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Procedia Engineering 212 (2018) 784–791

**Procedia
Engineering**www.elsevier.com/locate/procedia

7th International Conference on Building Resilience; Using scientific knowledge to inform policy and practice in disaster risk reduction, ICBR2017, 27 – 29 November 2017, Bangkok, Thailand

Pathways to raising disaster risk reduction awareness among the informal construction stakeholders: a case of Nepal

Ksenia Chmutina^{a,*}, Joanne Rose^b, Suman Dhun Shrestha^c and Dilip Bhatta^c

^a*School of Civil and Building Engineering, Loughborough University, Loughborough, UK*

^b*Department of Health Science, University of York, York, UK*

^c*School of Engineering, Kathmandu University, Kathmandu, Nepal*

Abstract

Nepal is a low-income country where the majority of people live in chronic poverty, with vulnerabilities exacerbated by various natural hazards (in particular earthquakes). Whilst Nepal has implemented comprehensive building codes and a Building Act, a major challenge exists as both the existing building stock is refurbished and the new stock is continuously added by the informal construction sector, without adherence to any building standards and codes. Such informal construction leaves urban areas highly vulnerable and with little resilience to any disaster. This situation is not unique to Nepal's urban areas, as rapid urbanisation in many developing countries has similarly led to a boom in informal construction sectors and construction that has little regard for building codes and regulations. Based on a case study of Banepa's 11 wards, this paper will discuss the informal construction stakeholders' awareness of disaster risk reduction measures, and provide an overview of existing initiatives to engage the informal construction sector in appreciating the importance of hazard-resilient buildings.

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Peer-review under responsibility of the scientific committee of the 7th International Conference on Building Resilience.

Keywords: Nepal; informal construction; resilience; building regulations

1. Introduction

Located at the border of the Indian and Eurasian tectonic plates, Nepal is considered one of the most disaster-prone countries globally, due to its complex geophysical structure. The country has extreme variations in the natural

* Corresponding author. +44(0)1509228526

E-mail address: k.chmutina@lboro.ac.uk

environment, and variations in altitude lead to severe changes in temperature and climatic conditions. Such conditions make the country prone not only to earthquakes but also floods and landslides [1].

Whilst impacts of earthquakes in Nepal are widely known, particularly since the 2015 Gorkha earthquake [2], the negative impact of floods and landslides on livelihoods and infrastructure is also significant. The main causes of floods and landslides are intensive rainfall, glacial lake outbursts, soil erosion, snowmelts, deforestation, water leakage, road construction, and infrastructure failure [3, 4]. The Government of Nepal [5] also lists fires, epidemics, windstorms, thunderbolts, hailstorms, avalanches, snowstorms, heat and cold waves, and droughts as hazards the country needs to consider. Table 1 provides an overview of disaster impacts that have affected the country in the past century.

Table 1. Summary of disaster impacts in Nepal (1900-2017) [6]

Type of hazard	Events count	Total death	Total number of people affect	Total economic loss (US\$)
Drought	6	-	4,903,000	10mln
Earthquake	8	18,905	6,372,100	5,480mln
Epidemic	20	4,568	174,797	-
Extreme temperature	7	217	25,210	123,000
Flood	46	6,931	3,806,043	421mln
Landslide and mass movement (dry)	25	2,033	443,130	15mln
Storm	7	180	359	3.6mln
Wild fire	3	106	54,000	6.2mln

It is clear that Disaster Risk Reduction (DRR) efforts in Nepal require a concerted and integrated national effort coordinated at all levels. The Government of Nepal has been working to reduce risks through mainstreaming DRR into sectoral development for preventing the occurrence of disasters, mitigating their impact and ensuring that there is adequate preparedness to ensure an effective response. A number of challenges however – including poor construction practices – hinder the progress in DRR. The Government of Nepal has established sound building codes and regulations; yet more than 98% of buildings in Nepal are constructed by informally employed local craftsmen. Consequently, most residential buildings do not receive any rational design for strength. Moreover, although a system of building permits exists in most municipalities, there is no provision for checking the submitted plans against the strength criteria. There is poor institutional and technical capacity within the local authorities for implementing strength-related provisions even if they were to be introduced in to the building permit process [7].

