Climate change and health Country Report- Nepal

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Capacity Strengthening in the Least Developed Countries (LDCs) for Adaptation to Climate Change (CLACC) Working Paper

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Executive Summary

The temperature is also rising in Nepal and Kathmandu valley and it will rise in the coming years due to increasing number of population, vehicles, development activities and change in agricultural pattern. There is an increasing trend of vector and water-borne diseases in the country. It appears that there is a strong relationship between temperature and precipitation, and vector and water-borne diseases. Increased disasters, particularly from floods related to glacier melt, would have a direct impact on health. It is already evident that Malaria, Kalazaar and Japanese encephalitis and other water borne diseases such as Typhoid and Cholera has been commonly seen in different parts of the country. Mostly the poor and disadvantaged groups are the one who suffer the most from these consequences and the health impact will be experienced across all sector and region. In recent years climate change has not been in the priority area of the government. It is recommended that the government should have clear sectoral policy to tackle with increasing climatic and environmental impacts. It is necessary to highlight climate change risks and adaptation measures in the government five year plan and poverty reduction strategy. More research and studies are needed to fill the existing information and knowledge gap and to identify key vulnerable areas, communities and sector for integrated planning and implementation. The National Adaptation Programme of Action (NAPA) must be started soon so that priority area and project can be identified and funding could be explored. It is also necessary to have integrated approach for health planning and research in different climatic regions in the country.

Chapter One: Introduction

Background

There is now widespread consensus that the Earth is warming at an unprecedented rate and it is likely to accelerate in the decades to come. All aspects of regional weather, climate and sea level will be altered by climate change. There are risks associated with these changes and there are strategies to minimize such risks. These elements of the problem of climate change are neither accurately quantifiable (scientific uncertainty will remain) nor easily achievable (negotiations over policy will be complex).

The over stresses on the climate system are already causing impacts on Earth's surface. These include not only rising temperatures, but also increasingly frequent floods and droughts, and changes in the natural ecosystems. The ecological and socio-economic damage of climate change in the region will have disastrous consequences, cause social unrest and environmental refuges. Economic development in the region, which is currently growing rather rapidly, appears unlikely to benefit over 60% of the population in this region due to poor adaptive capacity. For each 1°C increase in night time temperature, the decline in rice yield would be about 6 to 10% on an average in the South Asian countries. A significant risk was identified on the time scale of 2030-2050 for a warming of about 2.6°C with –20% precipitation changes. The risks of flooding will considerably increase in the main river basins of India, Bangladesh and Nepal. In Bangladesh, a rapid shift in extent and depth of flooding will occur in case of a rise in global mean temperatures of 2.6°C above pre industrial. Sea level rise will cause severe damages to ecosystems, agriculture and water resources especially in the coastal regions of Bangladesh and India. Widespread deglaciation in the Himalayas is likely to adversely impact the hydrological regime of the region.

Climate change is also a major challenge to Nepal. Although Nepal has a negligible share in the global emission, Nepal's major natural resources, biodiversity and water, are the forefront of climate vulnerability. It is expected that the increase in temperature would affect the snowline and disturb the discharge routine leading to extreme flooding and water availability. The formation of glacier lakes and the potentiality of deglaciation and its impact in the downstream community is really severe. For the last 3 years, the rainfall intensify has been very low compared to last 3 decades. Kathmandu saw only 71 millimeters of rainfall in the first two weeks of August, way below the average of 319.6 millimeters for this month. The weak monsoon has followed one of the driest winter spells faced by the country in some three decades, severely affecting agriculture and power generation.

There are strong evidences that climate change could affect human health. The effects can be direct such as through increased heat stress, and loss of life in floods and storms, or indirect through changes in the ranges of disease vectors such as mosquitoes, water-borne pathogens and water and air quality, as well as food availability and quality. Health authorities have already expressed their concern about climate change and its impact on human health. There has been recent call for national action by all countries to reduce and prevent as far as possible these environmental changes and limit the exposures of human populations to climate change and increased ultraviolet irradiation, thus addressing the likely health risks over the coming decades.

Extreme climate events are expected to become more frequent as a result of climate change in Nepal. Climate extremes can have devastating effects on human health and societies. In Nepal, the historical information reveals that disasters, famines and disease outbreaks have

been triggered by droughts and floods. Malaria, Kalazaar, arboviral diseases are common in Nepal. Scientists and health experts have predicted that these diseases are occurred due to climate change.

There are complex relationships between human health and water quality, water quantity, sanitation and hygiene. Changes in surface water quality and quantity are likely to affect the incidence of diarrhoeal diseases. This group of diseases includes conditions caused by bacteria such as cholera and typhoid. Infections with cholera and typhoid bacteria are dependent on the concentration of the pathogens in water or food. The IPCC concluded that changes in environmental temperature and precipitation could become more frequent in many part of south Asian countries and as a result could lead to outbreak of many water borne diseases.

Review of Literatures

Climate change: trends, scenarios, and key vulnerabilities

Fossil fuels when burnt generate 'greenhouse gases' (GHGs), which are building up in the atmosphere. Accumulation of GHGs has caused the earth's temperature to rise, and changing our climate, with very dangerous consequences. This phenomenon is often termed "Global Warming", but may lead to cooling in some parts of the globe, and is therefore more accurately termed 'climate change'.

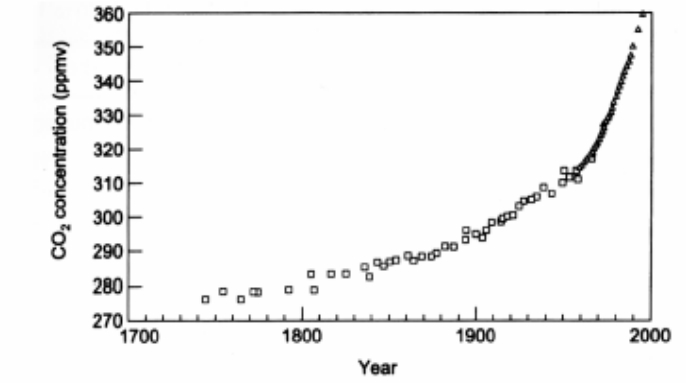


Fig. 1: Atmospheric CO2 Concentrations since Mid-18th Century

Plants and animals exchange carbon dioxide (CO_2) with the atmosphere in a carbon cycle that has remained in balance for the last 10,000 years. However, since the industrial revolution of the mid-eighteenth century, human activities have disturbed this balance mainly through burning fossil fuels (oil, coal, gas and wood) which produces CO_2 and the intensive rearing of cattle and high scale plantation of rice which produces methane. CO_2 concentration in the atmosphere has increased by about 30% in the last 200 years, from less than 280 parts per million ppm to 368 ppm today (Fig. 1). If current trend in fossil fuel burning continues, atmospheric CO_2 will be twice the pre-industrial level by 2030, and three times the figure by 2100.

Although the amount of GHG emission in Nepal is insignificant, there are clear indications on the impacts of climate change in the Nepal Himalayas, particularly snow melting and increase in the size of glacier lakes. For example, no lake was noticed in Barun area in the 1964 topographic survey. A small glacier lake of only 0.0245 square kilometer (km2) was observed in 1995 and but size had increased to 0.78 km2 by 1997. Expansion in the size of Tsho Rolpa

Glacier Lake is also obvious. A glacier lake assessment study clearly indicated that its size had increased from only 0.23 km2 in 1957-1959 to 1.02 km2 in 1979 and to 1.65 km2 in 1997 (MoPE).

Temperature, an important element of climate change, has risen for the last few decades in the world. The global average temperature has risen by almost 0.7°C over the last century, very probably as a result of human activity. The 1990s were the warmest decade, and the 1900s the warmest century of the last 1000 years (Fig. 2). According to the Intergovernmental Panel on Climate Change (IPCC), global temperature will rise to 1-3.5°C by the year 2100 (IPCC, 1996). Even if greenhouse gas emissions were stabilized today, atmospheric temperature would continue to rise because of the long life time of greenhouse gases.

