access the data? A typical citizen might be able to use data. However, a category of people with disabilities, uneducated and aged might have an issue with the access of data. According to W3C standards, it is critical to making the data useful for all category of people. In Nepal, many developers are unaware of this criteria.

3.3 General Information of Nepal

3.3.1 Geography

Nepal is located in central part of the Himalayan belt, situated between the latitudes of 26'22" to 30'27" north and the longitude of 80.04' to 88.012" east. It covers an area of 1, 47,181 square km spreading 145 to 241 km from north to south and 885 km from east to west (13). Nepal is known to have variable climatic conditions, rugged topography and complex geological structure (lies in the middle of Indian plate and Eurasian plate) and followed by continued seismic activities. The country is divided into three geographical regions i.e. mountains (15%), hills (68%) and the plain Terai (17%) of its total mass. The slope of the country rises from 70 m to 8848 m in height (13).

3.3.2 Socio-economic

In Nepal, life expectancy at birth is 69 years and the literacy rate of youth (15-24 years) is 85 percent (14). The net enrolment rate, primary and both sexes in education is 98 percent (14). Population below poverty line is 25.2 percent (15). Annual GDP growth rate of Nepal is estimated to be 4.1 percent (14). The World bank estimates the inflation rate with GDP deflator is 8.7 percent and total GDP growth for the year 2014 is 5.4%, and GNI is (current US$) is 20,642,759,531 (14). However, the graphics have declined to a very low Figure due to the ongoing political instability and strikes in borders in the south. The country depends mostly depends on imports (more than 80% from the south, India) and the obstacles in border has created huge downfall in the economy of a country.

3.4 Disaster Risk Management

According to the United Nations, 'A disaster is a serious disruption of the functioning of a community or a society and involve of widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources' (16). It can be further explained as a result brought together due to the exposure to a hazard, presence of the vulnerability and lack of sufficient or capable measures to minimize or tackle the adverse effects. The impacts of a disaster can be categorised into socio-economical, environmental and individual effects such as deaths, injury, mental issues, damage to property or assets, social and cultural problems and degradation of the environment and disruption of an economy and so on. These potential losses which may occur within the targeted area over a period are classified as disaster risk. The disaster risk is the outcomes of the disaster effects. It can be mapped, or its pattern can be studied further based on the prior knowledge of prevailing hazards to reduce or minimize the risk.

The United Nations defines a disaster risk management as a systematic process of using administrative directives, organizations and operational skills and capacities to implement strategies, policies and improved coping capacities to lessen the adverse impacts of hazards and the possibility of disaster (16). The primary aim of

disaster risk management is to keep away, minimize or change the pattern of the adverse effects of disaster through conducting activities and measures for mitigation, prevention and preparedness.

3.5 Disaster Risk Reduction

The United Nation describes a disaster risk reduction as the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment and improved preparedness for adverse events (16). Sometimes it is also used as the term "disaster reduction" giving itself a suitable recognition to face the nature of disaster and potential of the disaster itself to reduce its risks. The plans for disaster risk reduction has been carried through many countries where lies a minor to massive threats concerning the natural hazards, climatic change and another linkage to a disaster.

3.6 Disaster in Nepal

Nepal comes into 20th place in the disaster-prone country in the world due to its fragile geology and steep topography. Nepal ranks fourth (vulnerability to climate change), 11th (earthquake) and 30th (flood hazards) in the world. Among the natural hazards, earthquakes, floods, glacier lake outburst flood (GLOF), avalanches and landslides are the major disasters that have brought Nepal to lose lots of human death, a vast amount of property destruction and natural disturbances (17). The factors contributing to disaster vulnerability are listed below:

- Ecological, geological and hydro-meteorological phenomena

- Rapid population growth and migrations increasing population density

- Deforestation for urbanisation or human settlements

- Landmass texture

- Poverty

- Lack of skilled engineers

- Unplanned urban regions

- Lack of awareness programs and facilities

- Political instability and system of bribe

The scenario of deaths resulting from major disaster risks (2000-2011) in Nepal is presented in Figure 1.

year	Flood &landslide	Earth- quake	Thunder- bolt	fire	Hails- tone	Wind- storm	epidemic	avalanche	total
2000	173	0	23	53	1	2	141	-	393
2001	196	1	39	26	1	1	154	-	418
2002	441	0	3	14	0	3	0	-	461
2003	232	0	42	16	0	20	-	-	310
2004	131	0	10	10	0	0	41	-	192
2005	141	0	18	28	0	0	34	21	242
2006	141	0	17	28	1	0	34	-	221
2007	216	0	35	34	18	1	9	9	322
2008	134	0	14	11	0	2	10	0	171
2009	135	0	7	35	0	0	462	2	641
2010	201	0	39	42	0	2	34	2	320
2011	269	6	95	46	2	6	9	0	433

Figure 1. Deaths resulting from major disaster risks (2000-2011) in Nepal

(source: 17)

The number of death recorded are always less than what it is appeared to be due to the lack of proper information, accurate data and carelessness. There are various other reasons why government must understand its role in monitoring the disaster and retrieving the data through involvement in people or at a national level. The death tolls from the year 1971-2009 in Nepal is presented in Figure 2.
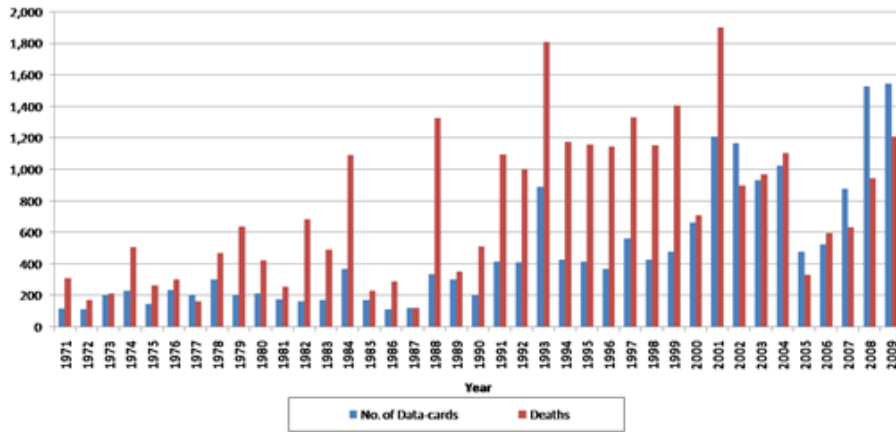
Figure 2. Human deaths and disaster records in Nepal, 1971-2009

(source: (18)

3.7 Major legal Arrangement in Nepal

3.7.1 Natural Calamity Relief Act (NCRA)

In 1982, NCRA was formulated and was amended in 1989 & 1992. The NCRA act implies natural disaster like earthquakes, floods, fire, landslides, storm, heavy rain, drought, epidemic and other similar natural disaster along with industrial accidents caused by the explosions or failure. The major works carried under this NCRA Act are to remove the inconvenience and grief caused to people, to protect public property and life, to facilitate immediate treatments and relocation of victims, to control and reduce natural hazards. The provisions that are frequently active and working are Central Natural Disaster Relief Committee (CNDRC), District Natural Disaster Relief Committee (DDRC). The other two Regional Natural Disaster Relief Committee (RDRC) and Local Natural Disaster Relief Committee (LDRC) are mostly active during the state of emergency due to disaster. The other roles of this act are to empower the government to the state of urgency during a disaster. It also allows some exclusive rights for the higher level managers to manage rescue and relief work in their way. It also empowers individual rights to allocate fund to the local level in the rescue purpose (20).

3.7.2   Local Self-Governance Act (LSGA)

In 1999, The LSGA was amended to empower local bodies to govern themselves. The aim of this act is to recognise that local people and local agencies are the most valuable points of entry to meet development requirements at the local level. The LSGA handles to undertake some functions on DRR by local bodies. Other provisions were established such as Environment Protection Fund and Disaster Management Fund at DDCs, VDCs and Municipalities. Some of the assigned task that local agencies can pursue by using the legal authority granted by the LSGA are to control natural calamities, prevention of infectious disease and epidemics, operation and management of fire brigades, developing mitigating and preventive measures against landslide and foods, (20).

3.8   Policies and Programs

3.8.1   National Strategy for Disaster Risk Management (NSDRM)

In 2009, the NSDRM was formed by Hyogo Framework for Action (HFA), 2005. Many special events were organised to get ideas from the local bodies, academic institutions, the private sector, governmental and non-governmental agencies, UN agencies, INGOs and others. The primary aim of this program is to enhance Nepal as a disaster resilient community. It helps in providing guidance and enhancing disaster management through the development and implementation of various concepts to prepare for mitigation, risk reduction and occurrence of hazards. The main principles that were adopted are listed below:

- Ensure safety and security of personal life

- Focusses on DRR concept into the development plan

- Holistic approach

- Gender and social inclusion

- Decentralization process

- Priority to staff safety and security

- Working style with spirit of participation, coordination and interaction

- Following one-window policy and implementation of DRM with cluster approach

- Flagship Approach on Disaster Risk Reduction

To support the government of Nepal, An International Consortium was formed in 2009 to promote a long-term disaster risk action plans to build on the National Strategy for Disaster Risk Management (NSDRM). The Consortium members were the Asian Development Bank (ADB), United Nations Development Programme (UNDP), UN Office for the Coordination of Humanitarian Affairs (OCHA), UN International Strategy for Disaster Reduction (ISDR) the International Federation of the Red Cross and Red Crescent Societies (IFRC) and the World Bank (20). Also, the Consortium involved a multi-stakeholder participatory process with the Government of Nepal and civil society organisations for finding disaster risk reduction priorities. These steps were meaningful and reasonable by current institutional and policy arrangements in the country.