The aim of this paper is two-fold: it will provide an overview of existing initiatives that engage the informal construction sector in appreciating the importance of hazard-resilient buildings; and it will explore the informal construction stakeholders' awareness of disaster risk reduction measures. Understanding these issues is important as this situation is not unique to Nepal: rapid urbanisation in many developing countries has similarly led to a boom in informal construction sectors and construction that has little regard for building codes and regulations.

2. Methodology

In order to understand the informal construction stakeholders' awareness of DRR measures, a case study approach (most appropriate when questions *whether* and *how* are asked) was applied [8, 9]. Whilst it cannot lead to any generalisations, the conclusions taken from case studies can be applied to the development of new theories and concepts, and the revision of existing ones [8], and to present a '*comprehensive research design, with a multi-disciplinary character and a large number of factors to be considered*' [10].

The data collection has been conducted by Nepali researchers, under the supervision of the authors. Such an approach addressed a number of common limitations, such as removing the language barrier, unwillingness to speak to a foreigner, deep understanding of the different cultures and castes, as well as access to different groups of workers. Extensive web and literature research was initially conducted to identify any secondary data. Site visits

were conducted in April-May 2017, which helped to obtain a valuable insight [11] when discussing ongoing development projects and to understand the environment and the context in which the projects are taking place.

Semi-structured interviews with a broad range of informal construction stakeholders (skilled and unskilled) working in 11 wards of Banepa were then conducted. Overall, 92 semi-structured interviews with range of informal construction stakeholders were carried out (overview is provided in Table 2). Each interview was approximately 60 minutes in duration, covering the following aspects: main hazards, workers' awareness of and engagement in DRR, and overall willingness to implement DRR measures in their practice. The aim of the interviews was to gain first-hand information regarding the decision-making process and the implementation of the DRR measures, as well as their awareness about various hazards and mitigation measures. The interviews were recorded and thematically analysed. Thematic analysis was chosen due to the complexity of the dataset and the need for a flexible analytical process to provide a structure [12].

Table 2. Overview of interviewees' demographics

		Contractors	Owners/ clients	Skilled labour (masons, carpenters)	Unskilled labour (stone carriers, cement mixers)
Number of interviews		24	16	30	22
Gender	Male	24	15	30	9
	Female	-	1	-	13
Age	15-24	-	2	4	4
	25-58	24	13	25	16
	58+	-	1	1	2
Education level	No formal education	7	2	18	12
	Basic education	11	1	7	3
	Secondary education	6	8	5	1
	Higher education	-	5	-	-

3. Current situation in Nepal

3.1. Existing building stock

Buildings in Nepal can be divided into three broad categories: frame structure buildings; load bearing wall buildings; and earthen building. In practice, however, mixed type buildings, different structural components, and/or different construction materials in different parts and levels of buildings are common [13]. The most popular constructions in the urban areas of Nepal are stone or brick masonry buildings constituting around 20% of reinforced concrete (RC) construction (whereas the adobe construction, wooden framed houses and rubble stone masonry constructions are more popular in rural areas); with 80% of the buildings non-engineered to poorly engineered [14].

Rapid urbanisation led to a very high rate of building production, which, in the absence of proper building permit processes, and a general lack of the knowledge and skills for hazard-resistant construction, created a built environment that is extremely vulnerable to a range of natural hazards, and in particular earthquakes [7]. For instance, the 2015 Gorkha Earthquake demonstrated that most of the crumbled and destroyed buildings were made of masonry that is not reinforced [14].

