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THE CLIMATE-HEALTH RELATIONSHIP: AN EMPIRICAL STUDY OF A SLUM AREA IN NEPAL

YASHODA RIJAL
University of Siegen, Germany

Introduction

Climate change is increasingly recognised as a global health problem (http://dohadeclaration.weebly.com/index.html). Yet the connectedness of global and local conditions that combine to create specific 'glocalising' climate-health dynamics and the complexity of such effects are not well understood (Costello et al., 2009). The debates into the risks of climate change are most advanced in (some of) the resource-rich countries with Europe in the driver's seat (Gough, 2010). In sharp contrast to the growing sensitivity, the health-related effects of climate change are more severe in the least-developing and tropical countries, and here, the low-income groups and slum dwellers are the most vulnerable groups (St. Louis & Hess, 2008).

The climate-health relationship and its linkage with global inequalities can only be understood when looking at 'chains' of conditions, because there is no single explanation and no initial causality. One major chain mechanism, next to the context-dependent variety, is a more rapid growth of the population in urban areas of resource-poor countries that meets with an overall low income rate and poor drinking water; consequently, in the emergent, more densely populated areas the shared resources are decreasing, and thereby, this area easily turns into a slum area. Socio-economic and environmental factors thus combine to create an explosive mixture of risky conditions for health (Few, Lake, Hunter,. &Tran, 2013; Kjellstrom et al., 2007).

Against this backdrop we introduce a research design that focuses on the most vulnerable regions of the world, namely slum areas in low-income countries. The aim is two-fold: first, to provide in-depth data on the health status of the population and second, to empirically investigate the relationships between poor socio-economic and environmental conditions and health. One innovative contribution of this research is the closing of a gap in existing international and local statistics and research. For the first time, the study provides representative data on the self-reported health status of households in the Balkhu slum area in the Kathmandu Valley in Nepal that are put in the context of climate variables. Here, we draw on a definition of a slum area as a densely populated area with poor sanitation and drinking water and lack of other public services, such as appropriate education and healthcare services, and essential infrastructures, like electrification and roads (UNCHS, 2007 ;Vlahov et al., 2007).

This adds new knowledge to a growing body of research into environmental and health relationships focussing to low income and marginalized people living at poor housing condition. This study highlights the relevance of local policy solutions (Ostrom ,2009). A mixed methods design is applied that combines quantitative and qualitative elements; major tools are interaction with patients admitted at particular governmental hospitals dealing with communicable diseases, Focus Group Discussions (FGDs) with the slum dwellers and an intensive household survey of 30 households and additional analysis of public statistics, documents and other secondary sources.

The article begins with linking the environmental conditions to health and then provides an overview of the situation in Nepal. This is followed by information on the methods and data collection. Next, the findings are presented and discussed in relation to the chain effects. We conclude this paper with our findings of the poor health conditions of the study population and recommendations for further a comprehensive study.

Linking environmental conditions and health in relation to low-income countries

Scholarly debate has outlined climate change as a global health threat of the twenty-first century (Costello et al., 2009), that will especially hit low-income countries (Grineski et al. ,2012;Patz & Kovats ,2002). Changing environmental conditions impact the health of the population through direct and indirect mechanisms. Major direct mechanisms, such as heat waves, floods and storms, are spotlighted by the media, thus gaining public recognition across the globe. However, wide ranging indirect effects are largely hidden to the global public and often ignored by local authorities. Examples of these include changing patterns of infectious diseases, disruptions of agricultural and other supportive ecosystems as well as population displacement and conflict over depleted resources, such as water, fertile land and fisheries (Haines, Kovats, Campbell-Lendrumb, & Corvalan, 2006;Pachauri & Reisinger, 2007).

