Urban Regeneration: A Tool for Urban Seismic Risk Reduction in City Core Areas of Kathmandu

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SUMMARY:
High seismic hazard and rapidly increasing earthquake vulnerability characterise the historical city of Kathmandu, the capital of Nepal. This demands a multi-faceted approach for earthquake risk management. The National Society for Earthquake Technology - Nepal (NSET) has been implementing several earthquake risk reduction initiatives and Urban Regeneration in Historical areas of Kathmandu is one of those. It is a concept plan of urban regeneration for city core of Kathmandu, a new model for redevelopment of city core a pilot program in a small block within dense settlement. This is based upon prefeasibility study conducted in 2011. A feasibility study is being carried out by NSET as a part of Public Private Partnership for Earthquake Risk Management with core funding from the Office of Foreign Disaster Assistance of USAID. So far, we have received positive response from stakeholders. This paper describes the methodology and findings of the feasibility study conducted so far.

Keywords: Earthquake Risk Management, Mitigation, Urban Regeneration, City core, Conservation

1. SEISMIC RISK OF NEPAL, KATHMANDU VALLEY AND KATHMANDU METROPOLITAN CITY

Nepal is located within the Himalayan range, a product of the continental collision of the Eurasian and Indian plates, initiated about 40-55 Ma ago. The collision was followed by subduction of the Indian plate underneath Tibet, which continues today at an estimated rate of about 3 cm per year. The subduction results in tectonic stresses along the Himalayan frontal fault system (HFF), the Main Boundary Thrust Fault System (MBT), the Main Central Thrust Fault System (MCT), and the Indus Suture Zone (ISZ), all parallel to the Himalayan arc. Numerous earthquakes have occurred in this region, including four major earthquakes of magnitude greater than M8 within the last 100 years (Seeber et al., 1981; Molnar, 1984; and Chandra, 1992). Table 1 shows the frequency of earthquakes instrumentally recorded since 1911 within 150 km of Nepal's border. The 1934 AD Bihar-Nepal Earthquake produced strong shaking in Kathmandu Valley, the country's political, economic and cultural capital, and destroyed 20 percent and damaged 40 percent of the valley's building stock. In Kathmandu itself, one quarter of all homes was destroyed along with many historic buildings. This earthquake was not an isolated event. Three earthquakes of similar size occurred in Kathmandu Valley in the 19th Century: in 1810, 1833, and 1866 AD. The seismic record of the region, which extends back to 1255 AD, suggests that earthquakes of this size occur approximately every 75 years, indicating that a devastating earthquake is inevitable in the long term and likely in the near future.

Table 1. Magnitude-Frequency Data on Earthquakes in Nepal and the Surrounding Region (1911-1991)

	Earthquakes of Magnitudes in Richter Scale				
	5 to 6	6 to 7	7 to 7.5	7.5 to 8	>8
No. of Events	41	17	10	2	1
Approximate Recurrence Interval , yr.	2	5	8	40	81

Source: Earthquake Catalogue in BCDP, 1994

Like many urban areas in developing countries, Kathmandu Valley's risk has increased significantly since the last major earthquake. The Valley has a burgeoning population of almost 2.6 million people (2011 census), uncontrolled development, and a construction practice that has actually degraded over this century. Nepal is among the poorest and least developed countries in the world. It has a per capita GDP of US$ 1268 (IMF-World Economic Outlook) making it one of Asia's poorest countries. A weak economy and abundant poverty affect earthquake risk management in many ways: a lack of government funds to support earthquake hazard mitigation programs, inexpensive and poorly constructed dwellings that often fail even in the absence of earthquakes, a tendency in the general population to ignore the earthquake hazard due to more immediate needs, and a lack of awareness about the earthquake hazard. Kathmandu Valley has an urban growth rate of 6.5% and one of the highest urban growths in the world. Kathmandu valley has 3 districts, 5 municipalities and 98 Village Development Committees. Although the government of Nepal has made building code mandatory in all public buildings construction in 2007and since then all new construction in municipalities and urbanizing Village Development Committees (VDCs) should comply with National Building Code (NBC), but only two of the five municipalities have enforced the National Building Code, that too only in the paper and there is not a single agency to look after the enforcement of seismic code during construction. The technical information about earthquake risk in Kathmandu Valley is incomplete and scattered among several governmental agencies. However, a more important contributor to the region's lack of earthquake preparedness was that the available technical information was synthesized, was not been applied to the infrastructure of modern day Kathmandu Valley, and not been presented in a form that the public and government officials could digest.