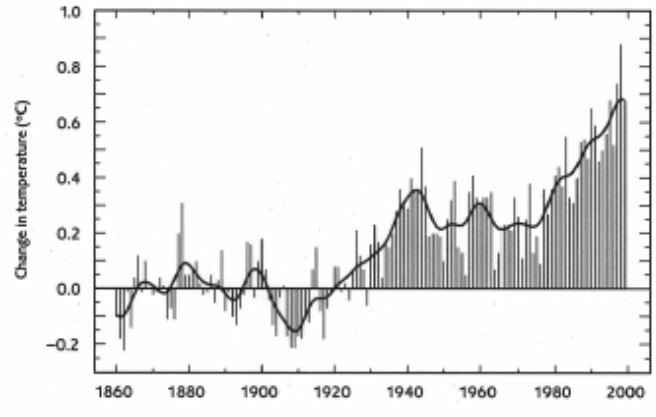


Fig. 2: Global Temperature, 1860-1999

a. Climate trends

Temperature observations in Nepal from 1977-1994 show a general warming trend (Shrestha et al. 1999). The temperature differences are most pronounced during the dry winter season, and least during the height of the monsoon. There is also significantly greater warming at higher elevations in the northern part of the country than at lower elevations in the south. This finding is reinforced by observations by Liu and Chen (2000) on the other side of the Himalayas on the Tibetan Plateau. Significant glacier retreat as well as significant real expansion of several glacial lakes has also been documented in recent decades, with an extremely high likelihood that such impacts are linked to rising temperatures.

The US Country Study of Nepal (USCSP, 1997) used records from 22 stations from the 1971-1990. The temperature differences are most pronounced during the dry winter season, and least during the height of the monsoon. Regarding spatial variation, temperatures will increase faster at higher altitudes than at lower altitudes. The study reported, "Jumla" with elevation of 2300 m shows the highest value of temperature change whereas the station over the southern plain region like Biratnagar, Janakpur with the altitude of around 80 m shows the lowest value of temperature change." This indicates that, in general, greater warming may be expected in the northern mountainous parts of the country.

The annual average precipitation in Nepal is 1,907 mm, with 80% of it falling during the monsoon season from June to September. Studies project that annual precipitation will increase significantly if CO_2 doubles; it will likely become drier during the dry season, with a significantly wetter monsoon season (as much as three times the current rainfall). It should be noted that the level of certainty for precipitation projections is less than for temperature. The

distribution of rainfall throughout the year is a reliable factor in determining the risk of floods. This pattern of precipitation would likely cause droughts during the winter months and floods during the monsoon. There are no definitive trends in aggregate precipitation, although there are some evidences of more intense precipitation events. A somewhat clearer picture emerges in stream flow patterns in certain rivers where there has been an increase in the number of flood days. Some rivers are also exhibiting a trend towards a reduction in dependable flows in the dry season, which has implications both for water supply and energy generation (Shakya 2003). Glacier retreat also contributes significantly to stream flow variability in the spring and summer, while glacial lake outbursts which are becoming more likely with rising temperatures, and is an additional source of flooding risk (Shardul et al, 2003).

There is a significant and consistent increase in temperatures projected for Nepal for the years 2030, 2050 and 2100 across the various climate models (Table 3). The overall temperature is found to be rising at the rate of 0.41% per decade. Increases in temperatures are somewhat larger for the winter months than the summer months. Climate models also project an overall increase in annual precipitation. However, given the high standard deviation the results for annual precipitation should be interpreted with caution. Even more speculative is the slight increase in winter precipitation. The signal however is somewhat more pronounced for the increase in precipitation during the summer monsoon months (June, July and August). This is because models estimate that air over land will warm more than air over oceans, leading to an amplification of the summer low-pressure system that is responsible for the monsoon. These results are broadly consistent, though more pronounced than the Country Study for Nepal that was based on outputs from four older generation GCMs, only two of which simulated the summer monsoon and its intensification under the carbon dioxide doubling (Yogacharya and Shrestha 1997).

Thus based on this analysis there is reasonably high confidence that the warming trend already observed in recent decades will continue through the 21st century. There is also moderate confidence that the summer monsoon might intensify, thereby increasing the risk of flooding and landslides.

Table 3. GCM estimates of temperature and precipitation changes for Nepal, OECD, 2003

Year	Temperature Change (^{0}C) Mean (standard deviation)			Precipitation change (%) Mean (standard deviation)		
	Annual	DJF	JJA	Annual	DJF	JJA
Baseline Average				1433 mm	73 mm	894 mm
2030	1.2 (0.27)	1.3 (0.40)	1.1 (0.20)	5.0 (3.85)	0.8 (9.95)	9.1 (7.11)
2050	1.7 (0.39)	1.8 (0.58)	1.6 (0.29)	7.3 (5.56	1.2 (14.37)	13.1 (10.28)
2100	3.0 (0.67)	3.2 (1.00)	2.9 (0.51)	2.6 (9.67)	2.1 (25.02)	122.9 (17.89)

b. Impact of extreme weather events

Extreme climate events are expected to become more frequent as a result of climate change in Nepal. Climate extremes can have devastating effects on human health and societies. In Nepal, the historical information reveals that disasters, famines and disease outbreaks have been triggered by droughts and floods. From 1954 to 2002, floods have affected over a million people in Nepal. As shown in the table below, floods killed 5,003 people (24% of deaths from all disasters), left almost 70,000 homeless (45%), and caused damages amounting to US$990,613 (75%). Floods, and other climate-related disasters such as drought, extreme temperatures, and windstorms, may occur with greater frequency or intensity in the future. Heavy rains often trigger devastating landslides, which are another huge concern for Nepal. Disasters severely disrupt livelihoods and community development, whether they are flashfloods or slower onset events, such as drought. In fact, droughts can affect a greater number of people, and often the event does not bring assistance until it is very late. By that point, many families may have sold off their productive assets, and they are left in a precarious state

Table 4. Damages caused by disasters.

	Killed	**Injured**	**Homeless**	**Affected**	**Damage US $**
All disasters	20,927	7,794	153,550	7,053,754	1,316,413
Floods	5,003	725	69,350	1,531,125	990,613
Drought	0	0	0	4,400,000	1,000
Extreme Tem	60	210		210	
Windstorms	97	19	0	184	3600
Climate related	5160	954	69,350	5,931,519	1,004,213
As a% of all disasters	24.7%	12.2%	45.2%	84.1%	76.3%

c. Vulnerability and Adaptation

Vulnerability is a subjective concept that includes three dimensions: exposure, sensitivity, and adaptive capacity of the affected system (Smit et al. 2001). The sensitivity and adaptive capacity of the affected system in particular depend on a range of socio-economic characteristics of the system. Several measures of social well-being such as income and income inequality, nutritional status, access to lifelines such as insurance and social security, and so on can affect baseline vulnerability to a range of climatic risks. Other factors meanwhile might be risk specific – for example proportion of rainfed (as opposed to irrigated) agriculture might only be relevant for assessing vulnerability to drought. There are no universally accepted, objective means for "measuring" vulnerability (Shardul et al, 2003).

A score of high, medium, or low for each factor is then assigned for each assessed sector. In ranking the risks from climate change, the scoring for all four factors was considered, but the most weight was placed on the certainty of impact. Impacts that are most certain, most severe, and most likely to become severe in the first half of the 21st century are ranked the highest. The results of this analysis are summarized in Table 5. Among the sector, health is also one of the most critical area which is mostly likely be affected in the years to come.

Table 5. Priority ranking of climate change impacts for Nepal: Source (OECD, 2003)

Resource/ranking of impact	Certainty of impact	Timing of impact (urgency)	Severity of impact	Importance resource

Water resources and Hydropower	High	High	High	High
Agriculture	Medium-low	Medium-low	Medium	High
Human health	**Low**	**Medium**	**Uncertain**	**High**
Ecosystems/Biodiversity	Low	Uncertain	Uncertain	Medium-high

Climate, weather and the current burden of climate sensitive diseases

Diarrhoeal diseases are still a major challenge in Nepal because of inadequate safe water supply, poor sanitation and living conditions. A yearly minimum death of 30,000 and morbidity of 3.3 episodes per child was estimated due to diarrhoea. Typhoid fever is estimated to have caused 21.6 million illnesses and 216,500 deaths globally in 2000 affecting all age groups.

Humans are the only natural hosts and reservoirs. It is spread by faecal-oral transmission. The bacterium can survive for days in groundwater, pond water and seawater and for months in contaminated eggs and frozen oysters. The infectious dose is between 1000 to 1 million bacilli given orally. The infection is transmitted by ingestion of food and water contaminated with feces. Established risk factors include contaminated water supply, eating ice cream, flavored iced drink or food from street vendors, raw fruits and vegetables grown in fields fertilized with sewage. Traditionally, typhoid is believed to be the disease of monsoon seasons. The case fatality rate for typhoid without treatment and with treatment is 15% and 1% respectively.

