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Disaster risk understanding of local people after the 2015 Gorkha Earthquake in Pokhara City, Nepal

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Abstract

The unique geography and fragile geological condition have made Nepal more prone to various types of disasters. The 2015 Gorkha Earthquake had a serious effect on one-third of the population of Nepal. Disaster comes with both opportunities and consequences. It depends on how a country and affected people deal with the situations. After the 2015 Gorkha Earthquake, many people especially those from the affected districts were assumed to be sensitized regarding the consequences of Earthquake disaster. In general, the disaster affected people have certainly gained know-how of the disaster to some extent even through experiences. But, the people who are less affected by the 2015 Gorkha Earthquake are yet to be aware of its major consequences. Hence, this research aims to understand the perception of people who were not severely affected by the 2015 Gorkha Earthquake but they are at high risk of future earthquake events. This research evaluated whether such people are aware of the major disaster consequences or not. Likewise, it also evaluated whether they are working on the risk reduction and disaster preparedness plans to minimize human and property loss in the future or not. So, this research was carried out in the rapidly urbanizing Pokhara City situated in the western part of Nepal which is at high risk of various types of disasters including earthquakes. The research was focused on understanding the perception of risk perceived by the people of Pokhara City in the aftermath of the 2015 Gorkha Earthquake. A household survey was conducted that involved the individual interview of a total of 152 participants from randomly selected houses. Various questions related to Disaster Risk Reduction (DRR) issues including readiness and mitigating behaviour of people, disaster risk adaptation and perceptions were asked. Histogram analysis, distribution analysis, bivariate correlations and independent sample t-tests were conducted to examine the relationship between people in disaster education-related programs and how they are following key DRR issues related to dependent (criterion) variables. A series of independent sample t-tests were conducted to examine the effects of age, gender, and disaster events on the dependent variables. Likewise, to evaluate the coherency of the data provided by the respondents, the Partial Credit Model (PCM) was used. Validity, reliability and unidimensionality of the scale were further evaluated by using PCM. The findings of this research show that the people residing in such a rapidly urbanizing Pokhara City are completely unaware of the major consequences of various types of disasters. Almost 60% of the respondents even well-educated conceived that the disaster is merely the act of God that is beyond our imagination to control and mitigate. This easily concludes that in Pokhara City, the local community, technicians and even policymakers are unaware of the proper disaster management plans and policies. Pokhara city lacks awareness of upcoming disasters and it is a serious drawback that can create too many issues in sustainable development practices in the city.

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Introduction

Earthquake disasters represent one of the most hazardous geological risks of Himalayan region. Nepal has a long history of destructive earthquakes as situated in the boundary of the colliding Indian and Eurasian plates, geologically it is situated in one of the most earthquake-prone regions of the world and has experienced devastating earthquakes in the past (Dunn et al. 1939; Chitrakar and Pandey 1986; Bilham 2001). From east to west, the sequence includes the 1905 Kangra earthquake (Mw ~ 7.8), the 1934 Bihar-Nepal earthquake (Mw 8.1), and the 1950 Assam earthquake (Mw ~ 8.6), the Sikkim/Nepal Border Earthquake of September 18, 2011 (Mw 6.9) and the latest is 2015 Gorkha Earthquake in Nepal.

On 25th April 2015 (Saturday), Mw 7.8 earthquake hit Barpak village of the historic Gorkha district at 11:56 am, local time (Rajaure et al. 2017; Wang et al. 2016; Dahal 2018). The epicenter lies about 76 km northwest of Kathmandu valley (15 km depth). The catastrophic earthquake was followed by more than 450 aftershocks greater than 4.0 local magnitude that killed 8970 people and injured more than 23,000 people (MoHA 2016). One aftershock measuring Mw 7.3 struck after 17 days with an epicenter near the Mount Everest (Chinese Border). More than one- third of the population of Nepal has been impacted by the devastating earthquake. Fourteen districts among 75 districts were declared 'crisis-hit' to make people more aware and speed up rescue and relief operations and another seventeen districts were declared 'partially affected' and over a million houses and heritages were damaged or destroyed. The earthquake affected residential buildings, schools, hospitals, health posts, water supplies, communication systems, rural roads, agricultural land, bridges, electricity and hydropower plants (MoHA 2016). The main reasons behind such massive destruction due to the earthquake were weak infrastructures, heritages, rapid population growth, haphazard settlements, poverty and lack of preparedness plans.

Researchers have confirmed the number of variables, such as age, household income, job, having school-aged children at home, education, working status, length of residency in that place etc. may influence the likelihood of taking an earthquake preparedness action (De Man and Simpson-Housley 1988; Edwards 1993; Russell et al. 1995; Karanci and Rüstemli 1995; Sattler et al. 2000; Dahal and Bhandary 2012). Russell et al. (1995) found that demographic variables, such as having higher education, being female and owning a home were associated with pre-earthquake preparedness. Individuals with higher household income were more likely to be prepared than people with lower household income for disasters (Edwards 1993). Likewise, Edwards (1993) and Karanci and Rüstemli (1995) also suggested that person with higher education were more likely to be prepared because they are more likely to understand the relationship between earthquake preparedness and the potential of these preparedness behaviors to reduce the impact of disasters. Edwards (1993) clearly mentioned that having children at home is another factor related to the prediction of the likelihood of earthquake preparedness. There are two possible explanations for the positive relationship between the presence of children at home and earthquake preparedness. Parents are either more sensitive to the safety of their children than themselves or children usually bring information from school to home about the importance of disaster preparedness. Kasapoglu and Ecevit (2003) conducted a study to examine the responsible behavior related to preparedness for future earthquakes and they confirmed that socio-demographic variables, education and working status are significant predictors. Those with higher education and employment showed more preparedness. De Man and Simpson-Housley (1988) suggested that education is the best predictor of the perceived probability of occurrence of an earthquake and it usually enhances earthquake preparedness behavior in an educated person.

Earthquake is an uncertain event. For the earthquake related disaster mitigation, preparedness and risk understanding among people plays a similar role as engineering mitigation measures (Miceli et al. 2008). Miceli et al. (2008) also suggested that there is very less or even no correlation between adoption of protective measures for earthquakes and anticipation of earthquake-related damage (Jackson 1981; Lindell and Perry 2000). Therefore, the earthquake related disaster mitigation works basically comply with earthquake preparedness activities and risk perception of the communities.

The relationship between disaster preparedness and risk perception in the growing urban city of Nepal can give an idea on the status of disaster risk understanding of people and it is a particular interest of this research. Rationalist definition of risk perception prevails that risk perception is the subjective evaluation of the likelihood of a future event occurring and of personal and material damage deriving from it (Miceli et al. 2008). Recent theoretical models in cognitive and emotional psychology suggested that the risk perception may be properly conceptualized as a complex process which encompasses both cognitive and affective aspects (Miceli et al. 2008; Taylor-Gooby and Zinn 2006). Effects and emotions in the aftermath of the certain major disaster may serve as an evidence for probability judgments for future disaster (Slovic et al. 2004). In general, people react to the prospect of risk either cognitively or emotionally in every aftermath of major disasters (Loewenstein et al. 2001) and in both cognition and emotional cases, major disasters always play a differential role in determining risk-

related behavior for future in the local communities. Considering these facts, the hypothesis of this research was Nepalese understanding and adopting the earthquake risk preparedness activities should have been changed both in rural and urban areas after the 2015 Gorkha Earthquake.

Objectives of the study

Based on the hypothesis, the present study is aimed to investigate the level of disaster risk understanding and the perception of risk in local community of Pokhara City in the perspective of aftermath of the 2015 Gorkha Earthquake. In line with the research carried out by Bilham et al. (1997), the western part of Nepal has not experienced earthquake for more than 200 years after 1803 (Uttarkashi) and 1833 Nepal's earthquake and the occurrence of one or more earthquake in the western part of Nepal can release > 6 m of co-seismic displacement, similar to other M > 8 Himalayan events that have occurred in the past 100 years. After the Gorkha earthquake, it is assumed that through news and advanced media as well as the Ad hoc rules imposed by the local authorities, people in the western part of Nepal (Pokhara) are aware of all the measures to be taken to reduce the risk and have perceived knowledge and overview of cycle of disaster risk management. Based on this particular assumption, questionnaire was developed to analyse the protective behaviours adopted by the citizens of Pokhara City as per the perceived awareness raising preparedness ideas for the earthquake disaster. On one hand, emotional components were investigated through the questionnaire survey in order to understand their experience of past 2015 Gorkha Earthquake. On the other hand, behavioural components were taken into consideration for understanding the preparedness major carried out by people and their understanding of disaster risk. Consequently, this is an evaluation study that intended to examine the effect of disaster aftermath on a number of aspects, including risk perceptions, emotion-focused components (e.g., disaster-related fear in people of Pokhara, present coping ability and resiliency in the event of a disaster), knowledge on available safety system in the event of a disaster, readiness in family and community, and the condition of disaster adaptations till date. Moreover, this study also explores future perspectives and demands that underpin relationships between existing DRR programs and perception of the people of the Pokhara city towards existing disaster risk, mainly risk related with earthquakes, floods, sinkholes, landslides, bank failures, etc. Furthermore, Pokhara, being at high risk of future earthquake, this study is important to understand their preparedness activities and to analyse their risk understanding and risk perceived. Thus, the main aim of this study is to examine disaster risk perception and understanding of people in Pokhara City after the 2015 Gorkha Earthquake.