Based on the significant priorities set by the government and also discussions with multi-stakeholder groups, five flagship areas were established and are as follows:

- Safety of school and hospitals- making earthquake resilient,

- Preparation for emergency and response capacity

- Flood management in the Koshi river basin

- Integrated community-based DRR/DRM

- Policy/Institutional support for DRM

3.8.2 Periodic Plans

The periodical management program was first introduced in the 10th national policy of the government of Nepal (2002-2007).

Similarly, the Three Year Interim Plan (2007-2010) brought a different chapter (19) on natural disaster management. The interim plan focuses on policy formulation, upgrading institutional mechanism, EWS, a coordinated and systematic approach for DRR and linking DRM on climate change. Again, the three-year development plan (2010-2013) was set to achieve the goals of Hyogo Framework for Action by 2015 (14). Long term

motive of this project is to develop disaster resilient Nepal. This project addressed disaster management issues more comprehensively.

Other policies and acts

- Soil and water conservation act, 1982

- Environment protection act, 1996

- National urban policy, 2006

- Water-induced disaster management policy, 2006 and so on.

3.9   Data Collection: Community Mapping Platform

An effort has to be made for a field data collection which starts from picking a city that is vulnerable or is at risk of disaster. It can be further extended to the neighbouring city or based on the priorities. The primary objective of a field data collection is to collect data that comes handy for a decision making. The initial steps are to train a small group of skilled mappers and volunteers that can be brought together as a core team. Their task would be collecting data, adapting the situations to the problems and recruiting other mappers and train them as the scale of data collection increases. The steps carried by OpenDRI (21) to make it more efficient and fruitful are listed below:

1. Preparation: The first is to identify the analytical problem that needs to be solved in disaster risk management. The preparation comes handy with the involvement of motivated and trained personnel, volunteers and well-tailored designs and so on. It might take a couple of weeks or months to make the first step. Next step is to define the scope of work and its strategy. Such as:

Scope: This is the phase where the team will need to realize what specific data is to be collected, on its focused concerned area and collecting of other associated data that may come handy for further research to handle a set of analytical problems.

Data Models: The data models are made before going to the field for the quick access of data. These models are created in the design process and objectives or based on existing data models.

A working place / Innovation Lab: A company or a stakeholders or volunteers that provide a place for planning, organising, supporting and managing equipment to work out the ongoing campaign. It involves in facilitating and providing services like training, motivating and designing. Innovation lab consists of a member from the government, NGOs and international organisations.

2. The start of Work: Once the working place or innovation lab is set, the work plan begins with recruiting, training and inspiring the teams for field surveys, data entry, mapping and so on. It involves following steps (21):

- Training: The recruiting of the team members follows up by training the needs as per the work and based on their positions. The team must have the knowledge of community mapping practices and relevant skills according to their task. The managers or trainers must ensure that his/her team does have the required skills and if not needed training must be given in key areas like:

- Outreaching, mobilization and training: The team must be able to provide the services and outreach to the local community to get the maximum benefits/help from the local. These team can be mobilized for further work, and they can be the base for training other incoming staffs.

- Software Development and Graphic Design: There is a need for software developers and graphic designers which help to provide a framework for entering data into a system, make the data accessible to the public and co-workers, create a data flow diagram or use cases and other various related design programs.

- Mapping and GIS: The use of these techniques provides a great framework in the concept of open data related to disaster risk management. GIS are computer-based systems which are designed to capture, record, analyse and visualise the data related to the different position of earth's surface (22). It uses multiple layers of data which show various information regarding the earth as illustrated in Figure 3.
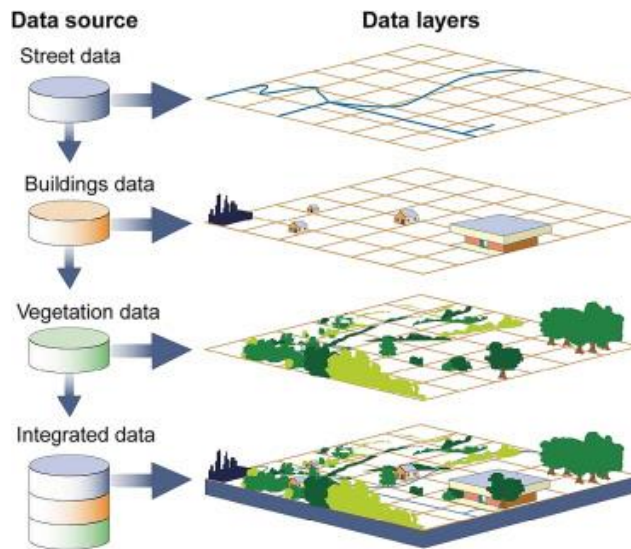
Figure 3. The different layers of GIS with particular type of data

(Source: (22))

The old hand made maps are to be scanned and digitalised to make data available. The images that are already in digital form takes no time to be uploaded into GIS. The GIS has its main role in supporting DRM. It is a massive digital storage for geographically based information related to disasters and natural hazards. A highly maintained digital source makes it more efficient and easier to interpret the data about risk in a particular area or for prevention in future. It helps to mobilize budgets, funds, medicines and shelter items.

OpenStreetMap

OpenStreetMap is an initiation started by a community of mappers working together under the OpenStreetMap Foundation (OSMF) licensed under the Open Data Commons Open Database License (ODbL) (23). Currently, it is helping in mapping and maintaining the data about roads, traffic, stations and hospitals and so on. The maps are designed as shown in Figure 4.
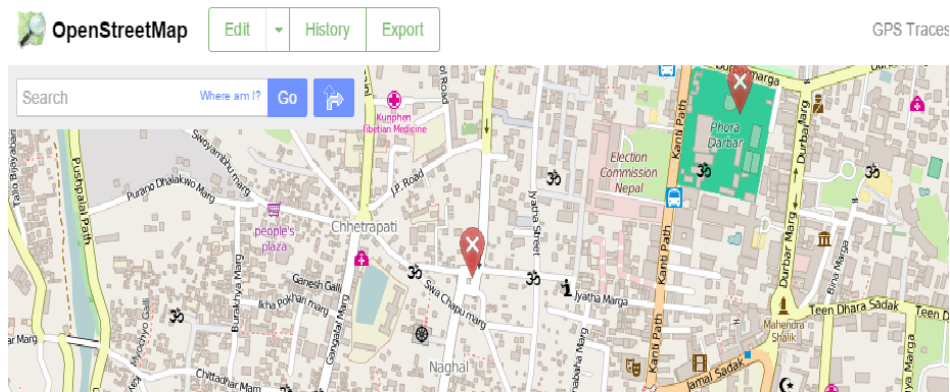
Figure 4. Open street map of Kathmandu valley

(Source: (23))

In 2006, openstreetmap.org was launched that would support development and distribution of free geospatial data to make it open to the public. In November 2012, the first step of Open Street Mapping concept started in Kathmandu with the involvement of the Government of Nepal, the World Bank and GFDRR (23). The project was based on DRM on a purpose of better understanding of seismic risk, building resilience in the education and health infrastructures in Kathmandu. The disaster risk model was generated by studying the relative vulnerability of the buildings in the valley. Soon another project to map the streets of Kathmandu was taken in an action under the same collaboration by the help of mapping team formed as OSM community. Most of the members were the graduates from the Kathmandu University. The team worked together to create a base map of Kathmandu valley by digitizing building footprints, traffic networking, and another necessary mapping.

3. Field Survey Preparation: The quality of the data depends on the preparation of survey from a team. It consists of preparing the questionnaire which brings all needed data in a limited space of page or form. The question must be logical and appropriate so that it would generate more reliable and significant information. The team must be aware of the occurring of duplication of data, recording of fraud data and so on.

4. Field Surveys: After the completion of given training, the team takes around to particular targeted area to collect data according to their plans and methods. The team

should be very polite with the local to gain much support from the locals. Soon the work is done, they left the place for the next process to fetch the data to designated team.

5. Data Entry: After the return of the survey group, the data given by them needs to be put into a GIS system so that it can be publicly available and can be used immediately. The data should work via different web-based platforms or other online tools and applications.

3.10 Technologies for Building a Web Application

3.10.1 HTML5

HTML5 was finalized and published on 28 October by the World Wide Web Consortium (W3C)) (24). HTML5 is a markup language, the next major Hypertext Markup Language (HTML) standard superseding HTML 4.01, XHTML 1.0 and XHTML 1.1. It is used to structure and present the content on the World Wide Web (WWW). The cooperation between the W3C and the Web Hypertext Application Technology Working Group (WHATWG) together brought HTML5. HTML5 has become a powerful tool for more than 1.4 billion Internet users (24).

What makes HTML5 different from the previous standards is that HTML5 has the potential to integrate and incorporate the various features of internet experiences. It has stood up to today's date and is unified as a broadly supported standard. The reasons why HTML5 (24) has gained so much of popularity are listed below:

1. HTML5 has provided a framework to create new innovative, intuitive and promising engagements through mobile platform:

    - Static and real-time rich media (e.g. audio, video), cross-platform and cross-network

    - Integration and enablement with social media

    - Better user experience in customer relation management

    - Use of enhanced and better user navigation, usability of web pages and automatic refresh of contents

- Supports user selection, preference and history for a better user specific and context appropriate personalized mobile site experience

- New experiences in social media and advertising to utilize the storage capacity of the context and history

- A Native app development for user experience within a browser also known as hybrid mobile apps or Web apps.

- New experience and support in a wide range of gaming, cloud-based service and other online services.

2. The new experience was only available with the use of essential features in the HTML 5 standard offering different capabilities (24):

- No need of third party plug-ins such as Silverlight and Flash for playback functionalities like embedded video, audio, barcode scanning and other rich media content in the browser.

- Streamlined coding and lightweight size of HTML5 has reduced the size of storage and is useful for limited memory devices.

- Storage of data on client-side or locally by using LocalStorage and IndexDB, which provides a richer and data management experience along with error handling, transactions, version management and so on.

- Native video and audio support using the canvas, also cross-platform game development with HTML5 due to improved JavaScript engines and the use of GPU to push graphics.

