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Role of groundwater in the disaster preparedness plan- a case study of Kathmandu valley

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ABSTRACT

Groundwater supply is an essential component in any disaster preparedness plan for the Kathmandu valley. Currently, groundwater supply contributes about 40% of the total urban water supply in the Kathmandu valley. In the event of natural disasters like earthquakes, groundwater may be the only water resource available. Considering the existing conditions and the facilities available at the abstraction points, however, reliability of this resource being extracted and put into use in the post disaster period however needs some serious planning and preparedness. Currently though large number of groundwater abstraction points are available in the vicinity of the the proposed Internal Displacement Person (IDP) sites, most of the sites do not have any preparedness plan in case of disaster.

Keywords: Kathmandu valley, IDP, groundwater, disaster, preparedness plan

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INTRODUCTION

The Kathmandu valley is a large intermontane basin located within the Lesser Himalaya of Nepal. Roughly circular in shape the valley occupies an area of 750 km^2 (GWRDB 2009). The valley comprises 3 administrative districts of Kathmandu, Lalitpur and Bhaktapur including Kathmandu metropolis, the capital of Nepal (Fig. 1). The voter's population of the valley is estimated at 2,517,023 according to the Census in 2011.

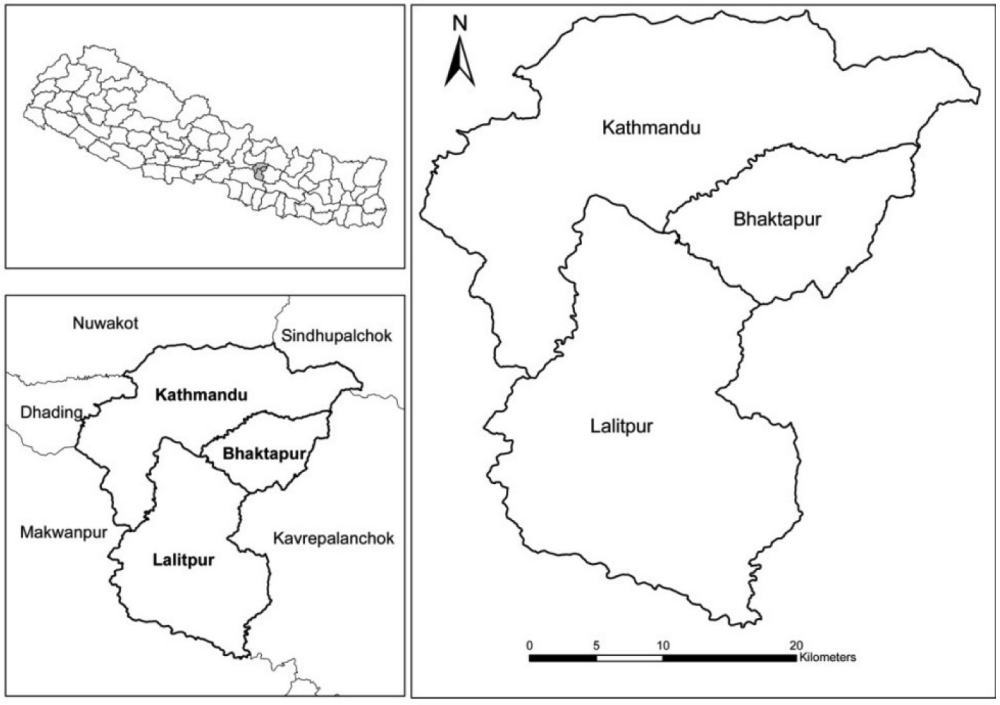

Fig. 1: Location map of Kathmandu valley.

The Kathmandu valley has seen rapid population growth in the past two decades. The urban growth, however, has been haphazard, which makes the cities extremely vulnerable to disasters like flood, earthquake etc. Adhikari (2011) identified 83 sites in the valley as probable sites for Internally Dispalced Person (IDP). Access to clean water has been one of the principal considerations in the proposed IDP sites. A study carried out recently revealed that most of the IDP sites may not have easy access to water supply when and if the disaster like earthquakes occurs.