Objectives of case study

The main objective of the study is to carry out research and analysis on adaptation to climate change for vulnerable communities, with emphasis on health and livelihoods in a selected vulnerable community. Specifically the study aims to:

- Briefly describe current state of knowledge about the likely impacts of climate change in Nepal, particularly the changes in temperature, rainfall, and the risk of flood and drought events.
- Review linkages between climate and health
- Identify key potential future impacts of climate change on health.
- Describe the groups most vulnerable to the health impacts of climate change.
- Identify some response options (adaptation options).

Process

a. Desk review

Secondary literatures were the principle sources of review. The journal articles, published books and papers (seminar/workshop proceedings), institutional reports, papers, articles, books and other publication materials were reviewed.

b. Consultation with key stakeholders

Various stakeholders working in climate change were consulted through series of meeting including government agencies. Government officials including the IPCC national focal point were consulted to inform them about the study.

c. E-mail and internet based search

The review used e-mail and Internet as source of information. Due to time and availability of some of the key expert people, e-mail was observed to be the best option.

d. Stakeholder Workshop

One day stakeholder workshop was organized to share the findings of the case study as well as get feedback and suggestion from participants. This workshop was also used as venue to be aware about the activities carried out by various partner institutions on climate change and adaptation in particular.

Data and methods

Typhoid data

Kathmandu (population > 1.5 million), the largest city in Nepal, is situated at an altitude of 1,300 meters. The climate varies from cool, dry winters (December to February), to the hot monsoon season (June to September). Traditionally, the monsoon season is characterized by a heavy burden of enteric infections, while respiratory tract infections are more predominant in winter. Patan Hospital is one of three large general hospitals within the Kathmandu metropolitan area. It has 251 beds and provides inpatient and outpatient medical, surgical, pediatric, obstetrics, and gynecology services, and serves as a primary care facility. Each year Patan Hospital has approximately 250,000 outpatient visits, 30,000 Emergency Department visits, and 15,000 admissions. Bed occupancy for medical wards runs at almost 100%, and approximately 90% of the patients are resident in the immediate Kathmandu Valley area (Bagmati Zone).

We obtained data on cases of laboratory confirmed episodes of Typhoid fever from 1997 to 2005. This includes both inpatient and outpatient data. The data were retrieved from Microbiology Laboratory where all the blood cultures from both in-patients and outpatients are collected and cultured.

Weather data

We obtained meteorological data for Kathmandu Valley from Department of Meteorology and hydrology, Nepal Government, Barbarmahal Kathmandu, Nepal. The data are from Khumaltaar meteorological station.

Chapter Two: Health Related Issues in Context of Nepal

One of the indirect consequences of global warming in mountain regions is increasing risk of infectious diseases. Scientists have reported that the mosquitoes that carry malaria, dengue and yellow fever are spreading to higher altitudes as temperatures warm. Mountain people are among the world's poorest citizens. With few resources to ward off infectious diseases, they are likely to be among global warming's greatest victims if human activities that contribute to climate change are not soon reversed (FAO).

Human health is arguably the most complex of the major types of global change impacts on societies. Global change in climate has been one of the major causes of health related problems in the least developing countries. WWF has published that there is reliable evidence that correlates climate change with health. It has been quoted that an increase in malaria has been attributed to climate change. Water is the breeding ground for mosquitoes and warmer temperature mean these disease carrying pests will breed in previously cool areas. Outbreaks of Kalaazar and Japanese encephalitis are also linked to climate change in the Nepal's subtropical and hot regions. Similarly, flooding and water contamination will lead to heightened risk of water-borne diseases. Contagious outbreaks are more pronounced after floods that disrupt sewage systems.

Because of the poor state of health services in Nepal, public health can indeed be at higher risks than before from unfavorable effects of Climate Change. Malaria and Japanese Encephalitis are the two most common vector-borne diseases in the country, mosquito being the vector of these diseases.

Increased disasters, particularly floods related to glacier melt, would directly impact on human health. Diseases such as malaria and Japanese encephalitis may also increase their impact through expanding to new regions. One area that would be at risk of an increase in disease is the lower flat pain of Nepal, the Terai region, which is warmer than the mountain regions. The current lack of primary healthcare for large portions of the population also contributes to their vulnerability (Raut, 2004).

Impacts of Climate Change on Human Health

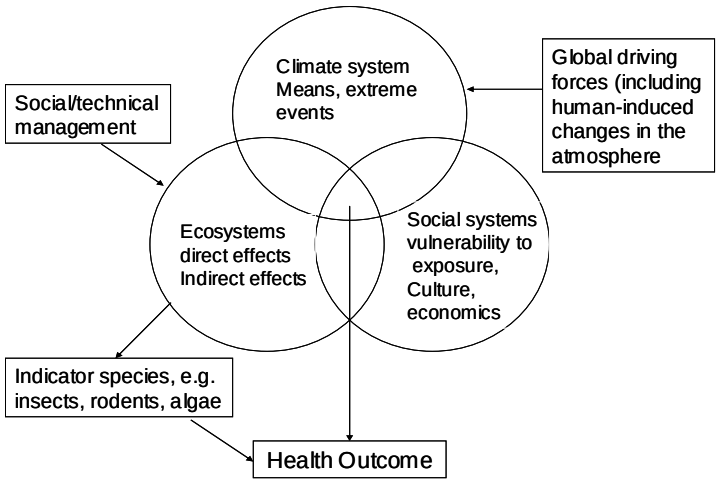


Fig 3: Impacts of Bio-geophysical Systems on Human Health

Environmental epidemiology involves comparing the health differences among the groups of people, exposures to environmental conditions, including climate. Figure 3 describes the major components of the process of climate change that are related to change in human health.

Interactive Pathways for the Climate Change and Health

The range of possible impacts of climate change is categorized into two types, such as direct and indirect, which are shown in figures 4 and 5.

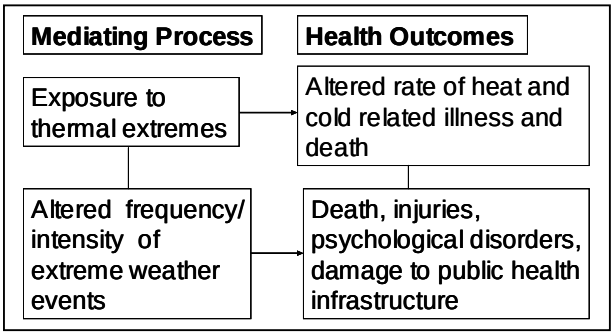


Fig. 4: Direct Possible Health Impacts of Climatic Change

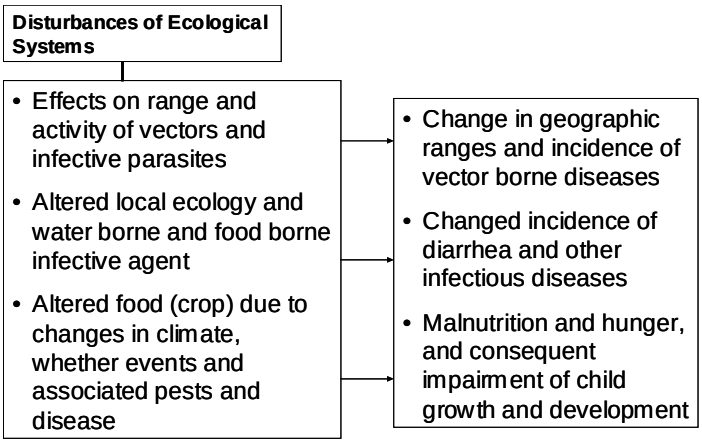


Fig. 5: Indirect Possible Health Impacts of Climatic Change

Table 1 indicates that different health outcomes are observed and each outcome can be relatively assessed in terms of climate change. In this context vector borne and non vector borne diseases can be considered important though they have shown medium to small relative effects of climate change respectively.