Kathmandu Metropolitan city has been a major population center with a prominent role in commercial, administrative and cultural activities for at least two millennia. Although as a settlement Kathmandu is more than 2000 years old, it started to grow rapidly only in the third quarter of the 20th century. During the last 40 years the population increased from 0.15 million (in 1971) to 1 million today. As an important social, cultural, administrative, touristic and economic center, Kathmandu has been the destination of migration from small towns and rural areas. The rapid population growth created an excessive need for housing, infrastructure facilities and as a result, the housing stock in Kathmandu reached 195,000 buildings. History shows that Kathmandu and the neighboring settlements were damaged by many earthquakes. According to historical records, 8 destructive earthquakes occurred during 1255- 1934 AD (the last 679 years). Considering the ground characteristics of Kathmandu, the quality of construction, deterioration and corrosion related to the age of the buildings, the earthquake risk is rapidly increasing. In order to assess the risks, there have been number of studies conducted for earthquake loss estimation for Kathmandu Valley. The following are the main earthquake risk assessments carried out so far.

- Earthquake Scenario of Kathmandu Valley prepared by Kathmandu Valley Earthquake Risk Management Project (KVERMP) of NSET in 1997

- Study on Earthquake Disaster Mitigation (SEDM) for the Kathmandu Valley in 2002 by JICA

- Cross-Cutting Theme Initiative for Kathmandu Metropolitan City (KMC) in 2003 by UNESCO, NSET and KMC

Out of the three studies, the risk assessment carried out during SEDM by JICA is assumed to be a more comprehensive study in terms of field data collection, geographical coverage, use of GIS tools and involvement and interaction with key stakeholders. A follow up study "Mainstreaming Disaster Risk Reduction in Megacities; Risk Sensitive Land Use Plan Final Report, KMC, Nepal, January 2010" that assessed the earthquake risk in Kathmandu was prepared to provide input in designing appropriate actions for risk mitigation. The Kathmandu Metropolitan City (KMC) has commissioned the Risk Sensitive Land Use Plan (RSLUP) for Kathmandu in 2011.

2. THE PROJECT

2.1 Overview

Urban regeneration of historic city core is a pilot program recommended by KMC RSLUP and the feasibility study of the program is piloted in Jhonchhe-Chikanmugal area of the historic city core, which is in one of the most vulnerable areas of Kathmandu. In this pilot, the mitigation measures were based on redevelopment of the area and conservation and retrofitting of the historically and culturally important monuments within the pilot site.

The pre-feasibility study of Urban Regeneration as a tool for Earthquake Risk Reduction in city core areas of Kathmandu was carried out from 1 September 2010 to 30 August 2011. Presently, a feasibility study is being carried out by the National Society for Earthquake Technology – Nepal (NSET) as a part of the 2nd Phase of Nepal Earthquake Risk Management Program and the program: Promoting Public Private Partnership for Earthquake Risk Management (3PERM) with core funding by the Office of Foreign Disaster Assistance of USAID.

Kathmandu city, similar to most of the world's major cities has been facing the pressure of new development and redevelopment due to their rapid socio-economic development during the last few decades. This rapid increase in population and new development without compliance to seismic code has posed a great risk to the residents and the unique heritage of the city. Every new development and redevelopment is apparently tearing down the old fabric and socio-economic character of towns and cities.