The significant impact of climate change, which started to gain notice from the 1970s, has been causing 140,000 deaths annually and is estimated to add 2-4 billion (US$) of annual health cost by 3030 (WHO, 2011). This effect is more pronounced in the least-developing countries even though their contribution to greenhouse gas emission is much less (St. Louis & Hess, 2008). A rapid and high population growth rate is found in the least developed tropical countries, and as a result most of the slum dwellers live in tropical countries. Their health is basically threatened by a variety of tropical diseases influenced by socio-economic and environmental factors (Kjellstrom et al., 2007). Urbanization in least developing countries accelerates water vulnerability through water scarcity and water contamination (Srinivasan, Karen ,Emerson, & Steven, 2012) which will create a conducive environment for the out-break of water born diseases. The infant mortality in those countries is typically four or more times higher in poorer segments than in richer segments. There are also large differences between richer and poorer populations in the incidence of environmentally related infectious diseases such as tuberculosis, typhoid and cholera, and in exposure to local air pollution and indoor air pollution (McMichael, 2000).

Tekce and Shorter (1984) have found that infant mortality was significantly influenced by mothers´ education, housing quality, occupation and income of the household´s head in a study conducted at the urban areas of Amman, Jordan in which author considered housing quality as a major variable. Timaeus and Hill (1985) have also found that child and infant mortality are significantly influenced by the housing quality, sanitation facility and more importantly the source of drinking water. Diarrhoea, worm infections, and other infectious diseases spread through contaminated water. In 2002, 51 percent of populations in developing countries lacked proper sanitation whereas 21percent lacked safe and sufficient drinking water (Kjellstrom, et al., 2007). Fashuyi (1988) has found that 95 percent of the children from the schools of urban slum from Nigeria have been infested with helminth parasite in comparison to only 52 percent of infested children from the rural schools. These significant differences were mainly due to highly dense population, poor sanitation and drainage and absence of clean drinking water facilities in the slum area.

Similarly, the prevalence and intensity of Ascaris and Trichuris was higher in the slum area in comparison to rural areas of Malayasia (Kan, Guyatt, & Bundy, 1989). The incidence rate of diarrhoea was significantly higher in the poorer area (urban as well as rural area) than the richer area in Brazil. Similarly, 2.2 times higher risk of diarrhoea incidence was found in the former case in comparison to the latter (Guerrant, Kirchoff, & Shields, 1983). Lenz (1988) has found only the environmental factors are responsible for the incidence of malaria and diarrhoea in the slum areas of Jakarta.

The distribution and seasonal transmission of malaria is affected by climate, as both vector and parasite are sensitive to temperature (van Lieshout, Kovats, Livermore, & Martens, 2004; Hales &Woodward, 2005). Similarly, IPCC Fourth Assessment report has also projected the high incidence of malaria and possibility of expanding it in new geographical zones (IPCC Fourth Assessment Report Climate, 2007).

From bad to worse: mapping the conditions in Nepal

Nepal is a least developed country situated in South Asia where more than 25 percent of the total population falls below the poverty line (World Bank, 2011). According to World Bank, there were 13 percent of people residing in urban areas in 2000 which had increased by 5 percent by 2010 (World Bank, 2010) which indicates the rapid pace of urbanization; and there is the risk of changing unmanaged urban areas into slum areas (World Bank, 2012). The studies show the concurrent urbanization of poorer countries brings vulnerability and health hazards from climate change which simultaneously contributes to other problems through a multiplier effect (Lendrum &Corvalan, 2007). As with most of the urban slum dwellers of least developed countries, their health is threatened by a variety of tropical diseases and environmental determinants (Kjellstrom et al., 2007). On the other hand, Nepal has very low per capita CO_2 emission of only 0.1 MT (19 nineteen times lower than USA) (World Bank, 2011;Lendrum & Corvalan, 2007).

The main climate-related risks in Nepal include the expansion of vector-borne diseases to the newer areas; diarrheal diseases due to changes in freshwater quality

and availability, and floods and landslides with consequent death and injuries (Ebi, Woodruff, Hildebrand, & Corvalan, 2007). The changes in major climatic variables such as altered temperatures and extremes of precipitation (floods and droughts) will bring health effects (Patz & Kovats, 2002).