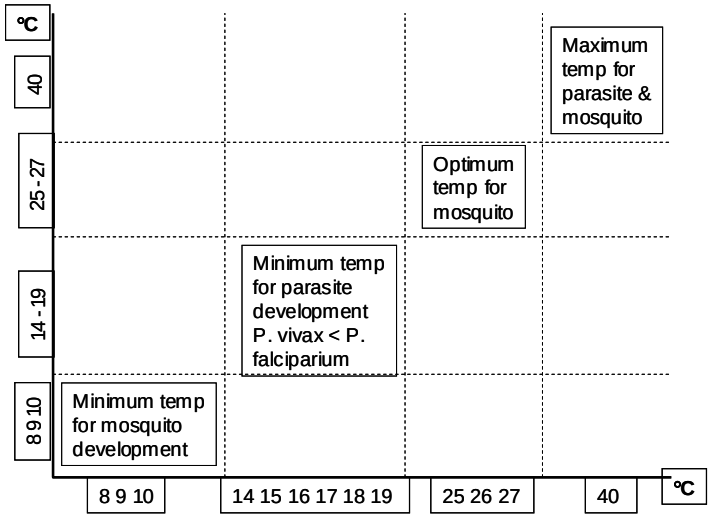
Table 1: Likely Relative Impacts on Health of the Climate Change Components

Health outcome	Aspects of climate change			
	Change in mean temp	Extreme events	Climate change variation	Day night difference
Heat-related deaths and illness		+++		+
Physical and psychological trauma		++++		
Vector borne infectious diseases	+++	++	+	
Non vector borne infectious diseases	+	+	++	
Food availability and hunger	++	+	+	
Consequences of sea level rise	++	++		

Respiratory effects – air pollutant	+	++		+
Population displacement	++	+	+	

Source: WHO/WMO (1996): pp 13.
Note: Number of + indicates the magnitude of effects; empty cells indicate no known relationship

Climate Change and Diseases in Nepal



Epidemiology (°C)

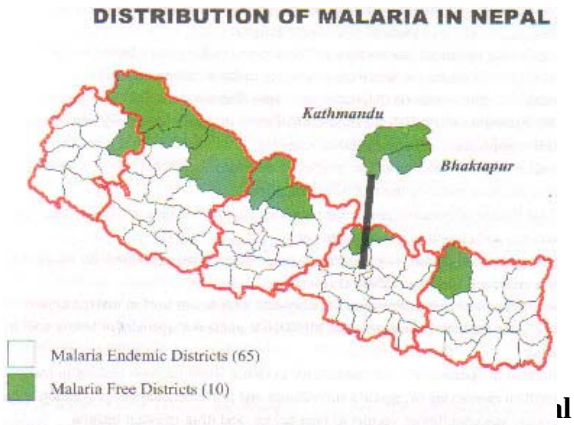
The climate related diseases in the context of Nepal are vector borne (malaria and leishmaniasis) and non vector borne diseases like Typhoid as case study of Patan Hospital.

The rate of development of the pathogen in the vector or in the environment also depends on the temperature (Fig. 6).

Fig. 6: Critical Temperature in Malaria

Mosquito: Malaria Parasite

Mosquito has four distinct stages such as egg, larva, pupa, and adult. The common groups of mosquitoes are *Aedes, Anopheles, Culex,* and *Culiseta* an average time for life cycle 10-14 days. A poor drainage condition has been favorable environment for mosquito breeding.



The general trend of Malaria positive cases was found increasing during the period 1963 to 1985, and then decreased due to mitigation measures taken (Figure below). Central Nepal recorded the highest number of Malaria positive cases, whereas the Mid-Western Nepal had the least reported cases. Malaria positive cases are normally found maximum during wet summers (Figure 5.15). Malaria positive cases are reported, when the average annual temperature is between 14 and 27º C, with the highest number of cases at 24-25º C in the tropical zone. Malaria cases are also found in the subtropical (18-24º C) and warm temperate (14-18º C) regions of Nepal. Obviously rise in temperature due to Climate Change will increase the Malaria cases; particularly subtropical and warm temperate regions of Nepal will be more conducive to the diseases. Temperatures between 22 and 32º C are very favorable for Malaria diseases to develop and complete their cycle, while those above 32-34º C could reduce their survival rates substantially. Thus the range of temperatures in Nepal is suitable for the Malaria

parasites to exist & develop. Climate variability does affect the transmission of these diseases and they are likely to be affected by climate change, but other factors are also important.

This disease is endemic in 65 districts of Nepal. The disease decreased abruptly after malaria eradication program in 1958. Later the name of the program has changed into malaria control program in 1978. The most common species of malaria parasite occurring in Nepal is *Plasmodium vivax.* Another comparatively more harmful species is *P. falciparum*. The increasing trend of this parasite is observed which may be due to the climate change (Fig.8). This fact is justified by the study done in Pakistan (Fig. 9). The common vector (definitive host) for the disease is *Anopheles minimus*.

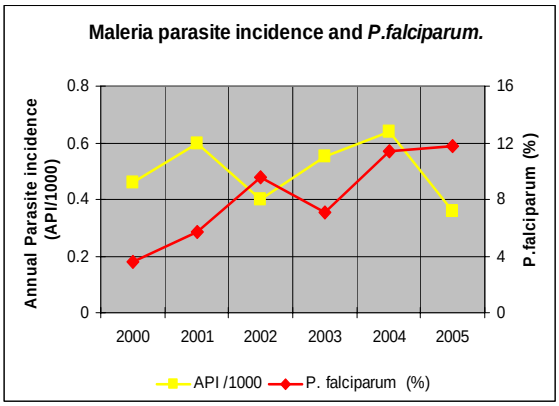


Fig. 8: Malaria Parasite incidence

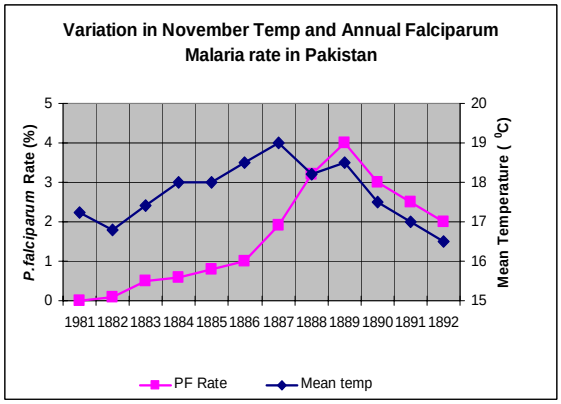


Fig. 9: Variation in Temperature and Malaria

Kala-Azar - Visceral Leishmaniasis

It is an endemic disease in 12 districts of Nepal. The trend of the incidence of disease is decreasing may be due to the use of regular pesticide spray α Cypermethrin with 0.025g/m^2 (Table 4). The long term consequences of the pesticide are not known. There is not much change in case fatality rate. However, this trend is becoming more pronounced in the recent years. Kala-azar reached epidemic form in eastern and central regions of Nepal especially in the Terai districts. Most vulnerable are the poor people and rural cattle keepers. This disease occurs mainly in the summer season when the vector is very active and gets optimum environment for breeding. Previously, Kala-azar was found only in the eastern and central Terai regions of the kingdom, but in 1998, cases were recorded in other non-indigenous districts as well.

Table 4: **Trend of Kala-azar**

Year	Incidence/100,000	CFR/100
2002	19.9	1.4
2003	24.6	0.8
2004	11.1	0.9

The common trend of the vector borne diseases in Nepal is decreased (Fig10)

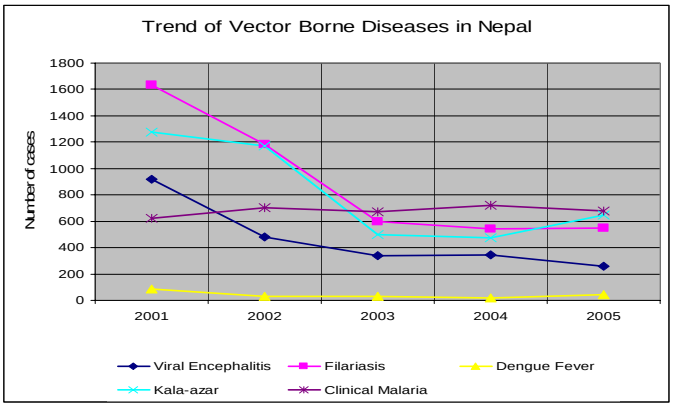


Fig. 10: Trend of the vector borne diseases in Nepal

Japanese Encephalitis

Changing climate may be one of the factors for its emergence in new areas. Similarly, the Japanese Encephalitis occurs mainly at the average annual temperature range of 23-26ºC, and increase in temperature will make the subtropical regions more vulnerable to this disease. Vulnerability is becoming serious in Nepal as the number of patients of this disease is increasing every year in the country most probably due to rising trend of temperatures (Figure below).