- Use of semantic elements providing provides an easy and immediate improvement in the structure and readability of the web pages.

- HTML5 uses advanced forms with browser validating supporting JavaScript to be more efficient and provides faster page loading.

- Offline capabilities are possible in HTML5 with the use of application cache composed of components like a manifest file, events and API methods that create updates.

3. Use of native APIs that can be adjusted based on real-time, such as (24):

- Drag and drop APIs, Full screen, Media Capture and Visibility to enhance application experience, reduce power usages and improve performance.

- Editing and creating the content. For e.g. Audio, video, images.

- Geolocation APIs to locate.

- Better and improve touchscreen and scrolling effects

- Auto-completion

4. Other essential features for HTML5 includes (24): -

- Use of standard and unified metrics and analytic cross platform

- Use of elements like carousels, pop-over menus, pinch/spread/zoom in or out, selections spinners and so on.

- The implementation of cross-browser consistency.

- Allows a device's hardware and software features, such as:

  - Inbuilt APIs used for microphone, cameras

  - Geospatial APIs

  - Text message services

  - RFID and NFC chips

  - 3D graphic engines

  - Notification systems

3.10.2 JavaScript

JavaScript is an extension of the ECMAScript programming language though historically ECMAScript is based on early versions of JavaScript. It is prototype-based and interpreted, similar in many respects to the ActionScript language used with Adobe Flash (27).

Virtually all web browsers are compatible with JavaScript and are contain with a JavaScript interpreter, and it is commonly used as a client-side scripting language for developing web pages. JavaScript code embedded into an HTML page (25) can interface to the Document Object Model (DOM) APIs to make web pages more interactive (26). Recently, JavaScript with features to cope with other XML-based applications like SVG (31) and techniques for developing better interactive asynchronous web applications like Ajax, the use of JavaScript has increased significantly.

1. What can we do with JavaScript? Let's start with some common purposes to deal with developing a web page (28):

   - Validate form fields

   - Set and retrieve web cookies

   - Automatic validation and provides real-time feedback

   - Hide and show elements

   - Move elements about the page

   - Capture user events and adjust the page accordingly

   - Scroll content

   - Interface with a server-side application without leaving the page

2. Besides these, there are various features that we can explore with the use of JavaScript. Such as (28):

   - The logic, functions and operators to control structure

   - Reliability of using JavaScript techniques in the multi-browser world of the web

   - Extensive mechanism that differentiates it from other tradition programming language

   - Form validation, DOM manipulation and interactive styling

   - Highly secure, the use web-browser sandbox, cookies and interaction with another object

- Creating of object libraries to handle common tasks

- Building of Ajax applications along with XMLHttpRequest object

- Creating libraries for special effects and Ajax interactions

3.10.3 jQuery

Due to its versatility and extensibility, jQuery has become essential in the world of web development. jQuery is a short, fast and feature-rich JavaScript library. It has proven to make the lives of web developers easier by making many features do the task in less time and easier way. jQuery was developed as a library to provide cross-browser inconsistencies for making JavaScript easier. jQuery 2.0 supports all the modern browsers, including the latest version of Safari, Google Chrome, Internet Explorer and Firefox (32). jQuery helps in following three categories for developing interactive and compatible web pages. Such as:

1. The jQuery APIs (32)

    - Selecting and filtering from the DOM

    - Handling events, creating custom events

    - Manipulating content of the web page and its attributes

    - Intuitive and versatile methods to work with CSS

    - Few lines of codes for iteration of arrays and objects

    - Making of direct AJAX requests from the server

    - Animation and easing effects, scrollbars, HTML5 Drag and Drop and own plugins

2. jQuery UI (32)

    - Drag and drop API using its plugins

    - Components like sorting, selecting, animation, accordion, date picker, dialog boxes, tabs

3. Third-Party jQuery plugins (32)

- TableSorter for sorting HTML tables

- Creating an Interactive slideshow (slideshow plugin)

- Working with HTML5 audio and video (MediaElement plugin)

- Creating a simple WYSIWYG editor

3.10.4 CSS3

CSS3 is the latest version of Cascading Style Sheet till today's date. It is simply a language which defines the look and formats the content of the web documents. It gives a defined form to the web documents that is written in XML or HTML. CSS Level 3 builds on CSS Level 2 module by module, using the CSS2.1 specification as its core. Each module adds functionality and replaces part of the CSS2.1 specification (29). The CSS Working Group intends that the new CSS modules will not contradict the CSS2.1 specification: only that they will add functionality and refine definitions. As each module is completed, it will be plugged into the existing system of CSS2.1 plus previously completed module (29).

From this level of modules are levelled independently, for example, Selectors Level 4 may well be completed before CSS Line Module Level 3. Modules with no CSS Level 2 equivalent start at Level 1 modules that update features that existed in CSS Level 2 start at Level 3 (29).

CSS, in contrast, offers the following advantages (29):

- Style sheets provide far more formatting choices than HTML. With CSS, it is possible to format paragraphs as they appear in a magazine or newspaper (the first line indented and no space between each paragraph, for example) and control the leading (the space between lines of type in a paragraph).

- When applying CSS to add a background image to a page, it is possible to see whether and how it tiles (repeats). HTML cannot even begin to do that.

- Even better, CSS styles take up much less space than HTML's formatting options, such as the much-hated <font> tag. It can be usually trim into many kilobytes from text heavy web pages by using CSS. As a result, the web pages look great and load faster.

- Style sheets also make updating your site easier. You can collect all your styles into a single external style sheet that's linked to every page on your site. Then, when you edit a style, that change immediately ripples through your site wherever that style appears. You can completely change the appearance of a site just by editing a single style sheet (30).

3.10.5 PHP

PHP is a dynamic and flexible language which supports a broad range of programming techniques. It has been used by the web developers over the years, adding features like a solid object-oriented model in PHP version 5.0, anonymous functions and namespaces in PHP version 5.3 and traits in PHP version 5.4 in the years 2004, 2009, 2012 respectively. PHP has become a complete set of object-oriented programming features including support for classes, abstract classes, interfaces, inheritance, constructors, cloning, exceptions, and more (33).

The reason for what PHP different from other scripting languages such as JavaScript, is that the execution of the code happens on the server, which generates HTML which is further forwarded to the client. The client receives the final result that the script has produced, but still cannot know what the actual code was. It is possible to configure the web server to consider all HTML files as PHP, so the possibility of users understanding the code equals to zero.

The PHP works with the web server, the software that delivers web pages. When you type a URL into your web browser's address bar, it means you are sending a message to the web server at that URL, asking it to send you an HTML file. The web server responds by sending the requested file to the designated location. Your browser reads the HTML file and displays the content of the web page. Similarly, upon clicking a link in a web page, you request a file from the web server. Also, the web server processes a file when you click a web page button that submits a form. This process is essentially the same when PHP is installed. You request a file; the web server happens to be running PHP, and it sends HTML back to the browser, thanks to the programming in PHP (34).

3.11 Recent Earthquake in Nepal

Based on demographical, physiological, geological, ecological, meteorological factors, Nepal is highly exposed to most vulnerable to many disasters like earthquakes, landslides, avalanches, floods, fire, storms, epidemics and other ecological hazards. Rapid population growth and high population density only in the cities, fragility of the soil, deforestation and environmental degradation and slopes of the land masses are the major factors contributing to disasters in Nepal.

On 25th April 2015, a powerful earthquake rocked Nepal with an epicentre 77km northwest of the capital city (Kathmandu) in Barak, Gorkha district (1). This earthquake is supposed to be a sequence of earthquakes that is happening in the Himalayan Arc region with the magnitude of 7.5 followed in years 1100, 1505, 1555, 1724, 1803, 1833, 1897, 1947, 1950, 1964, 1988 and 2005 (1) during the historical and instrumental period. The death toll reached more than 8500 people along with thousands of causalities, damage of houses, bridges and historical monument. This earthquake further brought avalanches in the mountains and landslides which again increased the death toll and damages. The main shocks along with aftershocks can be seen in Figure 5.

Figure 5. Location of the main shock (red star) and aftershocks (orange circles) for April 25, 2015, earthquake.

(Source: (36))

3.11.1 Main Problem Faced by Government and Public during Earthquake

There were lots of problems that occurred during and after the earthquake. However, these are some problems listed below that became worse than it should be because of lack of proper data and information from the government of Nepal.

1. Transportation and Access: The Kathmandu Airport being a sole international air entry point into Nepal, it was a nightmare situation for the handlers of logistic in the airport. Only a particular flight was able to land at Tribhuvan International Airport (TIA) due to its limited runaway and minimum storage capacity (37). The officials were not fully known to the situation and unable to manage and coordinate to facilitate processing of relief cargo. The relief aids that were brought to the airport were less important than what the actual need was. The government of Nepal was either slow in communicating with the foreign assistance or failed to deliver messages to bring the immediate requirement during the disaster. The immediate help was not provided in the rural areas due to the lack of helicopters in Nepal and roads being damaged due to the earthquake. Most of the aids were provided only to place where it was reachable.

2. Lack of communication: The local and foreigner volunteers were unknown where the relief aid was sent or distributed. It was also seen that the distribution was repeated in some places whereas there was not any distribution made in some affected areas. The concerned people were outraged due to the delay in supply of essential goods and some incident of the fight were noticed among the villagers and public administrators. The lack of proper data made the situation even worse because the administrator was supplying the goods by "first come" "first serve" principle. Some people got more than one supply whereas other were not provided.

3. Lack of Transparency in Relief Fund: This was a big controversy among the people who wants to volunteer and support the affected people. Since the previous record of government in using relief funds not being transparent and in most cases, funds are being used for self-purpose, most of the donator did not feel secure to donate to the national fund for relief aid. Despite this,

donator bought their selves relief aids and supplies and was distributed to the affected people. Some people send the relief fund to their relatives or person who are known to them and were trustful to help the victims.