The study shows that there is significant variation in mean annual air temperature and rainfall pattern in Nepal. The annual trend of temperature rise per decade was found to be 0.41^{0}_{C} (UNFCCC, 2004) and is expected to increase more in future years, which is predicted to bring many direct and indirect health impact. These problems are common in the poorer dwellings and the slum area because the poor people in Nepal are not in the position to afford quality health services that private institutions normally provide. Additionally, the health services provided by the Nepalese government are also poor, inadequate in the context of changing climatic variables and focussed to the poorest of the poor.

Research Questions

The slum dwellers have low income which directly impact their food and living condition. The consumption of less nutritious and unhygienic food, drinking groundwater near to polluted river and living in poor physical condition (such as poor ventilated house, less spacing, leakage of rainwater and problem of damp floor). These poor socio-economic and physical condition of the slum dwellers push them quickly to the climate sensitive diseases. On the other hand, the slum dwellers are the wage labour and they have to work hard at out-door environment to earn their bread and they are supposed to be exposed the variable climatic parameters such as too much rain, prolonged dry season, chilling cold and hot waves. The hypothesis of this study is that poor socio-economic and physical condition of the slum dwellers are more vulnerable to climate sensitive diseases. Therefore, the principal research questions of this study is: what are the socio-economic and environmental factors affecting the poor health condition of the slum dwellers.

The study area

Jagaran Tole a part of Balkhu Slum area is the study area which is situated at the bank of Balkhu river (*Balkhu Khola*, Tributary of Bagmati River) of Kathmandu. There are 370 households and 2226 total population in this slum area with a population density of 1,113 per square meter (Field Study, 2011/ 2012). The households in this settlement by default are ultra-poor having poor access to clean dirking water, poor health facilities, and poor education. This settlement has been established within a decade and a number of new household are still settling in this area from the different parts of the country with the majority of them from Diktel, Makwanpur, Jhapa, Syngya, Lamjung, Terathum, Sakhuwashava, Lamjung, Baglung districts of Nepal.

The settlement is very close to a river. In the rainy season, the volume of water increases sharply and normally comes up to their one story, Zink roofed houses. In such circumstances, the residents normally stay away from their houses up to 1-2 days and return when the water level diminishes.

Methods

Among the forty-five settlements of slum dwellers scattered in the Kathmandu along Bagmati and its tributaries, one settlement named *Jagaran Tole* situated at Balkhu slum area near to Balkhu river (tributary of Bagmati river) was selected purposively.

The region behind selecting this settlement is that it is relatively old settlement, the medium household's number to handle, very close to Bagmati River, and the households mainly depend on groundwater as a source of drinking water. This settlement possess unique character of slum area and representative to others slum areas. Another reason behind selecting this area is that the researcher had prior exposure to this settlement and had good rapport buildings with the local which is considered very important while handling especially slum households because they are very hesitant to provide response to the new comers. The final and most important reason of selecting this area as study site is that while frequently visiting government health institution, researcher encountered significant number of patients suffering from communicable diseases in the government institution during July-August, 2011. This study site possess unique characteristics of the slum area and the findings can be replicated to the other slum area of Kathmandu and other urban slums of Nepal.

A mixed method was applied for data collection, interaction with patients admitted at governmental hospitals related to communicable diseases, Focus Group Discussion (FGDs) followed by representative survey and relevant literatures and document analysis to triangulate the qualitative, quantitative and secondary information. As the participants of the study area were illiterate, depending on only one method might give biased results.

