Articulating Strategies for Developing Disaster Resilient Settlements from the Experience of the Tadi Rural Municipality of Nuwakot District

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Abstracts

Out of total 69.79 sq. km. of the Tadi Rural Municipality (TRM), about half land area is vulnerable. Out of 3582 total households, 431 households live in the vulnerable areas caused by landslides, excessive slope and flooding. Consequently, 50 people died and 181 people got injured in the year of 2015. More than NPR 29.16 million worth of private property and more than NPR 100 million worth of public property was destroyed. Under these circumstances, the objective of this study is to develop strategies for evacuating people from vulnerable areas and for resettling them in safe locations with the provision of livelihoods. Generally secondary sources of information were used. Focused group discussions were conducted. The main actors such as local government, policy making and implementing authorities, and beneficiaries were interviewed. Selected vulnerable areas were studied quite closely using satellite imageries and field observation. The National Reconstruction Authority (NRA) acquired land, provided required infrastructure for settlements, supported the construction of houses and created conducive environment for livelihood for the resettled people. Part of this intervention was supported by the Department for International Development (DFID) and Oxfam, a British NGO. Based on rigorous analysis of the project's best practices, a set of strategies were outlined: the people from the vulnerable settlements should be resettled in the safe locations, the local governments with the support from the federal government has to support such households for shelter, and the land of absentees landlords should be made available to the resettled people through land bank. This arrangement will not only enable people to escape from death and injury from natural disasters but also will generate employment opportunities by producing agricultural outputs from the abandoned land and from other livelihood opportunities.

Key words: vulnerable, strategies, livelihood, disaster, resettlement

1. Introduction

Nepal is 11th most risk prone country in terms of earthquake and 30th in terms of flood and landslide. More than 90 percent of the population is at high risk. During the period of 1971 to 2015, forty thousand people lost their lives, 75,000 people injured and 3,000,000 people affected (MoHA, 2018). It is estimated that Nepal incurs a loss of around 2 percent of its GDP annually which amounts NPR 84 Billion.

Tectonic forces, geologic formation, topography and climatic forces are mainly responsible for a majority of natural disasters. Tectonic force is generated from the continental collisions between the Indian and Eurasian plates. This action has generated a linear belt of cracks parallel to Himalaya (Sharma, 1990). Highest mountains consist of medium to soft rock on the top which is susceptible for erosion. The Lesser Himalaya is composed with soft phyllite and schist and brittle dolomite and quartzite rocks which are also fragile. Similarly, Mahabharat and Churia range

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which comprises sandstone, mudstone, sand and gravel which degenerate with the heavy rainfall and flooding. The alluvium deposit in Terai is highly vulnerable to flooding. The topography in the Himalayan belt is determined by tectonic forces which lift up mountains and climatic forces cause erosion which is exacerbated by human interventions. The climatic pattern is attributed to prolonged dry spell followed up with heavy rainfall culminating in cloud outburst which creates huge avalanches and flooding in the river.

The Tadi Rural Municipality (TRM) is located on the Lesser Himalaya where all macro level factors impact overwhelmingly. Landslide is the prominent feature in TRM. More than 31% people live in landslide areas and more than 52% people live on the steep slopes, more than 3% people live in the flooding areas and the remaining 13% people live with other vulnerabilities. In terms of Casualty and injury, the Gorkha earthquake played a significant role as it killed 80% of total victims and more than 97 percent of total number of injuries. Other contributors for death and injury were fire, landslide and pandemic diseases. The natural disasters caused damage of NPR 29.16 million in 2015, where nearly 59% was contributed by landslides followed by pandemic diseases (41.15%) and fire (0.41%) (TRM, 2016). In such a way, the TRM has been suffering a huge amount of financial and human loss which is an extremely serious phenomenon. Fatalities due to future earthquakes can be reduced by providing reliable information about hazard estimates and following building codes thoroughly (Cummins, 2017). Resettlement of the vulnerable population is one of the best long-term strategies for disaster risk reduction, not only for saving lives but also for reducing the future response and recovery costs. Although the resettled households can avoid the threat of natural disasters and escape poverty, resettlement itself entails certain social risks (Cernea, 1997).

