Study on Vector Borne Diseases and Climate Change along an Altitudinal Transect in Nepal

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ACRONYMS AND ABBREVIATIONS

DoHS	Department of Health Service
GoN	Government of Nepal
GPS	Global Positioning System
HP	Health Post
IPCC	Inter-governmental Panel on Climate Change
KAP	Knowledge, Attitude and Practice
KII	Key Informants Interview
MoHP	Ministry of Health and Population
NAPA	National Adaptation Program of Action
NGO	Non- Governmental Organization
NHRC	Nepal Health Research Council
PHCC	Primary Health Care Centre
RRT	Rapid Response Team
SHP	Sub Health Post
SPSS	Statistical Package for Social Sciences
VBD	Vector Borne Disease
VDC	Village Development Committee
WHO	World Health Organization

EXECUTIVE SUMMARY

The effect of climate change is obvious. There is global consensus that the entire global community is increasingly imperiled by environmental threats like landslide, extreme weather or unseasonal weather conditions, floods, droughts, epidemics and killer heat waves beyond anything we have ever experienced. These catastrophes are self-generated. Despite the ubiquitous associations to humanity, environmental issues are still not high on the national agenda. The objective of this study is to assess the effect of climate change on the vector borne diseases along an altitudinal transects and recommend guideline to develop action plan for its prevention and control in Nepal. The multidisciplinary team consisting of climate change expert, meteorologist, senior public health experts, and statisticians were formed for the completion of this research project. The interdisciplinary teams organized series of meeting to develop the concepts and collected the relevant data. Team was formed to develop some recommendations to take further step in climate change adaptation strategy.

The methodology of study was the mixing of descriptive retrospective and cross sectional study. Three different ecological regions with respect to their altitude from all the development regions of Nepal were selected for the study ranging from height below 500m, 500- 1500m and above 1500m.

Both the qualitative and quantitative method was used for data collection. In-depth and key informant's interviews were carried out with the health professionals and policy makers. Focus Group Discussion was carried out with the homogeneous and heterogeneous groups of female community health volunteers, local people and health workers. Questionnaire survey was also conducted with the elders aged above 60 years for KAP survey. Climate data on temperature and precipitation was collected from Department of Hydrology and Meteorology. Time series log-linear regression analysis was done to assess the relationship between climatic factors and vector-borne diseases. Judgmental and multistage random sampling technique was used. Fifteen PHCC were selected from five development region, three from each region based on altitudinal transect. Twenty seven wards were selected for KAP study from western region.

Key informant's interview was used to document the existing vector-borne disease case reporting, referring and treatment policy of Nepal Government through various level of expertise like health professionals, policy makers and local people towards vector-borne disease and climate change and developed a case study. Health facility data were collected from Primary Health Care Centre (PHCC) using standard format, analyzed through logistic regression analysis.

Most of the health workers had some knowledge about climate change and they were known about it compared to community people who don't even heard the term "Climate Change". Most of the health workers were focusing on the need of strengthening of the existing health programs. They even said that the current health programs at the district level are not sufficient and need to be expanded with the availability of proper service and manpower. Health workers from Himalayan region also felt the importance of vector control officer in these regions as well because they presume that the problems of vector are alarming and they are at risk of malaria.

KAP surveys were conducted in three districts of different ecological regions from terai, hill and mountain. Only 1.73% of the respondents from terai, 28% from hill and 19.18 % from mountain region have knowledge about climate change. Their major source of information about the climate change was radio which is local radio stations.

Time series analysis was also carried out between climatic parameters and malaria. Temperature (maximum and minimum), humidity and rainfall were taken as independent variables and malaria as dependent variable and were analyzed in the three cross section of Nepal from terai to mountain region. Occurrence of malaria was significantly associated with rainfall ($p<0.032$) and morning humidity ($p<0.007$) and others parameters were found insignificant in terai region. While in hill region, no significant association has been found between malaria and rainfall, evening humidity, maximum and minimum temperature. Malaria was found significant with morning humidity ($p<0.01$). From both the topographical zone (terai and hill) showed significant association of humidity and malaria. So, it is noted from the study that relative humidity is major climatic determinants for the occurrence of malaria, which is highly dependent on seasonality and rainfall. Malaria was not found in mountain region, so no association could be ascertained in this region.

CHAPTER I

Introduction

1.1 Background

Life is dependent on the dynamics of the Earth's climate system (Houghton *et al.*, 1997). An increase in greenhouse gases leads to increased warming of the atmosphere and the Earth's surface. It is estimated that average global temperatures will have risen by 1.0–3.5 ºC by 2100 (Watson *et al.,* 1996), increasing the likelihood of many vector-borne diseases.

