



AN ANALYSIS OF CLIMATE INDUCED HEALTH IMPACTS IN SIKKIM HIMALAYA, INDIA

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Abstract:

With the advent of the approaching days and time more social problem and social issues are forthcoming in which climate change dilemma is the most worldwide worry. Human health vulnerability has further more increased due to impact climate change around the globe. The diverse impact of climate change has also boom and is being visible in Sikkim too. This paper tries to make analysis and interrelation between climate change and health issues and the impact that is occurring in the reality. It also shows how global warming and climate change are liable and benefitting the parasites to breed, sustain and to thrive upon suitable and favorable rising temperature and weather, making Sikkim at risk and serving a platform for increasing number of cases of disease due to the parasites. Manifold cases of vector borne, water borne and air borne disease are rising up and skin disease has been increased over the years. Acute Respiratory Infection death toll has been rising over the years. A proper in-depth study and research is needed. Not only to understand human disease through medical assistance but rather social factor should also be considered to study medical illness.

Key Words: Climate Change, ARI, Human Health, Vector-Borne, Skin & Disease

Introduction

As global warming increase the temperature will rise and effects of global warming will lead to climate change on planet earth (IPCC, 2007; Parry et al. 2008). The changes in the climate are evident in the global and local level too. The weather pattern has been showing variation. Global climate change has already had observable effects on the environment. Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, plant and animal ranges have shifted and trees are flowering sooner. Effects that scientists had predicted in the past would result from global climate change are now occurring: loss of sea ice, accelerated sea level rise and longer, more intense heat waves (<https://climate.nasa.gov/effects/>). Climate change is not just an environmental issue but also a health issue (Lancet and University College London, 2009). Global temperature rise will directly affect health (Robine, 2003). The complex nature of climate change and its environmental and social manifestations results in diverse risks to human health (Epstein, 2011; McMichael and Lindgren, 2005). The number of human casualties will increase with the increase of temperature (Peterson and Zhang 2008). Heavy rainfall and a rise in temperature increase the rate of infection (Menne et al. 2002). Modeling of climate change in the Gulf predicts increased mortality rates due to cardiovascular and respiratory illnesses, thermal stress, and increased frequency of infectious vector-borne diseases in 2070–99 due to global warming (Husain & Chaudhary, 2008). Climate affects weather, air and water quality, local and national food supplies, economics and many other critical health determinants (Hegerl et al. 2007). Climate change is a real threat to global health and wellbeing, and is contributing to mortality, especially for people living in poverty and lacking access to essential health care (Lancet and University College London, 2009).

Manifold harms and diseases will be multiplied due to climate change. Vector-borne, Water-borne, Air-borne, skin diseases and other direct and indirect extreme events will increase. Changes in weather will affect the air quality through several pathways, including production and allergenicity of allergens and increase regional concentrations of ozone, fine particles and dust. Contagious disease such as influenza and pneumonia, as well as allergic disease such as asthma while higher level of humidity increase the incidence and severity of fungal infections and infestation and will cause respiratory disease and making children and elderly population to be more susceptible (Snow, 2015; Ashrae, 2012). Ozone depletion increases Ultra Violet radiation at the Earth's surface. The direct exposure of the Ultra Violet sun radiation to the human body will increase the chances of skin and skin associated disease. (WHO, 2003; Van der Leun & Gruijilfr. 2002). Vector borne carriers are very climate sensitive. (Kovats et al. 2005). (Menne et al, 2002). The ecology, development, behavior, and survival of mosquitoes and the transmission dynamics of the diseases they transmit are strongly influenced by climatic factors. Temperature, rainfall, and humidity are especially important, but others, such as wind and the duration of daylight, can also be significant (Hales et al. 2002). Climate change is likely to increase diarrheal disease incidence worldwide, and extreme weather conditions may also complicate already-inadequate prevention efforts (Charron et al. 2005; Zhou et al. 2008). Climate change will increase the rate of

pathogens and transmission of diseases as zoonotic carriers are susceptible to transmit disease. (Gage and Burkot, 2008). Climate change might can be one of many factors influencing violence (Barnett & Adger 2007).

In Sikkim also the traces of climate change is being been visible. Various studies and research on climate change and the available meteorological and automatic weather system data shows increase in temperature and unpredictable weather pattern. With the impacts of global warming becoming more apparent, Sikkim Himalaya is perhaps most in tune to the signs of change brought about by climate warming. The people across the towns and villages of Sikkim narrate revealing insights on how global warming is affecting their lives and livelihood (Khawas, 2011). Climate change in the Himalayas is already having a significant impact on biodiversity, hydrology, livelihoods and almost every other aspect of the environment and human enterprise. The impacts are beginning to cut across human socio-economic systems that will affect virtually all aspects of life in Sikkim. Indian Meteorological Department records reveal that between 1958-2005, there had been a slight change in the climate of Gangtok. Maximum temperature has been rising by 0.2° C per decade and minimum temperature has been raised by 0.3° C per decade. The annual rainfall has been increasing by 49.6mm per decade (Seetharam .K. 2012).