Against this backdrop, this study intends to formulate a set of strategies for evacuating people from the vulnerable settlements and resettle them in safer locations with proper livelihood provisions. While selecting the criteria for relocation, it is necessary to study about the future possible land use such as mining and other industrial activities. It showed that resettlement areas are unsuitable for displaced communities by comparing existing and predicted landscape character due to mining operations (Moomen, Dewan and Corner, 2016). It is the responsibility of the local governments to resettle vulnerable households to the safe locations. A resettlement project at the Kharanitar is taken as a case which was formulated for the households who were displaced from Urleni – one of the landslide affected settlements. The households were provided with some livelihood opportunities which are taken as reference for proposing future strategies.

This paper has not only reviewed the NRA's documents but also generalized its findings for national level replication. On one hand, people are living in extremely vulnerable settlements; on the other hand people from the safer areas have been abandoning land and heading towards either urban centers or migrating to other countries. This paper intends to bridge this gap by supporting to formulate a win-win strategy for both groups of people.

This paper reviewed policies, Acts, regulations and the best practices around the world in the area of resettlement of vulnerable households. The Ministry of Home Affairs (MoHA) formulated the Disaster Risk Reduction National Policy – 2075, Disaster Risk Reduction and Management Act – 2074 and Disaster Risk Reduction and Management Regulation – 2076. MoHA also formulated the Disaster Risk Reduction National Strategic Plan of Action (2018-2030). All these Policies, Acts and Action Plans have emphasized that improper land use system has been causing casualty and destruction of properties annually. Hence, all development interventions have to be viewed from a disaster perspective and all preventative measures have to be adopted. Achievement of this goal largely depends upon whether one can interfere on land use policy which has to be followed by constructing engineered and appropriate structures. In parallel to the disaster related legal documents, the Government of Nepal (GoN) also enacted Land Use Policy – 2075 (MoLRM, 2015), Land Use Act – 2076 (GoN, 2019), Land Act (Amendment) – 2076 (GoN, 2020). The Land Use Policy – 2075 intends to achieve sustainable land management for developed and prosperous life. This policy has created a legal environment for ensuring implementation of land use plans at the federal, provincial and local level. As it stands now, the country's backwardness can be largely attributed to the improper land use. Even Nepal's Maoist war was largely embedded to the land issues (Muni, 2003) . However, the present paper deals with the impact of improper land use on natural disasters. In this connection, the Land Acquisition Act 1977 (GoN, 1977) was also reviewed.

Finding land for resettlement is much easier in the Chinese environment. The 2008 Wenchuan Earthquake of 7.9 Mm affected more than 260,000 square km and 30 million people (EERI, 2008) which killed 69,226 people and another 17,923 were officially reported missing (Xinhua News Agency, 2008). The recovery was viewed as an opportunity to improve regional infrastructure, increase access to the mountainous areas, and expand urbanization of existing cities, such as Dujiangyan. In general, economic development policies revolved around a few simple concepts: close down industries in the mountains and promote tourism in those areas while promoting development of industrial parks to the new industrial areas. People were shifted to the newly urbanized areas which cost US$147 billion which was approximately equal to the entire Gross Domestic Product (GDP) of Sichuan Province in 2007, or about 20 percent of all Chinese government revenue in 2007 (Johnson and Olshansky, 2016). By May 2010, all housing reconstruction was finished, including almost 2 million units of new rural housing, 290,000 units of new urban housing, and untold millions of repaired units (Yong *et al.*, 2011) The speed of reconstruction and the organization required to accomplish it was remarkable by any measure. This was possible because the central government made reconstruction its overwhelming priority. This is a highly successful model in China which is extremely difficult to replicate in Nepal and other countries.

Fig. 1 (Woube, 2005) shows that the resettlement process is influenced by the physical, social, political and technological factors. It also demonstrates that the human bio-physical environments are related to the resettlement processes. The first box indicates the human

environment including demography, settlement morphology, land use, cultural system, health facility and cultures. The second box includes the biophysical environment: geomorphology, soil, topography, vegetation, climate and energy. The biophysical environment is extremely important for the wellbeing of human beings as it determines the quality of air, water, food and shelter. In the meantime it also exposes to floods, drought, hunger, diseases and deaths if the biophysical conditions are not appropriate for human beings.