At first stage, Department of Health, Epidemiology and Disease Control Division, Teku Kathmandu was visited frequently during June-September, 2011. This is only the Government health institutions handling the communicable and tropical diseases in Nepal. During the frequent visit of researcher to this institution, researcher found more patients from slum dwellers suffering from communicable diseases especially diarrhoea, cholera, malaria, jaundice and typhoid. Among the slum areas in Kathmandu, significant number of patients were from *Jagaran Tole*. The visit of government hospital prior field survey firstly helped to select the study area and secondly supported to formulate research question that is slum dwellers are more vulnerable to climate sensitive diseases. Two focus group discussions was conducted at *Balkhu slum area* to get the quick socio-economic and health status of the slum dwellers of the whole settlement consisting of 370 households and 2,226 total population. FGDs were conducted on 12 September in two settings. The village committee was contacted two weeks earlier asking for permission to carry out the focus group discussions. There were 22 and 26 participants in each FGD. Women were encouraged to attend the FGDs and 9 women attended the first FGD while 12 women in the second one, more than 33 percent representation. The large group size was due to volunteer participation of the participants as initially it was targeted to be confined to only 15 in each. The time taken for the first FGD was approximately 3 hours and for the second one three and half hours, a relatively greater time was required than typical FGDs due to the large number of issues that arose during

the discussion. Most of the male participants actively participated in the discussions while only a few women were active in participation, possibly due to cultural lag. From the participants, it was shared that the women participants share their views more freely in group meetings which consist of only females. A pre-designed checklist was employed that allowed for open-ended discussion and debate among participants and gave a clear direction for the discussion. The focus groups were designed to understand the health situation of the slum dwellers particularly children, women and the elderly. Equally important, the focus groups provided an opportunity to capture the perception of local people on climate change and their health. The issues and conclusions were systematically noted with the help of a co-worker. Participants could not be assured of the confidentiality of their recorded responses even after our effort of rapport building. No voice recording and video recording were done keeping the delicacy and sensitiveness of the society in mind even though participants were encouraged to take part in the photo-session after the completion of FGDs. The FGDs was guided with the major purpose to determine the overall health status of the slum dwellers and build a general health linkage with climatic parameters. More specifically, the following specific questions were considered to guide the FGDs:

1. What kinds of diseases that slum dwellers normally suffer and how they rate their current health status
2. What kinds of health institution they have access to, normally how often they visit the health provider and for what kind of diseases
3. What perceived linkage of health problems with climatic parameters are held especially temperature and the rainfall

According to LUMANTI (2008), there are 40 big and small settlement along river corridors ranging from 589 households to only 6 households. Among those settlement, middle part of Jagaran Tole is selected purposively for the representative household survey, which has a total of 120 households. The name list of all 120 households residing in the study area was prepared after the FGDs from the consultation with the key informant presented in the meeting which was later varied with local school teachers. The government authority has not given legal authority to this settlement and does not have record how many households reside in slum areas. Therefore, key informant presented in the FDGs helped to list the total number of households reside in the study area. 30 households were randomly selected from that list, representing 25 percent of the total population. The data was collected from each sampled household by household survey using pre-tested and semi-structured questionnaire. The major emphasis was given to collecting demographic, socio-economic and climatic variables in relation to health, particularly household income and sources of income, household health expenditure, types of communicable and non-communicable diseases persistent in the area, household health expenditure, types of health institutions available in the locality and their distance, quality of health delivery provided by the health institution, perceptions of local people to the major climatic variables and relationship with their health. The information collected from the representative households´ survey was triangulated with the FGDs. The representative household survey was conducted from mid-September, 2011 to February, 2012.In addition to the above two methods

described, literature survey and document analysis were accomplished side by side to find the gap and link the findings with the existing scientific knowledge. The secondary data were collected from published and unpublished literature and related stakeholders, particularly Ministry of Health (MoH), Government of Nepal, Lumati and World Health Organization (WHO).

The collected information was processed and entered into the SPSS format (Version 16, SPSS Inc, Chicago, IL). Then, statistical analysis such as frequency analysis, comparison of mean and standard deviations were done to make the statistical decision. Similarly, many generalizations on health status of slum dwellers were also made from the qualitative information obtained from the FGDs which can be considered as a hypothesis for the further research.