Study area- Pokhara City

The Pokhara City is the capital of Gandaki Province and lies in Kaski District of Nepal, and the second most favored destination of tourists in Nepal (Fig. 1a and b)). The city is famous as a base station to Himalayan trekking in mid-west such as Annapurna base camp and the Kaligandaki valley. All visitors are greatly impressed by the dominating view of the Machhapuchhre (Fish Tail Mountain) and Annapurna Range and beautiful Phewa and Begnas lakes that have added beauty to the valley. The Pokhara City extends along NW-SE direction, having about 5 km width and 20 km length. The valley-fill sediments are presently eroded very deeply by the Seti River, and also formed wide terraces and erosional scarp at different levels. Being nationally and internationally tourists favored zone, the agricultural land is converted into the settlement areas with the agricultural land decreasing from 50.33% in 1996 to 39.64% in 2007 along with the drastic increase in population density (UNDP, ERRRP 2009).

The shaking of the 2015 Gorkha Earthquake was not strong enough to make damages in the Pokhara City (Fig. 1a). However, people understood very well that ground shaking in a major earthquake is usually very strong and it could damage a lot. Thus, the study was conducted in the core part of Pokhara City, Western Nepal. More precisely, at the core city area surrounding western part of the Seti River (Fig. 1b). The altitude of the area ranges from 750 m to 890 m above the sea level and they occupy an area of 123 square km. The target population consists of about 100,000 adult inhabitants of the Pokhara City. The Pokhara City is selected for this research because Bilham et al. (1997) have described strongly about the earthquake risk associated in western part (Pokhara to far western Nepal) of Nepal that has not experienced earthquake for more than 200 years.

Seismic Hazard and vulnerability in the Pokhara Valley

When seismic hazard scenario of the Pokhara Valley is considered, it falls under the area of frequent earthquakes and has already experienced two strong earthquakes (Mw = 7, 1936; and Mw = 6.7, 1954) in the past 100 years (Thapa and Guoxin 2013). It has also faced latest great earthquake, the 2015 Gorkha Earthquake. But during this latest earthquake, the area did not face many damages as in the central part of Nepal, except few damages in old buildings and few bank failures along the Seti River.

UNDP, ERRRP (2009) has evaluated the vulnerability scenario of 2021 by making the sensitivity map of Pokhara Sub-metropolitan City, which is composite of

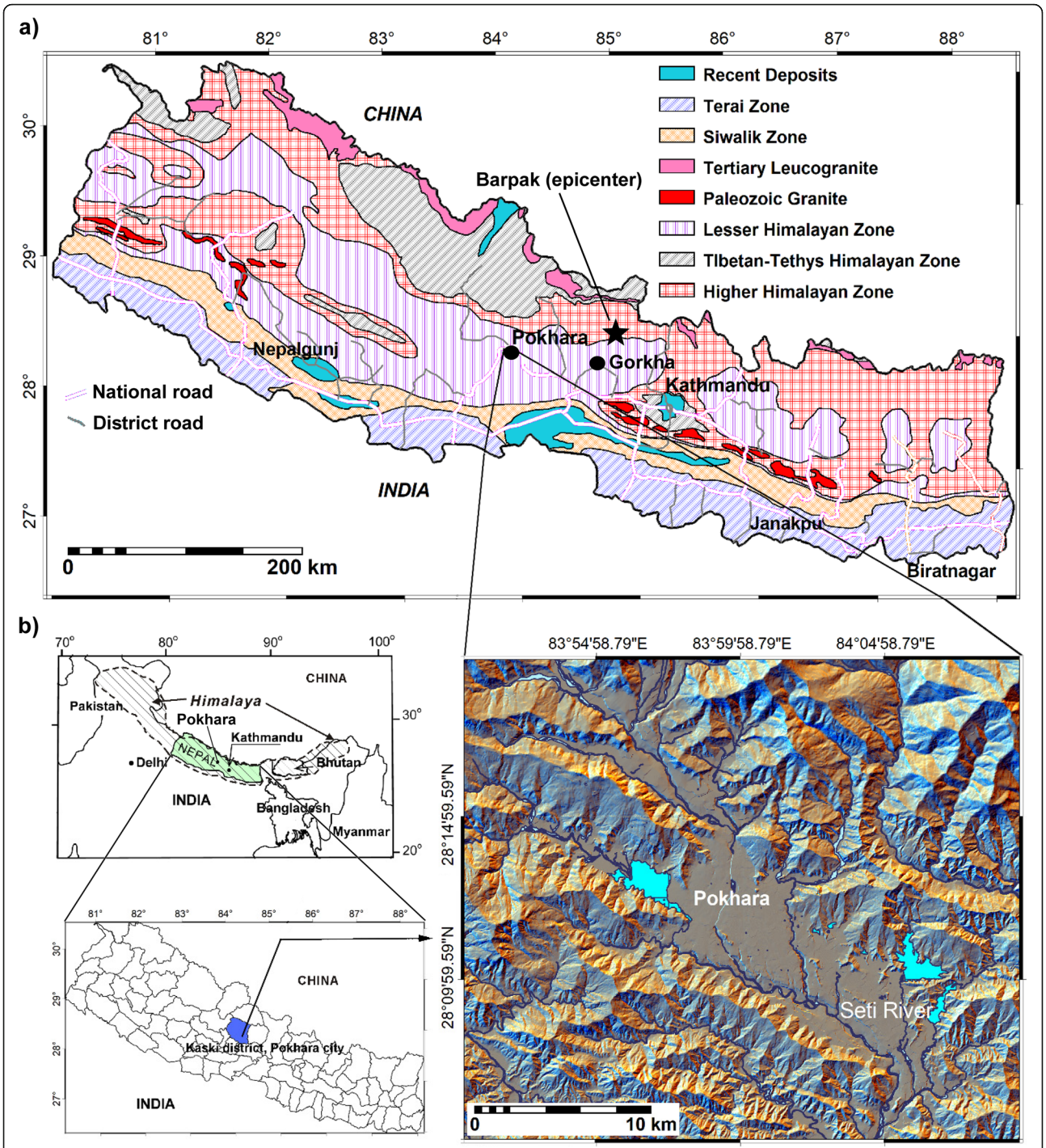

Fig. 1 **a** Location of the study area along with geological (modified after Dahal and Hasegawa 2008) setting and the epicenter location (Barpak) of the 2015 Gorkha Earthquake is also shown in the figure.and **b** Location of Pokhara city in the Himalaya along with geomorphological setting

geological sensitivity analysis, liquefaction susceptibility analysis map, sinkhole susceptibility analysis map and earthquake scenario intensity maps. The built-up area regarding the vulnerability scenario in 2021 reveals that, if the current trend is followed, 52.43% of the built-up areas will be in high sinkhole hazard susceptible areas, 17.07% of the built-up areas at sinkhole and collapse prone areas (UNDP, ERRRP 2009). Chaulagain et al. (2015) have analysed the peak ground acceleration of Kaski district and it is around 0.35 g, 0.46 g, 0.63 g and 0.79 g respectively for 10%, 5%, 2% and 1% for probability of exceedance in 50 years. Referring to Chaulagain

et al. (2015), the economic loss of Kaski district for 10%, 5%, 2% and 1% of probability of exceedance in 50 years are 1376 million euro, 1440 million euro, 1535 million euro and 1577 million euro, respectively. This shows that the Kaski district itself is highly vulnerable to the damage caused by the seismic hazard and huge economic and human loss can be predicted in occurrence of any seismic event.

Shrestha (2017) has performed a research to prepare a microzonation map based on fundamental frequency of Pokhara Valley with corresponding Horizontal to Vertical Spectral Ratio (HVSR) and high range peak frequency from microtremor survey especially where settlement and population are mostly concentrated and are more prone to hazard as indicated in vulnerability scenario map of UNDP, ERRRP (2009). He noticed that in the study area, spatial heterogeneity of fundamental frequency generally ranges from 0.39 Hz to 3.71 Hz with variable HVSR in different geological formations and verified accordingly correlating with average shear wave velocity. Similarly, he noticed that high range peak frequency lies in a range of 3.47 Hz to 9.67 Hz and he concluded that low to medium rise buildings are more vulnerable in Pokhara City in terms of resonance.

Pokhara Valley and flash floods

A devastating flash flood occurred in Seti River on May 5, 2012 that killed more than 40 people and 30 were missing. It was basically due to the massive avalanche in "Annapurna Greater Depression" which was debris-mixed snow avalanche. Within the period of 5–10 min, the snow slid falling off the elevation of about 6000 m and debris might have been close to the melting point produced by frictional heat leading to the sudden slurrification. During the transportation, the avalanche also hit glacial flour deposit and the slurry- debris fell into the gorge that cause the flash flood to occur. There were 7–8 waves of flood which could be as a result of damming up by debris- mixed ice mass and gradual melting and recurring avalanches for few hours that was accumulated in very narrow gorge of Seti River. Furthermore, seismic factor can also be another avalanche triggering factor and that can be repeated in future as well. Hence, this shows that Pokhara Valley is highly vulnerable to flash floods (Dahal 2012; Bhandary et al. 2012).

Pokhara Valley and sink holes

Sink holes has been identified and highly documented since November 2013 in Armala area of Pokhara Valley (north of the study area). There are many sinkhole problems which are filled up with time either by the government as a mitigation measure or by people and contractors for the bussiness purpose. Pokhrel et al. (2015) has conducted the site investigation and survey of sink-hole damage in Armala on June 2014 that was completely filled by the government after the damage. However, upon visiting by the team again on November 2014, they found many new sink-holes as well as the reactivation of the backfilled sinkholes was observed. Results from the Dynamic Cone Penetration Test (DCPT) suggested that the cave has started to form below the gravel layer of the sink hole that led to the increase in cavity size causing the loose upper layer to collapse. Hence, unique geology of the Pokhara Valley has many existing and new problems of sink holes occurring in other area as well.