3.2. Informal construction

The informal sector in Nepal employs about 96% of the economically active population and contributes over 50% to the national economy [15]. This is particularly prominent in the construction sector: according to the Department of Physical Planning and Works of Nepal, out of 90% of individually constructed buildings only 5% of

them have professional engineering design and supervision. Thus, in terms of building capacity and construction, there is limited planning control and land management. The majority of construction labourers employed by registered contractors are engaged through informal contracts (Figure 1). Contractors in the private sector largely depend on unregistered construction enterprises headed by 'Naikeas', the labour gang leaders, who supply labour for their projects. The Naikeas are paid on a piece-rate basis for the sub-contracted portion of the work or on the basis of a fixed fee (for example, a percentage of the wage paid to the labourers). The labourers are paid on daily wage rates, without any social benefits, such as sick leave or idle period compensations. Whilst such an informal construction system offers greater flexibility in the speed of building and lower costs, the quality of buildings suffers. In addition, there is a lack of professional liability, with the owner bearing all of the risks and responsibilities. Taking into account the risk profile of the country as well as the rates of urbanisation and urban sprawl, the quality of construction work is a salient issue [16].

The majority of construction workers have agricultural backgrounds and only work on construction sites outside the agricultural season. The construction teams can be joined either through relatives and friends already working under a Naikea, or at the pickup points. Workers start as unskilled labourers and acquire their skills through on the job training. After several years in the industry, most male workers are promoted to the semi-skilled or skilled category, or establish their own enterprises. This progression however, is not possible for female workers who can only undertake jobs appropriate for unskilled workers (for instance, stone crushers) ([17]).

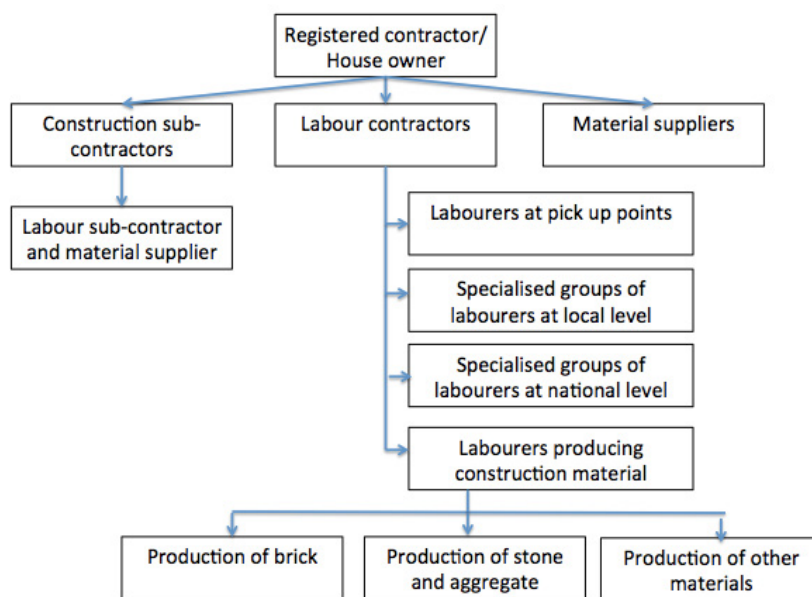


Fig. 1. Stakeholders of informal construction industry in Nepal (adapted from [16])

4. Construction sector and disaster risk reduction

4.1. Overview of Disaster Risk Reduction in Nepal

The 1982 Natural Calamity (Relief) Act and the National Strategy for Disaster Risk Management (NSDRM) are the basis for the disaster risk reduction activities in Nepal, establishing institutional frameworks from national to local levels [18,19]. The Act outlines the implementation of pre- and post-disaster relief and rescue works, which is considered to be a responsibility of the government. NSDRM outlines the DRR priorities for Nepal (which are largely based on the Hyogo Framework for Action 2005–2015) and is in charge of endorsing national policies on DRR, approving the National DRR and related to specific hazards plans, arranging the provision of funds for DRR, and providing an overall DRM policy guidance [20].