In terms of technology, the laboratory analysis and suitable shear tests are necessary to conduct for understanding the cause of landslide problem (SASSA *et al.*, 1996).The concept of seismic topographic amplification should be considered to understand the damage due to earthquakes induced slope failure in mountainous terrain. High precision of DEM is required for analyzing the earthquake-induced shallow slope failure potential (Hasegawa, 1996).

2. Data and Method

All secondary sources of information related to the landslides particularly triggered by the earthquake were reviewed. Particularly all relevant literature of the Tadi Rural Municipality (TRM) was scrutinized (TRM, 2016) particularly the TRM's periodic plan and resettlement scheme were studied. Maps relevant to the landslide hazard were used including detail review of topographic maps, goggle earth images, available reports and published geological map from the DMG. Landslide data and other geo-disasters of the earthquake affected settlements were collected from a number of different national and international sources. The data gaps were mitigated by Focused Group Discussions, direct interviews with NRA officials, and officials of the TRM. An intensive field observation at landslide areas and flooding areas were conducted.

3. Results

3.1. Study Area

The TRM is located at the distance of 55 km North from Kathmandu City and 22 km East from Bidur, the Nuwakot district headquarters (TRM, 2016). TRM is connected with a 11 km long Provincial Road to the Puspalal Midhill Highway. It borders with Dupcheswor Rural Municipality on the East, Suryagadi Rural Municipality on the West, Naukund Rural Municipality of the Rasuwa District on the North and Panchakanya Rural Municipality on the South. Having six wards, the TRM's area is 69.79 sq.km. The agricultural land covers more than 54 percent, followed by forest with 13.76%, water inundated area (0.4%), rocky area (0.49%) and others 31.24%. The irrigated land is 1080 ha. The population size in 2020 increased by 1.33 percent from 2015 and reached to 4032 households and 19,952 people and density of population is around 285.9 per sq. km. Nearly 22% people live outside of the TRM either in urban centers in the country or abroad. Nearly 23% people are involved in agriculture and livestock, followed by daily wages (10.87%). Negligible numbers of people are involved as employees and commerce and industry while more than 4% are unemployed. More than one-fifth people seem to be

absentee landlords and nearly 12 percent people are tilling land on sharecropping arrangements. Fig 2 shows the location map of TRM.

There are 20 commercial firms of agriculture, livestock and poultry businesses which employ 45 people. Eighty agricultural, livestock, cooperatives are active in this TRM which has a membership of 1452 people. One hundred seven business enterprises are active in TRM which have transactions of more than NPR 50 million. About one fifth of people are below the poverty line and more than two third people do not have sufficient food for the whole year. More than 74% people are literate.

Out of 4032 households, nearly 58% have constructed their houses in stone masonry in mud mortar and more than 37% have stone rubble masonry in cement sand mortar. Very negligible households have constructed their houses with framed structures and wooden poles. In terms of roofing, predominant households (83.58%) have CGI Sheet roofing followed by RCC roofing (13.94%).

3.2 NRA's Guidelines for field investigation of vulnerable settlements

NRA promulgated "Guidelines for the field investigation of earthquake-impacted vulnerable settlements: Assessment of geological, geomorphological, engineering geological, geotechnical, and pertinent social parameters (NRA, 2016). The objective of these guidelines were to evaluate the state of geo-hazards, mainly all types of landslides, in the pre-declared vulnerable settlements, and classify them as Category I where no interventions are required; Category II which require some mitigating measures and Category III which are unsafe settlements that must be shifted. The study team comprised with: Engineering Geologist, Landslide Engineer or Geotechnical Engineer or Earthquake Engineer or Civil Engineer and Watershed Engineer. Before starting the real investigation, the study team was required to conduct desk review which includes information of vulnerable communities, preparation of accessibility maps, relevant literature review, preparation of data collection sheet and preparation of action plan. From the walk over survey, the team is expected to collect information of the settlement which includes the position of geo-hazards. In the second form, the study team needs to collect information on what is the current status of shelter, slope magnitude and characteristics, characteristics of failure, status of vegetation, and the status of earthquake induced cracks, rock fall, surface and underground drainage system, history of flooding and status of landslides.