The above mentioned research reports clearly suggested that the Pokhara Valley needs a suitable disaster risk management plan against various possible geodisaster but very few program has been initiated in this context. Therefore, this research aims to evaluate risk understanding of people living in Pokhara city area and to evaluate ground scenario of disaster risk reduction.

Materials and methods

For this study, histogram analysis, distribution analysis, bivariate correlations and independent sample t-tests were conducted to examine the relationship between people in disaster education-related programs and the how they are following key DRR issues related dependent (criterion) variables: disaster-related knowledge, readiness behaviors of people, disaster awareness, disaster adaptations, and risk perceptions. A series of independent sample t-tests were conducted to examine the effects of age, gender, and disaster events on the dependent variables.

The histogram analysis is useful for numerical data and it helps to understand the shape of the data's distribution. It analyzes whether a process can meet the responder's requirements and also analyzes how the responder's understanding process looks like. It will also determine whether the outputs of two or more responses are different. The histograms always communicate the distribution of data quickly and easily to readers and give responsive understanding. The bivariate correlation, also known as Pearson Correlation, measures the strength and direction of linear relationships between pairs of continuous variables. It is a parametric measure and it also evaluates whether there is statistical evidence for a linear relationship among same pairs of variables in the data. The bivariate correlation is commonly used to measure the correlations among pairs of variables as well as within and between sets of variables. The bivariate correlation suggests whether a statistically significant linear relationship exists between data variables. The independent samples t test compares the means of two independent data in order to determine whether there is statistical evidence that the associated population means

are significantly different. It is also a parametric test. This test clarifies statistical differences between the means of two groups, the means of two interventions and the means of two change scores (De Man and Simpson-Housley 1988; Ronan and Johnston 2001; Ronan and Johnston 2003; Ross 2004).

Data collection and sampling procedures

For the questionnaire survey, a data sheet was developed and 152 local residents (participants) from the randomly selected area from Birauta to Srijanachowk area, west of Seti River of Pokhara city were interviewed. For this purpose, 500 m square grids were prepared in the 15 sq. km area as shown in Fig. 2 and about 9 or 12 households from each grid were selected for the questionnaire survey. Data were actually collected as area representative than population representative.

The survey criteria used within this study were adapted as per the suggestions in the available literatures (De Man and Simpson-Housley 1988; Kuroiwa 1993; Arya 1993; Edwards 1993; Andrews et al. 1998; Ronan and Johnston 2003;Russell et al. 1995; Karanci and Rüstemli 1995; Sattler et al. 2000, Tanaka 2005, Shiwaku et al. 2007, Ronan and Johnston 2001), and are embedded together within a single survey. The variety of past experience with disaster risk among the 152 respondents ranged from no previous experience to almost terrible feeling of the 2015 Gorkha Earthquake. Although the damages were few, they were varied considerably. About 25 questions were asked to respond in order to recognize the breadth and mixture of experience of the 2015 Gorkha Earthquake to keep the data manageable for the purpose of statistical analysis. Thus, the questions were classified into the experience of earthquake, house construction practices, site selection for construction, future earthquake at Western Nepal, engineering design and seriousness for earthquake risks.

The final sample is comprised of 152 respondents in total that were interviewed in 2016. Among them, about 59.2% of them were male while 40.8% of the respondents were female (Fig. 3) with their age group ranging from 20 to 75 years (Mean = 40.63, Standard Deviation = 12.9). Regarding the castes, 41% were Brahmin, 26% were Chhetri, 28% were Janajati and 5% were Dalit (backward community). With respect to composition of the family, 69% of respondents live with one to five members in the family, 28% of them live with six to ten members in the family while rest 3% live with above 10 members in the family. Almost all (99%) of them reported that they came across the disaster directly and 2.6% of the respondents admitted that they have disaster affected family members. Moreover, most of them responded that earthquake is the main disaster they have faced in last 5 years and it was the 2015 Gorkha Earthquake.

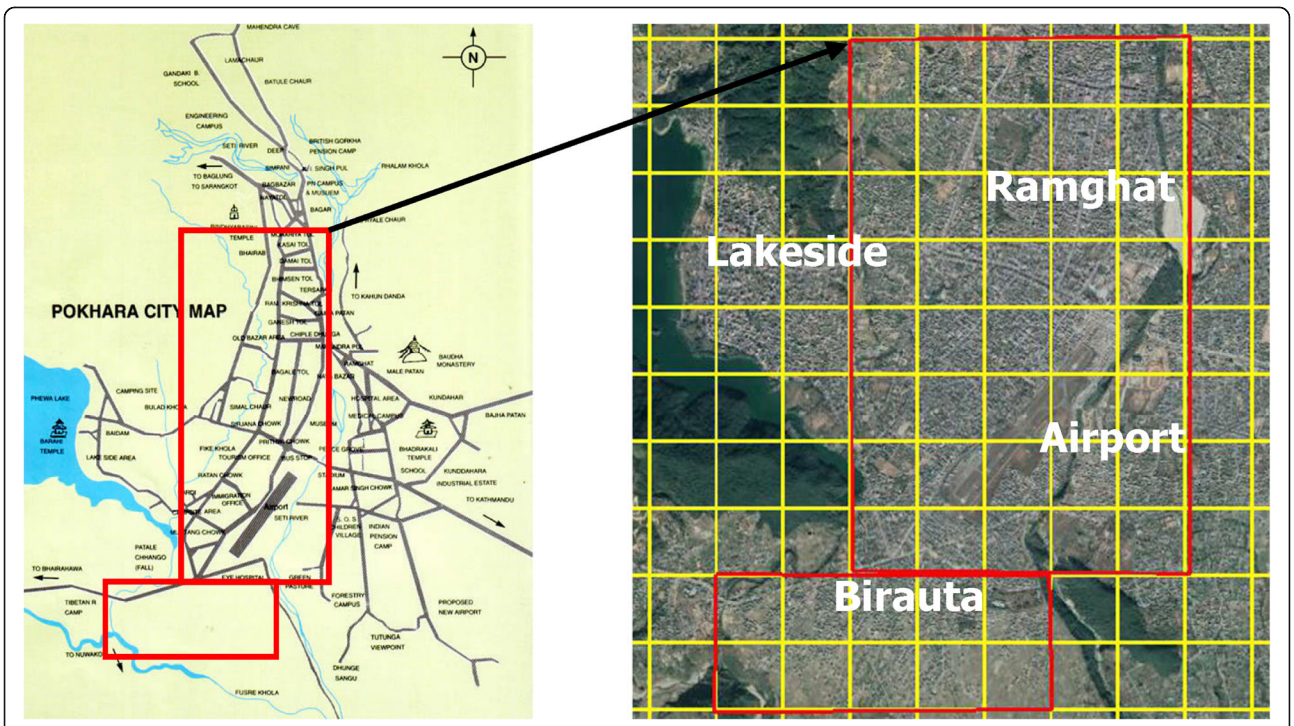

Fig. 2 Illustration of grid based data collection from local resident (source of base map: Tourist map of Pokhara and GoogleEarth). The red area is used for data collection

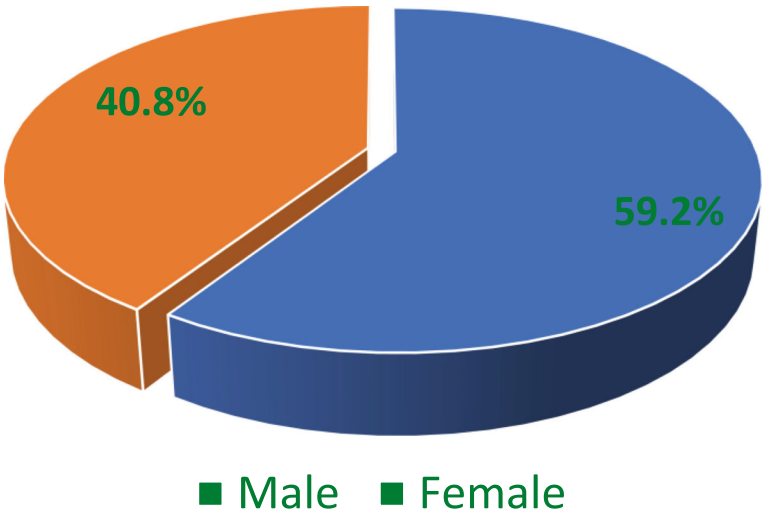

Fig. 3 Gender balance among respondents

Table 1 Few questions related to the 2015 Gorkha Earthquake and readiness behaviour

Questions	Responses					
Did you face the Gorkha Earthquake?	Yes	No				
Where were you during the earthquake?	At home	In the field	In the market	In school	Outside the house	Other
What did you do after the earthquake?	Stayed inside	Went in the field	Hid under the bed	Stayed holding the bed	Stayed out	Other
If you stayed out, for how many days	One day	Two days	Three days	More than three days		
In the future, scientists proverb that earthquake can take place in the West, if this happens do you think your house can transcend it?	Yes	No				
if yes, what are the reasons?	Consulted with the engineer	Have a plan to make a new building	Have a plan of Retrofitting	Will do nothing		
Have you consulted with the engineer before designing your house?	Yes	No				
Have you secured your drawer, frames and vase that could fall during the earthquake	Yes	No				
Have you noticed any type of diseases after the Gorkha Earthquake in your area?	Yes	No				
if yes, mention the type of diseases	Mental	Infectious	Nothing	Communicable	Other	
if yes, were the disease different than the previous ones?	Little different	Very different	Similar	Don't know	Others	
Did you find any mental patient after the earthquake?	Yes	No				
After the earthquake, how many people in your neighbor or family went to see the doctor?	More than 1	More than 5	More than 10	More than 20	Don't know	
How far is the hospital from your home?	1000–2000 m	2000-3000 m	3000-4000 m	Less than 1000 m	More than 4000 m	
Did anyone from governmental and non-governmental organization to understand the situation after the Gorkha earthquake	Yes	No				

Data quantification measures

The household survey questionnaire proposed for data collection had 25 questions in total and it was planned to understand the overall issues related to seismic hazard as well as other hazards prevalent in the valley along with the preparedness practices.