Results

Socio-economic characteristics

Table 1 gives the basic socio-economic descriptions of the surveyed households. The average age of the household head is 40,which shows that the younger generations are taking the responsibility for the household. Average educational level of the household´s head was found to be 5 years of schooling (grade 5 in Nepalese schooling system). The educational level of the household head is a determinant to making household level decisions regarding adaptive measures of climate change and success and failure of such measures. The average family size was 5 members/family, which is consistent with the national average.

The average household income was NRs 120,000/ household which is quite lower than the national per-capita and most income was earned through unskilled labour. The total household expenditure was NRs 144,000 per household which exceeds the

Table 1. Basic Descriptive. (Nrs= Nepalese Rupees, 1 US $ = 90 Nepalese Rupees) (Source: Field study 2011/2012).

	N	Min.	Max.	Mean	Std. Dev.
Age	30	20	73	39.80	14.35
Years of Schooling	30	0	13	4.93	3.03
Size of the family	30	2	8	5.10	1.53
Total household income in Nrs (1,000s)	30	10	400	120	100
Total household expenditure Nrs(1,000s)	30	10	144	145	2.54
Expenditure in food Nrs (1,000s)	30	0	120	52.23	39.45
Expenditure in agriculture NRs (1,000s)	30	0	59.00	10.36	13.73
Health Expenditure Nrs (1,000s)	30	0	30.00	8.33	9.72
Total Loan Nrs (1,000s)	30	0	95	32.13	23.76
Health Loan (in NRs)	30	0	80	7.73	18.55
Mortality (recorded in 10 years)	30	0	3	0.90	0.99

total income and the average loan per household was NRs 32,000. About 50% of the household income was spent to feed their families. The health expenditure was found quite low (7 percent of total income) and per capita health expenditure becomes less than the corresponding national figure of 24 $ for Nepal (WHO, 2012). Those socio-economic indicators were obtained from the households surveys. Important socio-economic indicators were also asked during FGDs. The researcher found very close figure in both FGDs and household survey. The reason of doing triangulation especially for socio-economic indicators because there is general tendency of hiding some socio-economic indicators expecting some incentives from the researcher and research organizations.

Health Status of the slum dwellers

The respondents ranked the most common diseases prevalent in this area as: Typhoid, Diarrhoea, Jaundice, Injuries, Cholera and Malaria (Table 2). These diseases are found to be normally occurring in the months of May-September in which monthly temperature and precipitation fluctuate very much (Figure 1, 2 and 3). The participants at FGDs mentioned the contamination of drinking water and foodstuffs due to flooding of the nearby river. As soon as the flood diminishes, many trenches surrounding the residences, including their temporary trench toilet will be filled with water and serve as suitable places for mosquito breeding. As a result, malaria is becoming a major disease in the slum area even though it is not considered as a problematic disease in Kathmandu valley based on the report published by Department of Health, Government of Nepal (DoH, 2009/10). Labour at slum dwellers also mentioned severe headache and frequent occurrence of cold and fever. Some participants at FGDs also mentioned the occurrence of Japanese Encephalitis regularly in their area from last 4-5 years.

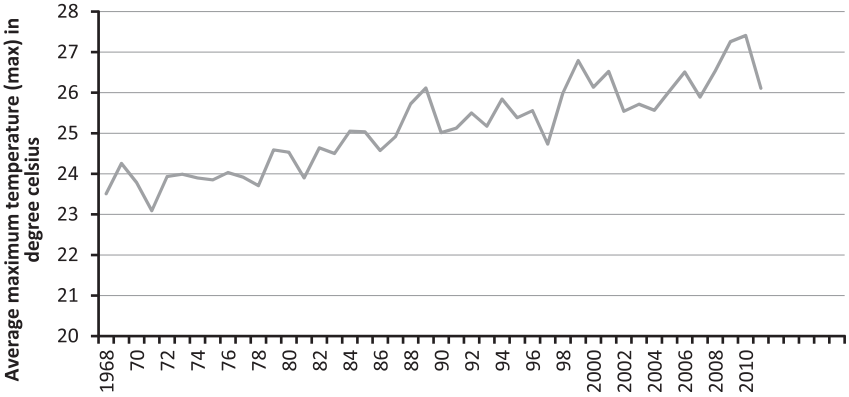

Figure 1. Increasing trend of yearly temperature (maximum) of study area (1968-2010). (Source: GoN, 2012)

