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**SUSTAINABLE WATER AND SANITATION SERVICES
FOR ALL IN A FAST CHANGING WORLD**

Climate change impacts on WASH and slum community based adaptation measures

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As with all climatic events, impact of climate change affects urban poor communities the hardest. Often the most vulnerable in terms of their limited access to safe water and hygienic sanitation as well as the vulnerable location of their homes and limited resources to cope with emergencies. This study attempted to access the vulnerability of squatter households in the Kathmandu valley to climate change, specifically on their water and sanitation situation as well as learn on adaptation measures adopted by urban poor. 30 households of Pathivara Informal Settlement were interviewed to understand the perception of climate change. The community has already adopted self-adaptation practices such as increased rain water harvesting, water treatment, use of public toilet, reuse of grey water to cope with climate. The findings of this study are useful to advocate for climate resilient urban planning and to encourage other urban poor communities to cope with climate change impact.

Background

Water, as basic need for human life is particularly threatened by climate change. The irrefutable evidence of global climate change and new evidence of its far-reaching ramifications on water security and water-related disease (especially in poorer water stressed countries) is also fuelling increased interest in the sector (UNICEF, 2006). In Nepal, as in many other parts of world, the urban poor are often particularly vulnerable, living in informal settlements on marginal land often not legally acknowledged by the authorities and therefore not served with basic water supply or sanitation. Many do not have land tenure, and lack rights or incentive to invest in infrastructure improvement.

Therefore fluctuation in availability of water due to climate change can directly affect their health and availability to be economic active, the main reason that the majority of informal residents migrate to the city. The evidence shows that the most important form of city adaptation to climate change is to push for progress on the Millennium Development Goals, especially providing potable water and sanitation and reducing the number of people living in slum (Danilenko and et. al, 2010). In Kathmandu valley there are 40 squatter settlements and 137 slum communities on which 40,237 population live in 8,846 households. Of these, 22% had no access to piped water supply and none had adequate sanitation (ADB, 2010). Due to climate change impact, the quality of water supply will be much lower during dry days which lead the inadequate sanitation and hygiene practice and flood causes damages the water infrastructures lead to shortage of water in rainy days.

Study objectives

The main objective of this study is to access impacts of climate change on water and sanitation, and exploring community level adaptation practices.

Specific objectives of the study are:

- To study the change in major climatic parameters (temperature, precipitation).
- To assess the vulnerability of urban poor due to impact of climate change on water supply, sanitation and public health.

- To study the adaptation mechanism of urban poor to cope with the impact of climate change on water supply and sanitation.

Methodology

The study was carried out at Pathivara slum community of Kathmandu valley where 162 families are living there and also they claimed as first squatter settlement of Kathmandu. Both qualitative and quantitative data were collected using household questionnaires, focus group discussions supported by field observation. To ensure equal probability in selection of respondents for the study, 30 households were randomly chosen and responses elicited from either the head of household or other senior members depending on their availability at that time. Climatic data from the Department of Hydrology and Meteorology (DHM) for the previous 30 years at Tribhuvan International Airport, a nearby Kathmandu International Airport as well as health data from Department of Health Services (DoHS). The collected data were analysed using SPSS-16, and Microsoft-Excel.

Results and discussions

Evidence climatic trend

Review of the rainfall data for 1981-2011 A.D from the Kathmandu International Airport nearby study area, found an annual increase of 0.388 mm in annual average rainfall (Fig. 1) but the decrease in annual winter (October-January) rainfall of 0.413 mm/year (Fig. 2).