The rates of change of all aspects of human and environment related actions are accelerating. This gives rise to numerous opportunities for unexpected or enhanced risks from vector borne diseases, arising from the interaction between different types of change such as climate, patterns of travel unplanned expansion of megacities, and intensification of agriculture. Intergovernmental Panel on Climate Change's (IPCC) concludes that climate change is likely to expand the geographical distribution of several vector-borne diseases, including Malaria, Dengue and Leishmaniasis to higher altitudes (high confidence) and higher latitudes with limited public health defenses and to extend the transmission seasons in some locations (IPCC, 2007). Nepal is located along the southern slopes of the Himalayan mountain range, with the lowlands in the south at 60 meters above sea level and the mountains in the north rising to over 8000 meters. Therefore, Nepal is facing various degree of climatic impact along these altitudinal transect. Keeping this in mind, Nepal might be a unique place for studying the impact, vulnerability and adaptation aspects of climate change with small but representative sample (Dhimal, 2008).

Rises in temperature and the associated changes in precipitation patterns (such as less frequent but more intense rainfall events) are likely to result in occurrence of vector borne and water borne diseases in country like Nepal along with poor sanitation, movement of people and changing life styles of people. Hence, climate change has given additional burden to achieve health related Millennium Development Goals. Vector borne diseases including Japanese Encephalitis (JE), Leishmaniasis, Malaria and Kala-azar (Visceral leishmaniasis) seem to have occurred in the higher altitudinal districts of Nepal.

The most common species of malarial parasite in Nepal are *Plasmodium vivax* and *P. falciparum* (DoHS, 2009). The available information shows the increasing trend of *P. falciparum* (DoHS, 2007). The increment of *P. falciparum* linked with increased temperature (WHO, 2005). Now, malaria is highly endemic in 13 districts and endemic in 52 districts of Nepal including few mountain districts (DOHS, 2010). However, the entomological evidence so far is lacking to explain the distribution of disease in terms of altitude in Nepal (Dahal, 2008). Other vector borne diseases such as Kala-azar (Visceral Leishmaniasis), Japanese encephalitis and Lymphatic filariasis are endemic in Nepal and their risk districts and populations are also increasing over the years. The people have felt that the mosquitoes are shifting to higher altitudes of Chitwan and Rasuwa districts, where there was previously no occurrence of mosquitoes in those areas (NHRC, 2009).

1.2 Objective of the Study

To study the vector borne diseases along altitudinal transects resulting from climate change and recommend guideline to develop action plan for its prevention and control in Nepal

The specific objectives are as follows-

- To assess the trend of major five vector borne diseases (Kala-azar, Malaria, JE, Dengue and Filariasis) in Nepal,
- To explore the relationship between climatic factor and health effect of vector borne disease on various ecological region,
- To assess Knowledge, Attitude and Practice of elder people on climate change and vector borne diseases,
- To document the existing vector borne disease case reporting referring and treatment policy of Government of Nepal,
- To compile the perception/ opinion of health professionals and local people towards vector borne disease and climate change,
- To prepare case studies on good public health adaptation to climate change in different ecological zones of Nepal, and
- To recommend guideline for the development of action plan to address the issues of climate change specific to vector borne diseases.

1. 3 Justification of Study:

As per Intergovernmental Panel on Climate Change's (IPCC), the third Assessment Report, about 3.8°C rise in temperature and 7% change in precipitation (increase as well as decrease) are projected by the year 2080 (IPCC, 2001). The fourth Assessment Report of IPCC (2007) also projects rise in temperature up to 4°C and sea level rise up to 0.59m by the year 2100. The rates of change of all aspects of human and environment related actions are accelerating. The international arena has proved the climatic conditions are an important parameter for the distribution, and degree of endemicity and epidemicity of diseases in an area. Global study has also shown the increasing trend of risks on vector-borne diseases in developing countries.

The health impacts of climate change in the context of Nepal are also obvious, because Nepal is afflicted with five major vector borne diseases (VBDs), namely Malaria, Dengue, Filariasis, Japanese encephalitis and Visceral leishmaniasis of which malaria ranks at number one. Currently there are few published information about climate change and vector borne diseases in Nepal based on altitude. The risk of vector borne diseases is considered limited to Terai and mid hill areas, but few new report has disclosed vector borne disease are shifting along higher altitudinal transect. The densities of vectors of vector borne diseases have perceived much more attention than previous period at higher altitudinal catchment area from hill and mountain side. But planner and researcher are still unknown regarding the fraction of changes on vector-borne diseases attributable to climate change and knowledge, attitude and practice of the community people. Hence, this study will try to disclose the shifting of vectors and its health impact on higher altitudinal transect, resulting from climate change and identifying the current applied practice for prevention from that risk and explore the current existing behavioral practice among communities from various altitudinal transect. With research prospective, the management system of source agency play important role for providing fact analysis to concern agency for future plan. Department of Health Service is responsible for gathering health data and management of it.