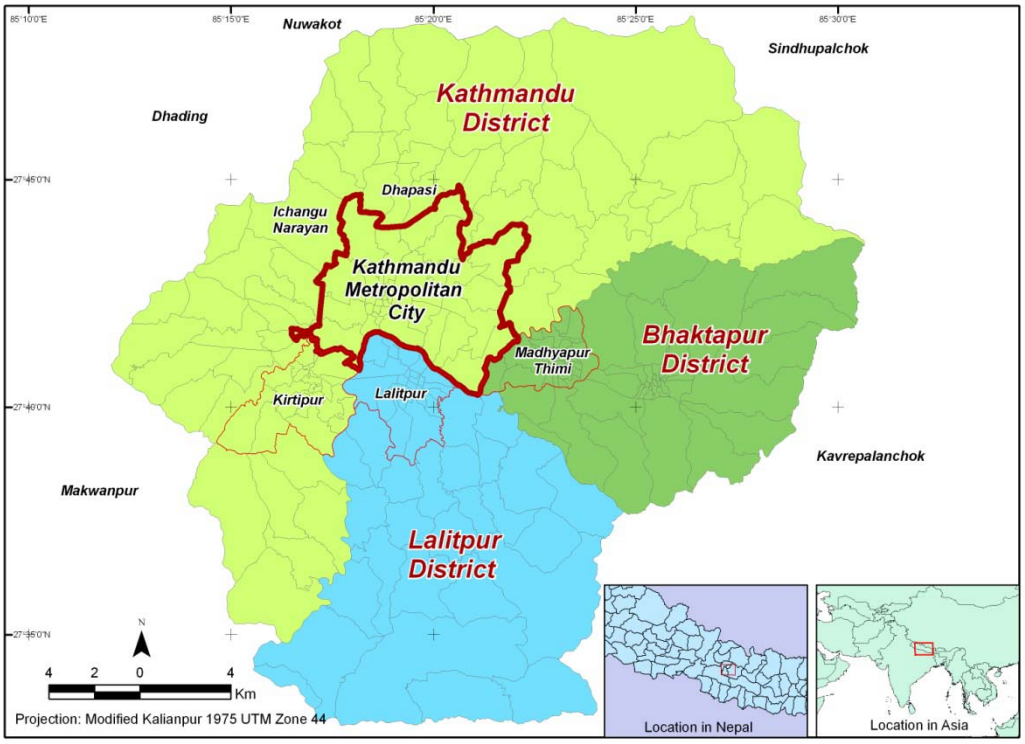

Figure 1. Location Map

Such urban growth, which was planned to improve urban life, actually has affected the social, cultural and environmental fabric negatively. After the evolution of term "*sustainability*" urban planners, developers and policy makers of the world have started thinking to create a balance between development and heritage conservation in the coming times, but in Nepal none of the government agencies and developer has thought about sustainable urban redevelopment of the historic cities except

Bhaktapur Development Project (1974-1984) supported by German government. This project aimed to cater to modernization and heritage conservation in Bhaktapur city. On the other hand, rapid increase in the socio-economic conditions has also changed the people's aspirations and expectations of their common future. The local community and people have also shown their concerns about heritage conservation and its loss with the passage of time.

2.2 The regeneration effort

The project aims to create a "Win Win" situation between heritage conservation and urban regeneration. Recent development was not only affecting the city fabric but also destroying the vernacular built environment, cultural values and collective memory of habitants. Till now our urban planners and policy makers have not thought about some practical way to solve this crucial problem. That is how to create a balance between the new development and the old urban fabric and townscape. How to retrieve the collective memory of community that can be a bridge between their ancestors and coming generations, as well?

This project aims to study the practical aspects of heritage conservation and sustainable urban regeneration with focus on economic development and earthquake risk reduction of the historic city core. What role heritage conservation and sustainable urban regeneration can play for sustainable development and how?

The specific objectives are to:

- adapt/develop an appropriate methodology for Urban Regeneration in Nepal
- conduct qualitative assessment of city cores of Kathmandu Valley and select a Pilot site for developing an Urban Regeneration plan
- conduct detail assessment of the pilot site and identify possible options for Urban Regeneration
- Formulate an Urban Regeneration plan of a block of 40-50 houses using identified appropriate Urban Regeneration process
- Advocate community, concerned local and central authorities to implement a model Urban Regeneration plan as a tool for earthquake risk reduction in historic city core areas.