Perception of earthquake risk

The respondents were evaluated for their understanding about prevailing earthquake risk in the Pokhara city after the 2015 Gorkha Earthquake disaster. With the purpose of not influencing the respondent's answers with questions about related topics, items respective to the earthquake risk perception were asked soon after the socio-demographic information at the beginning of the survey. Respondents were asked to visualize an earthquake disaster happening in the future in their city. Then, they were asked to answer questions regarding various domains related to knowledge, perception, readiness behavior and preparedness. Questions regarding earthquake safe design and observation of their home from the engineering point of view were also done.

Respondents were asked about probability of the possible consequences of an earthquake in the Pokhara area. In regards to the feelings of worry, respondents were asked various questions related to the 2015 Gorkha Earthquake and how much they were worried about the similar incidence in Western Nepal. Response categories ranged from 1 (yes) or 0 (No) and all the items are listed in Table 1.

Disaster awareness, adaptations and risk perceptions

Questionnaires about various natural disasters were used to assess the awareness of people and the best course of action to take after the 2015 Gorkha Earthquake. Questions about their knowledge on major disasters (namely, floods, landslides, earthquakes, fires, high winds, hailstorms, droughts, extreme rainfalls, sinkholes and subsidence) were asked to the people to obtain their experiences. For various kinds of disasters, people were also asked to indicate which behavior or behaviors they would endorse in the event of a certain disaster as per the disaster-related information obtained before and after the 2015 Gorkha Earthquake. The earthquake related safe design and their seriousness in the construction practice were also evaluated through questionnaires.

Also, people were asked a series of questions that addressed their knowledge on a number of issues related to disaster. Disaster-related psychological issues were also asked. Questionnaires related to food security and evacuation area as well as the likelihood of occurrence of earthquake disasters in the area were asked. People replied mainly in 3 categories such as "Accepted", "Not accepted" and "I do not know" or "Never", "Sometimes" and "Regularly" or "Less Important", "Important" and "Very Important" as shown in Table 2 and Table 3.

Socio-demographic and experiential characteristics

All socio-demographic and experiential characteristics were obtained at the beginning of the interview. This section of the questionnaire asked participants to respond to seven socio-demographic questions (e.g., gender, age, surname, family members, person less than 18 years in family, drinking water facilities, and land ownership) and four questions concerning experiential aspects (e.g., having family members affected by disaster, having suffered damage due to the 2015 Gorkha Earthquake, having earthquake safe engineered house, having community shelter). All the variables included in this section were codified as dichotomous variables and used for analysis. Likewise, scatter responses in few questions, were also not included in the analysis.

Partial credit model (PCM) to validate the perception of disaster risk scale (PDRS)

People of Pokhara area have noticed all the damages and calamities after the 2015 Gorkha Earthquake in Central Nepal. This research has been conducted presuming that the Pokhara city dwellers are also aware of earthquake and other disasters and they are giving high priority to the risk associated with any kind of disasters in their area. Therefore, to validate this hypothesis, PDRS need to be carefully evaluated. For this purpose, indices of reliability (theoretical correlation between true and observed data) and inter-rater agreement (the degree of agreement among raters) were evaluated by applying Partial Credit Model (PCM). Validity, reliability and unidimensional (used to describe a specific type of measurement scale) of the scale were also evaluated by means of a PCM (Masters 1982). The PCM is an extension of the

Table 2 Disaster awareness, adaptations and risk perceptions items

To rate, Less Important, Important and Very Important, following statements were asked:
1. Disaster discussion with neighbours
2. Disaster discussion with family
3. Drill works in the society
4. Participation in disaster training
5. Information of danger areas near settlement areas
6. Retrofitting of the houses to reduce earthquake effects
7. Importance of fire-brigades
8. Roads to enter fire-brigades near house
9. Fire-brigade near houses and schools
10. Discussion on Mitigation measures
11. Disaster Preparedness Measures
12. Local, district and national level disaster response
13. Recovery after disaster
14. Self-observation of your house after earthquake
15. Consultation with Engineering before building houses
16. Soil testing before constructing houses, etc.

Table 3 Disaster awareness, adaptations and risk perceptions items

To rate, Accepted, Not Accepted and I do not know, following statements were asked:

1. Disaster can be only predicted by GOD
2. Disaster is very destructive
3. I can escape during disaster
4. A disaster can reappear in 10 years' time
5. Residential area is safe from all types of disasters
6. I know about a secured place
7. I keep the stock of goods
8. Disaster can never be stopped by any means
9. I know about the disaster-prone areas of our community
10. I know preparedness plan of our community, etc.

Rasch model (Rasch 1980; Wright and Masters 1982) and belongs to the family of Item Response Theory (IRT) model which is defined as a theory of testing based on the relationship between individuals' performances on a test item and the test takers' levels of performance on an overall measure of the ability that item was designed to measure. IRT models are efficient and accurate to transform categorical item responses into objective scale measures. When items are polytomous, PCM models helps to measure characteristics of items and persons. Under the theorized concepts, PCM always provides statistically independent means of concurrently scaling both items and persons. Winsteps software (Linacre 2003) was used to perform PCM and an estimate of each individual's level of perceived risk and the severity of each item's content using an equal-inverval logit scale.

In PCM, correlation between item responses and the measures of the interviewed persons provides point biserial correlations. Infit and outfit statistics, which can be obtained from the sum of squared residuals, have an expected value of 1.0 and fit the model well when they range from .5 to 1.5 (Linacre 2003).

Data analysis and results

Response to the DRR issues

In the questionnaire survey, respondents were asked a number of disaster-related questions. First of all, after getting background information about the respondent, all respondents were asked about family size and disaster victim in the family. A question was asked whether they came across disaster in their life or not. 99% of them responded that they came across the disaster, 2.6% said they have disaster affected family members. Most of them responded that earthquake is the main disaster they have faced in last 5 years and it was the 2015 Gorkha Earthquake.

Statistically, significance of all responses of each key DRR issues was also evaluated with the predisposed disaster knowledge of the respondents. They were asked about their insecurity in various disasters, such as flood, landslide, earthquake, fire, sink-hole, bifurcated crack, storm, hailstorm, drought, and heavy rainfall and they responded with "Not dangerous at all", "Sometimes dangerous" and "Always dangerous" answers. The histogram clearly suggested that due to recent earthquake events respondents are fully aware of earthquake risk but they are not taking sinkholes and cracks are dangerous. In fact, this is not a correct answer because geologically, Pokhara is very critical to sink holes and cracks due to solution effects in debris deposit, but respondents were not taking it dangerous geohazards for their area (Fig. 4). More than 40% of respondents were thinking that sinkholes and cracks are not dangerous at all.

Likewise, few selective questions were evaluated by correlation analysis. The responses are very critical and

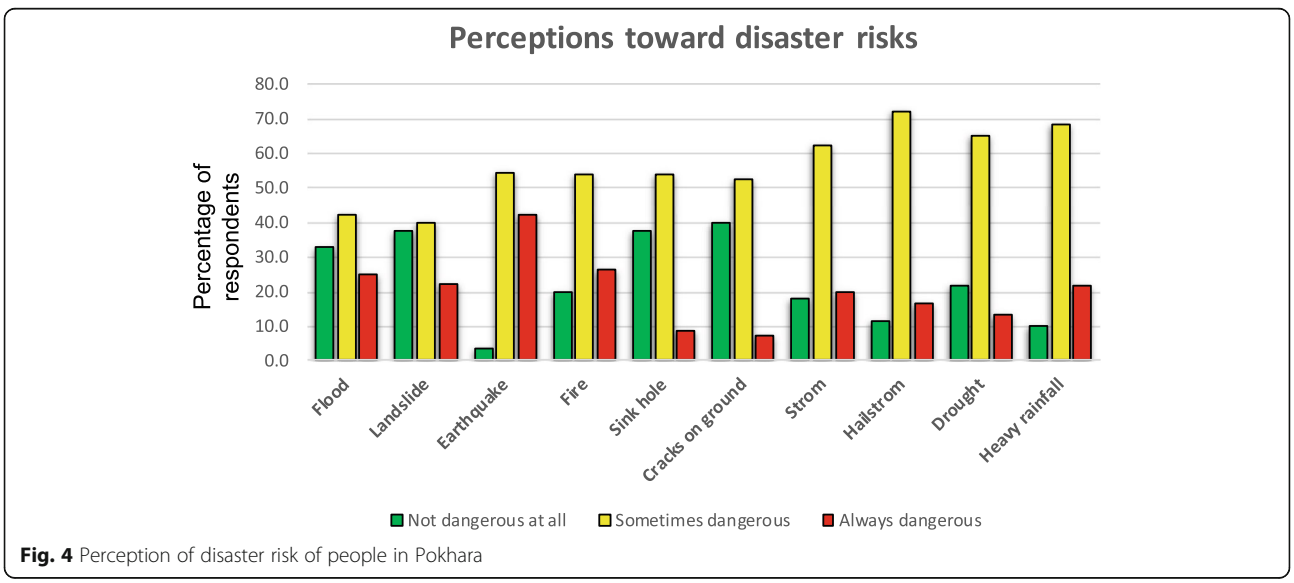

Fig. 4 Perception of disaster risk of people in Pokhara

Table 4 Disaster knowledge of the people, negative correlation exists between responses of consecutive disaster-related questions