In addition, the Government of Nepal formed the Nepal Risk Reduction Consortium (NRRC), which is supported by the donor communities and focuses on major ‘Flagship Programmes’ (namely, School and Hospital Safety; Emergency Preparedness and Response Capacity; Flood Management in the Koshi River Basin; Integrated Community Based Disaster Risk Reduction; and Policy/Institutional Support for Disaster Risk Management) [21], and proposed the National Disaster Response Framework (NDRF) that outlines clear brief guidelines for national response to large- and medium-scale disasters in the country.

Moreover, there is a wide range of acts, rules, regulations and guidelines, directly and indirectly related to DRM, including the Soil and Water Conservation Act 1982, Nepal Building Act 2007 and Building Code 1994, Environmental Protection Act 1996, National Agriculture Policy 2004, National Shelter Policy 1996, National Urban Policy 2006, National Water Plan 2005 and Water Resource Policy 1993, National Water Resource Strategy 2002, Water Induced Disaster Management Policy 2006, and strategies related to health and infrastructure sectors [22]. Despite these, Nepal still lacks a new practical DRR Act.

4.2. Building codes

In 1993, the Department of Urban Development and Building Construction (DUDBC) formulated and implemented the Nepal National Building Code (NBC). The NBC was first drafted in 1994 following the lessons learned from the 1988 M6.8 earthquake, which killed more than 700 people in Nepal. The NBC was approved by the government in 2003 and is a legally binding document in all 130 municipalities; however, the regulation is not applied to towns and villages, which fall under village development committees (VDCs), although some VDCs around Kathmandu have voluntarily adopted the Code. The Building Act, Building Regulations and the Building Code outline the building construction legal obligations to be followed by the builders or owners through the local government. The Code established a permit system, peer review, monitoring, certification of construction practices, and implementation of land use planning measures. NBC allows the use of any international codes and standards that meet minimum requirements of the NBC. In practice, however, for reinforced concrete structures, the NBC 201 and NBC 205 that stipulate mandatory rules of thumb are widely used.

It is important to note that unlike Codes in many developing countries, the NBC recognises locally available building materials or prevalent forms of vernacular construction, such as adobe and non-engineered construction, and addresses the full range of locally prevalent construction types, including non-engineered indigenous structures. It also recognises that the majority of the buildings in Nepal are built informally by groups that are not trained in seismic construction: it sets realistic objectives for the design of technical standards and guidance materials and proposes technical guidance known as “rules of thumb,” assuming that simple but essential structural details could be checked by non-specialist staff of municipal building departments [23].

A lack of resources and monitoring of implementation of the code however has been a big challenge since it was first legally enforced in 2005. Although some municipalities have done better in adopting and implementing than others, after over 20 years, implementation is still an issue. It is the responsibility of municipalities to issue building permits, however current municipal building permit processes do not ensure the compliance of NBC. Few generic checklists have been developed but these are often overlooked and easily manipulated. Compliance enforcement is further challenged by the high workload and limited number of trained professionals [24].

4.3. Existing initiatives

Initiatives for more resilient buildings range in scale and level, from national to local, and this paper only provides insight into a handful. At the national level, the Department of Urban Development and Building Construction led a series of capacity building and training. This ranged from the training of almost 9,000 masons on earthquake resistant construction to sensitisation training for social workers. The Ministry of Foreign Affairs has also undertaken a range of initiatives to raise awareness and training around the national building codes. Following the Gorkha 2015 earthquake, the Government embarked on a post-disaster initiative, which involved financial assistance to rebuild houses after the earthquake that was given in installments pending approvals that the construction works met with building standards. This initiative was less effective where financial assistance did not cover the full reconstruction costs.

The National Society for Earthquake Technology (NSET) in Nepal has undertaken a series of initiatives, including Shaker Table demonstrations; technical training for engineers and sub-engineers; training of trainers; and support to 30 municipalities to improve building permit processes and implementation of the building codes.