2.3 The pilot site

A pilot site has been chosen on the basis of NSET's experience on working with community in school building reconstruction and community's willingness to cooperate in seismic disaster management of their neighborhood. Apart from the willingness of the community to cooperate, selection of pilot site was based on the following criteria.

- Degraded and over populated city centres needing complex urban renewal and redevelopment,
- Under–utilized urban land and urban tourism on potentially most valuable locations (adjacent to World heritage site) necessitating increased land-use efficiency through the initiation of land recycling, in–fill development and re–development of underutilized historic city core area,
- Declined or abandoned tourist areas as a result of economic restructuring and competition from other tourist hub making necessary the promotion of local economic development based on restructuring and privatization, the attraction of foreign investments and transfer of technology,
- Built residential areas of poor standard, hazardous to public health, as well as natural (seismic) and technological risk demanding good access, efficient infrastructure and open spaces.

Based on the above criteria" Jhochhe-Chikamugal pilot site" is chosen for Urban Regeneration. Selection criteria and pilot site selection was further discussed with local community leaders, Kathmandu Metropolitan city (KMC) officials and officials of the Department of Urban Development

and Building Construction (DUDBC), and Kathmandu Valley Town Development Committee (KVTDC). Both local and central government agencies endorsed the pilot site selection, and local community leaders had shown their enthusiasm and commitment to aware the community about earthquake risk and to act for disaster risk reduction through the redevelopment of their area.

This Jhochhe-Chikamugal pilot site (Fig 2) is a culturally diverse social housing development in downtown Kathmandu known previously as high income family residential area and obviously it is one of the culturally rich neighborhoods in Kathmandu. Many of the buildings constructed over 50 years ago as load bearing masonry structure in mud mortar under individual family housing program (owner built house), Jhochhe-Chikamugal's housing stock was deteriorating and in desperate need of redesign, replacement, and repair. The majority of the buildings of that neighborhood are very vulnerable to impending earthquake and fire.

Figure 2. Pilot site shown in satellite photo from Google Earth

2.4 Characteristics of the pilot site

Preliminary diagnosis of the site revealed the pertinent problems of historic city core area. The pilot site as well as the historic city core is characterized by: 1) Dense settlement, 2) Highly vulnerable buildings without possibility of seismic retrofitting, 3) Poor accessibility, especially for emergency services, 4) Poor Infrastructure, 5) Underutilized high tourism and economic potentials, and 6) Cultural Heritage and Vernacular architecture at high risk due to seismic and fire hazards, and also due to the current trend of building repair & replacement. To ascertain the problems faced by pilot site, situation survey and analysis was conducted in April-June 2011. Survey area (Pilot Site) of 6.6 hectare of city core houses 796 privately owned residential building, one public school and 34 religious and cultural assets. Building condition, use, shape, age and typology were covered in building survey. If the city and its inhabitants are to be protected from the devastation earthquakes can cause, this hazard must be understood and the risk reduced. The Earthquake Damage Scenario (EDS) is a key tool to achieve both these ends (Shirley Mattingly, 1993). Based on an analysis of local condition, earthquake damage scenario of the pilot site is prepared for MMI VII (similar to Udayapur Earthquake of 1988), MMI VIII (Mid Nepal Earthquake) and MMI IX (similar to Bihar-Nepal Earthquake of 1934) earthquakes. The seismic vulnerability assessment of the buildings gives the clear picture of earthquake damage scenario of the pilot site, as shown in the Table 2.

Table 2. Magnitude-Seismic Vulnerability of buildings in pilot site, December 2011

S. No	Earthquake intensity in MM	Structural damage		
		Damage Grade 5: Destruction in %	Damage Grade 4: Very heavy damage in %	Damage Grade 3: Substancial to heavy damage in %
1	MMI VII	50	40	10
2	MMI VIII	50	45	5
3	MMI IX	71	28	1

In Kathmandu Metropolitan city being an earthquake prone, we know we face special seismic risks due to the vast numbers of people (1.06 million) and buildings (195,000) and amount of investment at risk. Response to and recovery from a quake are especially complex processes because of the interdependencies in the socio-economic systems and the physical infrastructures and lifelines. In the cities of Kathmandu Valley, the need to preserve historic and cultural monuments vulnerable to earthquake is a growing concern. Complex human factors such as increasing unemployment, homelessness, inadequate and unhealthy housing space also complicate the issues faced by earthquake hazard reduction planners.