An online survey and questionnaire were made to give light to the problems and make a better solution in disaster risk. The primary aim of this study would be to know the needs and values of open data in the process of disaster risk management. A web application will be build which provides open data to fulfil the requirement of public and stakeholders during and after the disaster in Nepal.

4 Practical Part

4.1 Introduction

To present what kind of data is to be provided in a web application, a survey was made focusing on the recent earthquake in Nepal. After the analysis and interpretation of data from the designed survey, a web application named "Data.Open.NP" was developed. It uses open data to map real-time earthquakes, the location of distribution of food, humanitarian aids, tents and also provide data on road safety, deaths, damages and an option for searching missing people. The reason behind the development of a web-based disaster risk application is to ensure that people will be aware of the disaster and be able to find their needs in relative time. By using this application, people can discover which area is safe to stay, where they should contact in case of injury and other health related problems if someone is missing, guidelines to be secure and other disaster risk needs. Furthermore, the users can download the data and can use according to their interest.

The web application was developed with use HTML, CSS, and JavaScript for the development of front-end, the design and structure of the application. Rest API was used to retrieve and insert the data into the data field through the client-side folder. WampServer was used as a virtual server for testing and debugging the file in local machine.

4.2 Questionnaire and Survey

For the purpose of the practical work, a survey was collected and was distributed to the people living in Nepal and currently working on open data campaign in Nepal. The respondents were presented with a list of 8 questions related to the role of government in disasters risk, the formats of data being published in the public websites of government, the needs of public during and after the disasters in Nepal. The online survey received responses from 10 respondents who are actively involved in open data campaign in Nepal. They were mainly data analyst, data scientists, data curator, team lead and so on. The research was done to support the

primary goal of the thesis by finding out the relevant information and data that is needed to publish in the web application "Data.Open.NP". The online tool "SurveyMonkey" was used to create and distribute the questioner to the respondents.

4.2.1 Analysis of Survey Data

1. What information is needed to be made available to public and relevant stakeholders?

In Figure below, we can see that respondents are more focused on getting information about water, food and shelter (70%), humanitarian supplies (80%), search for missing people (50%) as illustrated in Figure 6. It means these are essential than the remaining ones.
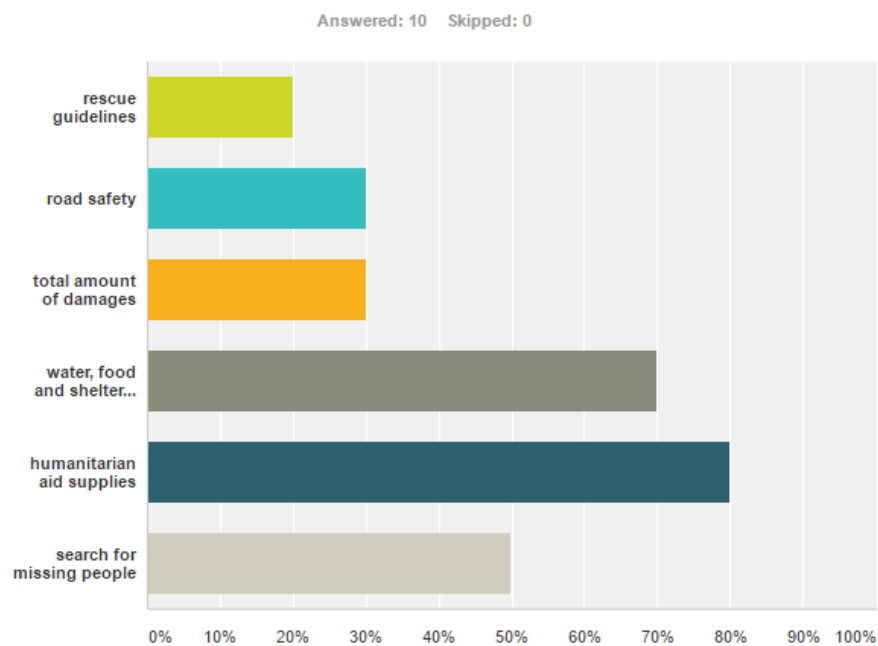
Figure 6. Graphs representing the respondent responses in need of information

(Source: own)

2. Which kinds of relevant information were you available to get from public administration sources (newspaper, TV, radio, Internet) during and after the earthquake in 2015 in Nepal?
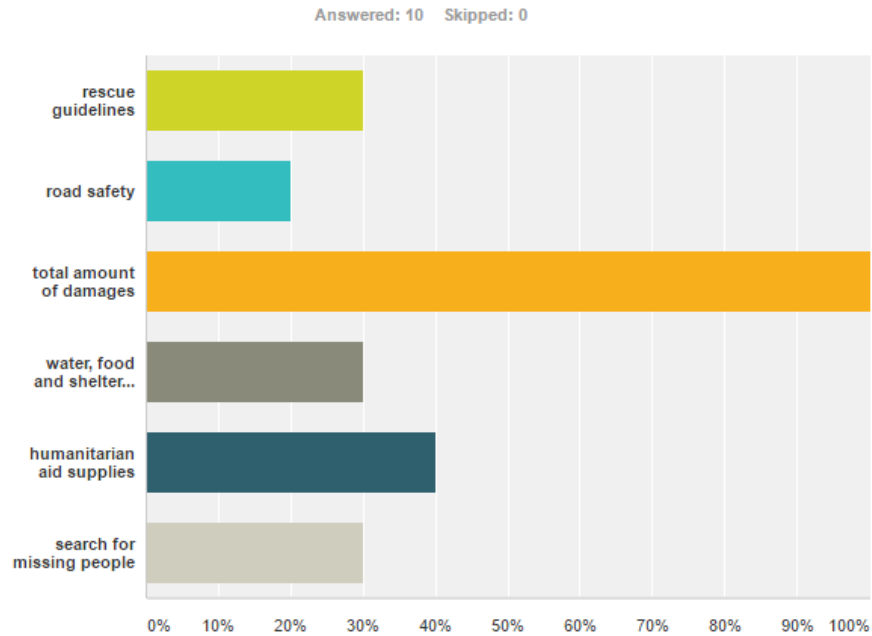
Figure 7. Graphs representing the respondent responses on availability of information

(Source: own)

In Figure 7, it is clearly seen that information about the total amount of damages (100%) is provided mostly by the public administration following humanitarian aid supplies (40%). Information about rescue guidelines, road safety search for missing people and water, food and shelter are provided less.

After comparing Figure 6 and 7, it was concluded to put the data for road safety, rescue guidelines, search for missing people since the information on them were less provided by the public administration and demand for the information is higher. The total amount of damages and deaths and injuries will also be provided in the web application since it is most important to know during the disaster as a whole.

3. How would you rate the role of government in providing good information to public and related stakeholders (e.g. medical, rescue, food, humanitarian aid services and citizens)?
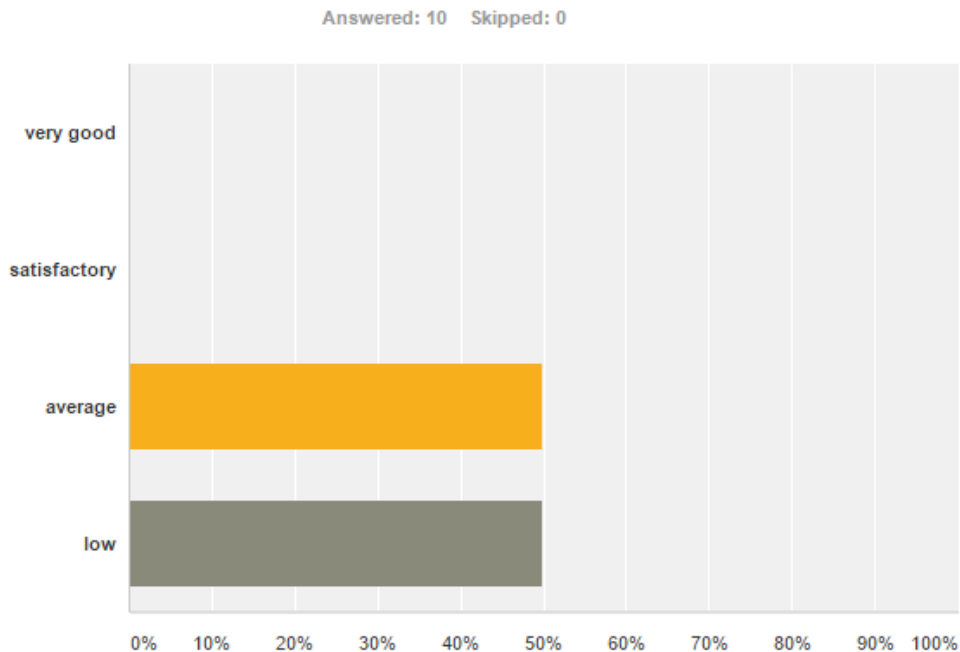

Figure 8. Graphs representing the respondent responses on role of government

(Source: own)

Figure 8 shows that the role of government in providing good information is in between low and average. To fulfil this, building a web application was needed that could provide the relevant information about disaster risks and could serve as a source of information to the public and related stakeholders.