The third form focused on the landslide. The variables that need to be collected are: basic information of landslides including dimension and movement, history and triggering factors such as Earthquake or rainfall. The next information the study team has to collect is the landslide impacts which include the number of houses and affected people, other affected social and technical infrastructures including road, irrigation, hydropower and drinking water schemes.

Geotechnical aspects of landslides also are expected to be collected. Depth of landslide including material and type, size of landslide based on toe width, nature of displaced materials, landslide state and velocity, tension cracks, possibility of plane, wedge and toppling failures and presence of seepage zone and condition of drainage in crown and toe area.

The study team's responsibility under geological and geomorphological investigation of settlement and surroundings include: Tectonic unit, stratigraphic information, lithological information including rock type, rock's attitude, mineralogical composition and the nature of lithological contacts. The major geological structures include fault and its attitude, fold axis and other engineering geological information. Under slope description curvature of slope, topographical break, slope angle and incidences of slope subsidence are to be recorded. Information on Seepage condition, springs, ground water table and soil characteristics need to be described. Intact rock description should be also recorded. A separate record of cracks also needs to be prepared which includes crack size and dynamics. In addition, discontinuity descriptions also need to be collected. The hazard information in and around the settlement include a fault, sinkhole, fold axis and limb, location of the settlement in terms of geomorphology needs to be also explained. Based on all the features above, the study team has to make recommendations which are followed up by other supplementary information.

The methodology is comprehensive. However, NRA used only some of the essential information which was required for resettling the people. Some of the information remained unused which bred the question for return on investment and value for money.

3.3. Landslides in Tadi Rural Municipality

Within the present TRM there were five Village Development Committees: Urleni, Ralukadevi, Sundaradevi, Narjamandap and Kharanitar. Unstable slopes and surfaces have become more susceptible to landslides after the 2015 earthquake that get exacerbated due to rainfall and further work on the land system. Hence, vulnerable areas of TRM are delineated and modeled landslide run-out extent maps are prepared as shown in Figure 3 and 4 (Source: Durham University). It shows landslide concentration on the northern steeper slopes TRM within the catchment of Darku Khola.

As shown in Table 1 and Figure 3, the landslides are concentrated in Urleni and Narjamandap VDCs. Out of 16 total landslides in the TRM, fifteen landslides are located in those two former Village Development Committees. There are certain sections where the slope exceeds 40 degrees.

Table 1: Landslides in Tadi Rural Municipality (*A- NRA, B-WWF Nepal*)

Former VDC	Settlement Name	Geo-hazard problems	Recommendation
Urleni-1[A]	Kalche	Rock fall, mud slide, tension cracks	relocate
Urleni-1[A]	Chihan Dada	gully erosion, mud slide	relocate
Urleni-1[A]	Thing, Waiba Tol	mud slide, cracks, gully erosion	relocate
Urleni-1[A]	Syangtan Tol	cracks, shallow slides	relocate
Urleni-4[A]	Chhelun	rock fall, rock slide	relocate
Narjamandap-6[A]	Thapa Gaun	poor surface drainage	mitigate
Narjamandap-8[A]	Talo Sangle	shallow slide, rock fall	mitigate
Sundaradevi-2[A]	Suntali Sunar (individual)	unstable slope	avoid construction
Narjamandap-4[B]		deep seated slide, tilting trees	mitigate
Narjamandap-4[B]	Amare	deep seated slide, tilting trees	mitigate
Narjamandap-6 [B]	Saman Tole	cracks on cultivation land, shallow slide	mitigate
Narjamandap-2[B]	Sahare	shallow seated slide	mitigate
Narjamandap-7[B]	Dotel	shallow seated slide	mitigate
Narjamandap-7[B]	Puwakhok	shallow seated slide, creeping soil	mitigate
Narjamandap-4[B]	Sathyya	deep seated debris flow	mitigate
Urleni-4[B]		rock fall, rock slide	mitigate

Source: (Silwal, 2016) & (WWF, 2016)

3.4. Geological Assessment of the Urleni Village

The settlements where geological assessment was conducted within the Urleni Village were: Kalche, Thing Tol, Syangtan Tol, Chihan Dada and Chhelun. Having similarity to Urleni, the outcome of the study on Narjamandap and Sundaradevi is not discussed. These villages are located at foothills of steep slope angle greater than 20-40 degree (Silwal, 2016). Mostly old landslides were reactivated and fresh shallow sheeted mud slides were also observed in this area. The elevations of the study area range between 2808 amsl at Bhalu Khop Danda and 1000 amsl at Darkhu Khola. This area is drained by the Darkhu Khola and their tributaries into the Tadi Khola forming the dendritic drainage pattern. Forest land, grassland in steep slopes below the cliff and other areas are cultivated land around their houses. Upper part of the steep slope is barren.