One time developed system and tools may not be appropriated and applied forever. It may be needed to remodel again and again according to time period. Therefore, the current study also tries to explain the drawbacks on government data reporting and referring mechanism and data sheet on the vector borne diseases.

Government of Nepal has developed the mitigation and adaptation priority project area on health sector in its National Adaptation Program of Action (NAPA) document. Though it is urgent need to initiate research on assessment of the impacts of climate change on vector-borne disease at national scale and adaptation strategies for short, medium to long term scales which generate appropriate data, identify the magnitude of problems, influence policy makers and planners and direct the national government and external development partners for investment in highly vulnerable groups. Therefore, the study will develop appropriate action plan to recommend Nepal government for preparing communities in Nepal for the anticipated impacts from vector-borne diseases in relation to climate change; and providing guidance regarding Nepal's participation in regional and national efforts addressing causes and effects of vector-borne diseases in relation to climate change.

Action plan will focus on improving knowledge of the connections between climate change and vector-borne disease in Nepal; developing guidelines on the health impacts of climate change; reinforcing disease surveillance mechanisms; improving cooperation between health authorities and international organizations; preparing action plans for extreme weather events; improving public health training; and building closer links between environmental and health policies.

CHAPTER II

Literature Review

2.1 Climate change and Knowledge analysis:

A survey conducted on "knowledge to health impact of climate change" in United States, Canada and Malta between 2008 and 2009 with feeling questions. Does the public believe that climate change poses human health risks, and if so, are they seen as current or future risks? Whose health does the public think will be harmed? In what specific ways does the public believe climate change will harm human health? A majority of people in all the three nations said that it poses significant risks; moreover, about one third of Americans, one half of Canadians, and two thirds of Maltese said that people are already being harmed. However climate change appears to lack salience as a health issues in all the three countries: relatively few people answered open ended questions in a manner that indicated clear top-of-mind associations between climate change and human health risks. Public health communication initiatives that increase the salience of the human health consequences associated with climate change need to recommend for tackling and addressing the climate change (Wirawan, 2010).

According to climate change specialist it is being threatening the eco-environmental health and had substantial knowledge about possible implications and impacts. A range of different methods for assessing vulnerability were suggested by the participants and the complexity of assessment when dealing with multiple hazards was acknowledged. Identified factors influencing vulnerability were perceived to be of a social, physical and/or economic nature. They included population growth, the ageing population with associated declines in general health and changes in the vulnerability of particular geographical areas due to climate change for example, increased coastal development, and financial stress. Education, inter-sectoral collaboration, emergency management (e.g. development of early warning systems), and social networks were all emphasized as a basis for adapting to climate change (Strand, Tong, *et al.* 2010).

Individuals, communities and societies are affected due to the health impact of climate change. A proactive action need to be developed to address the issue of climate change to enhance social capital across local and national levels. In addition to grassroots actions undertaken at the community level, reducing vulnerability to current and projected climate change will require top-down interventions implemented by public health organizations and agencies (Kristie and Semenza, 2008).

2.2 Climate Change and Vector Borne Disease:

The greatest effect of climate change on transmission is likely to be observed at the extremes of the range of temperatures at which transmission occurs, for many diseases lie in the range 14–18 ºC at the lower end and 35–40 ºC at the upper end. Warming in the lower range has a significant and non-linear impact on the extrinsic incubation period (Watts *et al,,* 1987), and consequently disease transmission, while, at the upper end, transmission could cease. However, at around 30–32 ºC, vectorial capacity can increase substantially owing to a reduction in the extrinsic incubation period, despite a reduction in the vector's survival rate. Mosquito species such as the *Anopheles fluviatilis*, An. maculates, An, annularis, *Culex quinquefasciatus, Cx. tritaeniorhynchus, Aedes aegypti, Ae. albopictus,* and the sand fly *Phlebotomus argentipes* etc. are responsible for transmission of most vector-borne diseases such as malaria, filaria, Japanese encephalitis, dengue, kala-azar in Nepal, are sensitive to temperature changes as immature stages in the aquatic environment and as adults. If water temperature rises, the larvae take a shorter time to mature (Rueda *et al.,* 1990) and consequently there is a greater capacity to produce more offspring during the transmission period.