Answer modes	Please evaluate these comments related to disaster knowledge and preparedness	Measure	SE	Infit (mnsq)	Outfit (mnsq)	PTBS correlation	Average Ability		
							Disagree	Agree	Don't know
1	Disaster can only be predicted by God	0.35	0.15	0.79	0.79	0.42	-0.96	-0.38	0.70
2	Disaster is very destructive	0.20	0.15	0.43	1.01	0.25	-1.03	-0.47	0.89
3	I have an easy way to escape during the disaster	1.32	0.16	1.07	0.52	0.43	-0.81	-0.17	0.44
4	A terrible disaster can occur in 10 years time	-0.22	0.15	2.07	2.04	0.3	-0.81	-0.45	-0.19
5	I think that my residential area is safe from any type of disasters I think that my residential area is safe from any type of disasters	1.07	0.16	1.18	1.16	0.35	-0.78	-0.26	0.18
6	I know about a secured place, where I can stay at the time of disaster	1.14	0.16	0.88	0.84	0.43	-0.89	-0.13	0.01
7	Disaster is recurring, so I keep the stock of goods.	-0.11	0.15	0.63	0.64	0.32	-1.06	-0.43	0.19
8	I think that disaster can never be stopped by any means.	1.04	0.16	1.00	1.01	0.35	-0.78	-0.31	0.62
9	I know which governmental body should be contacted after the disaster occurs	-0.11	0.15	0.48	0.5	0.33	-1.11	-0.44	0.77
10	I know about the vulnerable people of our community	-1.26	0.15	0.89	0.88	0.43	-1.45	-0.63	-0.04
11	I know about the disaster prone areas of our community	-1.51	0.15	1.19	1.16	0.54	-1.53	-0.64	-0.07
12	I am getting an up-to-date information about the preparedness plan of our community	-1.46	0.15	1.19	1.18	0.49	-1.57	-0.56	-0.14
13	Since, our government is providing us with sufficient facilities, times after disaster is not a serious problem for us	-0.04	0.15	1.22	1.2	0.63	-1.14	-0.41	0.33
Mean		0	0.15	1.00	0.99				
S.D		0.94	0.00	0.4	0.38				

Note: No missing responses and items are ordered according to their difficulty

a negative correlation exists between responses of consecutive disaster-related questions (Table 4). A person who has family member already affected by disaster still does not think that he/she has to know about information related to disaster-prone areas in his/her city. Pearson correlations among these responses are negative which suggests that people are not having enough DRR knowledge even after the 2015 Gorkha Earthquake.

Preparation after the 2015 Gorkha earthquake

The respondents were asked about their preparation for earthquake and evaluated their anxiousness towards future earthquake of Western Nepal. First, they were asked about whether they faced Gorkha Earthquake or not and four questions regarding earthquake safe house, the condition of non-structural items inside and outside of house, proper engineering design, and column and wall relation were asked with respondents. The responses were "Yes" or "No".

In general, a responder who had experiences of the 2015 Gorkha Earthquake might be aware of earthquake-related key DRR issues, such as earthquake-safe design, building typology, and status of house in the time of the earthquake. Previous exposure of respondents to the earthquake can be a proxy parameter of disaster risk perception. But independent sample t-tests between "yes" and "no" pre-exposed group in earthquake disaster-related questions revealed that pre-exposing does not show an effect on earthquake-related key DRR issues, because in all cases, pre-exposed group "no" has shown significance (Sig. 2-tailed > 0.05) of t-test results (Table 5).

Moreover, the responders were asked about various questions related to disaster knowledge, their responses did not prove that they have sound knowledge on DRR issues of the city. More than 40% of the respondents were not aware of disaster-prone area in community and preparedness plan of community. Meanwhile, more than 60% think that disaster is act of GOD! (Fig. 5).

Gender and age effect in DRRM process of Pokhara City

Demographic factors always possess some relationship with DRR process in the community. To explore these issues, preliminary analyses have been conducted to explore gender and age-based grasping of disaster concept among respondents. Likewise, few data, such as number person less than 18 years in family, drinking water facilities, and land ownership could not include in the data analysis due to scatter data of responses.

Table 5 Independent-samples T test to evaluate disaster preparedness of people in the Pokhara city after experience of the 2015 Gorkha Earthquake

Answer mod+B2 :K25es	Provide your comments in these disaster risk management related activities.	Measure	SE	Infit (mnsq)	Outfit (mnsq)	PTBS correlation	Average Ability		
							Less important	Important	Very important
1	Discussion about disaster with neighbours	1.13	0.28	3.33	3.39	0.08	0.80	1.45	1.09*
2	Discussion about disaster with family members	1.62	0.31	2.91	2.90	0.27	1.10	1.23	2.22
3	About disaster drill campaign	0.06	0.18	0.74	0.70	0.71	-1.29	0.73	2.95
4	Listen to the people working for the management of disaster	-0.49	0.18	0.81	0.74	0.69	-1.50	0.54	2.62
5	To participate in the community training related to disaster	1.35	0.18	1.36	1.34	0.61	-0.05	1.20	3.06
6	Volunteering activities	0.76	0.18	0.92	0.90	0.66	-0.44	0.95	3.22
7	Information about disaster prone areas	0.67	0.18	0.91	0.91	0.64	-0.76	1.03	3.03
8	Importance of retrofitting	1.01	0.18	0.85	0.82	0.69	-0.68	1.13	3.31
9	Importance of ambulance	-0.30	0.18	0.71	0.65	0.73	-1.87	0.62	2.77
10	Importance of entrance way for ambulance	-1.15	0.18	0.97	1.03	0.56	-2.44	0.53	2.16
11	Road blockage as well as works to resume the traffic	-1.39	0.19	1.20	1.21	0.50	-1.38	0.55	1.99
12	To share your knowledge and understanding about disaster with others	-1.46	0.19	0.88	0.91	0.59	-2.66	0.35	2.12
13	Maintenance of the ambulance	-0.30	0.18	0.77	0.72	0.69	-1.71	0.64	2.72
14	Discussion about disaster mitigation	0.19	0.18	0.63	0.62	0.65	-0.87	0.73	3.17
15	Disaster preparedness system	-0.30	0.18	0.74	0.75	0.66	-2.18	0.66	2.71
16	Disaster response at local, regional and national level	0.06	0.18	0.71	0.70	0.68	-1.56	0.75	2.94
17	Recovery after disaster	-0.04	0.18	0.92	0.88	0.60	0.07	0.62	2.84
18	Evaluation of your house after the earthquake	0.25	0.18	0.89	0.87	0.58	0.15	0.74	3.00
19	Counselling with engineers before building a house	-0.01	0.18	1.15	1.30	0.43	0.40	0.84	2.46
20	Soil testing before building a house	-1.67	0.19	1.09	1.35	0.46	-3.78	0.58	1.88
Mean		0.00	0.19	1.12	1.13				
S.D.		0.91	0.04	0.69	0.71				

Note: No missing responses and items are ordered according to their difficulty

Effect of gender

Histogram analysis and an independent t-test have been performed to understand gender-based response to the disaster risk management activities. The respondents were asked about their feeling on the level of danger for various kind of disasters which indirectly imposed their readiness behaviour toward disasters. The result (Fig. 6 and Table 6) suggested that there is very similar response to fire disaster from both male and female. Independent t-test suggested that female and male are considering a level of danger for all kind of disasters in the same way while their opinion on earthquake is different because significance of t-test results (Table 6) is less than 0.05 (two-tailed). The histogram also suggested that male and female responses are significantly different for the earthquake.

Likewise, when respondents were asked for source of disaster information, higher number of female respondents were using television broadcast (Fig. 7) for the disaster related information. Few male respondents are also preferring FM radios as the major source for the information. Use of internet for disaster information update was low among people. Very few were using newspaper as a source of information of disaster. Internet use for disaster update is also fair. Although many respondents are using social media, the study found that they are reluctant to use the internet for disaster information update.