Current water supply scenario

Water demand in the Kathmandu valley has risen to 320 MLD (KVWSMB 2013). The government, however, can barely supply 80 MLD (approx 28%) in the driest season when the demand is maximum. General public manage the deficit through number of alternative sources primarily the shallow groundwater system exploited through shallow tube wells, dug wells, rower pumps, spring sources and water supply tanker. Thus, household shallow groundwater contribution aside from KUKL supply is estimated at 80 MLD. Minimum requirement of water supply in the event of disaster is calculated at 52.5 MLD (Adhikari 2011). There is little difference between the current supply and the demand in disaster period. If the valley is to depend only on state supply, we are already on the brink of disaster.

A study carried out recently revealed shallow groundwater system to be the primary alternative source of supply both in urban as well as in peri-urban parts (KVWSMB 2013) Currently the state water supply is 80 MLD (40% comes from both shallow and deep groundwater sources). In addition, 50 MLD is supplied from tankers which mostly tap spring and shallow groundwater sources. Similarly 30 MLD is supplied from private tube wells, dug wells and other sources that tap shallow groundwater sources at household level. 30 MLD is also extracted from deep groundwater sources mainly for use in service sectors like hotels, housings and industries.

Hydrogeology

Groundwater was and is the principal source of water supply in Kathmandu valley. The groundwater system in the Kathmandu Valley consists of shallow aquifer system of 20-50 mthickess (KVWSMB, 2013) and deep aquifer system which lies at more depth. The unconsolidated coarse sediments which make up shallow aquifer system are as thick as 60 m (KVWSMB, 2010). The nature of the shallow aquifer differs within the valley. The deposits in the North are mainly sandy, but in the south, clay and silty clay predominates. The two systems are separated by Kalimati (black) clay of maximum thickness of 200 m. The black clay layer is thicker in the southern and central part of the valley but thins out in the north or even totally absent. The fluvio lacustrine deposits which occupy large portion of the valley floor are susceptible to liquefaction and settlement. For this reason it has been pointed out that most of the system may not function in the event of major disaster like earthquake. Recently natural springs in the valley periphery have been tapped by private entrepreneurs.

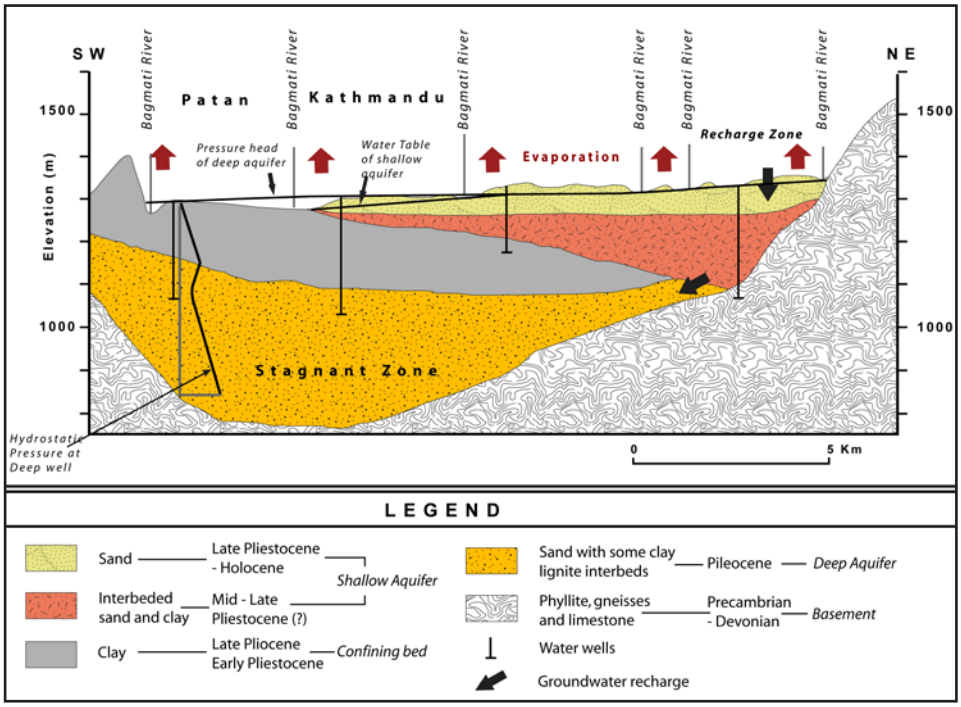

Fig. 2: Geological cross-section of Kathmandu valley.

