Convergence of Strategies to Reduce the Risk: A Case Study of Geohazards in Vijayapura District of Karnataka

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Abstract

As per the 2019 Vulnerability Atlas of India, the country is divided into four Seismic Zones. About 57 percent of the land area of the country lies in these four Seismic Zones and about 79% of the population resides in this area. On the other hand, most houses do not have all the necessary earthquake-resistant features built-in them. With existing scientific understanding, neither we can predict nor can prevent the occurrence of earthquakes. Therefore, adherence to the NDMA guidelines for earthquake-resistant constructions can minimise the damage. However, their adoption at ground level is very limited in scale. One of the causative factors is inadequately skilled workforce. The initiative of the National Urban Livelihood Mission of the Ministry of Housing & Urban Poverty Alleviation, Government of India along with Deen Dayal Skill Development Centres can help to resolve this problem of inadequate skilled manpower for the construction of earthquake-resistant dwellings in earthquake-prone regions of the country. This paper presents such a micro level effort in the Vijayapura district in Northern Karnataka, wherein different stakeholders such as district administration, masons and technical academic institutions were brought together as awareness building measure. Such efforts in earthquake-prone regions of the country can help to usher the Earthquake-Resistant India.

Keywords: *Earthquake; Vulnerability of India; NDMA Guidelines; Deen Dayal Skill Development Centres, Earthquake Resistant India.*

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1. Introduction

Disasters such as Earthquakes disrupt lives, livelihoods and infrastructure. Earthquakes, per se, do not cause any loss of life but the physical structures damaged by earthquakes. Removal of debris also results in loss of life due to a lack of required expertise and equipment. Depending on the possibility of incidence of Earthquakes, the Indian landmass is divided into five categories. The first such map was published by the Geological Survey of India (GSI) in the year 1935 and is constantly being upgraded. As per the Indian Standard IS 1893 (Part 1): 2016, which deals with earthquake resistant design of buildings and other structures, India's land area is divided into four Seismic Zones, namely Seismic Zones II, III, IV and V. Intensities of the earthquake ground shaking likely to be experienced in the land areas under each of these zones are:

1. Seismic Zone II: Low intensity of up to VI (and lower) on MSK Scale,
2. Seismic Zone III: Medium intensity of about VII on MSK Scale,
3. Seismic Zone IV: Strong intensity of about VIII on MSK Scale, and
4. Seismic Zone V: Severe intensity of about IX (or above).

As the 2019 Vulnerability Atlas of India indicates, about 57 percent of the land area of the country lies in Seismic Zones III, IV and V, in which about 79 percent of the population resides. Thus, the threat of potential damage to property, public infrastructure and subsequent loss of life is high. OAs there is a chance that a hazard may become a disaster sooner or later, it is in the best interest of all stakeholders to ensure that the hazard is removed altogether, if not, reduced to the extent possible. Following are some of the strategies to manage the hazards (Fig. 1)

- Elimination and Substitution are the most effective strategies for reducing the hazard but are very difficult to achieve from ongoing processes. If the hazard identification was done at the planning stages, then Elimination and Substitution can be very economical and also very effective. For instance, urban flooding during monsoons. As urban development in Mumbai city is already saturated, it is very difficult to eliminate the hazard of flooding of rail tracks. On the other hand, identification of potential flooding during the planning stages of a new capital city like Amaravathi in Andhra Pradesh, eliminating the risk of flooding is easy as the city is still in the planning stage.

- Engineering Controls aim to protect the community by removing exposure to hazardous conditions, for instance, by the construction of a barrier between the community and the hazard (like the construction of a dam to prevent flooding). Though the capital costs of engineering controls could be high, their long lifetime, and low operating costs etc make them more economical. A simple example could be the construction of a Road-over-Railway line at an unmanned level crossing. It would simply remove the hazard of accidents on a railway track.
- Administrative Controls and Personal Protective Equipment (PPE) are more useful in the circumstances where the hazards are not well controlled, for instance, COVID-19 virus infection. Administrative Controls are aimed to alter the behaviour of the community to minimize its exposure to the hazard, for instance, to contain COVID-19 virus, authorities across the world have ordered the places like markets, malls etc. to close down, thus altering the behaviour of community to minimize its exposure to the virus. PPE aims to provide maximum protection to the individual member against exposure to hazard, for instance, wearing a respiratory mask against potential infection of COVID-19. These measures, Administrative controls and PPE are relatively easy to enforce and also inexpensive to establish but, in the long run, they may be difficult to sustain and also may prove to be expensive.