The earthquake threat becomes meaningful when people relate to the experience of others and personalize the risk, imagining what it would be like if it happened to their city. Short of suffering an earthquake oneself, the best ways to become sensitized to a quake's devastating effects are twofold: listening to the real life experiences of others, and defining the earthquake's impacts on one's own environment, through an earthquake damage scenario. With the purpose of awaking community and concerned agencies, cultural heritage, socio-economical aspect, and physical and social infrastructure of the pilot site was also assessed and analyzed. At the same time community leaders and major stakeholders were identified. During survey period, series of awareness programs were conducted to all major stakeholders on devastation caused by recent earthquakes in the region and earthquake risk in our urban centers, especially in the historic city core of Kathmandu.

2.5 Conceptual plan of urban regeneration

A conceptual plan of urban regeneration of the pilot site was developed. Existing building and land use, socio-economic and cultural heritage survey and available physical and social infrastructure data were the basis for the development of conceptual urban regeneration plan. Affordable and safe housing development, promotion of mixed land use and conservation of traditional urban form, vernacular

architecture and cultural heritages and socio-economic development of the community were the main idea behind this conceptual plan. Experiences of other countries have illustrated the most interesting and effective urban conservation programs developed in the past have concentrated on integrating concern for preservation of elements of urban heritage within overall socio-economic development schemes. In a general aspect, urban regeneration is expressed as changing, transforming, improving or regaining the city by regenerating the urban structure, which become old, dilapidated, deserted or abandoned in some cases in time because of different reasons, by taking the socio-economic and physical conditions into consideration. Hence urban regeneration project having the aim of forming safe and healthy city includes:

1) Transformation of the unregulated and unsafe building areas,
2) Transformation of the dwelling or other used areas which are situated at inconvenient places where directly affected from the natural disasters like earthquake,
3) Transformation of the business areas of which usage is inconvenient in the city centre,
4) Transformation of the featureless, unhealthy areas and areas which are out of the city standards,
5) Transformation of the historical places which lost their characteristics and the protection places.

Preliminary assessment of the property value of 5.33ha of building plots and 796 buildings within pilot site revealed the property worth of US$167,310,627. Project activities needed to be carried out for redevelopment of the site are identified, quantified, and cost benefit calculated. Project activities identified are: 1) Resettlement of the families, 2) Administration of the project including detail planning and designing of the new construction including social mobilization and community capacity development 3) Demolition and removal of debris, 4) Rehabilitation of existing infrastructure, 5) Conservation of Cultural Heritages in-situ, 6) Site development 7) Safe and healthy building design and construction. The total cost of the pilot project is calculated at US$ 143,600,957. The property value after the completion of the project is re-evaluated and the market value of the redeveloped property worth US$ 345,466,262 which is more than the property value before project plus the redevelopment cost. Thus the cost benefit analysis, considering physical, socio-economical, and environmental improvement with seismic risk reduction mechanism in place, indicates that the return on the investment for urban regeneration would be considerable and the urban generation process is technically, economically and financially feasible business. But the urban regeneration process can be implemented only when the concerned community, central and local government agencies are prepared and convinced. Today, our cities have been deformed due to the intensity of over population, economical conditions, social unconsciousness, wrong places selection, and supply-demand trends. The deformation which is seen in our country as in the world, is not only observed in the developing countries which are still having pains of urbanization, but also in the developed countries which have been living the rapid transformation process since the 19th century. The concept of the urban regeneration (transformation) emerges with full of positive meanings at first because of dealing with the city core and metropolitan areas which are formed unplanned and out of control. It is known that the unplanned and uncontrolled area development has created negative life and sheltering conditions for the poor class dwellers, most vulnerable to impending big earthquake and it is also known that transformation projects would provide certain improvements.