Effect of age

Two age groups (< 40 years and > 40 years) are categorized (50% percentile) to evaluate the effect of age on the knowledge of the major disaster in the city. The analysis shows that both older and younger people categorizing level of danger in major disaster time in the same manner (Fig. 8). But, t-test shows that only opinion of

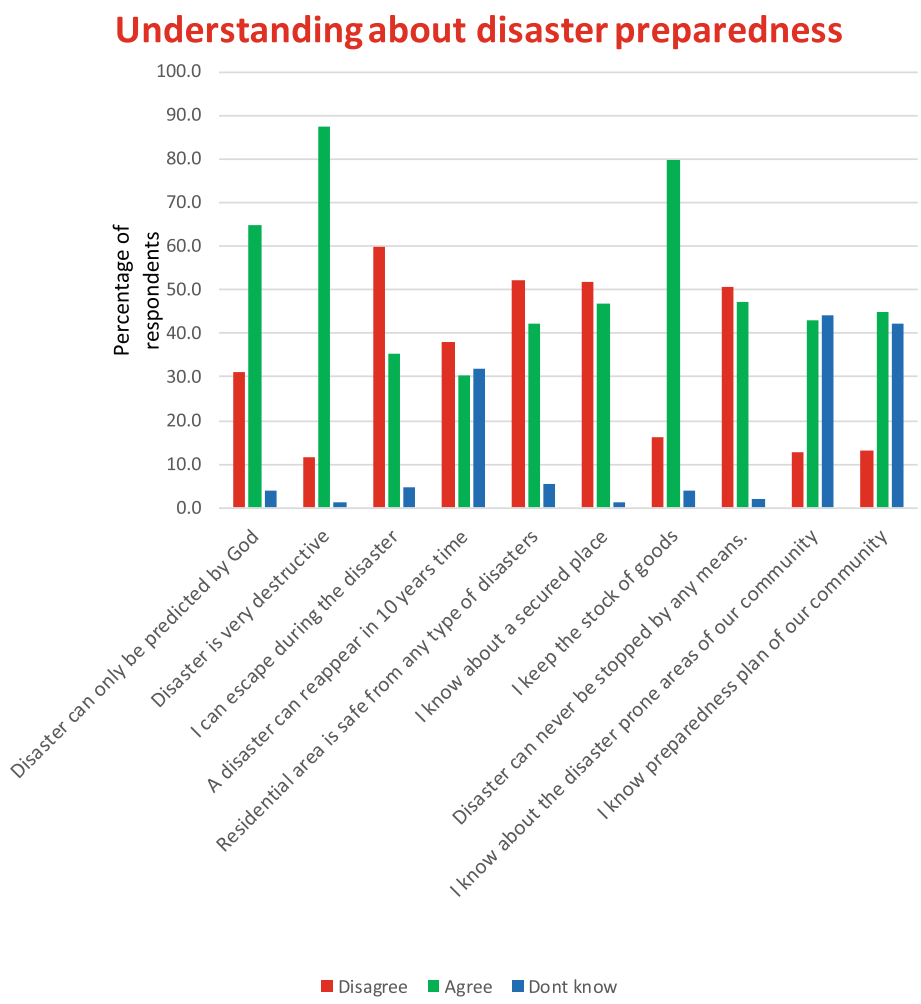

Fig. 5 Disaster knowledge of people of Pokhara city after the 2015 Gorkha Earthquake

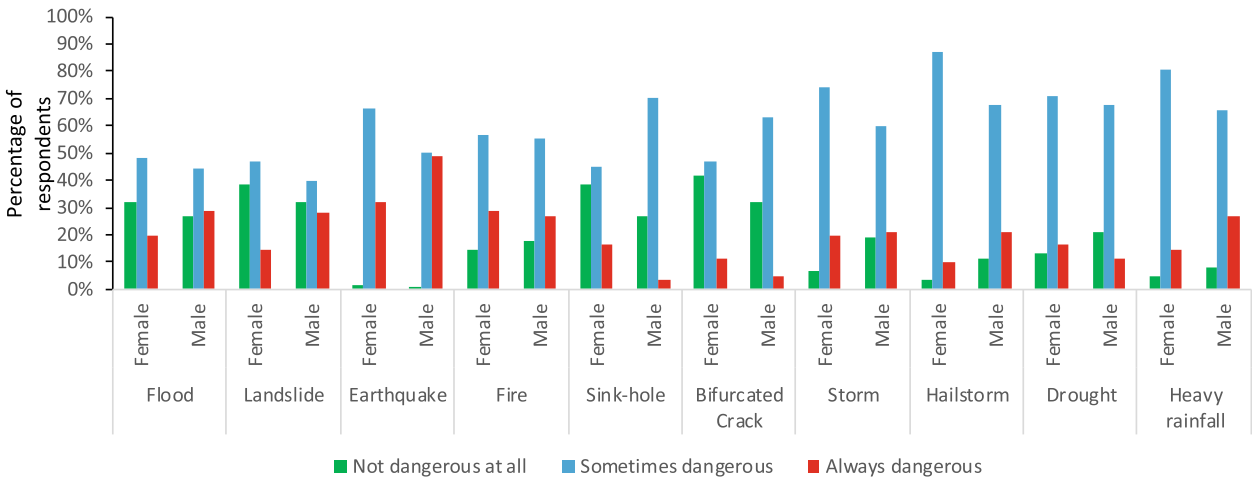

Fig. 6 Gender based response for various kind of disaster and associated level of danger

Table 6 t-test result for gender-based opinion on level of danger during major disaster

Disaster type	t(152)	Sig. (2-tailed)
Flood	−1.25	0.21
Landslide	−1.61	0.11
Earthquake	−2.02	0.05
Fire	0.52	0.61
Sink-hole	0.08	0.94
Bifurcated Crack	−.292	.771
Storm	1.111	.268
Hailstorm	−.440	.661
Drought	1.446	.150
Heavy rainfall	−1.092	.277

old and younger aged people are different in evaluating the level of danger during fire disaster. They evaluated fire disaster differently (Table 7) as significance level is less than 0.05.

More or less equal number of older and younger groups of people are using television to get disaster information. However, younger people are more interested to have disaster information from internet than older people but they do not use newspaper as a source of disaster information (Fig. 9). Only few older people are using newspaper to get disaster-related information.

Partial credit model (PCM) and validation of the perception of disaster risk scale (PDRS)

Statistically, significance of all responses to each key DRR issues were also evaluated with the predisposed disaster knowledge of the people. Various questions were asked to confirm people's opinion on disaster management system of city, insecurity towards various disasters, understanding of disasters phenomenon, and suggestions on disaster management plans. The responses were used to evaluate perceptions of disaster risk scale (PDRS). Similarly, coherency on the response and rating structures need to validate to obtain conclusions from collected data. For this purpose, Partial Credit Modelling (PCM) has been performed that was also the aim of this research. In total, 4 sets of analysis have been done. These sets of response are believed to estimate responders' level of perceived disaster risk after the 2015 Gorkha Earthquake. The results of analysis are given in Table 8, Table 9, Table 10 and Table 11. These tables illustrate item measures, their standard errors, fit statistics, and point-biserial correlation along with estimates of average ability. In present data, both infit and outfit statistics is fitting well as suggested by Linacre (2003).

As can be seen from the Table 8, all fit statistics except one with various answer modes are adequate and rating structure is consistent. Similarly, Table 9 suggests that all fit statistics are less than 1.5 and the rating structure is consistent. For disaster knowledge and preparedness (Table 10) response, only one fit statistic is more than 1.5. Likewise, for disaster risk management related activities (Table 11) response, only first two fit statistics is more than 1.5. Linacre (2020) has suggested that if the value is more than 1.5, both infit and outfit statistics does not fit well and the responders' level of perceiving disaster risk for the particular question is not much pertinent. Linacre (2020) has described importance of all the headings given in the column of Table 11. These values compared the coherency of each consecutive questions to evaluate responders' level of perceiving disaster risk. Validity, reliability and unidimensionality of used data are usually evaluated from these outcomes. For instance, if the value of S.E.s difference is more than 3, the present research could not be validated as the consecutive questions are not logical in the context for

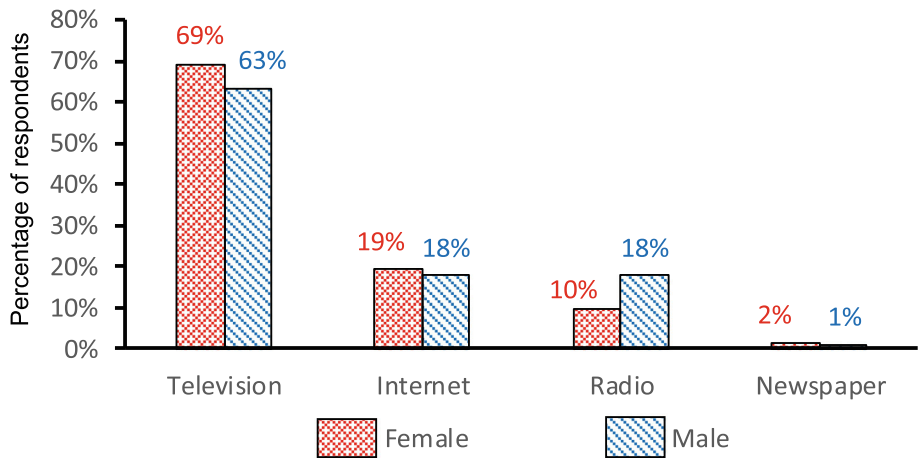

Fig. 7 Use of media for disaster information among male and female respondents. Both male and female group has clearly showed that the main source of information is television. While only 1% of male use newspaper to obtain disaster related information

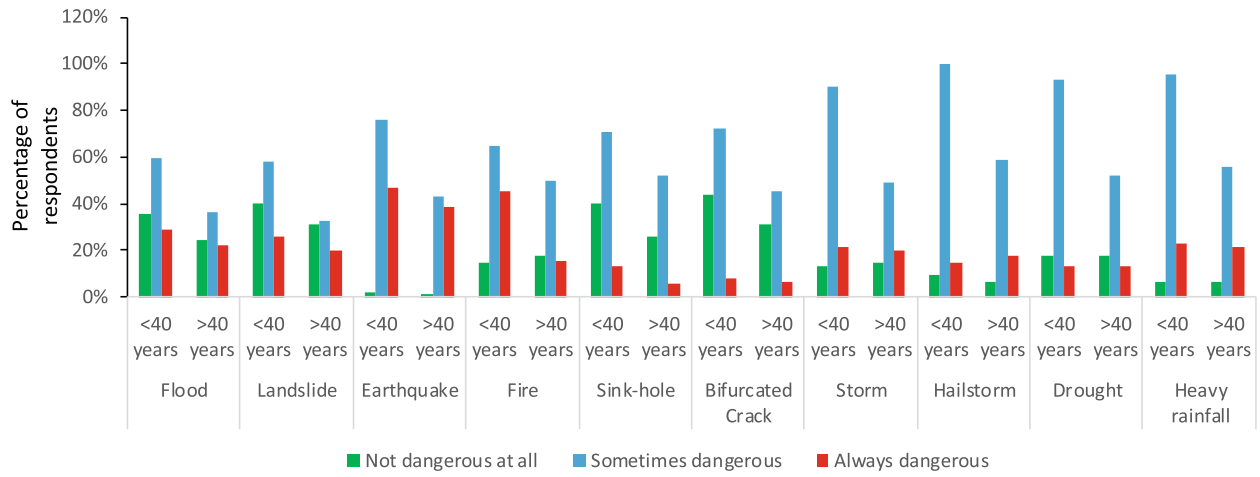

Fig. 8 Age based response for various kind of disaster and associated level of danger

responders' level of perceiving disaster risk. In fact, Linacre (2003) and Linacre (2020) have well suggested for particular use of fit statistics to understand coherency of questions and responses.