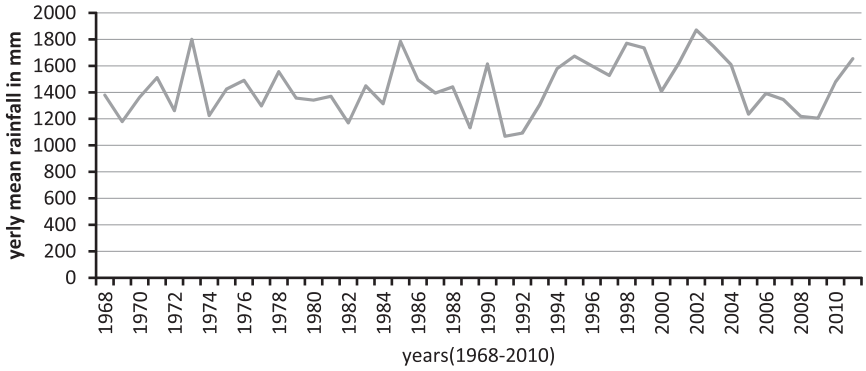

Figure 2. Fluctuating trend of mean yearly rainfall of study area (1968-2010). (Source: GoN, 2012)

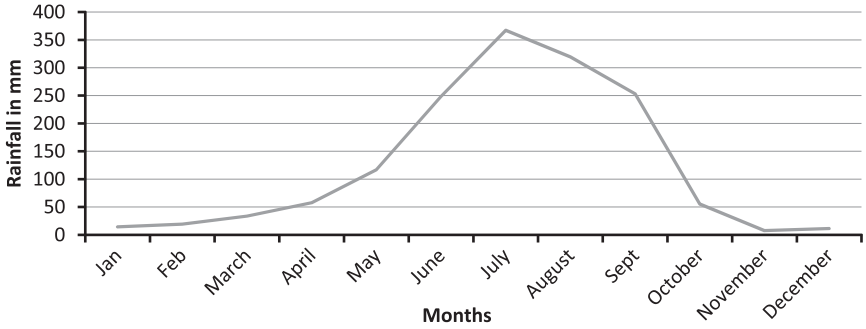

Figure 3. Monthly variation in rainfall of the study area (1968-2010). (Source: GoN, 2012)

Additionally, the people in the study area are also suffering from non-communicable diseases such as Tuberculosis, Diabetes, respiratory problems, cardiovascular disease, paralysis and HIV/AIDS (Table 2).

Most of the participants believed that their health status was poorer than previously. Older participants explained they are noticing more cold in the winter and suffered more from health problems but they did not know whether this is due to climate change or their advanced age. Most of the participants do not have access to quality health providers due to their low income. The government health institutions are less trustworthy for them even though it is less expensive. Normally, most of the households of the slum area do the delivery of babies in their home with help from experienced neighbours.

Table 2. Type of diseases prevalent in the study area and their ranking. 1 refers high disease prevalence in the area. (Source: Field Study 2011/ 2012)

Types of diseases	Ranking
Communicable diseases and injuries	
Typhoid	1
Diarrhoea	2
Jaundice	3
Injuries	4
Malaria	5
Chronic diseases	
Diabetes	1
Tuberculosis	2
Respiratory	3
Cardiovascular	4
HIV/AIDS	5

The mortality rate of the slum area is very high. It is found that every household has lost at least one family member in the past 10 years. If the correlation between mortality and the household income is analysed, the negative correlation is found with a significant coefficient. This shows that higher income will decrease the mortality rate and vice versa.