4. Please rank the factors that are hindering the government of Nepal to publish the data in standard formats?

When the question was asked to list the factors that are hindering the government of Nepal to publish the data in standard formats, the result was not surprising and obviously the primary reason was a lack of awareness of open data, lack of public interest and lack of skilled human resources and technologies. Nepal being an underdeveloped country, it is necessary to increase efforts on publishing open data. This thesis might provide the base for creating some general awareness among the people on how they see and know about

open data. Figure 9 shows the respondent answers on the behalf of factors that are hindering the government to publish data in standard forms.
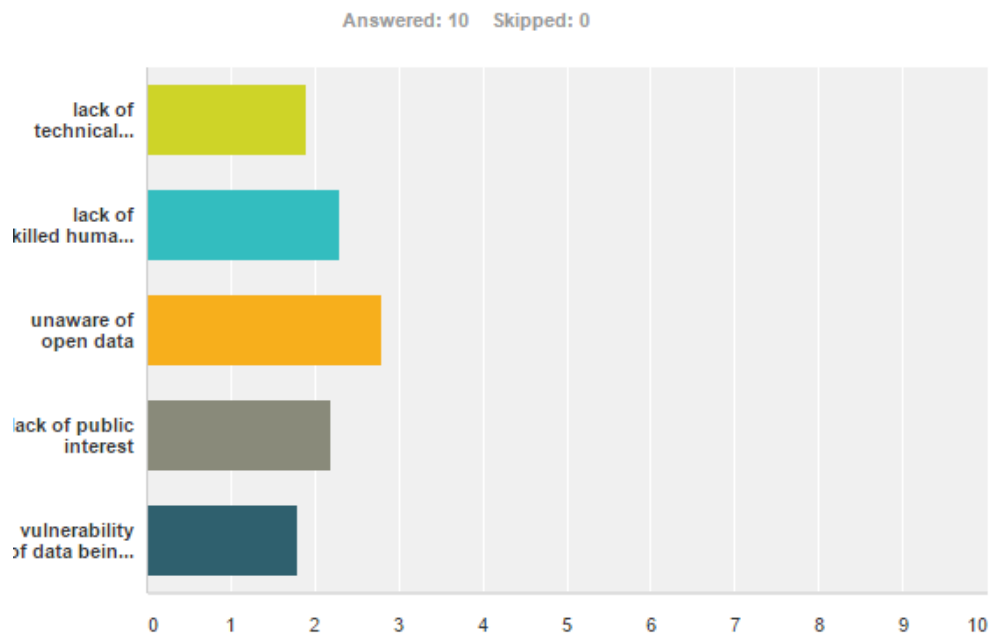

Figure 9. Graphs representing the respondent responses for ranking the hindering factors

(Source: own)

4.3   Use case Diagram

A unified modelling language diagram was created to simplify the usage requirements for a disaster management data in Nepal. The reason behind making a use case diagram was to present how a sequence of actions are done in the web pages. It further explains the requirement of the application as it shows a sequence of steps interacting between the actors and the flow of information between them and most importantly their relations.
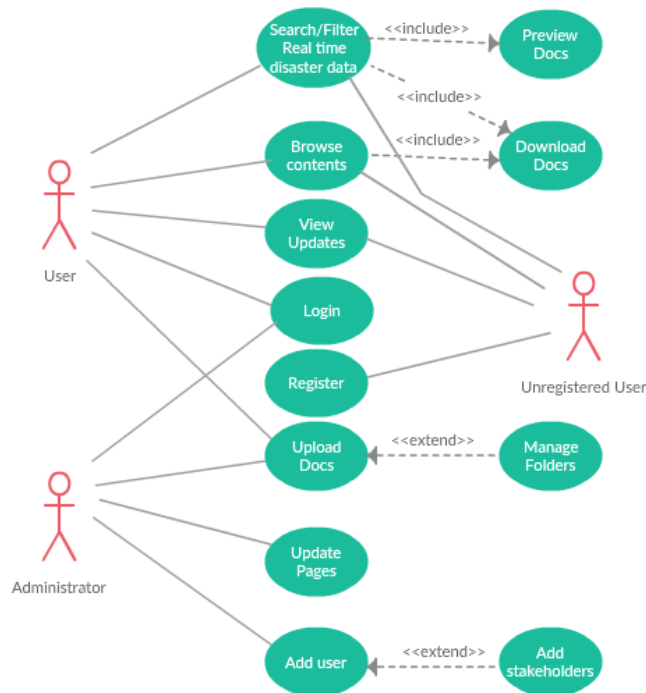
Figure 10. A Use Case Diagram

(Source: own)

1. Through Figure 10, we can see that an unregistered user will have the permission and access to:

   - Navigating the maps of recent earthquake,

   - Downloading the document in CSV format,

   - View the Data related with Disaster risk,

   - Filtering of data on user needs and

   - Registering.

2. A registered user can have extra access than of unregistered user, He/she can enjoy the full rights with some additional features like:

   - Users can give or ask the relevant data through message form

   - New updates and modification will be sent automatically through notification

3. The administrator can perform all actions as other users with extra activities and roles. Such as:

- Updating, manipulation, storage and deletion of data

- Reviewing the users message

- Keep in touch with the users and listening of feedbacks

- Login with administrator credentials to unlock actions available for the administrator.

4.4 Wireframe

The initial step to build a web application was to make a screen blueprint that would represent the skeletal framework for the future work of a web application. It is a necessary and vital approach, before the building of a web application because it provides guidelines and helps to establish functionality and relationships between the different templates of web pages including the contents, positioning of HTML elements and navigation systems.

At first, wireframe was created for the "index" page which is also a home page in "Data.Open.NP" as presented in Figure 11.
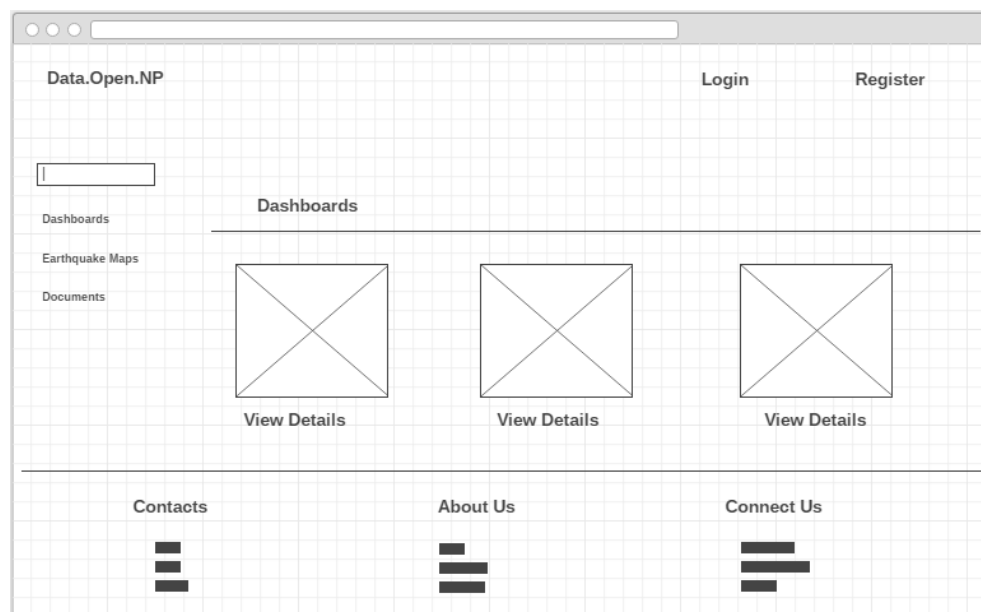

Figure 11. Wireframe for the index page

The wireframe above shows how the index or home page will look like on main application. On the top left corner, the navigation bar for brand-name with title "Data.Open.NP" will be placed and will be same for all pages. Furthermore, the navigation bar will continue with other two in the top right corner. The vertical navigation bar will be on the left side which will allow navigating different pages of this web application. On the middle section of the navigation bar named as "Dashboards", there will be main contents of the web application which contains details about earthquake maps, records of disasters, rescue guidelines. This central section can be added as per the requirements. On the bottom part, there will be details about contacts, about developers and the links to connect through social media.

The 2nd wireframe was created to build the page for the earthquake maps. Every design holds same as home page except the contents in the middle section that shows real-time earthquake maps. In the wireframe presented in Figure 12, the logo of a big picture holds the place for real-time earthquake maps.
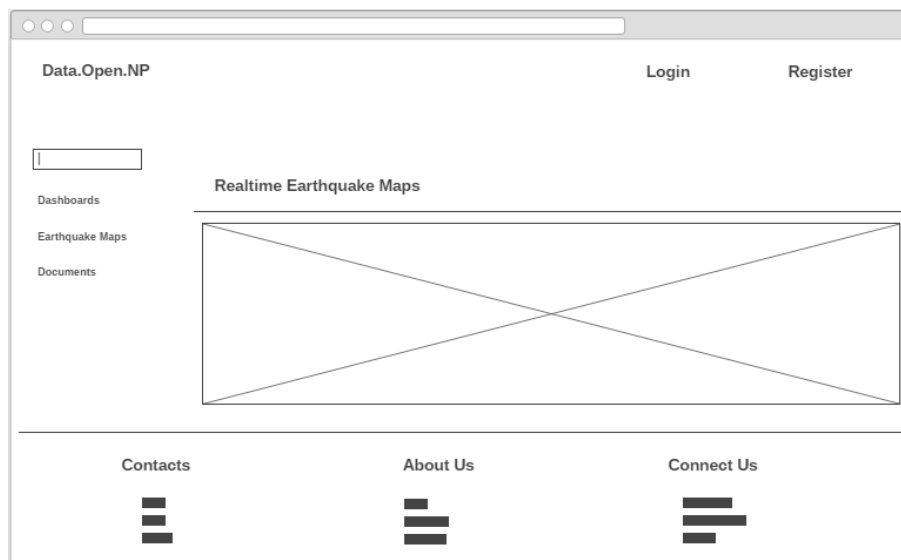

Figure 12. Wireframe for the earthquake maps

(Source: own)

