

Climate Change and Its Impacts on Human Health in Nepal

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Abstract

Nepal is one of the climate change prone countries in the world. Geophysical and socioeconomic condition of country have predetermined vulnerability of the country to drought, earthquake, epidemic, fire, flood, forest fire, land slide and other climate related events affecting human and animal health, injuries, and quality of life. In light of such a situation we aimed to review knowledge related to potential health impacts of climate change on population of Nepal. Literature search using major public health, environmental and social databases as well as international reports was completed to get an overview of existing knowledge. There is a little published knowledge related to potential health impacts of climate change on population of Nepal. However, the knowledge of relationship between climate change and health and knowledge of environment allow discussing main routes of potential impact as well as health effects is a crucial issue to explore. More direct, population based research would be necessary to provide sound knowledge for emergency planning and mitigation measures.

Keywords: Climate change; Disaster; Health impact; Nepal

Introduction

Climate change is one of the biggest global health challenges of the 21st century [1] and a growing public health threat [2]. Human beings are exposed to climate change directly through changing weather patterns (more intense and frequent extreme events) and indirectly through changes in quality of water, air, food quality and quantity, ecosystems, agriculture, livelihoods and infrastructure [3]. However, the effects of climate change differs on the basis of health vulnerability assessments that focus on understanding population sensitivity to the effects of specific exposures, measuring the ability to respond to and recover from these effects of climate [4].

The scientific evidence on climate change is complex and difficult to understand by non-expert, but there is a strong acceptance that the earth's climate is changing more rapidly than might be expected and such changes are likely to have results from human activities [5]. The number of attendant effects were already observable including an increase in global average surface temperature over the last 100 years of 0.74°C-0.18°C [6] and the prediction is that global temperature is likely to rise by 1.1 to 6.4 degree centigrade between the 1990 and 2100. This increase in temperature is likely to lead to:

Rising sea level, change in the amount of precipitation, above average rainfall, melting of polar ice caps and glaciers, storms & hurricanes [5],

A decrease in the average extent of mountain glaciers and snow cover in both hemispheres [6]

An acceleration in the annual rate of sea level rises during the twenty first century at an average rate of 3.7 to 9.7 mm per year [7] and

More intense and longer droughts (66%) over wider areas [6].

The climate change is receiving worldwide attention because of its anticipated impacts on the earth physical and biological system [8]. All regions of the world are affected by changing climate jeopardizing human health; resulting health risks to human population vary rapidly, depending on where and how people live [2]. Climate changes occurred as demonstrated by epidemiologic studies, as a result of urbanization, high levels of vehicle emissions and westernized lifestyle which are correlated with human health problems such as increased frequency of respiratory allergy, mainly in people who live in urban areas in comparison with people living in rural areas [9]. People living in slum areas, coastal regions, megacities and mountainous and polar region are more vulnerable [2,8]. About 5.5 million Disability Adjusted Life Years (DALYs) were lost in 2000 [10] and it is estimated that by 2020 human triggered climate change could kill 300 000 people worldwide annually [11]. Human migrations in response to climate change may make people more vulnerable to some vector borne zoonotic diseases [12]. Developing countries like Bangladesh, India, Madagascar, Nepal, Mozambique, Vietnam, Philippines, Sudan, Malawi, Zimbabwe, Turkey and Thailand are more vulnerable for climate change because of poverty, lesser capacity to adapt and lack of strong preventive measures, resources and strategies [13].

Nepal is already under considerable environmental stress and it is the seventh country ranked for climate change impact in the world [14]. Climate change will exert additional stress to the ecological and the social system and has the potential to produce major challenges for human health in Nepal. Nepal's emission level is among lowest in the world measuring only 0.025% of global greenhouse gases (GHG) emissions; however, this ratio is increasing over time. From the last couple of years, Nepal has been experiencing flooding, landslides, droughts and variability in the occurrence of the regular course of monsoon. Flooding of the Kosi River of Nepal in monsoon, over the past two years has displaced millions in Nepal. On the other hand, a weakened and irregular monsoon is causing drought threatening

thousands of farmers. Most of the big rivers of Nepal are glacier fed and its main resources of water hydroelectricity will be seriously affected due to the ongoing changes in glacier reserves, snowfall and natural hazards [15]. Nepal's temperature has increased by 1.8 degree centigrade during last four decades and the average temperature increase was recorded as 0.06 degree centigrade per year and that was in Terai region and Himalayas was 0.04 and 0.08 degree centigrade per year respectively [16,17].