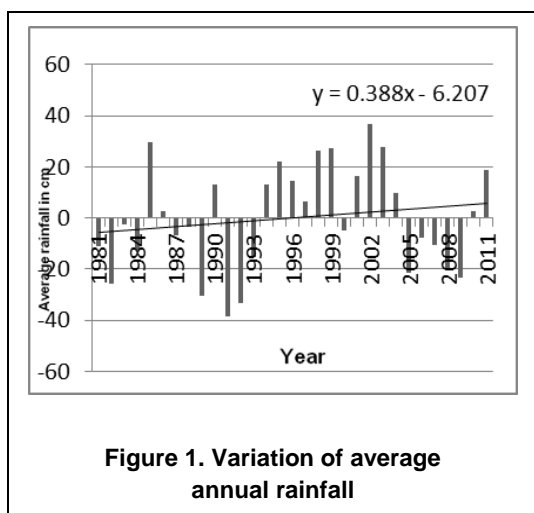


Figure 1. Variation of average annual rainfall

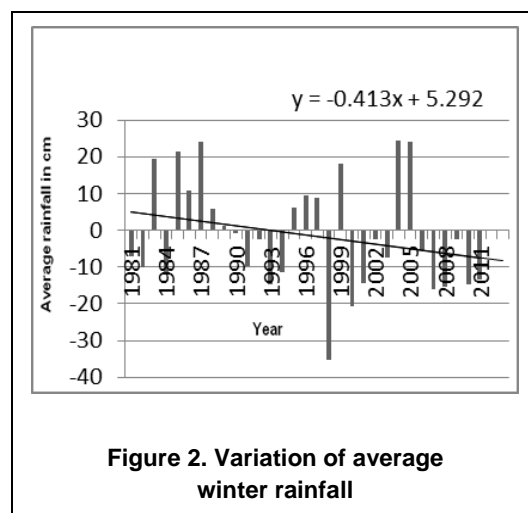
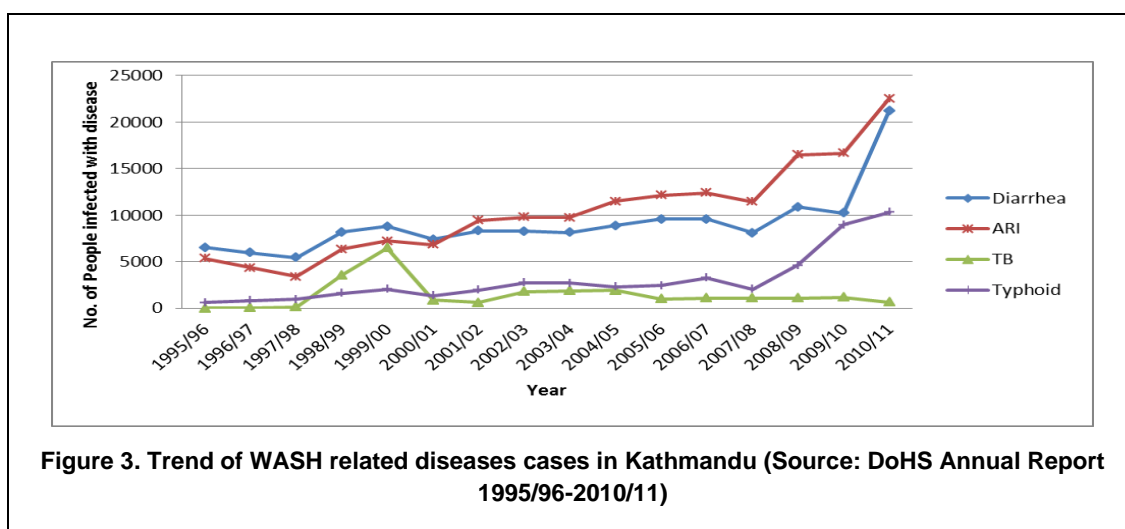


Figure 2. Variation of average winter rainfall

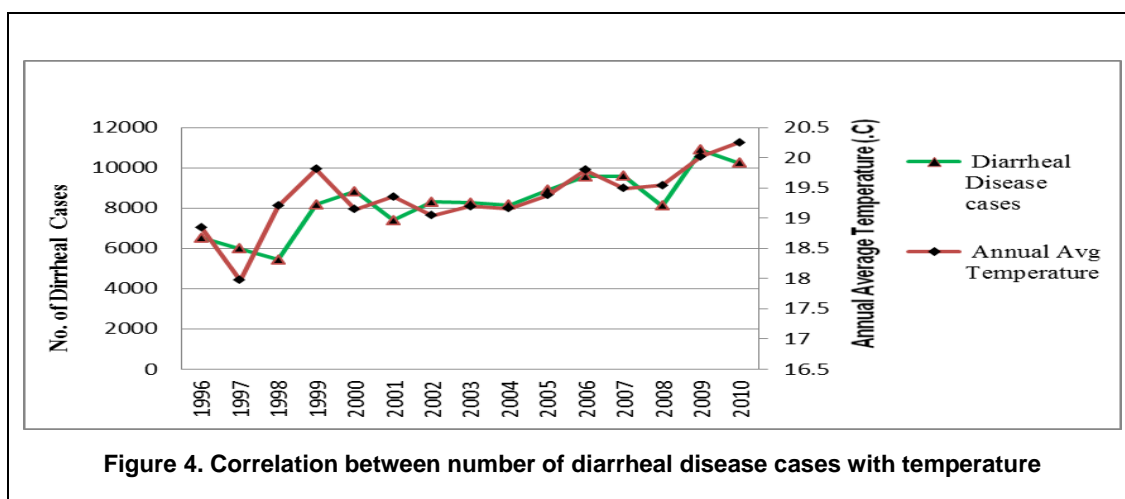
The average temperature is found to be increased and rate of increment of winter temperature (October-January) is more than summer temperature (June-September) which signifies the increase trend of number of hot days. The seasonal maximum average temperature is found increase in all seasons and the rate of increase in winter season is found greater comparing other season. Thus we could expect that the community was experienced less water available and hotter days in winter whereas water quality is worsening in summer due to flood damages as well as uncontrolled surface flow.