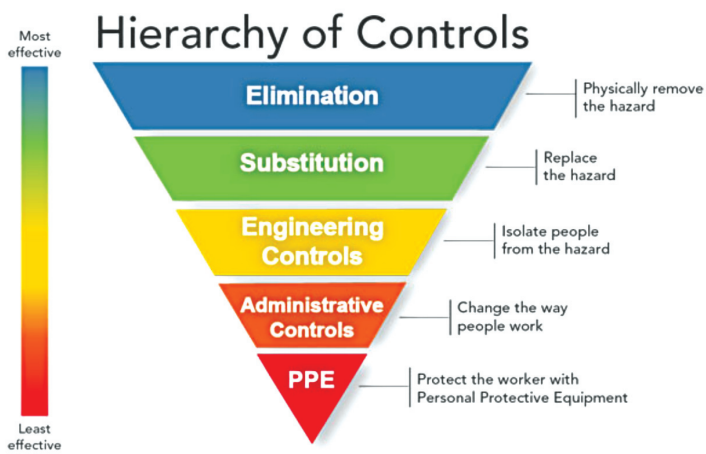

Figure 1: Different Strategies of Hazard Management

(Source: https://www.cdc.gov/niosh/topics/hierarchy/)

Our inability to predict the incidence of earthquakes stresses the significance of one option i.e., adopting a precautionary approach to minimize the damage due to the earthquakes. For instance, by adopting appropriate structural mitigation measures, countries on the 'Pacific Rim of Fire' could prevent earthquake damages to a large extent. In the Indian context, preventing earthquakes from affecting dwelling units is a small yet significant step toward building disaster resilience. In this direction, to reduce the impact of the earthquake, NDMA (2007), has recommended six sets of crucial interventions in high seismic risk areas, viz.,

1. Ensure the incorporation of earthquake-resistant design features for the construction of new structures.
2. Facilitate selective strengthening and seismic retrofitting of existing priority and lifeline structures in earthquake-prone areas.
3. Improve the compliance regime through appropriate regulation and enforcement.
4. Improve the awareness and preparedness of all stakeholders.
5. Introduce appropriate capacity development interventions for effective earthquake management (including education, training, R&D and documentation).
6. Strengthen the emergency response capability in earthquake-prone areas.

For the existing buildings, retrofitting guidelines have been developed by NDMA (2014). However, a close examination of the state of affairs or even a casual interaction with the stakeholders of construction sector indicates that there is still scope for better adoption and implementation of these guidelines and that non-adherence is higher in the case of constructions of economically stretched individuals. The dearth of trained and skilled personnel proficient in earthquake-resistant designs construction and additional costs are often mentioned as factors (KSWU 2016). But, the vulnerability assessments indicate that strict adherence to the guidelines is non-negotiable to prevent a catastrophic event (NDMA 2019). Findings of another research study under progress at the University (KSWU 2016) suggested that there could be a potential opportunity though unrelated, to overcome the inadequacy of skilled manpower, by a convergence of National Skill Development Corporation (NSDC) Reports on Skill Gap (NSDC 2013) and disaster management. NSDC reports indicated that the construction sector is projected to be a sector with significant growth in the majority of districts in the country and that there is a gap between the availability and demand of manpower

requirements in the sector. If one could combine these seemingly unrelated issues, viz., shortage of skilled manpower for earthquake resistant technology, growing sectors in coming years and unemployment, it could be a win-win situation as it could pave way for reduced risk from an earthquake on one hand and better employment to the growing population in construction sectors. Expanding on these lines, the Karnataka State Women's University, Vijayapura, Karnataka has made a few micro-level efforts and this article presents the full potential of such convergence

2. Profile of Vijayapura District

Vijayapura district (formerly Bijapur) is in the northern part of Karnataka about 500 km away from the State capital, Bangalore. It has a total land area of 10,536 sq. km (5.49% of the total State area). The district has a population of 21.7 lakh persons (3.6% of the state population) (2011 Census) and a literacy rate of 67.2%, lower than the state average of 75.6% and All-India average of 74%. Agriculture remains the main occupation of the people of the district, employing 70 percent of the labour force as either cultivators or agricultural labourers. Most of the population (78%) lives in rural areas. Of the 30 districts in Karnataka, The district ranks 21st Gender Development Index (GDI), with a value of 0.573. Some key socio-economic indicators are given in Table 1.