However in Sikkim Himalaya, there is a dearth of scientific reports on climate impacts on human health. Therefore, it is very necessary to address the consequences of climate change on outbreaks of many diseases, which can affects human health. The present studies have the following objectives:

- ✓ Analysis of vector borne disease and quantify their trends in Sikkim Himalaya.
- ✓ Analysis of the air borne disease and to look upon the death due to Acute Respiratory Infection (ARI).
- ✓ To quantify the relationship between climate change and health.

Materials and Methods:

The study was started with after collecting Annual Report of 2000-2015 and Sikkim Health Information Bulletin from Planning, Monitoring and Evaluation, PME Division, Health Department. The information included the demographic composition of Sikkim, Health infrastructure and various communicable and non-communicable diseases. The various information and data available was analyzed and correlation was made in relation to climate change and health issues. Geographic Information System was used to locate state hospitals, district hospitals, primary health centers and Primary Health Sub Centers existing in Sikkim. A further, thematic map of the same has been prepared through ESRI Arcgis Arcmap.

Limitation:

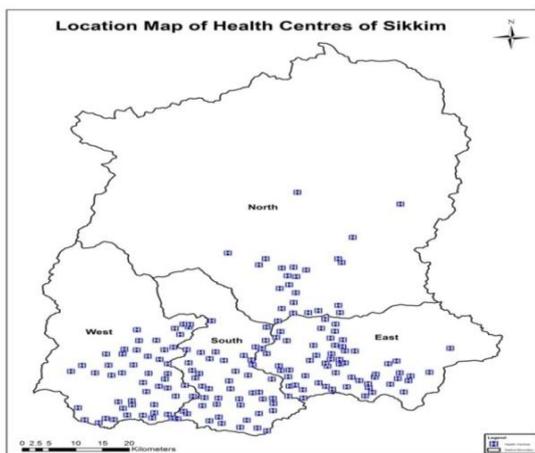
Further this study is not at all the representation of whole Sikkim. As data from Central Referral Hospital, Manipal have been excluded due to unavailability of medical data from MRD section.

Study Area:

Nestling in the Himalayan Mountains, the state of Sikkim is characterized by mountainous terrain. Almost the entire state is hilly, with an elevation ranging from 280m to 8,598m. The state of Sikkim is located between 27° 00' 46" to 28° 07' 48" north latitude and 88° 00' 58" to 88° 55' 25" east longitude. Sikkim is India's least populated state with 6, 10,577 inhabitants according to Population Census (2011). Sex ratio is 889 females per 1000 males, with a total of 3,21,661 males and 2,86,027 females. Sikkim comprise of four districts viz., East, West, North and South Sikkim. The state has five seasons; winter, summer, spring, autumn and monsoon season. Agro- climatic zones of Sikkim range from sub-tropical in the south to tropical and alpine in the north. Most of the inhabited regions of Sikkim experience a temperate climate, within temperature seldom exceeding 28°C in summer and average annual temperature for Sikkim is around 18°

(<https://en.wikipedia.org/wiki/sikkim>)

Health Centers in Sikkim:



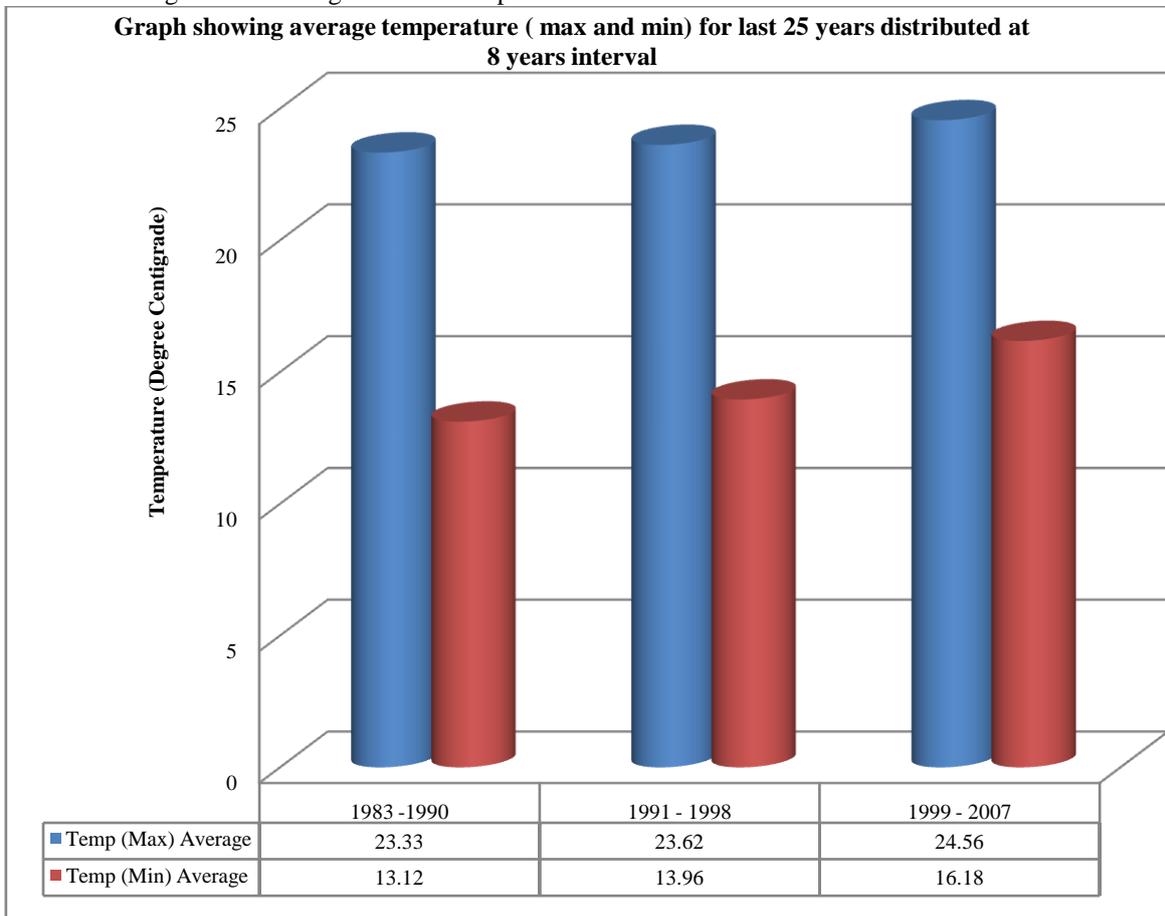
The district wise location of health centers in Sikkim has been mapped through GIS techniques. There are total one hundred seventy nine (179) health centres in Sikkim which includes One State Referral Hospital (Sir Thutob Namgyal Memorial Hospital) One (1) Central Referral Hospital, Manipal, four district hospitals viz; Singtam, Mangan, Gyalshing and Namchi. There are 24 Primary Health Centres, 146 Primary Health Sub-centres, Two Community Health Centres and One District Tuberculosis Centre, Namchi, which is under construction. A thematic map showing location of health centers in Sikkim (Sikkim Health Bulletin: 2005, 2010 & 2014)

Plate 1: Map showing location of Health Centre in Sikkim

Result and Discussion:

As per the data available from the Meteorological Data of ICAR Research Complex, Sikkim Centre, Tadong, Gangtok (1983 – 2007) gives details of temperature of Gangtok showing maximum and minimum trend of weather pattern from 1983 – 2007 which indicates increase of temperature from 23.33, 23.62 to 24.56 in the following year indicating upward rise of 1.23 degree centigrade according to the data tabulated.

Figure 1: Showing Trend of Temperature maximum and minimum from 1983-2007



Source: Meteorological Data of ICAR Research Complex, Sikkim Centre, Tadong, Gangtok (1983 – 2007)

Vector borne disease in Sikkim has also been on rise. The cases of malaria and dengue have increased a lot over the past decade or so. Sikkim health bulletin from 2005- 2015 has been analyzed to create a table of disease due to vector borne carriers. The table below shows the total number of vector borne disease registered from 2004-2015 in Sikkim.