In warmer climates, adult female mosquitoes digest blood faster and feed more frequently (Gillies, 1953), thus increasing transmission intensity. Similarly, malaria parasites and viruses complete extrinsic incubation within the female mosquito in a shorter time as temperature rises (Turell, 1989), thereby increasing the proportion of infective vectors. Warming above 34 ºC generally has a negative impact on the survival of vectors and parasites (Rueda *et al.,* 1990). In addition, changing precipitation patterns can also have short and long term effects on vector habitats. Increased precipitation has the potential to increase the number and quality of breeding sites for vectors such as mosquitoes, ticks and snails, and the density of vegetation, affecting the availability of resting sites. Disease reservoirs in rodents can increase when favorable shelter and food availability lead to population increases, in turn leading to disease outbreaks. Human settlement patterns also influence disease trends. Asia spans tropical and temperate regions and decrease such as Malaria, Dengue fever, Dengue hemorrhagic fever, Filariasis, Japanese encephalitis, Kala-azar etc are endemic in parts of tropical Asia. In the past 100 years, mean surface temperatures have increased by 0.3–0.8 ºC across the continent and are projected to rise by 0.4–4.5 ºC by 2070 (Watson *et al.,* 1996)**.**

An increase in temperature, rainfall and humidity in some months in the Northwest Frontier Province of Pakistan has been associated with an increase in the incidence of *P. falciparum* malaria (Bouma, 1996). In north-east Punjab, malaria epidemics increase fivefold in the year following an El Nin˜o event, while in Sri Lanka the risk of malaria epidemics increases fourfold during an El Nin˜o year. In Punjab, epidemics are associated with above-normal precipitation, and in Sri Lanka, with below-normal precipitation (WHO, Fact Sheet No.196 rev.) According to WHO many countries in Asia experienced unusual high levels of dengue and/or dengue hemorrhagic fever in 1998, the activity being higher than in any other year. Changes in weather patterns, such as El Nin˜o events, may be major contributing factors (? 1998), since laboratory experiments demonstrated that the incubation period of dengue 2 virus reduced from 12 days at 30 ºC to 7 days at 32–35 ºC in *Aedes aegypti* (Watts *et al.,* 1987). Dengue fever has been reported in several small island states in the Pacific where rainfall and local temperatures correlate with the southern oscillation index, a component of the El Nin˜o–Southern Oscillation phenomenon. Furthermore, a positive correlation was found between the index and dengue fever in 10 out of 14 such island states (Hales *et al.,* 1999).

In East Asia and the Pacific, 41–79% of the national domestic product comes principally from urban areas. Urbanization levels range from 16% and 19% for Papua New Guinea and Viet Nam, respectively, to 82% in the Republic of Korea, and the rate of urbanization in this region over the period 2000–2005 is expected to be about 3.5% and this trend will increase still further the risks of disease transmission (Githeko, unpublished data, 1999). In Asia, dengue fever and malaria (Bouma *et al.,* 1996) have been associated with positive temperature and rainfall anomalies. Urban developments in Asia and the surrounding regions may have a substantial impact on trends in the transmission of dengue fever. In some countries, such as Viet Nam, effects of past civil instability and slow economic growth may also be implicated for the increase in vector borne diseases.

2.3 Climate, climate change and vector borne disease in Nepal

Nepal is a small mountainous country situated on the southern slope of the Himalayas. Rapid changes in the altitude and aspect have given rise to a wide range of climatic conditions in Nepal (Nayava, 1974). As a result, almost all types of climates ranging from subtropical to alpine/arctic are found within a span of less than 200 km. According to the De Martonne classification, most of the eastern, central and western parts of the country are humid to very humid. Mid and far-western regions have mainly sub humid climate. The leeward side of the Annapurna range in the north of western and mid-western regions is largely semiarid to dry. Some portion of the western extremity of the country bordering India have humid climate due to the influence of winter rain in these regions. The southern plains (Terai) are also mainly sub humid (APN report, 2007).

Temperature in Nepal varies mainly with topographic variations decreasing along south-north direction following the geographical configuration of the country. The hottest part of the country is in the Terai belt where extreme maximum temperature reaches more than 40°C during summer. The valleys have especially pleasant climate with temperature range usually between 0 and 30°C. The coldest part of the country is high Himalaya in the north.

Eighty percent of the precipitation in Nepal comes in the form of summer monsoon rain (Nayava 1974; Shrestha 2000). The monsoon enters Nepal from southeast direction. Topography then plays the major role in the spatial distribution of rainfall. The windward side of the mountain barrier receives more rainfall than the leeward side. As a result, some high rainfall pockets along the wind ward side of the high mountain and Himalayas are observed with more than 4500 mm centered over southern part of Annapurna range and the driest part with less than 250 mm on the lee side of the same range.