The climate change and its rapid emergence in the past decades is together with health inequality and infectious diseases a major challenge to public health in Nepal [10]. It is likely to influence mortality and morbidity due to vector borne and zoonotic diseases, water borne diseases, flooding and accidents/injuries, cardiovascular diseases, and malnutrition which is increasing in Nepal every day [10].The objective of this paper is to review possible health impact of climate change in Nepal.

Methods

Literature search, national and international report analysis like IPCC reports, WHO reports, national statistics, and annual reports of Department of Health Services Nepal, and other documentation search and analysis were used as methods for this paper.

An in depth literature search was done using the electronic data base Pubmed/MEDLINE employing MeSH database keywords as follows: Climate change, Disaster, Nepal, Nepal and Climate Change, Climate change and health, Health, Health impact, Malnutrition, Vulnerability. The papers and reports had to be written in English language and time period of 2001 and 2015 was searched.

Results and Discussions

Table 1 presents results of literature search.

Keyword or combination of keywords	No. of papers	Limits of search
Climate change	231	Last 10 years, human, review type, English language
Disaster	4	No limits
Nepal	3569	No limits
Nepal	22	Last 10 years, Humans, Meta-Analysis, Journal Article, English language , Systematic reviews
Nepal and Climate change	4	No limits
Nepal and Climate change	0	Last 10 years, human, review type, English language
Climate change and health	67	Last 10 years, human, review type, English language
Climate change and health	504	No limits
Health	228	No limits
Health Impact	3	No limits
Malnutrition	5	Last 10 year, human, review type and English language
Vulnerability	2	No limits

Table 1: Summary of the literature search.

In addition the report, documentation and other type of information search yielded resources summarized in Table 2.

Documents used	No of documents/papers	Limits of search
IPCC report	2	Last 10 years , published , English language
WHO report	2	Last four years , published , English language
UN Report	1	Last one year, published, English language
Department of Health services/Annual report	1	Last two years published and English language
Centre Bureau of Statistics Nepal	1	Last two years published English language
MoHP	1	Last 10 years published English language
DoHS	1	Last three years published English language
MoFA Denmark DANIDA	1	Last two years published in English

Daily national news paper	1	Published in 2010 from Nepal , English language
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Table 2: Summary of published reports.

Based on literature search it can be concluded that there is no scientific information upon health impacts of climate change in Nepal. However, there is enough data on health impact of climate change in general and adding knowledge of Nepal environment and population allows us to discuss potential health impacts of climate change in Nepal.

Over the last few decades, Nepal has been experiencing a warming temperature at 0.6°C due to which people specifically at Terai region of Nepal are being affected in summer season. There are lack of studies on the heat exposure and its effects on different working groups of people who are more exposed to sunlight [18]. It could be estimated that thousands of people are affected by climate change in Nepal. Nepal was highly affected in 1993 due to flooding, landslides and storm; about 1300 people died, 163 injured, 25400 livestock killed, 17100 houses were destroyed, 5500 hectare of land was affected and the properties equivalent with 51.5 million of EURO were lost [19]. The major

disaster induced health impacts are shown in Table 3. The risks of flooding and landslides, storm and heat wave due to climate change are increasing every year. The monsoon in 2009 caused floods and landslides affecting 14 districts out of 75 districts of Nepal and the disaster claimed 78 rivers affecting more than 175 000 people and 29 000 families while 15 000 people and 2 800 families were displaced [19]. About 20% of population especially from western part of the Nepal is affected by heat wave problem like diarrhea, dysentery, high fever and typhoid fever. To a large extent, public health depends on safe drinking water, sufficient food, secure shelter, and good social conditions. A changing climate is likely to affect all of these conditions and causes health problems [2]. Twenty-four glacial lakes are forecasted to cause possible outburst of flooding which as a major concern of Nepal; about 10 000 people are at risk due to glacial lakes are threatening to burst their banks. The potential health impacts of climate change in Nepal could be divided into two groups.

SN	Events	Deaths	Injuries	People affected	Livestock deaths	Remarks
1	Drought	1	NA	1512	NA	
2	Earth quake	873*	6842	4539	2257	*721 lives died in 1988
3	Epidemic	15,843*	37,773	323,896	78	*640 deaths in 1992
4	Fire	1,081	735	218,128	113,922	
5	Flood	2,864	349	3,315,781*	31,117	*257785 affected in 2009
6	Forest Fire	24	13	10718	1698	
7	Land slide	3899	1188	480069	9046	
8	Other	2388	2670	360725	79,935	
	Total	27,299	49,570	4,973613	236,459	

Table 3: Major natural disasters in Nepal and their impact on human health between 1983 and 2009.