The study area lies in the Higher Himalaya (DMG, 2011) which consists of garnet-biotite gneisses, kyanite biotite gneiss, garnetiferous mica schist, augen gneiss, micaceous quartzites and thin bands of marble. The rocks are dipping towards the east with moderate dip angle. These rocks are moderately to highly weathered, thinly to massive banded with lots of fractures and joints. General attitude of the bed is 850/300. The area consists of thick colluvial brown to reddish brown soil with thickness ranging from 1-5 m with fragments of gneiss, augen-gneiss and schist and clay minerals. The Topographic Map of Urleni with the mark of studied sites is shown in Fig. 5 (Source: Silwal, 2016).

Kalche: This settlement is located on the steep eastern flank of the Urleni Village which composed of with 1.5 m thick colluviums and residual brown to reddish brown soil. Rock fall, mud slide can be observed in this area. The landslide was first commenced in 2014 and reactivated after the 2015 earthquake. The landslide dimension is 20m wide, 70m long and 1-5m deep. Altogether 56 households were at risk among them six households were directly below the landslide. Visibly subsided tension cracks with 5 m long, 1-5 m wide and 0.1-0.3 m deep were observed in the crown part and cultivated land is subsided about 1m. No ground water observed. Fig. 6 and 7 shows the landslide features.

Chihan Dada: This settlement is located in the 1-5 m deep thick brown colluvial soil. The landslide initiated in 2014 was reactivated by the 2015 Earthquake. Slow slide movement and shallow mud slide with cracks of 5m long, 0.5 -1m wide and 1.5m deep and 1 m of subsidence were observed on the upper part of the slope. Boulders of banded gneiss, schist are randomly distributed which may fall down to the Chihan Danda settlement. Unmanaged drainage induced gully erosion and caused shallow mudslide. Fig. 8 shows the debris flow on the upslope.

Thing and Waiba Tol: Thing Tol is located on the 1-3 m thick brown colluvial soil. The 2015 Earthquake triggered shallow mudslide and cracks in this area. Unmanaged runoff is the major culprit for landslides. A number of boulders of gneiss are overhanging on the 20 houses. Fig.9 shows the land subsidence.

Syangtan Tol: Having an elevation of 1583 amsl, it is the lower part of the Kalche Village. The landslide with 50 m width, 100 m length and 1-3 m depth was first observed in 2014 which was further aggravated by the 2015 Gorkha Earthquake. Cracks of 1-5 m long, 0.5 m wide and 1 m deep are observed in the crown, in the cultivated land upslope. Vulnerable boulders with high probability of sliding down were observed. Fig.10 and Fig.11 show metastable boulders and shallow slides on downslope of houses.

Chhelun: This settlement lies below the south facing steep slope of more than 600 m. However, the settlement itself is located on the gentle slope on thick brown colluvial soil. This 30 m wide, 100 m long landslide occurred a long time back but was reactivated by the 2015 Earthquake. Banded gneiss and augen-gneiss are exposed. Rock fall and rockslide are the major problems. Fig.12 demonstrates the accumulated boulders after earthquake 2015.

Almost all these settlements which were studied have some commonalities. All of them are located either on the steep slope or on the foothill of the steep slope. Secondly, the original landslide took place earlier and the 2015 Gorkha Earthquake further aggravated. In retrospection, if proper slope management would have been adopted after 2014 landslides, the destruction in 2015 could have been minimized. Thirdly unmanaged water runoff with cultivation of water intensive crops may be the major culprits. Consequently 80 households had to be resettled.