The monsoon rainfall usually decreases from south to north and east to west (Shrestha 2000). During monsoon season most of the Tarai and Siwalik get more than 80% and the central mountainous regions receives between 75% - 80% of the annual total rainfall. However, the low precipitation area of western high altitude regions receives below 65% and rest of the country gets about 65% to 75% of the annual precipitation during the monsoon season (Devkota et al., 2006). The mean monsoon rainfall for Nepal amounts to 1422.8 mm (Shrestha, 2000). In general, during pre- and post-monsoon periods, thunder activities produce more precipitation in the east than in the west. However, during winter months, the western disturbances produce more precipitation in the western than in the eastern parts of the country. Winter is the driest season for Nepal.

Due to the altitude and orientation of the topography, considerable variation in precipitation is observed from place to place resulting in some places susceptible to floods and some places vulnerable to drought. Twenty four hour extreme rainfall analysis shows that the churia and southern plain area (Terai belt) are especially susceptible to flooding (APN report, 2007).

Malaria in its various forms was the cause of mortality in Nepal throughout the ages. Malaria was one of the most important causes of economic misfortune engendering poverty and intellectual standards of the nation and hampering prosperity and economic progress in every way.

There is no documented record about the prevalence of malaria in Nepal during nineteenth century except few historical descriptions. The first documented epidemiological survey dates back to 1925 by Major Philips of Indian Military service in Makwanpur and Chitwan valley. Out of 889 children examined,712 or 80% had enlarged spleen, the enlargement of spleen ranged from 65% to 100%.The mortality rate in children was estimated at about 43% among pahadis (hill people) and 17% among Tharus (tribal of the Terai areas).Up to that period it was further estimated that approximately two million cases of malaria(40% of the total population) occurred annually and ten to fifteen per cent among those resulted in death.

As a start, an operational field research on malaria was carried out at Hetauda, Makwanpur district to prove that field workers from Kathmandu can carry out malaria control activities and survive in highly malaria areas of Hetauda. The project unit was called Malaria control Unit for Gandaki Hydro Power Project.

In 1954, with the objective of controlling malaria mainly in southern terai belt of central Nepal,a large-scale malaria control project named Insect Borne Disease Control(IBDC) supported by USAID(then USOM) was started in Nepal. Another planned malaria control project was taken up in Rapti valley by HMG/WHO/USAID during, 1956-58 to obtain baseline data and to recommend an appropriate strategy for a malaria eradication programme.

National Malaria Eradication Programme (NMEP) was launched as a vertical programme in 1958, with the objective of eradicating the disease in a limited period of time from the country.

Since, the inception of the Malaria Eradication Programme, remarkable progress was achieved in controlling malaria. The major event in 1960's was the incrimination of An. minimus responsible for transmission of malaria at an altitude of 6500 ft MSL in Mugu district of Mid-western region.The virtual disappearances of An.minimus the primary vector with high anthropophilic index(>90%) and high Sporozoite rate(up to 16%) was also the magnificent achievement. The programme was well organized with regular monthly surveillance and indoor residual spraying with DDT. Annual Blood Examination Rate was more than 13% in all the years and reached up to 17% in 1964 and 1970. The highest API and AFI were recorded during the period 1966 was 2.4% and 0.52% respectively and lowest in 1968 was 0.4% and 0.031% respectively.

During the 1960's and 1970's VL ceased to be a public health problem which was mainly attributed to countrywide malaria eradication activities with DDT spraying. With the advancement of malaria eradication activities and improvement of malaria situation, insecticides spraying were reduced. After more than a decade of curtailment of insecticides spraying particularly in Southern Terai VL cases started reappearing and were first recorded in 1980 with the incidence rate of 1.5 per 100000 populations and case fatality rate of 5.88 percent. The highest CFR was in 1982 and the highest case incidence was in 2003.

VL is mainly confined to the southern plains of Eastern and Central regions bordering VL endemic districts of Bihar State of India. However, a few sporadic cases are occasionally recorded from other parts of the country. Approximately 6.5 million populations are estimated to be at risk of Kala-azar. A total of 28,424 cases with 582 deaths were reported during 1980-2006 and the Case Fatality Rate (CFR) varied from 0.23 to 13.16.