Chapter 3. Case study on Climate, Weather and Typhoid Cases in Kathmandu, Nepal

Typhoid fever is a systemic infection with the bacterium *Salmonella Typhi.* It was an important cause of morbidity and mortality in the overcrowded and unsanitary urban conditions of 19th century. The provision of clean water supply and good sewage systems led to a dramatic decrease in the incidence of typhoid in these countries. Today the vast burden of disease is encountered in the developing world where sanitary conditions remain poor. Incidence rates of 198 per 10^5 per year in Vietnam have recently been reported and we estimate that the incidence in Kathmandu is considerably higher.

Typhoid fever is estimated to have caused 21.6 million illnesses and 216 500 deaths globally in 2000 affecting all age groups. Humans are only natural hosts and reservoirs. It is spread by feco-oral transmission. The bacterium can survive for days in groundwater, pond water and seawater and for months in contaminated eggs and frozen oysters. The infectious dose is between 1000 to 1 million bacilli given orally. The infection is transmitted by ingestion of food and water contaminated with feces. Established risk factors include contaminated water supply, eating ice cream, flavored iced drink or food from street vendors, raw fruits and vegetables grown in fields fertilized with sewage.

There are preliminary reports of re-emergence of vector borne diseases like malaria, visceral leishmaniasis and encephalitis in areas where they had been eradicated. Scientists are concerned that not only antimicrobial resistance but also global warming and climate changes must have contributed to his phenomena. With this view in mind, we tried to explore if recent trends of climatic changes and rising temperature of the Kathmandu valley has any association with increasing number of culture positive typhoid cases in an urban hospital of the valley. Typhoid fever is considered to occur during summer and monsoon seasons. Typhoid fever has started occurring in winter significantly in recent years.

Typhoid fever – indirect effect of climate

- Systemic infection by *Salmonella typhi*
- 3-4 weeks continuous fever - communicable disease
- Incubation period - usually 10-14 days but it may ranges from 3 (short) 21 days (long) depending upon the dose of the inoculums
- Enteric fever includes both typhoid and paratyphoid
- Nature of spread -sporadically, epidemically & endemically
- Occurs where water supply and sanitation is substandard
- Estimated that 6 million people affected and 600,000 deaths by typhoid

Sources of infection

- Faeces and urine of infected person
- Contaminated water, food, fingers, flies
- Occurs throughout the year
- Peak incidence is reported during July-September (rainy season)
- Survive in water, ice, soil and food, vegetables
- Multiply in food
- Sanitation condition

Factors

- Agent – S. typhi, S. paratyphy – infecting dose and virulence
- Reservoirs of infection – Cases & Carrier
- Carrier: (i) temporary (6-8 weeks), about 4% one year, and (ii) Chronic - Person who excrete bacilli for more than a year (50 years)
- Typhoid Mary >1300 cases in her life time

Epidemiology

Typhoid fever is a systemic bacterial infection caused by *Salmonella typhi*. Typhoid is usually acquired through ingestion of water or food contaminated by the urine or feces of infected carriers and, as such is a common illness in areas where sanitation is poor. Today, outbreaks of typhoid fever occur most often in developing countries, in refugee camps and in overwhelmed areas with a high population density. In some areas the annual incidence is as high as 198 cases per 100,000 and contrary to a previously held view, the disease causes considerable morbidity in children. Worldwide, at least 17 million new cases and up to 600,000 deaths are reported annually. The case-fatality rate of typhoid fever is 10%, but it can be reduced to 1% with appropriate antibiotic treatment (WHO 1996).

Infections with other *Salmonella* bacteria also occur. Paratyphoid fever is also a systemic disease, caused by *Salmonella paratyphi*. Its presenting symptoms are similar to those of typhoid fever, but they are milder and the case-fatality rate is much lower. The other pattern of *Salmonella* infection is primarily enteric (food poisoning) and can occur with exposure to one of hundreds of different *Salmonella* species.

Clinical management

Although in most cases a transient and mild episode of diarrhea develops shortly after ingesting *S.* typhi bacteria, most cases are asymptomatic during an incubation period of 7 – 14 days. The disease manifests most often a week or so after ingestion and begins with an intermittent fever that becomes high and sustained, severe headache, poorly localized abdominal discomfort, malaise and anorexia. There may also be a nonproductive cough. Although the focus of the infection is the intestine, constipation is more common than diarrhea in adults. The reverse is true in AIDS patients and children.

Typhoid fever is diagnosed by means of bacterial culture. Blood culture is usually done and is most sensitive in the first week of illness. Bone marrow culture is more sensitive than blood culture, regardless of the duration of illness or treatment with antibiotics, but it is technically more difficult to perform. Fecal culture yields positive results in only one-third of cases. Serologic testing for *Salmonella* antibodies (Widal's test) is possible but shows cross-reactivity with some other *Salmonella* species and has a sensitivity of only 70%.

Prevention and control

Prevention measures target hand washing, sanitary disposal of human feces, provision of safe public water supplies, controlling of flies, scrupulous food preparation, and pasteurization of milk and other dairy products. In addition, because many seafood beds are contaminated with sewage, attention is given to limiting the collection and marketing of shellfish to approved sources, and to steaming or boiling shellfish for at least 10 minutes.

Immunity is conferred after infection or through vaccination. In either case, it is only temporary. Typhoid fever vaccine can be given orally or parenterally, and the efficacy of, and adverse reactions to, each type differ. Vaccination is often recommended for people traveling to endemic regions, although the cost-effectiveness of this strategy has been questioned. The

effectiveness of mass vaccination in endemic regions is undergoing further study but should be considered in high-risk situations, such as disaster relief sites and refugee camps.

Housefly

The followings are about the description of housefly and associated human diseases:

- Housefly (*Musca domestica*), Lesser housefly (*Fannia canicularis*), Stable fly (*Stomoxys calcitrans*) are the most common flies occurring in homes
- Houseflies go through 4 stages of development, such as egg, larva, pupa and adult
- Entire life cycle can be completed in 7-10 days under ideal conditions; Adult females can lay as many as 2,700 eggs in 30 days but more commonly lay 350-900 in 5 or 6 different batches; adult flies live from 30-60 days during warmer months.
- Generally, the warmer the temperature the faster the flies will develop. In the winter, most of them survive in the larval or pupa stage in some protected warm location.
- They are capable of carrying over 100 pathogens, such as typhoid, cholera, Salmonella, bacillary dysentery, tuberculosis, anthrax ophthalmia, and parasitic worms. Some strains have become immune to common insecticides.
- It carries bacteria on the outside of its body, it regurgitates saliva and deposits wastes on human food.

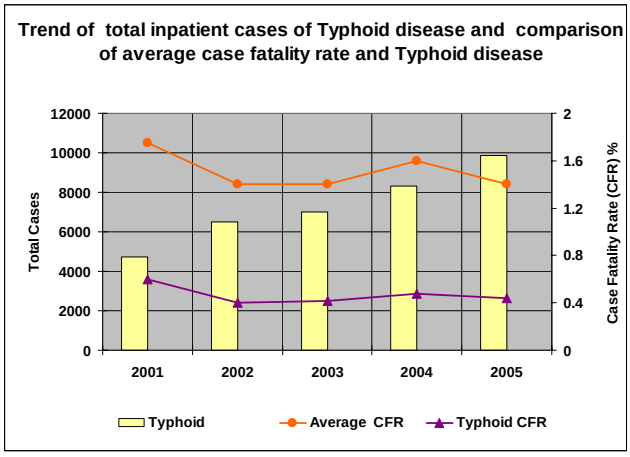


Fig 11. Trend of Typhoid cases

Figure 11 shows that the case of typhoid is in increasing trend but the average case fatality rate shows decreasing trend despite some fluctuations.

The diseases of people in Nepal can also be indicated in terms of access to drinking water sources and sanitation conditions. Table 5 describes the households' accessibility pattern to available drinking water sources. Still slightly below 30 percent households have not accessed to pipe water source, which is considered 'safe' drinking water source. This means they have to depend on other sources, which are relatively less safe because of lack of well protection from the rainy season.