3.5. NRA Resettlement Policy

The magnitude and characteristics of destruction is explained in Section 3.4. The Department of Mining and Geology (Silwal, 2016), conducted the geological study. The DMG categorized all settlements into three categories following NRA's requirements as: a. no intervention required; b. settlement can continue in situ with infrastructural intervention; c. vulnerable settlements which need to be resettled. For the category c settlements, there are two options: a. with NRA land grant of NPR 200,000 they can buy land at their convenient location; b. if there are more than 10 beneficiaries, NRA supports developing integrated settlements for which NRA funds for land and infrastructure. The grant amount ranges between 300,000 to 500,000 NPR depending upon the topographic region and Nuwakot as a hilly district per household NPR 400,000 would be effective.

3.6. Process of resettlement from Urleni to Kharanitar

As mentioned above, the Urleni Village was declared as a Category C settlement and vulnerable households were desperate for shelter. The beneficiaries themselves identified Kharanitar as an appropriate location for settlement which was confirmed by the NRA team of geologists. The integrated settlement development was possible with joint support of NRA, Oxfam, DFID and the TRM. The NRA funded for the land acquisition by providing NPR 200,000 as land grant for the displaced people and further infrastructural support is on the way. Oxfam provided technical and financial support for housing reconstruction and for livelihood. DFID provided a water supply system through their reconstruction project called as Purnima and the TRM constructed access road to the settlement which is around 500 m. Individual households contributed their labor for housing reconstruction. Fig.13 and 14 show imagery of resettlement site and newly constructed houses.

Oxfam adopted a participatory approach for housing reconstruction. It formed an Integrated Settlement Development Committee from the participating households. Under the leadership of that Committee, Oxfam supported the housing construction for 71 Tamang households. Among them, 68 households were married man led families, 2 were widows and one single woman. Fifty eight percent have a family size of 4-7 members, 27 % are 8-10 members, 5 % have 1-3 members and 10% are more than 10 members. Fifty six percent of the population was educated (Oxfam, 2020). The families have access to 2000 – 3000 Sq. ft of leased land for farming and they also work in the construction sites and agricultural fields as wage laborers. They earn NPR 30,000 in average annually from farming who market their products in

Kharanitar, Satbise (4 km) and Bahan Besi (3 km) and Bidur Bazar (21 km). Fig. 15 shows settlers being engaged in livelihood initiatives (Source: Oxfam, 2020).

In Kharanitar, the individual household income is not sufficient for their livelihood. In Urleni, all of them had sufficient land which was sufficient for their subsistence. They are also detached with their social institutions, natural resources which might have increased their level of vulnerability. There were also social challenges to integrate in the new environment. It required some infrastructural intervention where the local communities could have been benefited. The water supply scheme was provided not only to the new settlers but also to other local people which enhanced harmony between the two communities. The use of natural resources, waste disposal, and sharing of natural resources could be potential flashpoints between the new settlers and the local people.

The traditionally practiced subsistence farming has been the major mainstay for the new settlers. Some others were engaged as wage laborers, carpenters and trekking helpers. Reported household income ranges between NPR 20-25,000 per month but only 30% of the households were financially secure to meet their food and other livelihood needs. Hence, the issue of livelihood has to be handled with utmost priority (Oxfam, 2020).

4. Discussion

The objective of this study was to develop a set of strategies for evacuated people from the vulnerable settlements and resettle them with shelter and livelihood provisions. This section deals with the socio-economic context for the resettlement in TRM, methodology for delineating vulnerable areas and resettlement in Nepal's new legal environment.

4.1. Socio-economic context for resettlement

Having 55 km distance with the Kathmandu Valley and 32 km from the district headquarters, the TRM is appropriately placed for producing cash crops. Having accessibility to the major markets, the TRM farmers have ample opportunity to sell their products. Moreover, the wholesalers visit their own farm gate which makes things further simpler. As 22% people are absentee landlords which means approximately one fourth area of land has gone barren. Traditional arrangement of share cropping is not largely prevalent in the rural environment as youths tend to go away from their village. On the other hand, the desperate people who live in the vulnerable settlements find it difficult to cultivate land in the distant location. It is essential for farmers to have their farmland within a distance of about one kilometer for transporting manure and harvesting the crop. As 52% people live in steep slopes and 31% people live in landslide areas, it is urgently required to relocate these people or adopt some mitigating measures. The 22% absentee landlord's land is available for 31% people living in the landslide area. Under these circumstances, the concept of a land bank will become a win-win solution for both landlords and tenants.