Table 1: Vector Borne Disease from 2004 to 2015 Sikkim State

Year	Malaria	Kalazar	Dengue
2004	160	NIL	12
2005	69	NIL	NIL
2006	93	05	NIL
2007	48	Nil	NIL
2008	38	04	NIL
2009	42	05	NIL
2010	49	03	07 (Imported Case)
2011	51	07	02
2012	77	05	07
2013	39	07	679
2014	35	06	03
2015	27	05	35

Source: Health Information Bulletin, Sikkim-2005, 2010, 2014 & 2015

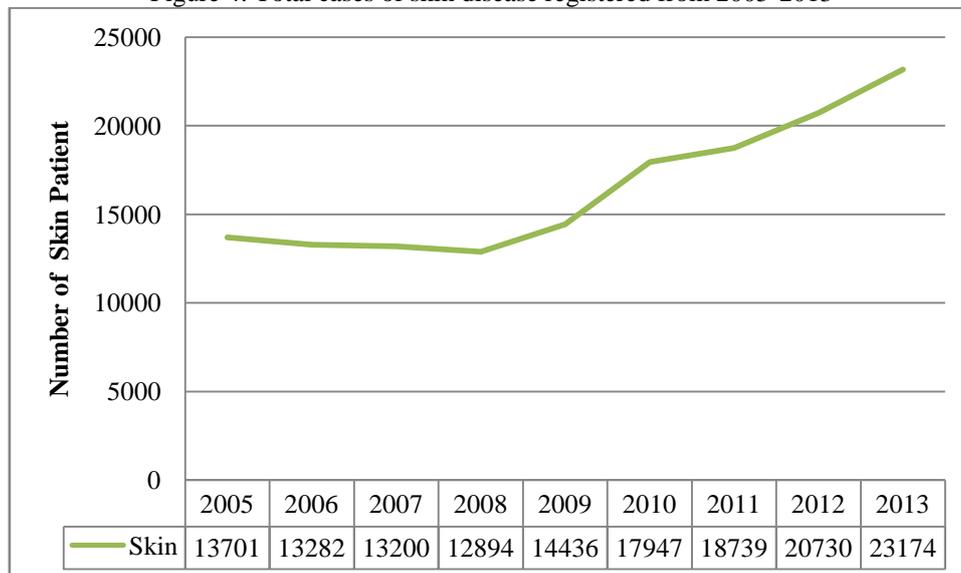
The data reveals the situation from 2003 to 2014 indicates that, Acute Respiratory Infection has been on the rise in matter of death ratio than other persisting air borne disease. In 2003 the total death due to ARI was 5, in 2004 2, in 2005 3 and substantially increased to 15 in 2013 and 23 in 2014, as one can prefer table 2 for detail analysis.

Table 2: Death toll due to Acute Respiratory Infection from 2003 to 2014 Sikkim State

Year	ARI
2003	5
2004	2
2005	3
2006	4
2007	0
2008	1
2009	13
2010	12
2011	12
2012	7
2013	15
2014	23

Source: Health Information Bulletin, Sikkim-2005, 2010, 2014 & 2015

Figure 4: Total cases of skin disease registered from 2005-2013



Source: Health Information Bulletin, Sikkim-2005, 2010, 2014 & 2015

There are increased cases of skin related disease from 2005(13701) to 2013(23174) in Sikkim. The information shown and given by Health Bulletin 2005, 2010, 2014 and 2015, within preceding years of 8 year, the number of skin patient has increased to 9473 from 2005- 2013 as per the data.

Conclusion:

Climate change affects weather, air and water quality, local and national food supplies, economics and many other critical health determinants (Hegerl et al. 2007). Sikkim Himalaya is perhaps most in tune to the signs of change brought about by climate warming (Khawas, 2011).. From the collected data's and information, the cases and events of climate change have been apparent and have started to occur in Sikkim. The changing weather patterns, increasing rainfall distribution, low humidity in winter and high heat-stress are now being faced by the people of Sikkim. The cases of vector-borne diseases have been increased. The migration of vector-borne diseases is also being observed to the alpine regions, as their population is growing the risk factor of vector-borne disease are multiplying. The cases of growing patient population due to various vector-borne diseases signify the growing extent of parasites in Sikkim. The maximum death victims due to Acute Respiratory Infection (ARI) have been recorded which signifies that alarm should be maintained on the air borne disease which has been escalating over the coming year. Climate change and health status of Sikkim can be inter-related as increasing number of air-borne, water-borne and vector-borne disease are raising. The cases of diseases registered due to skin patient are also being increasing in the state.

Additionally, a more in-depth and comprehensive study/research is require to highlight the problem and to discuss on the subject concern with health and climate change issue. Not only to understand human disease through medical support but rather social factor should also be considered to study medical illness.

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Acronym:

AWS	=	Automatic Weather System
CC	=	Climate Change
CO ₂	=	Carbon dioxide
GHG	=	Green House Gases
ICAR	=	Indian Council of Agricultural Research
IMD	=	Indian Meteorological Department
IPCC	=	Intergovernmental Panel for Climate Change
MRD	=	Medical Record Division
WHO	=	World Health Organisation