Discussion

This research checked coherency of the questionnaires and evaluated responders' level of perceiving disaster risk by PCM. Validity, reliability and unidimensionality of the data and statistical analysis were evaluated by means of PCM. The PCM has validated the statistical analysis because only three questions are showing less coherency in the consecutive questions as they have higher value of fit statistics. This validations has facilitated to interpret disaster risk understanding of people in the Pokhara city for the upcoming disasters in the area.

The findings of this research related to disaster risk understanding and measures needed to be undertaken in the aftermath of the 2015 Gorkha Earthquake has brightened few critical issues of urban disaster risk management programs in Nepal. Various organizations working in the Disaster Risk Reduction (DRR) sectors are expressing that conceptual course of DRR are already in the school curricula of Nepal and people are getting DRR knowledge through DRR awareness campaigns, trainings, meetings and so on. Likewise, those organizations are also claiming that after the 2015 Gorkha Earthquake, the DRR situation is well improved in Nepal and people are fully aware of disaster risk and giving care to disaster risk management works both in urban and semi urban area. However, this research of Pokhara City realized that the real ground scenario of DRR in Nepal is different than the claim of organizations working in Disaster Risk Reduction (DRR) sectors. In this research, risk understanding and measures undertaken in the aftermath of the 2015 Gorkha Earthquake at Pokhara city were explored with people of Pokhara city and findings are not encouraging. Still, people are confused for disaster adaptation and risk perception. Only one satisfactory result was noticed in the status of disaster knowledge of people. Maximum number of people are thinking that disaster-related knowledge is very important and the roles of governmental and non-governmental institutions are not satisfactory. DRR knowledge of both male and female in the Pokhara city is not so different. Source of disaster information between male and female is distinct from each other. The higher number of females are using television as a major source of information whereas, males are depending on FM radio and newspaper also. Either old or young, people are not using newspaper and internet as a source of disaster information. Lack of availability of newspaper and limited access to the internet facility might be causing this problem. The analysis shows that people do not have correct knowledge of disasters and mitigation. Although 99% of them already faced earthquake disaster, their opinion for

Table 7 t-test result for age-based group's (< 40 years and > 40 years) opinion on level of danger during major disaster

Disaster type	t(152)	Sig. (2-tailed)
Flood	−.211	.833
Landslide	.135	.893
Earthquake	−1.065	.288
Fire	2.616	.010
Sink-hole	.199	.842
Bifurcated Crack	.079	.937
Storm	−.018	.985
Hailstorm	−1.195	.234
Drought	.159	.874
Heavy rainfall	−.522	.602

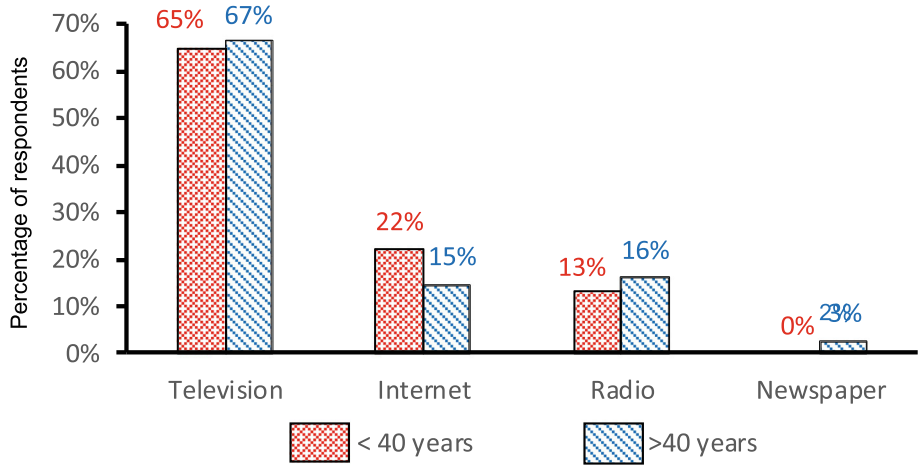

Fig. 9 Use of media for disaster information among older and younger people. The two-age group has clearly showed that the main source of disaster information is television. While none of < 40 years age group use media to obtain disaster related information

disaster adaptation and readiness behaviors are somehow unexpected. Nearly 60% of people are thinking that disaster risk perception is not important and are confused on the matter.

This research shows that the rapidly urbanizing cities like Pokhara and other similar places should speed up the safety works and adopt proper mitigation measures in order to minimize the possible risks and reduce the loss of lives and property. Total number of 152 people, each from one house responded to the questionnaires among which 60% were male and 40% were female and the mean age of respondents is 40.63 year with standard deviation of 12.858. Analysis of gender-based perceived risk shows that the perception of disaster risk is different for male and for female. On one hand, after facing the 2015 Gorkha Earthquake, many people have developed a kind of fear regarding earthquake danger and are showing more interest in the construction of Earthquake Resistant Buildings but, on the other hand, along with the fear, they are confident that Earthquake will have no effect in the western part as well as Terai region of Nepal as it has caused more damage on the central part of the country.

This research shows that almost all respondents agree on the fact that they have sink holes problems in the valley but analysis shows that they don't find it dangerous. Also, field survey showed that people ignore sinkholes and cracks in many places by refilling it and plotting in

Table 8 Partial Credit Model on perception of disaster risk scale measurements through a question related to disaster management activities in the Pokhara city

Answer modes	How do you evaluate disaster management activities in your city?	Measure	S.E	Infit (mnsq)	Outfit (mnsq)	PTBS Correlation	Average Ability			
							Not Effective at all	Less Effective	Effective	Very Effective
1.	Data collection method	-0.69	0.15	2.48	2.57	-0.60	-1.10	-2.15[a]	-3.13[a]	-
2.	Role of the municipality	0.82	0.16	0.91	0.90	0.29	-2.62	-2.17	-	1.34
3.	Role of local people	0.82	0.16	0.94	0.92	0.67	-3.05	-2.02	-0.54	-1.66[a]
4.	Role of NGOs/INGOs	0.65	0.16	0.75	0.73	0.69	-3.15	-2.07	-0.54	-
5.	Role of district administration office	0.25	0.16	0.55	0.54	0.79	-3.58	-2.07	-0.73	-
6.	Role of DDC	0.20	0.16	0.64	0.63	0.74	-3.53	-2.08	-0.94	-
7.	Role of Municipal Disaster Management Committee	-0.45	0.16	0.66	0.65	0.67	-3.93	-2.24	-1.34	-
8.	About resilience program	-0.79	0.15	0.91	0.90	0.58	-3.29	-2.48	-1.39	-
9.	About preparedness program	-0.81	0.15	1.11	1.11	0.49	-3.32	-2.36	-1.66	-
Mean		0	1.16	0.99	0.99					
S.D.		0.65	0	0.55	0.58					

Note: No missing responses and items are ordered according to their difficulty
[a]Average ability does not ascend with category score

Table 9 Partial Credit Model on perception of disaster risk scale measurements through a question related to major disasters and feeling of dangerous

Answer modes	How did you rate the following disasters in terms of its effects?	Measure	SE	Infit (mnsq)	Outfit (mnsq)	PTBS correlation	Average Ability		
							Not dangerous at all	Sometimes dangerous	Always dangerous
1	Flood	0.21	0.17	1.23	1.23	0.71	-1.77	0.46	1.38
2	Landslide	0.58	0.17	1.2	1.21	0.75	-1.62	0.59	1.58
3	Earthquake	1.78	0.18	0.88	0.98	0.58	-2.01	-0.74	1.16
4	Fire	-0.44	0.17	1.09	1.09	0.64	-1.8	-0.0	1.4
5	Formation of sink-hole	1.05	0.17	0.86	0.85	0.68	-1.58	0.65	1.75
6	Bifurcated crack	1.32	0.18	0.8	0.79	0.71	-1.56	0.86	1.66
7	Storm	-0.24	0.17	1.12	1.14	0.49	-0.95	-0.25	1.68
8	Hailstorm	-0.32	0.17	0.91	0.92	0.45	-1.19	-0.17	1.63
9	Drought	0.24	0.17	0.96	0.96	0.53	-1.45	0.11	1.71
10	Heavy rainfall	-0.61	0.17	0.82	0.82	0.55	-1.84	-0.26	1.62
Mean		0.00	0.17	0.99	1.00				
S.D.		0.85	0.00	0.15	0.15				

Note: No missing responses and items are ordered according to their difficulty

the area for business purposes. There is even a case that people try to hide the fact that the land they own have sink hole problems and don't want anybody to know about it which is a serious issue that has to be taken care of by the municipality itself. Furthermore, such a fragile city that is vulnerable to different types of disasters lack hazard maps and 40% of the respondents are unaware of the disaster-prone area in the community and no preparedness plans has been developed by the community. Also, 60% of the respondents, even educated, consider disaster as an act of God which is unsure and have a very low chance of mitigation.