Table 5: **Households' Accessibility Patterns to Drinking Water Sources**

Ecological Region	Total Households	Percent of Total Households					
		Tap/Pipe	Well	Tube Well	Stone spout	Stream	Others
Mountain	285,217	72.2	6.2	0.0	17.1	3.4	1.0
Hill	1,950,345	72.2	12.0	2.4	10.1	2.0	1.2
Terai	1,938,895	30.8	6.5	58.6	1.1	0.6	2.5

The sanitation conditions can be explained in terms of households' access to toilets and sewerage. Table 6 shows that about 54 percent households do not have access to toilets, which mean they use open defecation in open fields, river banks, around ponds and lakes or in the jungle, which eventually mix with the water sources such as river, ponds, and lakes. This becomes serious particularly during the rainy season. Likewise, the sanitation coverage is also very limited, but they are all directly discharged into the rivers and lakes. The waste water is used by the farmers in vegetable gardening. These all cause water borne diseases such as typhoid, diarrhoea, dysentery, hepatitis, and the like.

Table 6: **Households' access to Toilets and Sanitation**

Ecological Region	% toilet coverage	% sewerage coverage
Mountain	40.4	1.0
Hill	55.8	18.7
Terai	37.3	7.4
Nepal	46.1	12.1

Kathmandu Valley

The climate, water sources and human health are explained based on the data available in the Kathmandu Valley. Briefly, the climatic conditions of the valley are characterized by cool winter days, warmer summer days and morning frost in winter days, which is however lessening.

Table 7 indicates that different sources of water consumed by the people of the valley are not free from faecal contamination, though they are safe within WHO guidelines in terms of selected chemical parameters. This is verified by the study of Pradhan (2000). According to this study, not a single drinking water source such as dug well, shallow well, deep well, spring, stone spout, pond and river, and pipe water is 100 percent safe in terms of pathogenic bacterial contamination.

Table 7: **Water Quality Indicators of Different Sources of Kathmandu valley**

Parameter	Water sources				WHO
	Pr_Tap	Pu_Tap	Well	S. spout	GV
pH	6.5-8.2	6.5-7.5	7.5	7.5	6.5-8.5
Iron (mg/l)	ND-0.2	0.2	0.2	0.3	0.3 -3
Chlorine mg/l	ND	ND	ND	ND	0.2
Chloride mg/l	10-30	22-45	26-27	23-45	250
N-NH4 (mg/l)	ND-0.2	0.2	0.2	0.2	0.04-0.4
PO4 – P (mg/l)	0.1	0.1	0.1	0.1	0.4-5.0
Coliform bacteria (source)	+/-	+	+	+	-
Coliform bacteria (consumption point)	+				-
E. coli cfu/100 ml	10-131	3-20	48-200	58	0

Pr_Tap = private tap; Pr_Tap = public tap; S. spout = stone spout; WHO GV = World Health Organisation Guideline Values.

In addition to household use, the water of these different sources is used by the farmers to wash fresh vegetables for marketing. The consumption of such vegetables also causes water borne diseases.

There are data available on the temperature and typhoid cases for the Kathmandu Valley. Figure 12 shows that the cases of typhoid recorded at the hospital are risen from the month of May; reached at peak in July and declined in the following months. This pattern coincides with the rising Celsius in temperature. The months May to June fall in the summer season, during which the monsoon rainfall also occurs.

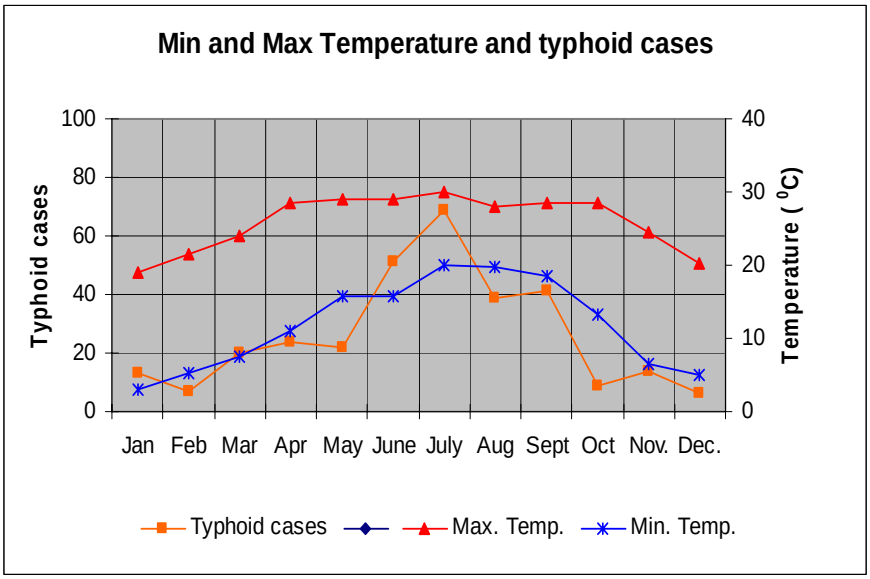


Fig. 12: **Distribution of Temperature and Typhoid Cases by Month, Kathmandu**

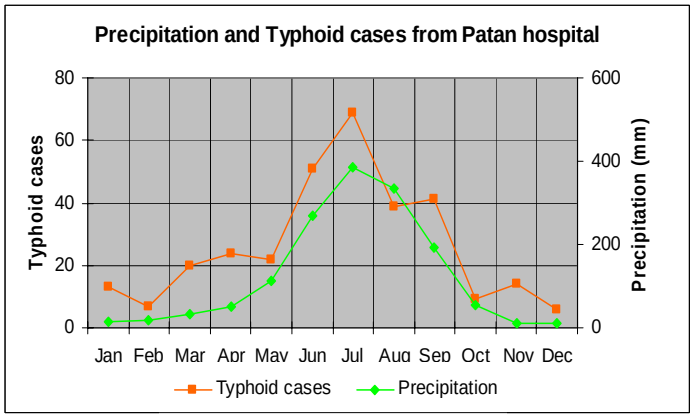


Fig. 13: **Distribution of Rainfall and Typhoid Cases by Month, Kathmandu**

The cases of typhoid can also be linked to the precipitation pattern in the valley (Fig. 13). The millimeter graph of rainfall rises from the mid of May; reaches maximum in July and goes down from the month of September. Coincidently, the cases of typhoid are raised during the months of June, July, August and September. Though we do not have cause and effect data between these two parameters, we can predict this that most of the drinking water sources are contaminated with faecal matter by means of rain water.

There is an increasing trend of typhoid cases from 1997 onward (Fig. 14). The typhoid positive cases have been confirmed by the blood culture test that ranges from 6 to 19 percent of the total cultured.

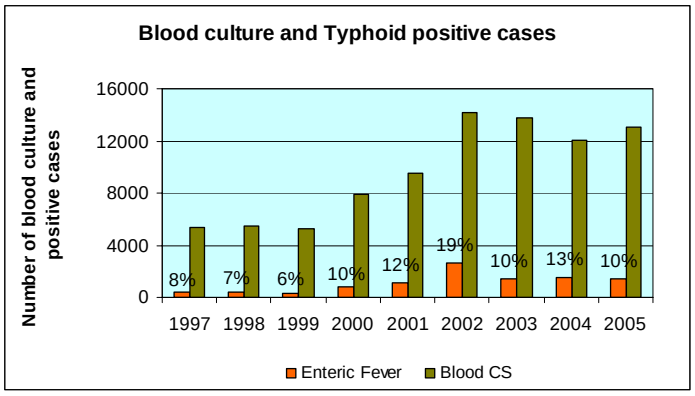


Fig. 14: **Pattern of Blood Culture of Typhoid Cases**

Discussion

A number of studies have shown an effect of ambient temperature on the occurrence of certain enteric diseases. A study exploring growth rates of salmonellosis under varying temperatures found that the growth rate increased as the temperature increased (Mackey and Kerridge 1988). It has been noted that enteric diseases in temperate latitudes have a seasonal pattern, with the highest incidence of illness during the summer months (Isaacs et al. 1998). A study of foodborne illness in the United Kingdom found a relationship between the incidence of disease and the temperature in the month preceding the illness (Bentham and Langford 2001). It is believed that the survival and growth of certain enteric pathogens are, within limits, positively correlated with ambient temperature (Hall et al. 2002). In a study of five cities in Australia, D'Souza et al. (2004) found a significant positive association between mean temperature in the previous month and the number of notifications of cases of Salmonella in the current month. We found that weekly count of typhoid fever generally increased with weekly temperature in Kathmandu after adjusting for trend, season and 2002 outbreak.