Families suffer commonly from malarial fever, encephalitis, common fever, typhoid, diarrhoea, jaundice in the summer and rainy season where as common cold, pneumonia and viral fever are very common in winter (Field Study, 2011/2012). According to them, they are very vulnerable to diseases due to high temperatures in the summer immediately followed by heavy and unusual rainfall. The children and elderly people are more vulnerable to seasonal diseases and epidemics whereas females are more vulnerable in comparison to males (FGDs, 2011). Grineski et al. have also found in their study that children and women are more vulnerable and over-burdened by the impact of environmental injustice (Grineski et al., 2012).

Discussions

The households´ socio-economic characteristics are considered as the basic determinants which directly impact the food and housing condition of the slum dwellers. The poor socio-economic condition, poor housing condition and more exposed to out-side harsh environment for wage earning makes the slum dwellers more vulnerable to health.

The household income of the study group is quite low and working as an unskilled wage labour in the surroundings such as agricultural field, brick chimneys, road

constructions are the main source of livelihoods of the majority of the slum people. Food security is found to be the major issue of the study area and the households were found to spend 60 to 100 percent of their income on feeding the family. Especially, during rainy and winter season, it will be difficult to get labour work outside and most of the households are food insecure during the same time. Insufficient food during the rainy and winter months and working at harsh weather (both rainy and cold weather) makes the slum dwellers more vulnerable to diseases. They lack sufficient saving for the health expenditure because most of their expenditure is spent on buying foodstuffs for the family. Due to low income, the slum dwellers have poor housing quality. At the time of the FGDs, the author inspected the slum dwellers residing in the poor quality temporary houses thatched with Zink, plastic tunnel and straw and houses got damp spoiling the stored food and creating favourable conditions for pathogen development and vector multiplication during the rainy season. The houses lack proper ventilation and proper spacing. Indoor environments can allow growth and propagation of pathogenic ecosystems. Overcrowding and poor ventilation are recognised as environmental risk factors for airborne infectious disease transmission (Vardoulakis, Thornes, Lai, 2012).

Households were found normally suffering from typhoid, diarrhoea, cholera, jaundice, and malaria during the 2-3 month rainy season. Typhoid, diarrhoea, Cholera and Jaundice are mostly related with contamination in drinking water because the source of drinking water is only the groundwater because Government consider slum area as illegal settlement and this area is not connected urban water supply pipelines. As slum area is very close to Balkhu river which is very polluted and there is higher probability of ground water contamination and during rainy season, all the slum area used to be frequently flooded making the drinking water more contaminated. Typhoid, diarrhoea, Cholera and Jaundice outbreak every year mostly in the rainy season in the slum area.

As soon as the flood diminishes, many trenches surrounding the residences, including their temporary trench toilet will be filled with water and serve as suitable places for mosquito breeding. As a result, malaria is becoming a major disease in the slum area even though it is not considered as a problematic disease in Kathmandu valley based on the report published by Department of Health, Government of Nepal (DoH, 2009/10).

The people are realising the increases in occurrence and intensity of above diseases and during FGDs, the participant mentioned that the old-aged and children are more vulnerable to those diseases. This can be taken as an important hypothesis for conducting further research.

For the adult and who mostly involved into labour market, injuries are the major heath problems because they often have to do heavy labour outside the house resulting in heat related injuries during summer and cold related injuries during winter. They opined they would have a severe headache in both cases. Some participants also mentioned some cases of heart attack while working during the hot weather in the brick chimneys.

The inhabitants also raise chicken, ducks and pigs which plays a significant role to supplement their household income but at the same time raising such domestic animals in their houses which is also helping to spread diseases like Japanese Encephalitis which is new diseases in this area but now occurring regularly in some intervals.