IDP sites

The government has identified 83 IDP sites in the valley and categorised them into large, medium and small. These 83 sites are to accommodate in total 710,000 people. Their distribution in 5 municipalities is as given in Table 1.

Table 1: Distribution of IDP sites in 5 municipalities in Kathmandu valley.

S.N.	Municipality	No. of IDP sites
1	Kathmandu	33
2	Lalitpur	24
3	Bhaktapur,thimi	20
4	Kirtipur	6

Water sources nearby IDP sites

Recent study carried identified large number of these sources at the distances of 100 m, 200 m and 300 m from the IDP sites. 1934 earthquake is reported to have temporarily destroyed most of the shallow dug wells and *dhunge dhatas* in the valley. It is assumed that in the event of major earthquake (similar to 1934 earthquake of magnitude 8.4 or higher), most of the shallow sources are likely to be damaged due to liquefaction and sand boils. This rules out availability of large number of shallow groundwater sources. Experiences from other countries show deep wells have high probability of surviving the earthquake. Thus only deep wells (> 50m depth) are assumed to remain functioning provided they have been properly drilled. Only these sources were considered in terms of potential water sources. Fig. 3 shows the distribution of deep wells near IDP sites in the valley.

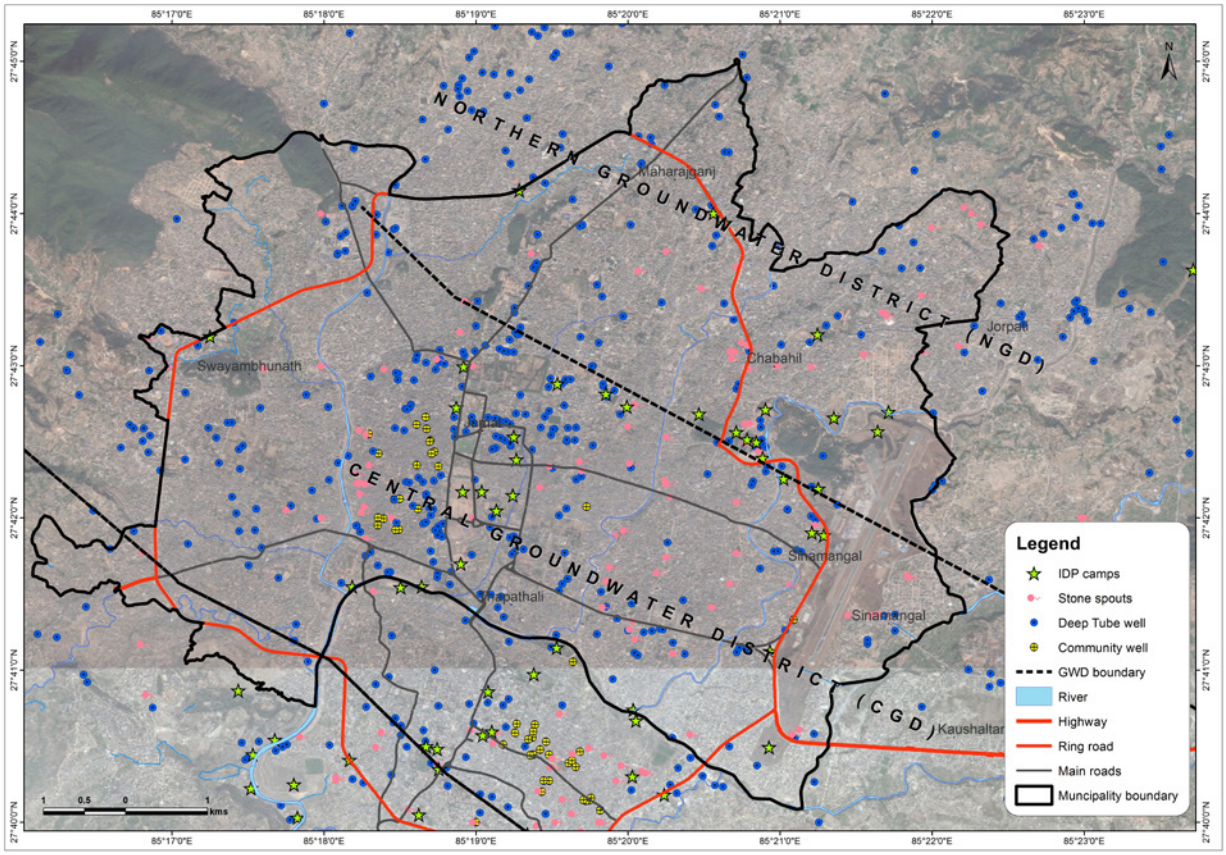

Fig. 3: Distribution of water sources and IDP sites.

Post disaster water supply scenario

Sphere standard of 15 L/d/p is assumed to be the requirement of water which totals the demand to 13.5 MLD for 83 IDP sites and 52.5 MLD for whole of the valley.

In the assumption that 95% of KUKL supply is disrupted and that the disaster occurs in dry months when the overall water availability is low, the total KUKL supply is likely to dwindle to 3.5 MLD and restricted to areas nearby the reservoirs and treatment plants. Similarly, the tanker supply is expected to reduce to 10 MLD due to disruption in the road network and shortage of fuel supply. Its supply is also expected to be restricted to peripheral areas or nearby spring source areas.

Current supply of 30 MLD from deep wells is likely to reduce to 10 MLD due to lack of backup power provided the deep wells survive the disaster. Most of the IDP sites are located on the moderate category of liquefaction and areas susceptible

to settlement. The supply from shallow wells is reduced to 20% or from 30 MLD to 6 MLD due to damage in the wells as a result of liquefaction. In total only 24.5 MLD supply is assumed to be available from the total demand of 52.5 MLD. Remaining 28.1 MLD will have to be pumped from deep wells around IDP sites. With regards to water availability, IDP sites can be categorized into:

IDP sites with no deep wells nearby