Table 1: Key Demographic Indicators

Indicators	Year	Vijayapura	Karnataka
Population, Nos.	2011	2,175,102	61,130,704
Decadal growth rate of population, %	2001-11	20.4%	15.7%
District's share in State's population, %	2011	3.6%	100%
Urban population as a percentage of total population, %	2001	21.9%	34%
SC population, %	2001	18.5%	16.0%
ST population, %	2001	1.7%	7.0%
Sex ratio, No. of females per 1000 males	2011	954	968
Population density, per sq. km.	2011	207	319
Literacy rate, %	2011	67.2%	75.6%
Main workers, No.	2001	551,972	19,364,759
Marginal workers, No.	2001	166,241	4,170,032
Human Development Index	2001	0.59	0.65

(Source: Census 2001 and 2011, Karnataka Human Development Report 2005)

2.1 Earthquake Profile of Vijayapura District

Karnataka State Natural Disaster Monitoring Centre (KSNDMC) is designated as the Nodal Agency in Karnataka State for monitoring of Seismic activity and it has established a network of 12 Very Small Aperture Terminal (VSAT) enabled Permanent Seismic Monitoring Seismic Observatories (PSMS) during 2009-10 and later extended it to further 13 Observatories. The sites of these Observatories were chosen in the manner of geological importance and vulnerability of the regions.

Vijayapura district is prone to earthquakes and recent incidences of the same are given in Table 2. The District Disaster Management Plan (VDDMA 2020) refers to earthquakes as potential disasters and recommends measures/actions to be taken during the earthquake, provides a detailed Standard Operating Procedure (SOP) in the event of an earthquake, for instance, activating fire brigade, rehabilitation of victims, relief materials etc (DDMP 2020-21), However, it does not elaborate on risk reduction measures during the pre-disaster phase such as awareness programs, structural strengthening. Stressing on the incorporation of earthquake-resistant measures as recommended by NIDM and measures to ensure the same by respective departments could have ensured the safety of public infrastructure (Table 3 and 4).

Table 2: Recent Earthquake Profile of Vijayapura District

Magnitude	Origin Time	Lat.	Long.	Depth
2.3	2021-10-02 08:31:02	16.92	75.48	10
2.9	2021-10-01 16:09:37	16.77	75.67	10
3.1	2021-10-01 13:46:41	16.55	75.80	10
3.2	2021-09-11 08:18:47	16.82	75.72	26
4.1	2021-09-04 23:49:24	16.81	75.71	2
3.3	2021-09-04 23:48:17	16.80	75.74	2

(Source: NCS 2021)

Table 3: Structural Mitigation Measures for Earthquake

Structural Measures	Identified Locations	Implementing Departments
Retrofitting (if required) of public utility buildings like offices, schools/banks/ markets etc	EQ prone Taluka	PWD, RDPR, ZP
Retrofitting of unsafe rural houses	RDPR, ZP, LSG	Rural housing schemes and departmental programs
Identifying and safely dismantling unsafe structures	R & B department	–

(Source: VDDMA 2020)

Table 4: Non-Structural Mitigation Measures for Earthquake

Non-Structural Measures	Location	Responsible Departments	Time Frame
Capacity building of architects, engineers and masons on earthquake-resistant features	EQ Prone Talukas	RDPR, ZP	Regular Interval
Registration of trained and certified mason	Entire District	RDPR, PWD	Continuous Process
Strict enforcement of guidelines pertaining to seismic safety for government rural housing	PWD, RDPR, ZP	Rural housing Schemes	Regular Interval
Mock-drills for Schools, Hospitals and, Public Buildings and training for mason, engineers and architects	Entire district	DDPI	Regular Intervals

(Source: VDDMA 2020)

About the private constructions like individual dwelling units, incorporation of earthquake resistance measures were reported to be suboptimal (KSWU 2016) and during the interaction, the following factors were quoted, viz.,

- A dearth of skilled personnel proficient in earthquake-resistant designs and construction
- Adherence to traditional methods
- Non-adherence to stipulations of concerned departments
- Associated higher costs