4.2. How to delineate vulnerable areas?

It is indicated that steep slope, improper land use pattern, fragile rock types and associated discontinuity, soil type and its depth and rampant urbanization are main influencing factors for slope instability in Nepal Himalaya (Chamlagain, 2010). The NRA promulgated guidelines for the field investigation of earthquake-impacted vulnerable settlements were prepared for a very specific purpose. Now these guidelines have to be replicated to the planning process of the local governments. It was found that that the guidelines were quite comprehensive but not all information that was collected was used for the preparation of the report. There are a number of collinearities among different variables. In order to avoid collinearity and for making the methodology straightforward and simple which can be implemented by the local governments, the variables which should be used for assessing vulnerability are: slope angle and shape, soil type, rock type, structure and strength, discontinuities orientation, drainage condition and history of site (movement, old landslide, flood plain). In addition to above contexts, human activities, such as; disturbing drainage patterns, destabilizing slopes, removing vegetation etc. may cause hazard. It is most important that the comprehensive analysis is essential. Figure 16 and 17 show how inaccurate analysis contributed to collapse of building in China (Khudeira, 2010).

In general, it is necessary to understand that stability of slope is governed by slope angle, geology and moisture condition which is depicted in Fig.18 (Rice, 1977). In terms of slope angle, any land having slope greater than 30^0 is considered unsafe (MoUD & MoFAGA, 2015). It is considered that convex curvatures of slope are more stable as they disperse the runoff more down the slope, whereas concave slopes concentrate water and cause impoundment. Normally no structure is recommended on soft clay unless significant efforts to improve bearing capacity are in place. Since, soil strength plays an important role in foundation design; its properties need proper analysis. Similarly the strength of rock varies with the degree of weathering condition and orientation of rock beds plays a significant role in direction of subsurface rain water flows direction (Refer Fig:19 and 20) which governs the failure conditions. Excessive presence of surface and subsurface water indicate relative vulnerability of the location. Proper drainage management helps to control erosion activities. Numbers of shallow slides are stabilized by appropriately designed drainage structures. An example of improper drainage management is shown in Fig: 21 (Silwal, 2016). Some land use types such as rice fields contribute additional vulnerability. Site history indicates previous landslides, localized faults and cracks and flooded areas should be avoided, these can be interpreted using aerial photographs. Sites with signs of slow mass movements can be distinguished by observing tilting trees and disturbed slope terrain as in Fig: 22 (Silwal, 2016). Although the variables seem quite simple, it requires professional inputs from a geotechnical engineer and a geologist to assess vulnerability properly.

4.3. How to take forward resettlement in the new legal context?

NRA resettled the Earthquake triggered landslide victims by using the authority of land acquisition that is bestowed by the Act Related to the Reconstruction of Earthquake Damaged

Infrastructure 2072 (GoN, 2015). In the new context, such land use related activities have to be implemented by the local governments. Three different types of legal documents are promulgated more recently: Local Government, Disaster Management and Land Use. The National Planning Commission (NPC) issued a directive for the preparation of local level annual planning and budgeting which is founded on the Constitution of Nepal, Local Governance Act – 2074 and National Natural Resources and Financial Act – 2074. The directive mandates the local governments to prepare the short, medium and long term plans and these plans should incorporate the disaster prevention and reconstruction activities. In parallel to that, the Ministry of Home Affairs (MoHA) issued another Guideline. The striking difference between the NPC and MoHA directives is that the district doesn't have any role in NPC initiated directives as there does not exist any district level government. However, the MoHA directives have a very clear role at the district level as the District Disaster Management Committee (DDRC) plays a prominent role in planning and implementation of disaster. The MoHA operation is top down and the local government follows bottom up. Such anomaly creates serious confusion and will induce sub-standard handling which is extremely dangerous.