From 1980 to 1989 the incidence rate per 100,000 populations remained below 10 except in 1988 when the incidence rate was 17.18. The minimum incidence rate was 1.50 in 1980. The case fatality rate was 0 in 1985 and was as high as 13.16% in 1982.After 1989 the incidence rate remained quite high and reached up to 20 in 1992. From 1993 onward it was always above 33 and up to 54 in the year 2003, however, case fatality rate fluctuated between 3.63 in 1995 to 0.37 in 1993.Higher case incidence rate lower case fatality rate during the later part of the last decade indicates probably to the prompt and regular reporting of KA cases and also to the betterment of treatment of the cases at the hospitals.

Among many species of mosquitoes that transmit Japanese encephalitis virus (JEV), Culex tritaeniorhynchus (Diptera: Culicidae) is the most important vector in many south-east Asian countries. About 50,000 cases JE and 15,000 JE deaths are reported worldwide (Solomon et al.,1998). JE not only causes death but also leads to permanent and neuropsychiatric sequale. Japanese encephalitis (JE), one of the important mosquito-borne diseases in Nepal, is now expanding its prevalence up to a thousand cases per year (Reference). The disease regularly occurs in different parts of Nepal during the rainy season, corresponding with high densities of vector populations.

Japanese encephalitis (JE) was first recorded in Nepal in 1978 as an epidemic in Rupandehi district of the Western Development Region (WDR) and Morang district of the eastern development region (EDR). It is endemic in the Terai region of Nepal. There is little information on the occurrence of this disease in the densely populated Kathmandu valley. JE was confirmed in 40 residents of the Kathmandu valley, including 30 cases that had no history of travel outside the valley during the incubation period. Incidence was 2.1/100,000 and the case fatality was 20% (8/40) (Partridge et al., 2007). At present the disease is endemic in 24 districts namely Jhapa, Morang, Sunasari, Saptari, Siraha, Udayapur, Dhanusa, Mahottari, Sarlahi, Sindhuli, Rautahat, Bara, Parsa, Makawanpur, Chitwan, Nawalparasi, Rupandehi, Kapilvastu, Palpa, Dang, Banke, Bardiya, Kailali and Kanchanpur. Among them, 10 districts namely Jhapa, Morang, Sunsari, Parsa, Rupandehi, Dang, Banke, Bardiya, Kailali and Kanchanpur are affected most (Bista and Shrestha, 2005). Several studies on JE vectors in Thailand (Gould et al., 1974; Leake et al., 1986) revealed that, besides Culex tritaeniorhynchus, Cx. gelidus Cx. fuscocephala and Cx. vishnui may be involved in the transmission of JE virus. The JEV undergoes a zoonotic cycle in mosquitoes breeding in paddy-fields, domestic pigs, water birds and humans, and the humans are incidental hosts (Vaughn and Hoke, 1992).

Climate change will have significant and diverse impacts on human health. These impacts will include changes in infectious disease incidence like JE. From the socio-ecological view point, an outbreak of JE may be facilitated by two factors, i.e. global climate change and the modulation of agriculture practices. Temperature and precipitation are the proxy variables that have been representing the density level of mosquitoes (Gingrich et al., 1992; Lin and Lu, 1995). The disease dynamics are found in the Terai region; hence, longitudinal study is necessary in Terai, hills and mountains of Nepal for better understanding of the seasonal abundance of JE vector population and their associated environmental parameters.

Dengue fever is a mosquito-borne disease which in recent years has become a major international public health concern. Dengue virus, the causative agent of this disease, is transmitted by Aedes mosquitoes (Aedes aegypti and Aedes albopictus). With globally about 50-100 million cases of dengue fever every year, it is one of the important and rapidly spreading causes of health problems in world. Dengue fever and its more severe and often fatal forms namely dengue hemorrhagic fever and dengue shock syndrome are emerging health problems in many part of the globe, and to date there is no specific drug or vaccine to combat or prevent the disease. Infection with dengue viruses produces a spectrum of clinical illness ranging from a nonspecific viral syndrome to severe and fatal hemorrhagic disease. Important risk factors include the strain and serotype of the infecting virus, as well as the age, immune status, and genetic predisposition of the patient.