Evidence of health trends

By reviewing the available health data from 1995/96-2010/11 AD of Kathmandu specifically looking at the incidence of diarrhoea, acute respiratory infection, tuberculosis, and typhoid the numbers of people infected with water borne diseases increased over the time (Fig. 3). We could expect that the increasing case of typhoid, tuberculosis and acute respiratory infection would threaten residents,' ability to be economically active or care for dependents.



An untimely fluctuation in temperature affects the availability of water and reduces the access to sanitation and hygiene facilities and enhances cases of diarrhoea. Number of diarrheal infected people is found increase with respect to increase in temperature ($r=0.7504$) as shown in Fig.4.



WASH facilities with socio-economic status

The findings presented here come from the 30 interviewed households. Almost 84% households owned their own house and the remaining 16% families rent from others. 76% of the sampled household had tin roofs, followed by straw, then cemented.

Although the city authority's services include piped water supply, it does not serve all area of Kathmandu. Since this is an informal settlement, none of the houses are able to apply pipe water supply connection. The most common source of drinking water are public taps, private shallow hand pumps and public dug well. Various studies on water consumption indicates that the per capita water consumption for secondary/renter (squatter communities) household is 46 litres and the average water consumption for all types of households is found to be 73 litres per day (NGO Forum, 2006). The daily water demand of Pathivara squatter community ranges from 40-300 litres per day and the average daily per capita water supplied is only 62 litres.

Almost half of the sampled households have flushed toilet, 30% have temporary, and remaining households uses public toilet and ultimately discharge to river. Households with temporary toilet are not able to use toilet during rainy season as toilet is inundated and they also use public toilet for defecation. The majority of the respondents said they washing hands after using toilet however, they are not aware of washing hand at the other critical times.

Majority of the respondents said they usually dump waste to river bank as well as road side. Inadequate facilities of safe water and sanitation are more prolonged to the water borne diseases that resulting poor health status of community people. Diarrhoea is the most common water born disease for children under five ages and followed by the typhoid, Jaundice and fever respectively.

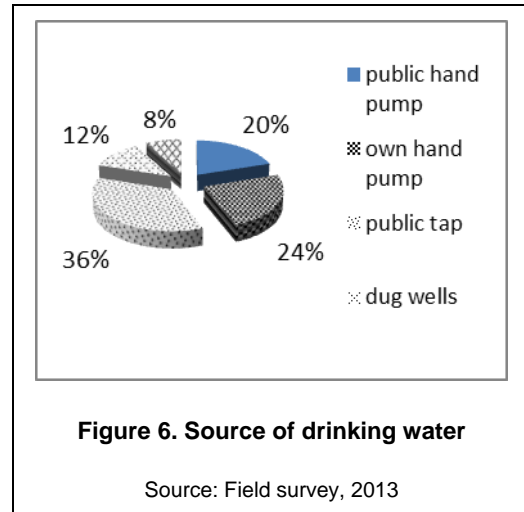
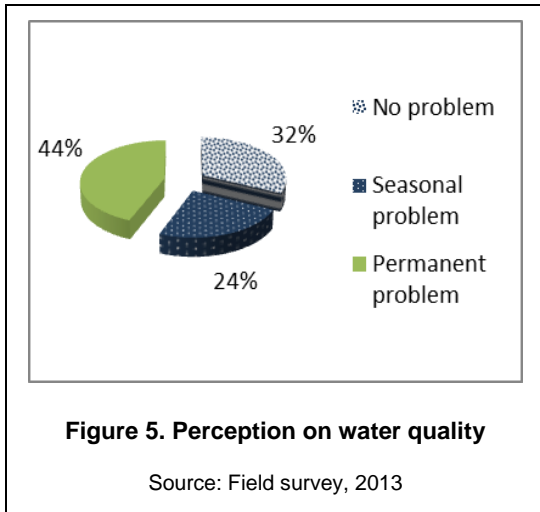
Community perceptions and community based adaptation measures

The majority of the community members were not aware about climate change and its consequences; however they reported observing changes in weather. 70% respondent said that the temperature is increasing these days is higher in comparison to previous years. Majority of respondent (80%) said that the water availability and its quality are decreasing with rapid urbanization and migration of squatter communities towards the bank of river and streams. The community people are facing various problems due to variation in climatic parameters. Both individual respondent of questionnaire survey and the focus group discussion noted that greater fluctuations in rainfall, contributed to flood risk along with poor water and sanitation situation.

During rainy season the community confirmed the findings of the meteorological data, that rainfall has increased and water is everywhere and drains get blocked by waste and sewerage line overflow. They recognise that this could be contaminate their water supplies and reported that many people are suffering from water borne diseases especially in summer.