Many people through experiences have understood effects of disaster and have developed some knowledge on it. But, weak governmental law and order regarding disaster mitigation have hindered the development of positive attitude towards preparedness measures. Thus, with such attitude, people cannot practice disaster mitigating activities. Furthermore, people are aware of the disaster effects but, are ignoring the preparedness methods. Despite the fact that disaster education program is

Table 10 Partial Credit Model on perception of disaster risk scale measurements through people's comments on disaster knowledge and preparedness

Answer modes	Please evaluate these comments related to disaster knowledge and preparedness.	Measure	SE	Infit (mnsq)	Outfit (mnsq)	PTBS correlation	Average Ability		
							Disagree	Agree	Dont know
1	Disaster can only be predicted by God	0.35	0.15	0.79	0.79	0.42	-0.96	-0.38	0.70
2	Disaster is very destructive	-0.20	0.15	0.43	0.52	0.25	-1.03	-0.47	0.89
3	I have an easy way to escape during the disaster	1.32	0.16	1.07	1.01	0.43	-0.81	-0.17	0.44
4	A terrible disaster can occur in 10 years time	-0.22	0.15	2.07	2.04	0.30	-0.81	-0.45	-0.19
5	I think that my residential area is safe from any type of disasters	1.07	0.16	1.18	1.16	0.35	-0.78	-0.26	0.18
6	I know about a secured place, where I can stay at the time of disaster	1.14	0.16	0.88	0.84	0.43	-0.89	-0.13	0.01
7	Disaster is recurring, so I keep the stock of goods.	-0.11	0.15	0.63	0.64	0.32	-1.06	-0.43	0.19
8	I think that disaster can never be stopped by any means.	1.04	0.16	1.00	1.01	0.35	-0.78	-0.31	0.62
9	I know which governmental body should be contacted after the disaster occurs	-0.11	0.15	0.48	0.50	0.33	-1.11	-0.44	0.77
10	I know about the vulnerable people of our community	-1.26	0.15	0.89	0.88	0.43	-1.45	-0.63	-0.04
11	I know about the disaster prone areas of our community	-1.51	0.15	1.19	1.16	0.54	-1.53	-0.64	-0.07
12	I am getting an up-to-date information about the preparedness plan of our community	-1.46	0.15	1.19	1.18	0.49	-1.57	-0.56	-0.14
13	Since, our government is providing us with sufficient facilities, times after disaster is not a serious problem for us	-0.04	0.15	1.22	1.20	0.63	-1.14	-0.41	0.33
	Mean	0.00	0.15	1.00	0.99				
	S.D.	0.94	0.00	0.40	0.38				

Note: No missing responses and items are ordered according to their difficulty.

Table 11 Partial Credit Model on perception of disaster risk scale measurements through people's comments on disaster risk management related activities

Answer mod+B2 :K25es	Provide your commnets in these disaster risk management related activities.	Measure	SE	Infit (mnsq)	Outfit (mnsq)	PTBS correlation	Average Ability		
							Less important	Important	Very important
1	Discussion about disaster with neighbours	1.13	0.28	3.33	3.39	0.08	0.80	1.45	1.09*
2	Discussion about disaster with family members	1.62	0.31	2.91	2.90	0.27	1.10	1.23	2.22
3	About disaster drill campaign	0.06	0.18	0.74	0.70	0.71	-1.29	0.73	2.95
4	Listen to the people working for the management of disaster	-0.49	0.18	0.81	0.74	0.69	-1.50	0.54	2.62
5	To participate in the community training related to disaster	1.35	0.18	1.36	1.34	0.61	-0.05	1.20	3.06
6	Volunteering activities	0.76	0.18	0.92	0.90	0.66	-0.44	0.95	3.22
7	Information about disaster prone areas	0.67	0.18	0.91	0.91	0.64	-0.76	1.03	3.03
8	Importance of retrofitting	1.01	0.18	0.85	0.82	0.69	-0.68	1.13	3.31
9	Importance of ambulance	-0.30	0.18	0.71	0.65	0.73	-1.87	0.62	2.77
10	Importance of entrance way for ambulance	-1.15	0.18	0.97	1.03	0.56	-2.44	0.53	2.16
11	Road blockage as well as works to resume the traffic	-1.39	0.19	1.20	1.21	0.50	-1.38	0.55	1.99
12	To share your knowledge and understanding about disaster with others	-1.46	0.19	0.88	0.91	0.59	-2.66	0.35	2.12
13	Maintenance of the ambulance	-0.30	0.18	0.77	0.72	0.69	-1.71	0.64	2.72
14	Discussion about disaster mitigation	0.19	0.18	0.63	0.62	0.65	-0.87	0.73	3.17
15	Disaster preparedness system	-0.30	0.18	0.74	0.75	0.66	-2.18	0.66	2.71
16	Disaster response at local, regional and national level	0.06	0.18	0.71	0.70	0.68	-1.56	0.75	2.94
17	Recovery after disaster	-0.04	0.18	0.92	0.88	0.60	0.07	0.62	2.84
18	Evaluation of your house after the earthquake	0.25	0.18	0.89	0.87	0.58	0.15	0.74	3.00
19	Counselling with engineers before building a house	-0.01	0.18	1.15	1.30	0.43	0.40	0.84	2.46
20	Soil testing before building a house	-1.67	0.19	1.09	1.35	0.46	-3.78	0.58	1.88
	Mean	0.00	0.19	1.12	1.13				
	S.D.	0.91	0.04	0.69	0.71				

Note: No missing responses and items are ordered according to their difficulty.

satisfactory in Nepal (UNESCO and UNICEF 2012), people reported perceiving a greater likelihood of being insecure in all kind of disasters in Pokhara. It is convincing that they are insecure of earthquake because it is very recent disaster that they faced, but they are not aware that sink holes and cracks are major geohazard issues in Pokhara City and did not feel more insecure in these. In fact, geologically, Pokhara has an extreme risk of sink-holes and cracks. This proves that people of Pokhara city still could not understand risks associated with various disasters in Pokhara city.

Yet, most people do not have site-specific disaster knowledge and level of anxiousness for various kind of disaster is same. More than half a population of responders think that all nine kinds of disasters (Flood, landslide, earthquake, fire, sink-hole, bifurcated crack, storm, hailstorm, drought, heavy rainfall) sometimes can happen in their area. In fact, this is not a real opinion since landslide, flood, storm and hailstorm are there, drought cannot be frequent.

DRR knowledge in people was also evaluated with their previous exposure to disasters. It was believed that the pre-exposure in disaster event gives the lesson for DRR issues indirectly. Therefore, previous exposure of people in disasters usually can be taken as a proxy parameter of disaster education and risk understanding. The result shows that previous exposure of people in the 2015 Gorkha Earthquake could not elaborate knowledge of disaster risk management issues. Overall, the questionnaire survey shows that people are less aware of the disaster risk and even those who are aware are ignoring and less concerned about the mitigation and preparedness measures. This type of risk adaptation strategy of the local people was also a raised issue during the key informant interview. The major restriction of this study was its correlational and cross-comparison methodology with Partial Credit Modeling of responses to confirm

their coherency. The PCM clearly suggested that the rating from responders is coherence. However, given a less sample, the major findings of this research pointed out unsuitability of current disaster education and awareness program in Nepal. These research findings must encourage line agencies who are working in the disaster awareness program in the Pokhara city for modification in the present plans and program.

Conclusion

This research confirms that people of Pokhara city lack awareness on upcoming disasters and it is a serious drawback. People residing in Pokhara City are completely unaware of the major consequences of various types of disasters. Almost 60% of the respondents conceived that the disaster is merely the act of God that is beyond our imagination to control and mitigate. Local community, technicians and even policymakers are unaware of the proper disaster management plans and policies. Even after the formulation of Disaster Risk Reduction and Management Act 2074, lack of proper policies, by-laws and guidelines has hindered the implementation of effective land use planning that can be triggering factors for the future disaster scenario. Lack of awareness on the grassroots level of DRR is more challenging and the trend of reacting only after the disaster strikes needs to be changed. Moreover, the study also showed that people who are aware of the disaster risk are ignoring it and are not focusing on preparing for the future disaster. Focusing more on the formulation of preparedness plans and mitigation measures as well as developing a proper know-how in the field of disaster from local to the governmental level only solve the various disaster problems and it can be managed effectively in the Pokhara City.

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Authors' contributions

Chandani Bhandari was involved in the data collection in field, data analysis, simulations and writing the manuscript. Ranjan Kumar Dahal contributed in data analysis, simulations and writing the manuscript. Manita Timilsina was involved in paper writing, statistical analysis and figure preparation. The authors read and approved the final manuscript.

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Availability of data and materials

The most of the data is collected from field work. Some of the data generated or analysed during this study are included in the published articles which is mentioned in the paper.

Competing interests

The authors declare that they have no competing interests.

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