Since the task was an unconventional one, special terminology and spelling of principles were necessary during the preparation phases of urban regeneration process to keep the work within track.
To this end, it is applied through horizontal approaches which comprise several fundamental principles:

1) It is location-specific, as it deals with the difficulties specific to all urban components. But it aims at reducing disparities, within the global vision of a more homogeneous social environment.
2) It covers different timeframes, as it answers to the social needs at present, and then those of long-term sustainability, aimed at predicting the future change. It also includes the lessons of the past, since in Bhaktapur today consensus is largely in favor of the conservation of urban heritage following a period of German Government funded Bhaktapur Development project to cater to modernization and heritage conservation, in the 1970s-1980s.

3) It is multidimensional, as it is applied by many different public and private stakeholders. Urban regeneration must serve to overcome contradictions, through negotiation, and prioritization of the objectives. Priorities depend on the alignment between national policies and local strategies.
4) Urban regeneration strategies are implemented in one sector and induce positive effects elsewhere.

2.6 The feasibility study

Currently as a part of a feasibility study, a series of consultative meetings are being held with major stakeholders (local residents, community leaders, KMC officials, DUDBC and KVTDC Officials) with an objective to disseminate the Urban Regeneration concept and to motivate community, local and central government agencies to formulate urban regeneration plan. As a by-product of this advocacy and consultative meeting, KMC and DUDBC have initiated a preliminary study on urban regeneration planning and for the first time, they have allocated necessary budget for the study. After obtaining feedbacks from interactions with community, local and central government agencies the aim of urban regeneration process is refined and the aim of urban regeneration is to take into consideration the complexity of urban dynamics.

2.7 Immediate objectives

The objectives of urban regeneration efforts are:

1) Attract investors, create employment, and renew the urban economy;
2) Enlarge the supply of affordable and safe housing and develop local infrastructure;
3) Improve living conditions, to prevent natural (seismic) and manmade (fire) risk, combat pollution, while taking into account the values and preferences of society and each social group;
4) Enhance architectural heritage of historic core and to promote cultural tourism.

2.8 A note of caution

Urban Regeneration is a new concept that is being ingrained into the psyche of local residents and government of Kathmandu. While, we have made efforts to raise awareness on the social, economic, technical and scientific aspects of this concept, many questions still prevail. In this context, it is found very useful to explain “What urban regeneration is not!”:

1) An operation confined to the ‘retrofitting’ of specific buildings in the city core area.
2) Rather, the urban environment is considered in its totality, with its life-lines, emergency facilities, land uses and management processes.
3) A conventional ‘development plan’ describing simply some future physical state, employing solely the devices of methods of physical rearrangements and standard land-use planning apparatus. Rather, Urban Regeneration has to consider social, economical and environmental tendencies and development processes.
4) An exercise in strict confine of existing ‘legal and administrative constraints’. Rather, it has considered proposals for the development of new methods and tools of enforcement, and the revision of existing legal frameworks.
5) A ‘one-shot’ undertaking. Rather, sustainable mechanisms and institutions for a safer and more robust city and resilient communities are to be introduced.
6) An excuse to allow further expansion of the city, generating new waves of demands over the land, forests and water basins. Rather, it is a comprehensive methodology for upgrading the existing built-up areas in safety and quality, and protecting the natural and manmade assets.
7) A program for post-disaster activities or a form of crisis management plan, but a comprehensive plan to cover all forms of action for the long-term minimization of damages or loss in the city.
8) A simple exercise of diagnosis, but a scenario of action and steps to be followed.

3. CONCLUSIONS AND LESSONS LEARNED

The feasibility study of Urban Regeneration of the pilot site has clearly shown above stated objectives of the projects can be achieved successfully, provided the main stakeholders are involved and their concerns are addressed starting from project inception to its completion. Many lessons, both positive and negative, were learned in the process. The lessons learned include the following: (1) awareness raising became part of urban redevelopment project components, (2) vernacular and modern technical approach with seismic code compliance is the most, (3) emphasis on community involvement and community capacity development in project management are important, (4) focus on heritage conservation with earthquake safety is essential, (5) efforts for transparency were difficult but valuable and must, and (6) a new Public Private Partnership (PPP) model for redevelopment of city core is initiated and (7) local-national-international project partner relationships is being developed.

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