The occurrence of chronic diseases such as Tuberculosis, Diabetes, respiratory problems, cardiovascular disease, paralysis and HIV/AIDS (Table 2) are also found prevalent in the study area. These diseases might or might not have linkage with ongoing rapid changes in climatic parameters which need to be explored through more concentrated scientific efforts. As diabetes was found spread widely in the study area. Ghaffar (2004) have also reported an increasing trend of diabetes in Nepal and more in urban areas. Kart, Kinney, Subedi, Basnyat and Vadakkan (2007) have found pollution and other environmental factors are the potential causes of diabetes among the other reasons. Kan, Huang, Chen and Zhao (2009) have found significant impact of environmental pollution on cardio-vascular diseases in China which might be linked with incidence of cardio-vascular diseases of slum area of Kathmandu Regarding HIV/AIDS, participants ranked it as 5 in terms of prevalence but they were very reluctant to express their views and did not tell who is affected by HIV/AIDS due to social stigmas. From FGDs, we came to know that there are some women involved in prostitution in the study area. The Department of Health (DoH), Government of Nepal has estimated around 70 thousands adults have been affected by HIV/AIDS which is 0.49 percent of the adult population. Around 2.3 percent of sex workers have been estimated to be affected by HIV/AIDS in Kathmandu (DoH, 2009/10). The participants ranked TB as the second most prevalent disease in the study area. In Nepal, TB is considered as a major disease and 5000 to 7000 people die annually (DoH, 2009/10). HIV and TB have a mutual relationship as HIV weakens the immune system. Someone who is HIV positive and infected with TB is 5-7 times more likely to develop active TB than someone infected with TB but not infected with HIV (DoH, 2009/10).

This study has discussed most prevalent diseases of the slum area and tried to connect with their poor socio-economic condition and exposure to harsh environment. But is difficult to pin-point which are due to the impact of socio-economic and which are only due to the climate change. This study is not able to examine this complexity which is one of the main constraints of this research. The findings of this research tells the health status of slum people is vulnerable due to their low affordability to health related expenditure and climate has further added more health uncertainties.

Conclusion

This study has discussed major diseases prevalent in the slum area. The poor socio-economic condition and need of hard work to earn bread, poor housing, contaminated water source and more exposed to outside environment are considered as the main factors behind the poor health of slum dwellers.

The result also shows that people are aware somehow about the health effects of climate change. However, there are cognitive, behavioural, and structural obstacles to voluntary efforts to mitigate the impact of climate change (Semenza et al., 2008).

The people in the slum area have very little surplus for the health related expenditures and on the other hand they do not have insurance policies neither government nor private. Creation of employment opportunities (on-farm and off-

farm) in the slum area will create surplus income for health related expenditures and insurance. Most of the people in slum area have poor housing facilities, poor drinking water facilities, poor nutrition and poor health status due to their poverty. Once they get additional income, they will spend this additional earning for balanced diet, to pay for health insurance premiums and other health related expenditures. The poor housing quality in the slum area is the major trigger for climate-sensitive diseases. Therefore, investment on well-ventilated and scientific housing infrastructure is very essential. Similarly, improved health infrastructure and services are an essential component of climate change mitigation and adaptation. Such health interventions contribute to the empowerment of women-headed and under-privileged families to build their resources, reduce poverty, and thus increase the resilience of their households and communities to prepare for and deal with climate change.

In the Nepalese context, there are very successful examples of community managed and participatory governance for the management of water and forest resources (Ostrom, 1990) which recommend switching the mono-centric governance to poly-centric governance (Ostrom, 2009). Therefore, the author would recommend and seek the scope of a participatory and polycentric health governance system in Nepal. However, rigorous research needs to find the best fitted policy options among the various models in the Nepalese context.

This study has contributed to literature by bringing climate health nexus of the slum dwellers which can be considered as a bench mark for the further research. It bring the attention of the urban planners to think in the direction of climate resilient settlement by improving the housing condition, access to quality drinking water, access to reliable health institution nearby slum dwellers.

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Biographical note

Yashoda Rijal is a PhD student at the University of Siegen, Germany in the faculty of Sociology. Her research focuses on the health situation of poor and vulnerable people living in remote rural areas and urban slums in Nepal and its linkage with on-going climate change. Before starting PhD study, she worked more than 5 years at HEIFER International Nepal, a US-based organization working for the mainstreaming marginal people of Nepal.