Data from the study reveals 13 IDP sites have no water sources within 500 m distance. Most of these sites are located in Bhaktapur and Thimi sub metropolis. This also includes Bhaktapur Durbar square area in the city core. Bhaktapur Hospital which would be a focal point in the event of disaster relies on tanker water supply to run the hospital after the deep well in the hospital collapsed.

Forty five IDP sites have 1-4 deep wells nearby including 2 largest IDP sites of Tribhuvan University (TU) and National Agriculture Reaerach Centre (NARC). TU is designed to hold 70,000 people which requires large amount of water. A deep well has been drilled for the very purpose. Treatment facilities, backup power could however be a problem.

Eight IDP sites have more than 10 deep wells nearby. Most of these IDP sites lie in the core part of Kathmandu Municipality. Most of these sites are of small size category.

Twenty nine IDP sites are better off comparatively with functioning wells, reserve tanks, treatment plants, back up power etc. Most of these are located in hotels, apartments and housing complexes. Most of them have back up power too however sharing these resources in the event of disaster could be a problem resulting in social conflicts. A clear understanding needs to be worked out.

Water supply system and distribution has been designed for IDP camps keeping in mind the the population capacity of the camps, however how will the water supply be managed if population not residing in the camps come to receive water supply? This is especially serious as camps are near the core city areas. The result would be chaos and conflicts.

Although deep wells may be the only option available for most of the sites however most of the deep wells have little or no disaster preparedness plan. Besides the back up power, water quality could be a major issue both in shallow and deep wells. Due to lack of supply and other means, people are likely to use easily accessible near surface water which however are most likely to be polluted from broken sewerage pipes and septic tanks in the aftermath of disaster. Also natural water quality would be an issue too. Wells especially in the southern part of the valley have high iron, ammonia, etc. Water security map with regards to shallow groundwater quality and availability is under preparation through Japan government funded SATREPS program. The map is expected to provide the planners the necessary guidelines for various IDP sites.

CONCLUSIONS

Water storage and treatment facilities are insufficient or not available in most wells near IDP sites. IDP sites near hotels and apartment blocks may have sufficient supply, but sharing may be a problem and may lead to conflicts. In the event of disaster, water shortage both in the IDP camps as well as outside could be a major problem.

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