At a local level, the knowledge and initiatives of the informal construction workers are less well known. The awareness of the informal construction sector regarding disaster risk reduction and resilient buildings is discussed further in the following section.

4.4. Awareness among informal construction workers

The interview data demonstrates the awareness of hazards is high among the informal construction stakeholders. From the most prominent hazards that should be considered during the construction process, stakeholders acknowledged earthquakes, floods, storms, fire, lightening, and landslides (in order of importance). Out of 92 interviewees, 30 have received formal training (including some of the training mentioned in previous section); however, in most of the cases knowledge about and techniques for the implementation of DRR measures was received not through the formal training but from colleagues and mentors (See Fig. 2b). The data demonstrates that informal construction workers find the advice provided by their co-workers and by the engineers who monitor construction process the most useful (see Fig. 2a).

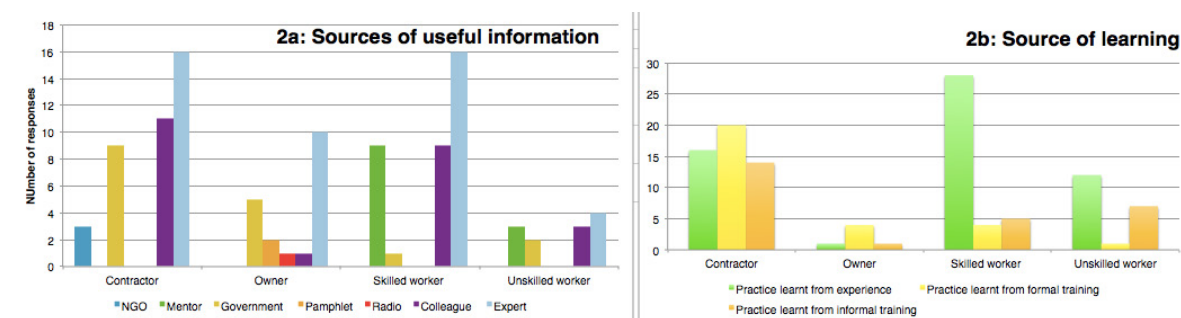


Fig. 2 Overview of sources of information and learning about DRR techniques among informal construction stakeholders

According to the interviews, most members of the informal construction sector would strive to construct more resilient buildings based on their own self-awareness (i.e. willingness to construct better safer buildings that would not collapse when a disaster strikes). Nevertheless such willingness to implement resilience is hindered by a number of technical (e.g. lack of skilled labour; reliance on traditional construction methods), social (e.g. age, gender) and financial challenges, as well as Client/Owner attitude towards DRR measures (e.g. unwillingness to increase construction budget that would allow for a provision of better quality materials).

The interviews show that only one third of the interviewees are aware of the training offered by the governmental and non-governmental organisations; the rate of awareness is particularly low among skilled and unskilled workers (9 out of 30 and 2 out of 22 people, respectively). At the same time, all groups of interviewees express a willingness to learn more about DRR techniques. The interest to learn more is driven by a number of factors including:

- The 2015 earthquake being a ‘wake up call’ to build more resilient buildings;
- Overall reputation of the worker and the team s/he are working in (as many teams are employed through word of mouth);
- Interest in learning more about structural performance (since the majority of workers have not received any form of engineering education);
- Meeting like-minded people and sharing novel ideas and skills;
- Enhanced skills to help career progression (e.g. from skilled worker to contractor).

The main barrier to training acknowledged by all groups of stakeholders was the focus on contractors and masons; many skilled and unskilled workers felt that whilst they are eager to learn, their roles are perceived as irrelevant to enhancing the resilience of buildings. Other training barriers included:

- Training is repetitive as a large amount of skills is already developed through the experience;

- Lack of promotion of training activities;
- Training is often arranged during the working hours (which means that workers are losing a day's income).