The last wireframe was created for the final page of "Data.Open.NP". Similarly, the contents are same except for the middle section that allows the user to

see the disaster risk data. It consists of text filter which will allow the user to filter the data on their interest. Also, there will be different "toggle-button" to download the documents and view live data by clicking the "view" button. Figure 13 shows how it looks like in wireframe.
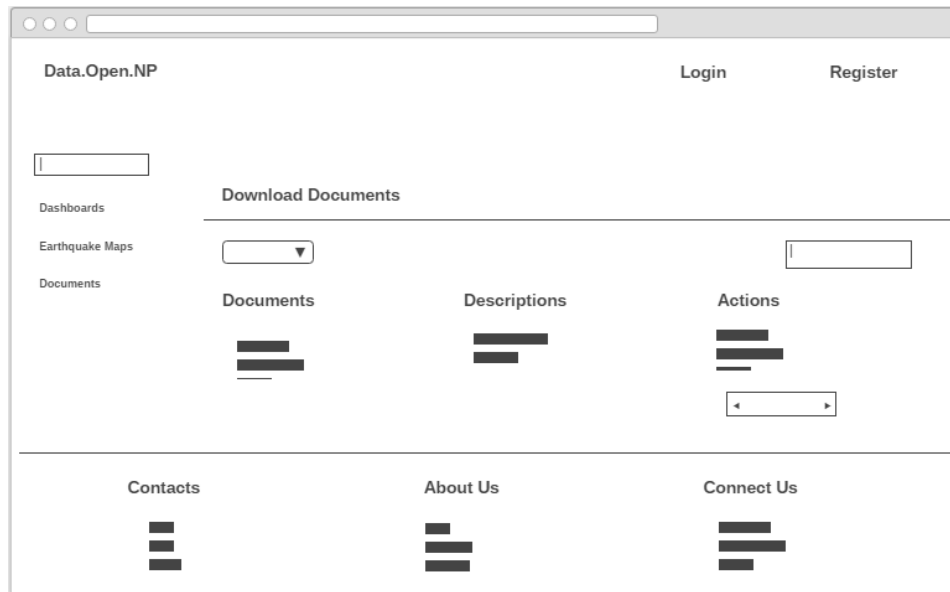

Figure 13. Wireframe for the document page

(Source: own)

4.5   Use of Data Files

The different formats data and files are used by Data.Open.NP regarding damages, deaths, injury due to the earthquake and were downloaded from https://data.hdx.rwlabs.org/. The Google Maps API uses the earthquake real-time data from the United States Geological Survey (USGS) and mostly uses formats like ATOM, KML, GeoJSON Spreadsheet and QuakeML (25). Apart from real-time earthquake data files, CSV files are used as an option that could be downloaded from a user and JSON files are used to display the data in a tabular form.

4.5.1   JSON

Figure 14 shows the contents of the JSON file that contains open data and is used to parse JSON into HTML tabular format to view respective disaster data.

```
[{"district":"Sindhupalchok","deaths":"1587","injuries":"614"},
{"district":"Kathmandu","deaths":"1049","injuries":"2400"},
{"district":"Nuwakot","deaths":"707","injuries":"964"},
{"district":"Bhaktapur","deaths":"261","injuries":"1886"},
{"district":"Kavrepalanchok","deaths":"274","injuries":"889"},
{"district":"Gorkha","deaths":"405","injuries":"1000"},
{"district":"Lalitpur","deaths":"169","injuries":"1090"},
```

Figure 14. Source code in CSV format

(Source: (37))

4.5.2 CSV

Figure 15 shows the contents of the CSV file that contains open data and is used as a source of open data that can be downloaded by the end users.

```
status,name,gender,age,pob,fathername,source
alive,A. Michelle Page,Female,50,USA,unknown,Online Registration
alive,Aagat Awasthi,Male,27,Kathmandu,Lava Deo Awasthi,Online Registration
missing,aashis karki,Male,27,damak,indra karki,Online Registration
alive,Abhinav Kant Mainali,Male,21,Kathmandu,Utsav Kant Mainali,Online Registration
missing,Abhisekh Thapa,Male,8,"Selang, Sindhupalchok",Bijaya Thapa,Online Registration
alive,abhishek kakri,Male,19,damak,indra karki`,Online Registration
```

Figure 15. Source code in CSV format

(Source: (38))

4.6 Front End

This application uses the client-side storage to store the data without needing to keep all data on server side. It was important to design a client-side layout and structure where all the data and API will be shown. This application uses the technologies like HTML5, CSS and JavaScript. For making a responsive, consistent and customizable application, the layouts and premade styles of Twitter Bootstrap was used. The static sections of Data.Open.NP are given below:

- Header/Horizontal navigation section

- Vertical navigation section

- Footer

Header section consists of the name of the web application and continues with the navigation bar (Feedback, Log in and Register) on the right as shown in Figure 16.

Figure 16. Header section along with Navbar

(Source: own)

The navigation bar on the right are the buttons which pop up when clicked so that the user can fill in the form or send feedback to the administration. He/she can either log into the page or register if he/she is not registered.

Furthermore, vertical navigation section was developed so that the user can navigate to the different pages of the Data.Open.NP as presented in Figure 17. The vertical navigation section consists of following buttons:

- Search Engine: possibility to filter selected data

- Dashboard as Index Page: It consists of different APIs and on click leads to new page

- Earthquake Map: It consists of recent earthquake map using the Google APIs

- Documents: In this page, a user can download or view the related documents.

- Guidelines: This page includes general informational guidelines to be followed.
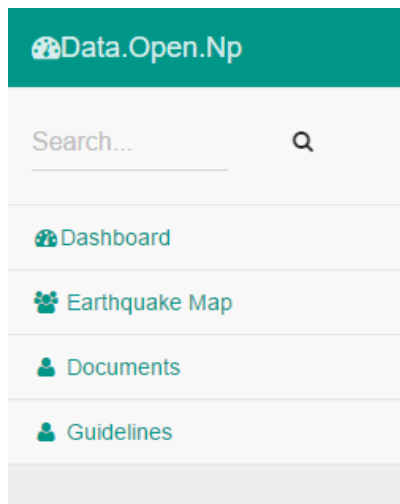

Figure 17. The Vertical Navbar section

(Source: own)

4.7 Main Page

The main page or index page is the most important part of Data.Open.NP. It consists of all necessary navigation section and all the main features and functionality of the Data.Open.NP has been implemented on it.

4.7.1 Dashboard

When the user navigates first to the web application, they will see the panel which will allow them to move to other pages. The dashboard was created so that it provides more visibility to the users and enable them to navigate to the desired section of the Data.Open.NP. The dashboard in the web application looks like Figure 18.
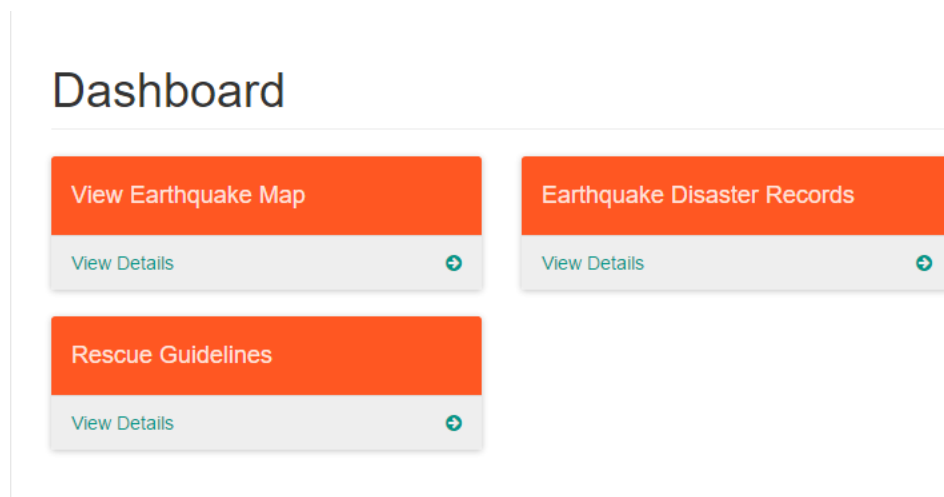

Figure 18. Dashboard in Data.Open.NP

(Source: own)

4.7.2 Earthquake Map

An earthquake map was created in Data.Open.NP with the use of Google Maps API to provide the recent earthquake triggered location. As soon as the earthquakes hit the country, it shows the site with red circle pattern which indicates that area is affected by the earthquake. The user will be notified with the necessary information regarding the range of earthquake, location and time of the event. Figure 19 represents how it is visualized in the Data.Open.NP.
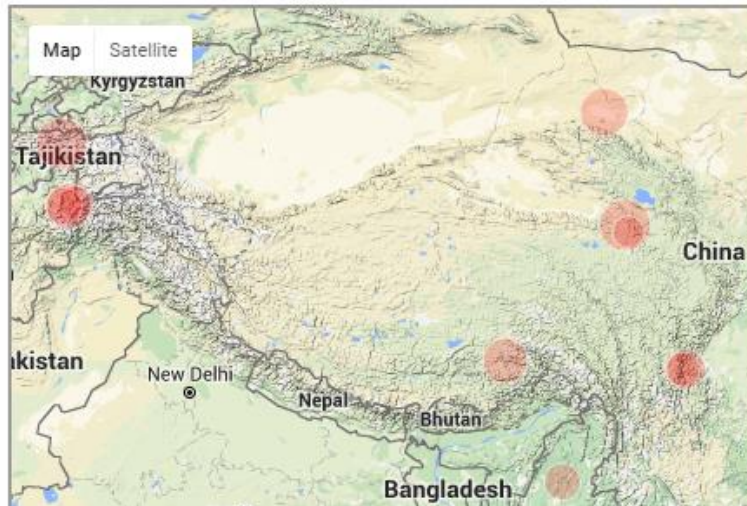
Figure 19. Real Time Earthquake map with markers

(Source: USGS real-time map (own processing))

The section for the earthquake map was created with HTML5. With the help of JavaScript code or a function call, it was possible to return JSON data through the URL request via XMLHttpRequest. The code starts with initializing the functions and verifying the map options. In the code below, it can be seen how an HTML element (<script>) specifies for its attribute (src) to requested URL that returns JSON data as coded in Figure 20. The script tag was used to retrieve the data from the USGS URL as the source. After this, function getCircle was initiated so that it could draw a circle based on path and scale by the magnitude value. Finally, the variable circle is returned, and it works as a marker for real-time earthquake map as shown in Figure 19.