Direct effects like; illness and death due to thermal extreme and injuries resulting from floods and storms, increased sensitivity to and vector borne diseases i.e., malaria, kala-azar, Japanese encephalitis, leishmaniasis etc.,

Indirect effects like; water borne diseases i.e. diarrhea, cholera etc., malnutrition, and air borne diseases i.e. pulmonary tuberculosis, pneumonia, viral influenza etc., [20].

As of direct effects climate change is contributing to National burden of vector borne diseases like; malaria, kala-azar, lymphatic filariasis, Japanese encephalitis and more recently dengue fever [21] due to flooding and excessive rising of heat because of ineffective land use and settlement regulations [22]. The poor, uneducated, and unemployed people are compelled to make a living by settling in flooding and land slide prone areas in the hilly region of Nepal as well as plain and urban areas which are now became more vulnerable to disasters due to climate change. The estimated deaths were 114 and affected families were 18,300 due to the natural disaster in the year

2006/07; similarly the total property loss was US \$ 3.92 million [23]. A study about the climate change and heat stress in Terai region of Nepal showed that the heat stress syndromes like faint, tension, irritation, laziness, loss of sleep, appetite loss, urinary tract infection, unconsciousness, hypertension, typhoid, diarrhea, rash, boils and malaria are seen due to the climate changes [18]. It is well known that malaria is influenced by climatic factors such as temperature, precipitation and relative humidity. There are 22 high risk districts having 8.9 million people at risk of malaria. The considerable clinical malaria cases were 49550 within a 65 districts out of total 75 districts of Nepal and the total 2092 cases were detected as malaria positive during 2012/13 [27]. Eighty percent of malaria patients were age group of 15 years and the 70% of malaria cases were seen in hard core forested, foot Hills, inner Terai and Hills valley areas of Nepal. The trends of malaria positive cases are different and the prevalence is decreasing since 2004 and the data was 6,365 malaria cases in 2004, 4557 cases in 2005, 5691 cases in the year 2006, 5293 cases in 2007 and 4574 cases in the years of 2008 [25]. Estimated Japanese encephalitis cases of Nepal is between

1000-3000 and 200-400 patients already died; more than 50% of cases are children and the case fatality rate is 20%. The kala-azar also endemic in Nepal with 12 districts out of total 75 districts of Nepal and more than 5.6 million people are at risk and the case fatality rate is 1.7%.

Concerning indirect effects rising temperatures and variable precipitation are likely to decrease the production of staple foods in Nepal and further increase the risks of malnutrition (IPCC 2007). Malnutrition further increases the vulnerability to infectious diseases, water borne diseases and vector & rodent borne diseases. The fast-growing cultivars have less time to absorb micronutrients from the soil, so they might provide people with sufficient calories but leave them vulnerable to vitamin and mineral deficiencies and it leads to malnutrition and others nutritional deficiencies diseases [11]. According to data of the Ministry of Health of Nepal about 47% of children below five years of age being underweight; 54% of them being stunted (less height as per age), and 7% being wasted (thin for height) [26]. The Nepal Demographic Health Survey 2011 also reports 29% of children were under weight, 41% stunted and 11% wasted [26]. The country is susceptible to disasters, including flash flood, *glacial lake outburst flood* (GLOF) and melting snow in the mountains and droughts and inundation in the Terai/Plain region.

The variability of potential health impact is large for Nepal; lack of primary, purpose based data collected with sound epidemiological methodology hinders precise estimation of health impacts of climate change on population of Nepal. A major consequence of this could be in-proper emergency and adaptation planning to mitigate the potential impacts. Epidemiology based public health research needs to be supported to get necessary and valid information [27,28].

Conclusions

The impacts of climate on human health will not be evenly distributed around the world. Developing countries are more vulnerable since the lack of preventive ways and effective policy, lack of knowledge about climate change threats etc. Nepal is facing huge climate change problems due to excessive increase of heat and natural disaster like, flooding, landslides, and vector borne diseases. Both direct and indirect effect on health could be expected further enhanced with social and environmental differences within the country and lack of preparedness of the health system to adapt. More researches based on the quantitative and qualitative measurements of health impacts of climate change on human health are needed to identify most important impacts and priorities for action.

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