3. Proposed Convergence for Better Preparedness

National Skill Development Council (NSDC), prepared detailed reports for every district about a) economic sectors/activities that are likely to grow in that particular district and b) exiting skill levels of human resources available in that district. According to NSDC estimates, between 2012 and 2022, incremental demand for 2.03 lakh persons is likely to be generated in the Vijayapura district. The report indicated that agriculture and allied activities remain as biggest employers, followed by the food processing industry. With the economy of the district growing, employment demand in supporting sectors such as construction, transportation would also increase at a faster rate (Table 5) (NSDC 2012) and the Building Construction sector requirement is 41,304 out of which half of the requirement is for semi-skilled manpower (Table 6).

Regarding educational infrastructure, the Vijaypura district has a total of 49 Industrial Training Institutes (ITIs)/Industrial Training Centres (ITCs) (as of March 2012). Of these, three were Government ITIs, six were private aided ITIs and the remaining 40 were private unaided ITIs. With an annual intake capacity of 3,492, none of the 49 ITIs incorporates the skills of earthquake-resistant construction. If suitable intervention such as knowledge of earthquake-resistant construction is made available to this semiskilled manpower through Urban Livelihood Programmes or Deen Dayal Upadhaya Skill Centres, Vijayapura district could hope to progress in the direction recommended by National Disaster Management Authority and also Sendai Framework for Risk Reduction (SFDRR).

Table 5: Incremental Demand - 2012 to 2022

Sector	Total	Minimally Skilled	Semi-Skilled	Skilled	High Skilled
Agriculture and Allied	59,998	49,971	7,469	1,359	1,200
Building, Construction Industry and Real Estate	41,304	12,391	20,652	6,196	2,065
Transportation, Logistics, Warehousing and Packaging	30,302	6,060	17,575	6,060	606
Tourism, Travel, Hospitality & Trade	26,437	5,287	17,977	2,644	529
Total (all other sectors as well)	203,663	75,169	72,539	45,810	10,145

(Source: NSDC 2013)

Table 6: Key ITI Indicators in Bijapur District

Indicator	Value
Total Number of ITIs	49
Number of Government ITIs	3
Number of Private aided ITIs	6
Number of Private unaided ITIs	40
Total Intake Capacity	3,492
Student Pass Rate	80%
Student Drop-out Rate	5%

(Source: NSDC 2013)

For effecting such a systematic change, a close interaction of different departments and stakeholders are required and a tentative framework is provided here, based on the KSWU experience.

Office of Deputy Commissioner/District Collector: District is the unit of administration in India and it is the office of the Deputy Commissioner that oversees the functioning of all other departments. Through a proactive approach, it can facilitate various national flagship programs at the district level by involving the concerned line departments, for instance,

- Deendayal Antyodaya Yojana: National Urban Livelihoods Mission (DAY-NULM): Based on a strategy that the poor are entrepreneurial and have an innate desire to come out of poverty, this Mission aims to enhance the skill sets of urban poor so that they can access self-employment and skilled wage employment opportunities, resulting in an appreciable improvement in their livelihoods. To realise the mission objectives, involvement of different stakeholders is required, *viz.*
- Knowledge Providing Agencies: NDMA has developed guidelines on earthquake-resistant construction and this knowledge has to be converted into a suitable manner – like hands-on training - to reach out to the mason. Faculty of engineering colleges or trained civil engineers can fill this role.
- Facilitating Agencies: Industrial Training Institutes/Engineering colleges/Non-Governmental Organizations can be requested to facilitate the knowledge transfer. Line Departments like Public Instruction, Municipal Directorates, Revenue can play the supporting role.

4. Conclusion and Way Forward

Inadequate awareness coupled with a lack of a skilled workforce is contributing to the sub-optimal adoption of preventive measures against the potential threat of earthquakes in the Vijayapura district and a similar situation prevails in other earthquake-prone districts as well. The pilot experiment carried out by the Karnataka State Women's University in Vijayapura district in collaboration with District administration and other line departments have indicated very good potential for convergence of national flagship programmes not only in risk reduction but also in mainstreaming disaster management. Given its potential, it is suggested that the participation of academic institutions should be actively encouraged in disaster management. In this backdrop, **India Universities and Institutions Network for Disaster Risk Reduction (IUINDRR-NIDM)** being established by NIDM is very timely and significant.

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