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```javascript
var map;
function initialize() {
  var mapOptions = {
    zoom: 6,
    center: {lat: 27.7000, lng: 85.3333},
    mapTypeId: google.maps.MapTypeId.TERRAIN
  };
  map = new google.maps.Map(document.getElementById('map'),
      mapOptions);
  var script = document.createElement('script');
  script.src = 'http://earthquake.usgs.gov/earthquakes/feed/v1.
  document.getElementsByTagName('head')[0].appendChild(script);
  map.data.setStyle(function(feature) {
    var magnitude = feature.getProperty('mag');
    return {
      icon: getCircle(magnitude)
    };
  });
}
function getCircle(magnitude) {
  var circle = {
    path: google.maps.SymbolPath.CIRCLE,
    fillColor: 'red',
    fillOpacity: .2,
    scale: Math.pow(2, magnitude) / 2,
    strokeColor: 'white',
    strokeWeight: .5
  };
  return circle;
  }
function eqfeed_callback(results) {
  map.data.addGeoJson(results);
}
google.maps.event.addDomListener(window, 'load', initialize);
```

Figure 20. Structure of codes for the real time earthquake map in JavaScript

(Source: (35))

4.7.3   Documents

Under the section documents, a list of data is uploaded to the page so that the user can view or download the data as per their need. As already mentioned, the data put in this field are under the open licensed and in CSV formats. The view of this section is illustrated in Figure 21.

Figure 21. Section for documents

(Source: own)

As it can be seen in Figure 21, the document table consists of the title of the document, description and the actions that will allow the user to view and download the document. It further includes filtering feature which will allow shortlisting the documents in case users want to get the information quickly or on their selection.

The localhost server was used to fetch the data. In Figure below, the user can view the data table with the option of the filter. When a letter "b" was typed in the filter place, it showed the correspondence results as presented in Figure 22. For this, WampServer was used to host the web application.

Figure 22. View section in documents

(Source: own)

The document page uses DataTables plugin for JavaScript to filter and sort Table contents while Bootstrap modal is used to pop-up Table when clicked on the view button. When the button is clicked, an HTTP request is sent through AJAX to fetch the required document from the server. The document is stored in JSON format and thus, when the AJAX call requires it, is returned as JSON object. This JSON object is then parsed by the JavaScript and displayed in the tabular form. The DataTable plugin is then activated, and the final result is the Data table with sorting and filtering capabilities built into it. The code that was used to display Table is presented in Figure 23. This code was repeated in a similar way for displaying other data.

```
$(document).ready(function() {
    $.material.init();
    $('#dataTables-user').DataTable({
        responsive: true
    });

$('.missing').click(function() {
    var url = $(this).data('json');
    console.log(url);
    $.ajax({
      url: url,
      type: 'GET',
      error: function(jqXHR, textStatus, errorThrown) {
        if (textStatus === 'error') {
          console.log(textStatus);
        }
      },
      success: function(data) {
        console.log(data);
        $('#missing-body').empty();
          var theTemplateScript = $('#missing-template').html();
          var theTemplate = Handlebars.compile(theTemplateScript);
          $("#missing-body").append(theTemplate(data));
          $('#missing-modal').modal();
          $('#dataTables-missing').DataTable({
            responsive: true
            });
      }
    });
})
```

Figure 23. Code to display the JSON data with JavaScript

(Source: own)

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4.7.4 Guidelines

This section shows the general information related to earthquakes. It was created to aware the public about the safety measures and things to do or not to do during the disaster. The safety guidelines help to reduce the risk of disaster and hazards.

4.8 Footer

The last part consists of the footer. The footer was created to provide all the information. It consists of links to access the contacts, links to the purposes and aims of the web application, links to connect to social media and the terms and condition for using the application. Figure 23 shows the overview of the footer that was created for Data.Open.NP.
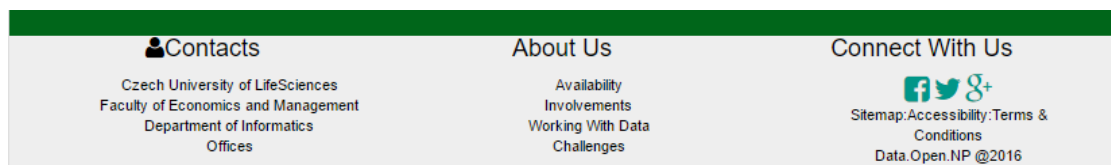

Figure 24. Footer section

(Source: own)

4.9 Forms

Data.Open.NP was built using the HTML5 forms on its web pages. The different forms that are developed on the web pages have different features and purposes. The Login, Registration and Feedback forms were created so that a user can enter his/her data and can be saved on the server for processing its distinct outputs.

4.9.1 Feedback

Overall, all functionality of Data.Open.NP is available to all web visitors, to view maps, download files and view data. However, users can enjoy one more features by registering to Data.Open.NP. through the Registration form as presented in Figure 27. After the registration, the user will have his/her accounts through which they can send feedbacks as well as fetch data to the administration. Upon checking the data submitted by

users, it can be uploaded on the web page. The user needs to fill form feedback form with their details as requested. The details to fill the form is illustrated in Figure 25.
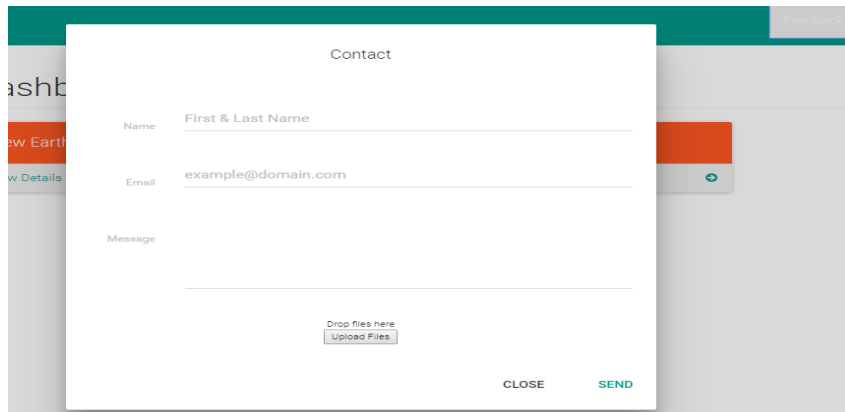

Figure 25. Contact/feedback form

(Source: own)

4.9.2 Log in

This form pops up to allow the user to pass secure authentication of their account. After login, the user will be directed to their account. Figure 26 shows how it is seen on the web page.
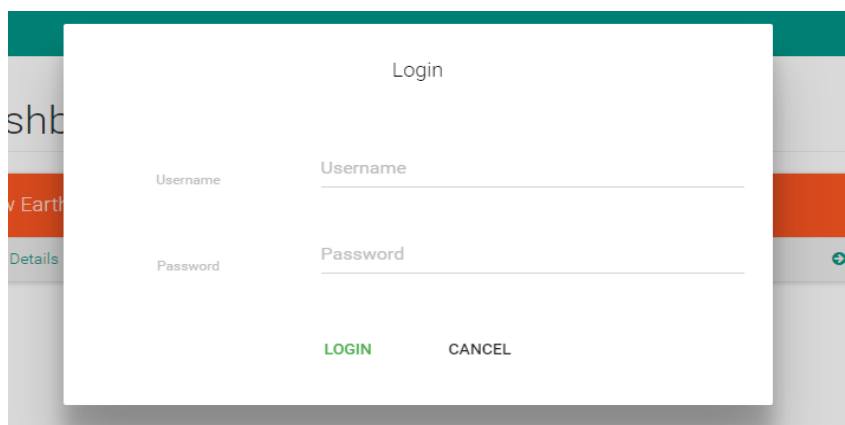

Figure 26. Log in form

(Source: own)

4.9.3   Registration

As already mentioned, the user needs to register a Registration form so that they can enjoy extra features than the unregistered features. Figure 27 shows the list of the field that is required to be filled to complete the registration process.
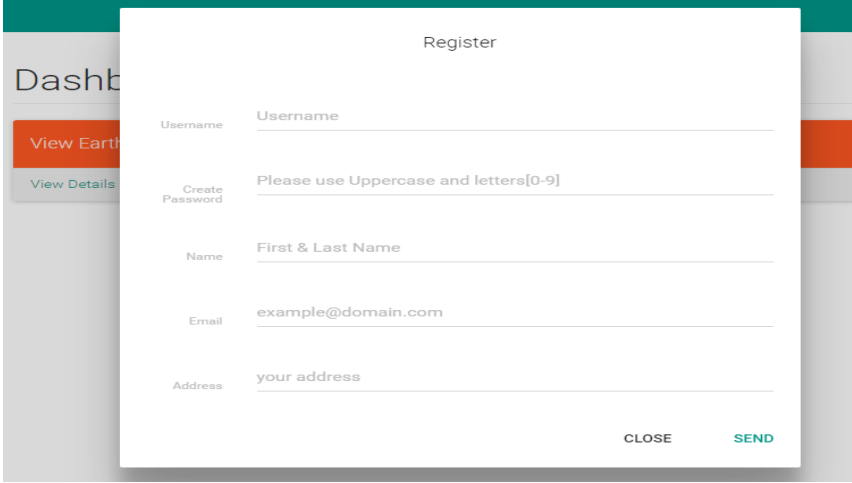

Figure 27. Registration form

(Source: own)

The forms are available in Data.Open.NP are the HTML form. For this, Bootstraps plugins were used to create a dynamic and responsive form. In our case, the modal plugin was used to create a form that provides an automatic popup window upon each click. In the code below presented in Figure 28, it can be seen that different modal has been used for its distinct function. After setting modal-body, <fieldset> was set where all the essentials fields could be created. As soon as <fieldset> was set up, each field was given their label, placeholder and type of field was declared. The size of the input field and layout was also adjusted through bootstrap classes i.e. col-lg-4 and col-lg-6. At last, two buttons were created for login and cancel with the help of default button and btn-success. Similarly, other forms were created applying same procedures to display the fields and respective data types.

The code in Figure 28 only helps to popup the window when a user clicks on form buttons and enables to fill the form. However, whatsoever is filled in the field, they will not be stored anywhere neither in client-storage nor the server. These forms were made only using the client side script, so it does not interact with the data provided. In the future,

it can be further updated by using server-side web programming languages like PHP and database server MySQL or even JavaScript to process and validate the forms.