The interviews investigated the methods of future training on DRR construction practices and ascertained how different members of the informal construction sector want to be trained in order for training to be most effective. There were both differences and commonalities among how different groups of construction workers would want to be trained in DRR techniques and practices. Almost two thirds of contractors would like training in the form of booklets, pamphlets or the television. This leads to the assumption that most contractors are literate and have access to a television. Contrastingly, no unskilled construction workers would prefer training via booklets and only two out of the 16 that wanted further training think that television would be a good medium. Overall, the majority of informal construction workers wanted to receive hands-on practical training from experts/engineers. A number of them commented that theoretical training or 'classroom' based training would not work for them. Most informal construction sector workers, whether contractors or unskilled labourers, have learned most from on the job training and as such, it is somewhat not surprising that they would want any future trainings to be similar in method.

5. Discussion and conclusions

The data presented gives rise to four critical discussion points. Firstly, the 2015 Gorkha earthquake acted as a driver for many stakeholders, from owners and informal construction workers to INGOs and the Government, to rethink how buildings are constructed in Nepal and to drive towards more resilient buildings. Conversely however, the Gorkha earthquake has resulted very much in a single hazard planning and there is a great need to ensure all future work - from policy and training to on the ground construction - adopts a multi-hazard approach. Overall, the awareness about disaster risk is high among the construction stakeholders: unsurprisingly earthquakes are seen as the most prominent hazard, with floods following as a close second hazard that affects buildings and impacts construction process. The majority of the training initiatives however, are aimed at earthquake-resistant building techniques. Similarly, building codes and regulations do not address the risk of flooding (instead, wind and snow loads are covered in addition to earthquakes).

Secondly, the challenges identified through the interviews present a clear issue of targeting both in terms of who and what. The most commonly identified challenge to developing more resilient buildings was technical. This refers to the capabilities of the construction workers and demonstrates a need - and an opportunity - for training and education in resilient building techniques and practices. Whilst a large number of successful initiatives aimed at enhancing the skills of the informal construction stakeholders are taking place in Nepal, our research demonstrates that these are largely focused on specific groups of workers and specific types of hazards. The overall perception among the workers is that only already skilled workers can receive more training, whereas those with less skills/lower levels of responsibility do not have access to training. Whilst the knowledge about techniques is generally shared among the team workers, it is not clear to what extent it is applied; in addition, it is not clear how exactly such knowledge is shared. Additionally, there was a consistent self-identified need for further training on construction practices and DRR amongst all construction workers – both skilled and unskilled.

Thirdly, the challenges of finance are prominent. These are difficult to overcome, particularly as government funding is limited. This leans itself to the need for further research in Nepal to examine traditional forms of good practice or low/cost-effective measures of developing more resilient building stock.

Fourthly, another major challenge identified was the will of clients to agree to build in a more resilient manner. This identifies a clear gap in previous and ongoing initiatives in developing resilient buildings – the owners – where awareness raising and training has been lacking. This group is far from homogenous and further research is needed to understand how this group can be engaged in order to effectively raise awareness of the importance of disaster resilient buildings.

In conclusion, it is evident that informal construction sector workers across all levels want training in how to build more disaster resilient buildings. It is also apparent they want this training to be delivered by experts or engineers in the field. Further, any training should be designed and delivered as 'on the job' / hands-on training as opposed to theoretical or abstract simulations. What this training would look like in practice however, remains unknown. Also, how do we engage those unskilled workers that will most likely one day be the skilled and contractors? And, how do we raise awareness and engage with the 'owners', to ensure any training and good

practice can be implemented? With rapid urbanization gripping Nepal and many other low-income disaster prone countries, the answers to these questions will become critical if we hope to achieve sustainable, disaster resilient urban areas.

Acknowledgements

This research is undertaken as a part of the Royal Academy of Engineering's Global Frontiers for Development Corn-seed funding.

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