Our results are consistent with research carried out by Bentham and Langford (1995, 2001), D'Souza et al. (2004), Kovats et al. (2004), Fluery et al (2006). Previous studies have demonstrated the threshold temperature value above which there is linear relationship with occurrence of typhoid fever. However, we didn't find any threshold value suggesting that the temperature has effect in the lower end i.e. warm winters. No other studies have studied effect of rainfall on the occurrence of typhoid fever. We found that the cases of typhoid fever are positively linked with up to 50mm weekly rainfall. When temperature, season, trend and 2002 outbreak is included in the model no association is seen. This reflects that only temperature has stronger relationship with typhoid.

In summary, warmer ambient temperature in Kathmandu is associated with an increase in the risk of typhoid fever after controlling for season, trends and 2002 outbreak. It is known that many pathogens in the environment are sensitive to ambient temperature. Given global climate change and projections for warmer summers and warmer winters, an increase in cases of food-borne illness may be expected. Problems may arise from production to consumption of food during warmer periods. Although some trends in enteric disease infections are decreasing, public health authorities may want to take action and focus public education programs and other polices to particularly vulnerable groups and to relevant occupational groups in the short term, and may consider new policies in anticipation of additional cases of food borne disease due to climate change.

Chapter Four: Vulnerabilities and Recommendations

Key Vulnerabilities

There is an increasing trend of vector and water-borne diseases in the country. Coincidently, the occurrence of cases of water borne diseases such as typhoid has increased in the summer months (May to September) where the temperature and the amount of rainfall are also risen. It appears that there is a relationship between temperature and precipitation, and vector and water-borne diseases, but this does not mean the cause and effect relationship, which can be explained by further studies.

There are recently outbreaks of Malaria, Kalazaar and Japanese Encephalitis in the country side and all are associated with the change in temperature. Thousands of people die from these vector borne diseases every year. Similarly, severity of water borne diseases is also very high. Typhoid, cholera and other diarrhea diseases are becoming common in Nepal due to extreme draught, flooding and poor sanitation.

The most vulnerable group is the poor households who do not access to good sanitation, regular health check up and other facilities. Mostly women, children and old people have been the most severely affected groups within the poor households. The case of Malaria, Kalazaar and Japanese Encephalitis is happening in the Terai districts. Water borne diseases are mostly common in the urban areas like Kathmandu and other cities and mostly the poor people living in squatters and in poor physical condition are the one who are impacted the most.

Health and Development

Nepal's environmental challenges cover a wide range of complex issues, which are interrelated and detrimental to health. The still high population growth and pervasive poverty, especially in the hills, are primary contributing factors to most of the country's environmental problems. The main environmental issues are water pollution due to poor sewerage and sanitation, industrial discharge and wastes, and pesticides from agricultural sources. Air pollution is due to combustion of fossil fuels, vehicular emissions, industrial emissions and combustion of bio-mass. These have caused deterioration of air quality, especially in urban areas, resulting in respiratory and eye problems. The rapid urbanization has exceeded the capacity of municipal services to provide basic services and the concept of healthy cities is limited to discussion only. The main constraints in the implementation of environmental measures have been lack of resources and trained manpower, weak infrastructure and coordination, and lack of awareness on environmental issues.

The future vision of the government is to provide equitable access to quality health care services in both rural and urban areas. Central to this vision of health and development is the recognition of self-reliance, gender sensitivity in health programmes, full community participation, private sector participation (public/private mix), and decentralization as characteristics essential to the health system. In addition the country's socio-economic circumstances affect the severity of climate change impacts. The future development and health indicators provide some good indication that the impacts of climate change on human health will be tackled through new coping strategies and government actions.

Policy Recommendations

1. Health sector should have strategic focus and programme and even policy to combat with negative impact of climate change
2. There is a warrant of integrated approach to be adopted for health planning and research in different climatic regions in the country. It is argued that the health should not be seen in isolation.
3. The control of typhoid cases in Nepal is not only possible with curative approach, this requires to be supported by preventive and promotive activities such as control of reservoir, identification, isolation and treatment of the diseases and disinfection, sanitation, and immunization
4. Quarantine program needs to be strengthened, and effective mechanism on eradication and disease control program should be given more emphasis.
5. Promotion of health education for creating community awareness to diseases may be an effective adaptive measure to prevent occurrences these diseases.
6. Public awareness regarding the changing climatic situation and its impact is necessary. This can be an important strategy to reduce the vulnerability to climate change and increasing the effectiveness of the adaptation options.
7. Government should focus on expediting the NAPA formulation process.

Research Recommendations

a) This data of course doesn't provide cause and effect relationship of typhoid with temperature. We just have demonstrated that there is positive relationship between increase in temperature and typhoid cases. Since typhoid is usually seen in summer months or during warmer temperature. During warm temperature, the growth of typhoid bacilli is favored drastically. It is not only water borne disease but also food borne disease. We do recommend that there should be larger epidemiological study to explore the possibility of effect of climate on the typhoid cases.

b) Undertake research on low thermal environment management and control strategies in work places.

c) Conduct studies on epidemiological forecasting and early warming systems using RS/GIS technology applicable in high-risk areas for Malaria, Japanese Encephalitis, diarrhoeal disease and nutritional disorders.

d) Undertake prospective and retrospective studies on identified disease patterns such as eye and skin disorders relevant to Climatic Change.

e) Conduct studies on vector mosquito dynamics and change patterns on all vector borne diseases.

Conclusions

Climate variability will increase and some climate extremes will become more intense or more frequent with climate change. An observed warming trend over the past several decades is already having discernible and generally adverse impacts on both of these key resources – many mountain glaciers are in a general state of retreat, and some are expected to disappear entirely in the coming decades. Glacier retreat and ice melt more generally are also significantly increasing the size and volume of several of Nepal's more than two thousand glacial lakes, making them more prone to glacial lake outburst flooding (GLOF). Climate change scenarios across multiple general circulation models meanwhile show considerable

convergence on continued warming, with country averaged mean temperature increases of 1.2°C and 3°Cprojected by 2050 and 2100. Continued glacier retreat can also reduce dry season flows fed by glacier melt, while there is moderate confidence across climate models that the monsoon might intensify under climate change. This contributes to enhanced variability of river flows. Potential intensification of monsoons combined with enhancement of GLOF risks also contributes to enhanced risk of flooding and landslides which can have serious an impact on mountain agriculture and rural livelihoods.

There are strong evidences that climate change could affect human health. The outbreak of Malaria, Kalazaar, arboviral diseases have been observed in Nepal. The water borne diseases like typhoid is also causing serious problem in the densely populated urban areas of Nepal like Kathmandu. There are almost negligible research and development support from the government and other concerned agencies. It was also found out that there is limited knowledge, information and awareness among health sector community about the potential impact of climate change on human health.

There is an increasing trend of vector and water-borne diseases in the country. Coincidently, the occurrence of cases of water borne diseases such as typhoid has increased in the summer months (May to September) where the temperature and the amount of rainfall are also risen. It appears that there is a relationship between temperature and precipitation, and vector and water-borne diseases, but this does not mean the cause and effect relationship, which can be explained by further studies.

The caste study shows that Typhoid shows seasonal trend with peaks in summer months. Ambient temperature has positive effect on Typhoid cases with no threshold value. No threshold apparent- that is temperature has an effect even at lower end of temperatures (in winter). Typhoid cases are positive association with rainfall upto 50 mm per week, beyond that there is no clear association.

This data of course doesn't provide cause and effect relationship of typhoid with temperature. We just have demonstrated that there is positive relationship between increase in temperature and typhoid cases. Since typhoid is usually seen in summer months or during warmer temperature. During warm temperature, the growth of typhoid bacilli is favored drastically. It is not only water borne disease but also food borne disease. We do recommend that there should be larger epidemiological study to explore the possibility of effect of climate on the typhoid cases.

Annex 1: Workshop details

Workshop Report

Background

There is now widespread consensus that the Earth is warming at an unprecedented rate and it is likely to accelerate in the decades to come. Climate change is also a major challenge to Nepal. Although Nepal has a negligible share in the global emission, Nepal's major natural resources, biodiversity and water, are the forefront of climate vulnerability. Extreme climate events are expected to become more frequent as a result of climate change in Nepal. Climate extremes can have devastating effects on human health and societies. In Nepal, the historical information reveals that disasters, famines and disease outbreaks have been triggered by droughts and floods. Malaria, Kalazaar and Arboviral diseases are common in Nepal. Scientists and health experts have predicted that these diseases are occurred due to climate change.