```html
<div class="modal fade" id="login" role="dialog">
    <div class="modal-dialog">
        <div class="modal-content">
            <form class="form-horizontal" role="form">
                <div class="modal-header">
                    <h4>Login</h4>
                </div>
                <div class="modal-body">
                    <fieldset>
                        <div class="form-group">
                            <div class="col-lg-4 col-sm-4">
                                <label for="username" class="control-label">Username</label>
                            </div>
                            <div class="col-lg-8 col-sm-8">
                                <input class="form-control" id="txt_username" name="username"
                                    placeholder="Username" type="text" required />
                            </div>

                        </div>
                        <div class="form-group">
                            <div class="col-lg-12 col-sm-12 text-center">
                                <input id="btn_login" name="btn_login" type="submit"
                                    class="btn btn-success" value="Login" /> <input id="btn_cancel"
                                    name="btn_cancel" type="reset" class="btn btn-default"
                                    value="Cancel" />
                            </div>
```

Figure 28. Code used to generate HTML form for login

(Source: own)

The full source code of Data.Open.NP will be attached on http://is.czu.cz/ along with diploma thesis under a zipped file named as "sourcecode".

5   Results and Discussion

The challenges for making open data available on the application was to increase the availability and to provide relevant data about disaster risks in Nepal. Normally, it takes more than expected time to find the disaster risk data through the government offices of Nepal. In most cases, the data were protected and reserved for only the government purposes and the data could be only visualized through their websites without having any download options. However, after finding the open data from different sources that were related to the disaster risks in Nepal, it was possible to give a final structure and functionality to Data.Open.NP. The disaster risk data which was supplied through the USGS and the website https://data.hdx.rwlabs.org/ was processed with better visibility and with an option to download the data in standard formats.

Data.Open.NP was created after knowing what kind of information or data are relevant to the public based on disasters. According to the needs of the public, it was necessary to place an interactive earthquake map that would show the recent earthquake triggered location and information on it. The map was created with the use of latest Google Maps API, which includes the functionality of navigating the maps to any direction including zoom in and zoom out options. Based on this mapping feature, the user can navigate the map to find secure places reading the pattern of earthquake shocks and aftershocks. Furthermore, it could help the volunteers, government officers, rescue teams and so on to find the intact location and provide the essential support to that places. It can enhance the decision-making process regarding the disaster risks.

The next feature introduced in Data.Open.NP was to make the data available in an open source format. Through this application, the user can view or download the data that are in CSV format. The public can get the information about the disaster risks regarding deaths and injuries, searching the person, damages of buildings, road safety and so on. If the user is looking for certain data, he/she can search for database through the built-in filters i.e. finding a missing person with his name, gender, age group and so on.

Furthermore, Data.Open.NP includes forms to register the user which will allow them to request or send the data to the administration. Upon the request, the administrator can provide the necessary data as per registered user needs. Also, the administrator can upload the accurate data fetched by registered user through feedback form in the

application after validating and confirming the data source. Although Data.Open.NP was created with few datasets; it has the essential features that are important for fulfilling the requirements of public in disaster risks. Being a scalable web application, it can enhance the decision-making process among the users.

Data.Open.NP is contained with almost new features that can be used to make the disaster risks data open and offer service to the public. The administrative privilege can be given to any governmental or private organisation under a particular term of agreement and licenses. The question lies why would any agency or individual would be interested in Data.Open.NP. Let's compare this web application to some other similar existing web applications that are launched in Nepal. Two web application have been selected. i.e. OpenNepal (http://data.opennepal.net/) and Nepal Disaster Risk Reduction Portal (http://drrportal.gov.np/) to compare the features of Data.Open.NP. The comparison has been made on (Table 3).

Table 3. The comparison between the Open.Data.NP and other web application in Nepal

Features/Web application	Nepal Disaster Risk Reduction Portal	OpenNepal	Data.Open.NP
Services	Provides disaster risks data, huge datasets	Provides different types of open data, huge datasets, apps	Provides open data related with disaster risks, small datasets
Data Formats	Pdf, image	CSV	CSV
Data Licenses	All right reserved	Open Data Commons Open Database License	ODbl and Creative Commons attribution
Downloads	No option	Yes	Yes
Data Visualisation	Pdf, image and tabular form with search engines, real-time earthquake map with different markers	No option, however, it uses links to GitHub to explore data	Tabular form with search engines, real-time earthquake map
Others	Possibility to send feedback, no user registration	Possibility to send feedback, no user registration	Possibility to send comments and user registration

(Source: (40,41) and own processing)

After making the comparison on some individual features, the discussion can be done on the uses and the motive of the web applications. It can be seen that Nepal Disaster Risk Reduction Portal provides all sort of disaster risks data but uses data only for the sole purpose, but it lacks to provide data under an open license and does not offer the download option. Also, it provides all kind of real-time earthquake maps with different markers and information. This feature can be added on Data.Open.NP to provide a broad range of information. OpenNepal is successful in providing open data however it does not provide the data to visualise and the option of search engines. Although, Data.Open.NP uses small sets of data that are licensed under open and creative commons attribution; it provides a

detail information to the user and the availability to download data in standard formats allowing features such as search engines and real-time earthquake map. It also features the option to register the user and collect the feedback from them. If a user requests the particular type of data or if the user wants their data to be listed in the application, it is also possible after certain validation and check-ups. However, to make the features available longer and forever, it is needed to update and maintain this application thoroughly. This application was created for diploma thesis, and it lacks some useful features of a web application. This incompleteness can be fulfilled by further maintenance and providing authority to some other administration.

6 Conclusion

The primary aim of this paper was to improve the decision making under disaster risk management (such as earthquakes) using Open data for both government and public level in Nepal. A web-based application can be a good source of providing disaster risks data to the public and another group of institutions. It is important to know that availability of open data in a web application can help to enhance decision-making ability of the public, government and non-government authorities during a disaster risk. If data can be collected through different methods like field survey, feedback from the public and GIS. We can use such data with the purpose to provide the information to the people in need or the user. In this paper, a web application was built to release the open data regarding the disaster risks using real-time earthquake map, a build in function to view the data with a search engine and option to download the data in a standard format. Also, the field to interact with the user was created by using the forms for registration and feedback. A survey was done to support the primary goal of the thesis by finding out the relevant information and data that is needed to publish in "Data.Open.NP". The different technologies like HTML5, CSS3 and JavaScript, were used to build the application. Finally, building of Data.Open.NP was done with the implementation of all essential features and functions.

Until today's date, Data.Open.NP cannot be accessed by the user since it was developed only for the purpose of diploma thesis using the client-side and local server storage. In future, it can be uploaded to the server using the absolute domain or IP address., It would be possible to see how the user interacts with this application after uploading Data.Open.NP to the internet. The feedback and user rating will be helpful to make this application even better and interactive. Furthermore, the usability of the web application can be analysed if it has helped the public and other authorities to build up their decision-making ability.

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8   Appendix

Images of Questionnaire and Survey

Impacts of Open data in Nepal

Consent

Please read the following information carefully. It describes how your contribution to this survey will be used:
You are invited to participate in a research study to understand the factors motivating and supporting the supply and use of open government data. This survey will be used as part of an MSc Dissertation, to be submitted for examination at The University of Life Sciences (www.czu.cz) by Sajjan Ghimire.

CONFIDENTIALITY & VOLUNTARY PARTICIPATION

Individual responses to this survey will only be used by the researcher, and will be kept securely. No responses will be
attributed to individuals in the analysis of the survey and the identity of respondents will be protected. Your participation in this study is voluntary. If you wish to end your participation and/or remove you information from this study you can do so by contacting the researcher at any time.

SHARING AGGREGATE RESULTS

To contribute to shared learning around open government data, aggregate statistics from this survey will be released online when the study is complete. No personally identifying information will be included in this. The analysis and write-up from this study will be shared at its completion under an open license.

CONTACT

If you have questions at any time about the study or the procedures, you may contact the researcher, Sajjan Ghimire(najas_rko@hotmail.com) or the project supervisor Ing. Ulman Milos, Ph.D. (ulman@pef.czu.cz).

* **1. What is your current job title?**

[   ]

* 2. Which of the following is your job provider? Please choose all that apply.

☐ Private

☐ Government

☐ INGOs

☐ NGOs

Other (please specify)

[   ]

* 3. For the purpose of earthquake disaster management, what information are needed to be made available to public and relevant stakeholders (medical, rescue, food, humanitarian aid services and citizens)?

☐ rescue guidelines

☐ road safety

☐ total amount of damages

☐ water, food and shelter supplies

☐ humanitarian aid supplies

☐ search for missing people

Other (please specify)

[   ]

* 4. Which kinds of relevant information were you available to get from public administration sources (newspaper, TV, radio, Internet) during and after the earthquake in 2015 in Nepal?

☐ rescue guidelines

☐ road safety

☐ total amount of damages

☐ water, food and shelter supplies

☐ humanitarian aid supplies

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☐ XML - eXtensible Markup Language

☐ JSON - java script Object Notation

☐ RDF - Resource Descriptor Framework

☐ KML - Keyhole Markup Language (geodata)

☐ SQL Database Dump

☐ RDFa - RDF Embedded in web pages

* 8. Please rank the factors that are hindering the government of Nepal to publish the data in standard formats?

	Minor	Average	Major
lack of technical equipment	○	○	○
lack of skilled human resources	○	○	○
unaware of open data	○	○	○
lack of public interest	○	○	○
vulnerability of data being open	○	○	○

Next

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