Water supplies

The interviewees reported that the increase in temperature and rainfall fluctuation has led to worsening conditions, availability of water is not sufficient for daily use during dry season and 24% of respondent noted worsening of water quality between the seasons (Fig. 5). People have adopted by collect water from other sources such as public tap, and nearby private water selling company or either they buy for drinking purpose. Some of them collect water from the local school which allows the public to take water if there is surplus quantity.



There is also increased use of household water treatment reported by interviewees. The households reported using filtration, chlorination and SODIS to make their water potable. Rain water harvesting has become more common for the drinking purpose. The rain water is collected and store in tank. Any additionally captured rain water is used for the bathing and anal cleaning purpose.

Families also try and reduce the amount of water by reducing bathing frequency, re-use of water from cleaning clothes and vegetable, and etc. for flushing toilet. Clearly this impact on hygiene is likely to have an effect on their health. The public toilet is being used by many people, especially people without household toilets and renters. The sanitary condition of this toilet is not good due to lack of maintenance and water scarcity.

Environmental pollution

The water discharge in river is not sufficient at dry season and the increase in temperature and rain fall fluctuation led worse condition. It is filled with waste that creates bad smell and they feel that many diseases are related to the state of river. Frequent cleaning activities, spreading of odour controlling chemicals/powders and waste collection is also done to overcome this problem, however is not sufficient to reduce its impact.

Sanitation

Public toilet is being used by many people, especially people from not having toilet at their house and renters; the situation of this toilet is not good due to maintenance and water scarcity problem. The water is not available at toilet and they use to bring water themselves for anal cleaning and flushing of toilet. None of the people are taking responsibility for the operation and maintenance of toilet and regular users use to clean and maintain toilet in periodic basis. They collect fund from community people if it need to be maintain.

Table 1. Community based adaptation measures		
Change in climate	Consequences reported by surveyed residents	Adaptation practices by community
Less rain in winter	<ul style="list-style-type: none"> • Lower yields from shallow hand pumps • Longer queues at public taps • Perception of low water quality from all hand pump • Not enough water for sanitation purpose 	<ul style="list-style-type: none"> • Collect water from nearby private water sale company • Children and aged member from HH goes for queues • Collect water at night time • Reduce bathing frequency
		<ul style="list-style-type: none"> • Rationalising water uses • Increasing reuse of grey water for toilet flushing and anal washing • Buying of water for drinking purpose • Declining water quality – increased use of water treatment
Higher temperatures in summer	<ul style="list-style-type: none"> • Greater need for water by the HH and community • Need to go further to use other public and private supplies • worse odour from river and drainage • increase in frequency of illness 	<ul style="list-style-type: none"> • Spreading bad smell controlling chemicals and powders • Maintain environmental sanitation clean and tidy • Maintain personal hygiene and buy medicine
		<ul style="list-style-type: none"> • Rain water harvesting for drinking purpose • Construct flood control wall using local resources • Adopt household level drinking water purification system • Increase frequency in drainage cleaning and waste collect in one place and call waste picker • Use public toilet and neighbour toilet for defecation purpose • Remove water manually if entered inside toilet and houses
More rain in summer/ Wider fluctuation in rain between seasons	<ul style="list-style-type: none"> • More incidents of flooding • City drainage not coping with rain, with solid waste blocking drains, and surface water contaminating other supplies and spreading pollution • Toilet and water point inundated 	<ul style="list-style-type: none"> • Attempts to clean up river by community groups, spreading odour control agents – but proving ineffective
Lower flows in the river	<ul style="list-style-type: none"> • River is not flowing as it used to • Waste is stagnating and smells are worsening 	

Conclusions

Qualitative responses from the surveyed residents confirmed changes in climate between past and present years, with increase in number of hot summer days and the winter rain decreasing. Data from DHM and DoHS suggests that diseases associated with poor water and sanitation facilities are increased with change in climatic parameters. The adaptive capacity of people living in squatter and slum settlements is very low compare to other communities because of the lack of resources, infrastructure and low coping capacity to climate stimuli. Also, the availability of water, sanitation facilities is also influenced due to change in climatic parameters. The communities have adopted different community based self-adaptation measures to

cope with their water and sanitation situation, but are restricted due to lack of land tenure which reduces motivation to invest in infrastructure improvements. As a result this poor urban community pays high costs and time for fetching the water whilst their sanitation needs remain unmet.

Recommendations

The majority of the residents came to squatter settlement are economically active. However their water, sanitation and hygiene situation may be seriously curbing that potential. Therefore disseminating the adaptation measures such as rain water harvesting, grey water recycling, efficient use of water, use of public toilet as found in this study, and developing such measures to all urban users would also provide benefits by reduces water usage. However, in the long term, the problem will only be addressed by reducing poverty which leads to increased urban migration and to the poor living marginal land which exacerbates their vulnerability to climate change.

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