Local Initiatives for Biodiversity, Research and Development (LI-BIRD is carrying out case study on "**Impact of climate change on human health: Climate, weather and typhoid cases in Kathmandu, Nepal".** This study is being undertaken by LI-BIRD under the Capacity strengthening of civil society in least developed countries on Adaptation to Climate Change (CLACC) Project. It is being funded by the Department for International Development (DFID) of the United Kingdom.

Objectives of the workshop

The main objective of the workshop was to increase interest and awareness among stakeholders on climate change. Specifically the workshop aims:

- To share the findings of the project study on the impact of climate change on typhoid cases in Kathmandu valley
- To share current initiative and work of partner organizations in climate change
- To discuss on future linkages and collaboration among stakeholders

Participants

The workshop invited government and non-government research and development organizations, researchers and donors, academics, and practitioners. The workshop particularly targeted government and civil society organizations working in climate change and health.

Presentation

The workshop was started under the chairmanship of Dr. S. B. Mathema, Chairperson of Executive Board of LI-BIRD. Mr. Bimal R. Regmi, team leader of the project welcomed the participants and shared about the objectives and expected output of the workshop. It was followed by introduction among the participants.

The technical session was started with the presentation by Mr. B. R. Regmi about the introduction about project, its major activities and climate change and its impact in various sectors in Nepal. He highlighted the impact of climate change on agriculture and human health. Dr. Bandana Pradhan presented the outcome of case study on the impact of climate change on typhoid cases in Kathmandu valley. Participants raised their concern about the degree of information and need for further study and research. It was suggested that further

research is needed based on the outcome of current study to provide more scientific information to highlight the findings.

There was institutional presentation from WINROCK International, World Wildlife Fund (WWF) and Practical Action. All of them presented about their institutional experiences in projects related to climate change. Mr. Sandeep C. Rai from WWF gave a summarized presentation about the awareness raising activities that WWF is promoted including the GLOF studies and action research. Mr. Prem Sagar Subedi from WINROCK presented about CDM projects and its potential for scaling up. Mr. Gehendra Gurung from the Practical Action presented about the adaptation project of the Practical Action. Participants raised questions to clarify as well as add on the presentations. There was an intellectual discussion on the pros and cons of current CDM projects, its relevance and applicability for Nepal. Similarly, participants agreed that Nepal should focus on adaptation projects.

Dr Pooja Lama presented about the perception of medical professionals in climate change and its impact. The last presentation was made by Mozaharul Alam from Bangladesh Centre for Advanced Studies (BCAS) to provide COP 12 agenda and role of Least Developed Countries in International negotiations.

Outcome of Group work

There were two groups and participants were divided according to their interest and expertise. One group dealt with the issues for COP12/MOP 2and the country priority and focus. The second group discussed about the impact of climate change on human health, current gaps and research and development priority and needs.

Group One: Major Issues for COP/MOP 2 that Nepal need to focus.

National Issue

1. Delegate Participation at COPs:

Climate Change is the new area of intervention and there is a high need of awareness raising and capacity building of the government representative. In most of the UNFCCC COPs it has been seen that the government delegates participate in number is very less. This result that Nepal issues and concern are not full reflect as it supposed to be because most of the negotiation occurs during same time and few delegates cannot cover all the discussion. There is a need for the increase in number of the government delegates to participate in the upcoming COPs.

There are also numbers of organizations that usually participate in UNFCCC COPs as they have strong existing Climate Change Program at Nepal. So if there is a possibility of inclusion of the NGOs representative to be included in the government delegates lists than both the government and NGO representative can work jointly together in all closed meeting and can representative Nepalese issue strongly. This kind of trends is already being adapted in many developing and least developed countries.

2. Formation of alliance of Mountainous Countries:

Climate Change Impact of most of the mountainous countries is similar. If Nepal government can take a step in creating an alliance of Mountainous countries than it will be much more easy and push strongly the issues and concerns of the mountainous countries. There are many these kinds of alliance that works jointly in the International negotiation at the COPs. E.g.:

SIDS (Small Island Developing State), AOSIS (alliance of Small Island State), OPEC (Organization of Petroleum Exporting Countries), etc...

Key Area of Interventions for COP/MOP 2:

3. Carbon Market:

After the Kyoto Protocol entry into force, the carbon market is activated. Nepal has already submitted two Activity 1 & Activity 2 of Biogas CDM project to the CDM executive board. But during COP/MOP 1 that took place in Montreal, the CDM executive board had almost took decision to exclude non-renewable biomass from CDM project. If this happens than the existing Bio gas project that Nepal is developing and proud of it will come into dilemma. In these aspect Nepalese delegates has to lobby strongly for the reconsideration of the non-renewable bio mass CDM project. Nepal also need to lobby strongly to the CDM executive for the waive of the registration fee for the CDM projects.

4. Adaptation:

Adaptation is the urgent need for vulnerable countries like Nepal. There is no needed of any further waiting for implementing the adaptation project in Nepal as she is already facing many climate change impacts. Thus Nepalese delegates needs to lobby strongly for the adaptation funds. The focus for the lobby needs to be concentrate on the:

a) Increase in Adaptation fund
b) There should be clear mechanism for the disbursement of the fund and
c) Five year adaptation program need to be finalized and developed countries need to put substantial resource for the five year adaptation program that supports developing countries

5. Post 2012 Negotiation:

Now there is clear that climate change is happening and we cannot hide from it. The impact will increase more than double fold in coming years and there is a need of high emission reduction from the developed countries and also from the developing countries like China and India to reduce threats from climate change. In this negotiation at COP/MOP 2, the Nepalese government delegates' need to voice out strongly that there is also a high need of legally binding commitment from the developing countries to reduce their annual carbon emission to reduce threats from climate change in coming years.

Group Two: Climate change issues, impact and Current Gap

Climate Change Issues:

- Evidence- information
- nutrition security
- food security
- Disaster prepared ness
- Flood
- Heat Stress
- Vector population

- human population
- industrialization
- development of infrastructure

Direct effect

- Flood
- physiological
- Respiratory disease
- Extreme heat

Indirect effect

- Food
- water
- vector

Gap

- Evidence based health research lacking
- Sporadic Research
- Information dissemination system weak
- Advocacy policy weak
- awareness lacking

Workshop Recommendations

1. Need for strong linkages and coordination among government and non-government sector. Public and private partnership required to deal with climate change issues
2. Government should have sctoral as well as focused policy on reducing the vulnerability of climate change impacts
3. Carry out study and research on vulnerability mapping and creating climatic data bank
4. Poverty reduction strategy to incorporate climate change risk and adaptation measures
5. Financial resources is needed to focus on adaptation mechanisms
6. Capacity building of implementers and organization particularly, the development organization is needed
7. Mass awareness campaign for public awareness on potential impact of climate change on livelihood

Tentative Programme schedule for the workshop
19th October, 2006, Hotel Greenwich, Kupandole, Kathmandu

Time	Activities	Who
8.00-8.30	Breakfast	All
8.30-9.00	Registration	All
9.00-10.00	Opening session	Erica Udas
	Welcome	Bimal R. Regmi
	Chairing	Dr. S. B. Mathema
	Objectives of the workshop	Tara Lama
	Introduction	All
10.00-10.30	Climate Change and Related issues in Nepal	Bimal R Regmi
10.30-10.45	Discussion	All
10.45-11.15	Winrock experiences	Prem Sagar Subedi
11.15-11.30	Discussion	All
11.30-12.00	WWF experiences	Sandeep C. Rai
12.00-12.15	Perception of Medical Professionals on Climate Change	Dr. Pooja Lama
12.15-12.45	Case study on impact of climate change on human health	Dr. Bandana Pradhan/ Dr. Pooja Lama
12.45-13.00	Discussion	All
13.00-14.00	Lunch break	All
14.00-14.30	ITDG experience sharing	G. Gurung
14.30-14.45	Discussion	All
14.45-15.05	LDCs perspective and COP 12 agenda	M. Alam
15.05-15.20	Discussion	All
15.20-15.30	Break	All
15.30-16.30	Group discussion and presentation - COP 12 agenda and Nepal's position/agenda - Impact of climate change on health, issues, gaps and recommendations	All
16.30-17.00	Wrap up and closing	
	Wrap up	Diwakar poudel
	Closing by chairperson	Chairperson

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