As in TRM, a majority of people all over the country have been living in vulnerable locations. More recently, the Ministry of Land Reform and Management (MoLRM) introduced Land Use Policy and Act which has provision that the land can be classified into various classes as residential, industrial, agricultural, forest and so on (MoLRM, 2015). It is also mentioned in the Act that the MoLRM will prepare land use maps within one year of Act's enactment. Based on that map, each local government is expected to prepare its land use plan. There are three interrelated issues here. First: what are the factors that need to be considered for defining the type of land use? Second: what is the appropriate methodology for preparing the land use plan? Third: how will the land use plan be implemented? The response to the first question is rather technical. For example for determination of land use depends on: Agro-climatic and ecological data, they are: rainfall data, major landform types, surface stones, dominant soil type, slope gradient, soil drainage condition, slope position, soil texture, frost hazard, erosion status, water resources, major land cover types. The agro climatic and ecological information are juxtaposed with major land cover types such as cultivated land, forest, marsh land etc. Based on these information land use plans can be prepared (MoA & LAUD, 2012). However, it is not only a technical issue but also a socio-political agenda which must be endorsed by the local government.

In terms of methodology it is rather straightforward. At the initial stage, the technical team needs to work and set the basis for land use planning. In the second stage, the political stakeholders are involved and they also take decisions. They also design implementation arrangements.

The most difficult though is the implementation of the land use plan. Under the present laws and regulations how the local government will be able to implement the land use plans is not very clear. The people who are living in vulnerable areas need to be evacuated but how will they be

resettled? How will land be organized for them? It is particularly difficult in the context that the appropriate land for settlement in mountainous region is extremely scarce. All appropriate lands are registered. What is the policy for the abandoned land? Should vulnerable people be allowed to practice appropriate types of farming? There are numerous issues which need to be sorted out. Against all these odds, the draft Land Use Regulations – 2076 has generated glimmers of hope with the provision of Land Bank.

In this connection, NRA presented one model how people from landslide prone areas can be settled in the areas of absentee landlords. NRA procured land for homestead; house construction was supported by Oxfam according to NRA's rule. The NRA would have provided a housing grant if Oxfam would not have been there. DFID provided a water supply system and the TRM provided a budget for approach road construction. Limited support was provided by Oxfam for livelihood purpose. The households are engaged in sharecropping arrangements with absentee landlords which is rather an ad hoc arrangement.

The proposed model for vulnerable households also offers livelihood opportunities. Based on the land use planning, the local governments will need to evacuate people from the vulnerable settlements. A serious consultation and interaction should be undertaken with the vulnerable settlement people on what profession they would like to engage with. What skills do they have? The local governments have to liaise with the commercial banks for loan. The Federal Government also will need to develop policy around land bank initiative. The vulnerable people may wish to adopt farm or non-farm enterprises. They may wish to initiate such enterprises jointly or collectively. Based on that, the local government should develop a support mechanism. The Land Bank detail working procedure has to be worked out by the Federal Government. After ascertaining the demand side management, the supply side arrangement has to be ensured. For example, the terms and conditions for land banking have to be elaborated. The terms and condition of land banking has to be clarified. Concluding agreement between the lessee and lessor would start a real production system. However, continual nurturing of budding entrepreneurs is essential.

5. Conclusion

The NRA's resettlement model demonstrated that vulnerable people can be resettled in a safe location with livelihood opportunities. This intervention was introduced in a very special circumstance of the post-earthquake reconstruction period. However, in the context of recently introduced local level planning directives, disaster related policies, acts and regulations, and land related policies, acts, and regulations, a comprehensive resettlement policy can be introduced. Local governments have to prepare a land use plan based on Agro-climatic and ecological data. The vulnerable area households need to be delineated based on slope of land, rock/soil type, structure and its strength, discontinuity orientation, drainage condition and history of site for resettlements. On this GoN has to introduce the land bank act and regulation with the provision that the local government should have an authority to acquire land from the absentee landlords

and ability to hand this over to the vulnerable households. The land which was provided to the vulnerable households should have provision for practicing other livelihood activities where the government should provide infrastructural and financial support. This practice will benefit the land owner by providing certain financial benefits while retaining ownership. The internally displaced community will not only find shelter but also find livelihood opportunities in the safe locations. The national economy will avail a productive basis through which the country will not only become independent on a number of production sectors but also will enjoy impressive sustainable growth.

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