No cases of dengue virus infection had been reported from Nepal until 2004 when Pandey et al., (2004) for the first time reported a case of dengue fever from Nepal. Thus, dengue fever (DF) is an emerging mosquito-borne disease in Nepal. Like other vector-borne diseases, outbreaks of DF have been related to travel and frequent movement of people which is common due to the porous border between Nepal and India and the intense socio-cultural and economic activities in cross-border areas. Initially, there were reports of suspected DF outbreaks in Banke district. The clinical observation, pathological and laboratory investigation results then proved introduction of DF in Banke, Bardiya, Dang, Kapilbastu, Parsa, Rupandehi, and Jhapa districts. A total of 32 suspected and confirmed DF cases were recorded. Two suspected, 7 probable and 23 confirmed DF cases were recorded during the 2006 outbreak. Seventy-five per cent of DF cases were reported in the month of October and a few cases were reported in September and November of that year. Only 11 per cent patients had a travel history to India in the past two weeks prior to clinical manifestations of DF, suggesting the possibility of local transmission in Nepal. Indeed, Aedes aegypti was identified in five major urban areas of the Terai region suggesting that DF transmission may occur locally at least in these Terai areas if imported cases with viraemia are introduced (SEARO, 2006). Nepal has no dengue surveillance programs, and health professionals do not usually consider dengue as a differential diagnosis when attending fever cases. A sero-epidemiological study on dengue viruses conducted in the Terai region of Nepal from August to December 2007 showed that 28% of the febrile patients were positive for dengue infection. In view of the report of the outbreak in 2006 it indicated that dengue is firmly established in the Terai region of Nepal. Thus, it is expected that more extensive outbreaks can occur in the coming years with the start of rainy season (Pandey, 2008).

The first outbreak of dengue occurred in Nepal in 2006. The cross-sectional entomological survey conducted in 2006 identified the presence of Ae. aegypti in five major urban areas of Terai regions bordering India, i.e., Biratnagar (Morang), Birganj (Parsa), Bharatpur (Chitwan), Tulsipur (Dang) and Nepalganj (Banke). Similarly, an entomological survey conducted in Kathmandu Valley in 2009 revealed the presence of Ae. aegypti in Kathmandu (Gautam et al. 2009). Before these reports, A. aegypti had not been recorded in Nepal. One of the reasons why this disease is becoming more common in some regions of the world, and for its continuing spread to geographical regions where it was not present before, might be climate change. For example, it is expected that the increased temperatures due to climate change may create conducive environments to the breeding of these mosquito species in areas where it used to be less hotin the past. More research is certainly needed to discern the attribution of climate change from that of other factors (Dhimal and Bhusal, 2009).

In September 2010, many cases of dengue fever along with the presence of its potential vector A. aegypti were reported from Butwal, Chitwan and Damauli. However, detailed studies in these areas have not been carried out yet. Elsewhere in the world, social and environmental factors including increased urbanization, particularly of poor populations lacking basic health services, as well as the rapid expansion of international travel and trade have been linked to the global epidemic of dengue. Climate change may also affect transmission today, as dengue mosquitoes reproduce more quickly and bite more frequently at higher temperatures. However, detailed study on dengue vectors has not been carried out in Nepal, regarding the possibility of transmission by the vectors and the environmental conditions associated with their occurrence and activity.

METHODOLOGY

3.1 Formation of Study Team

The multidisciplinary team consisting of climate change expert, environmentalist, meteorologist, senior public health experts, and statisticians were formed. The interdisciplinary team held series of meeting to develop the concepts and collected the relevant data. Team was formed to develop some recommendation and to take further step in developing climate change adaptation strategy.

3.2 Study Design

Both the qualitative and quantitative method was used in this study. Desk review was done to assess the existing vector borne diseases control program in Nepal. Focus group discussion, in-depth interview and key informants interview were carried out with the health professionals, and local peoples. Questionnaire survey was carried out with the elders aged above 60 years for KAP survey. Climate data on temperature and precipitation were collected from Department of Hydrology and Meteorology and if applicable it was collected from study areas as well. Time series log-linear regression analysis has been done to assess the relationship between climatic factors and vector borne disease

3.3 Study type

It was mixing of both retrospective and cross sectional study. The retrospective information was used for ecological information, for instance maximum and minimum temperature, relative humidity (morning and evening), rainfall, to access the association with occurrence of malaria. Similarly, cross section information was used to explore the knowledge, attitude and practice related to climate change among the respondents more than 60 years.

3.4 Study site

Three altitudinal heights (below 500m, 500- 1500m and above 1500m) were mapped based on the GIS mapping system of Department of Health Services. Primary Health Care Centre (PHCC) were selected from five development region (Eastern region, Central Region, Western Region, Mid-Western Region and Far Western Region) based on those altitudes. List of the selected PHCCs within districts and their altitude has been listed in the below:

Development Region	Altitude range (population catchment area according to altitudinal base)		
	Below 500 meter	**500 to 1500 meter**	**1500 meter above**
Eastern Development Region	Mangalbare PHCC, Morang GPS Location: NA	Phikal PHCC, Ilam Geographical coordinates: 26° 54' 0" North, 87° 56' 0" East	Dungeshangu PHCC, Taplejung GPS Location :Taplejung Latitude: 27 21' 00" Longitude: 87 40' 00"
Central Development Region	Lalbandhi PHCC, Sarlahi GPS Location: NA	Kapilakot PHCC, Sindhuli GPS Location: NA	Dolakha PHCC, Dolakha GPS Location: NA
Western Development Region	Basantpur PHCC, Rupandhehi GPS Location: Altitude: North: 27^0 20' 00" to 27^0 47' 25" East: 83^0 12' 16" to	Kisti PHCC, Kanski GPS Location: Altitude: 1085 meter North : 28^0 09' 78" East:83^0 57' 75"	Lete PHCC, Mustang Elevation: 2489m GPS Location: North:$28^0$38'022" East :$83^0$36'411"

	83^0 38' 7"		
Mid-Western Development Region	Khajura PHCC, Banke GPS Location: Altitude: 151meter North: 28^0 06"89 East: $81^0$34' 85"	TopJari PHCC Rukum GPS Location: Altitude: 695 meter North :$28^0$36'16" East :$82^0$11' 41"	Kalikakhetu PHHC Jumla GPS Location: Altitude; 2235 meter North: $29^0$14' 005" East: $81^0$55' 93"
Far Western Development Region	Malakheti PHCC, Kailali GPS Location: Altitude, 266 North: $28^0$06'90" East: 81^0 34' 873"	Patan PHCC, Baitadi GPS Location: Altitude: 1206 meter North : 29^0 28' 027" East :$80^0$33' 40"	Deolekh PHCC, Bajhang GPS Location: Altitude; 2529 North: 29^0 33' 33" East: $80^0$43' 11"

3.5 Sample size

For ecological study:

Fifteen PHCCs were selected from five development regions and all three ecological belt, three from each region based on altitudinal transect, one PHCC from Terai, one PHCC from mountain and one PHCC from himalaya region for study of the vector borne diseases and climate change. The ecological data related to climatic factors and occurrence of malaria was collected from all eco-developmental region during 2004 to 2009 and mean value was calculated to assess the association.

For cross-section study:

The study used the respondents aged 60 years and above to assess the knowledge, attitude and practice related to climate change, where 702 respondents were used to serve the purpose and calculated using the given standard statistical method below in text box. The response rate was only 77.77% with final sample size to be 546 for the KAP study.

Sample size calculation formula for cluster sampling

$n=4pq/d^2$

Where,

n = sample size

P= 50%, probability assumption

d= 10% of 50 (0.05)

Design effect = 1.5

Assume non response rate = 20%

Sample size = 702

3.6 Sampling technique

The multistage cluster sampling technique was carried out for KAP survey. Fifteen PHCC (annex – VI) therefore had been selected from the entire western development region according to the above mentioned altitude, three PHCC from each development region. One PHCCs was selected from each altitudinal height through lottery method, if it has more in number than study requirement from same height, otherwise judgmental sampling method technique was adapted. For the KAP survey, the western development region was selected judgmentally.

Selection of PHCC in western region for KAP survey

Three PHCCs were selected each from one altitude. Three VDCs (Annex VII) were selected from each PHCC and three wards randomly selected from each VDC. Of those VDCs, the sampling frame was computed and the sample was taken proportionately to the size.

3.7 Justification for the selection of study sites

Climatic variations are being observed at different altitudes ranging from flat to mountain region. Vector borne diseases that were previously reported only from Terai region and same in valley are now being reported from higher altitudes as well. Selection of different altitude therefore at different ecological regions was thought to be important to study the vector borne disease and climate change. Vector borne diseases prevalence according to ecological strata of Nepal, is believed to differ widely.

3.8 Data collection tools and techniques

3.8.1 Desk review for secondary information collection:

Desk review was carried out as secondary information to assess climate change and vector borne diseases. The relevant literature on climate change and public health was assessed through international and national journal (Medline) and other concern organization's websites like such as World Health Organization (WHO), Intergovernmental Panel on Climate Change (IPCC), and relevant national concern body. We collected more than fifteen published international article on health impact of climate change. Here, on reviewing the article, we were specific on vector borne and diarrheal diseases. More than ninety percent were review articles and few of articles were original article which had incorporated time trend analysis of climatic data and the health effects over a long period of time. In addition, national grew information was reviewed through concerned ministry as well as resource center.

3.8.2. Primary data collection:

3.8.2.1 Qualitative data collection:

Focus group discussion was carried out in each PHCC to local people including health professional, teachers, and elderly person from community, towards vector borne disease and climate change. Key informants interview was used to document the existing vector borne disease case reporting referring and treatment policy Government of Nepal through various level of expertise like health professionals.

3.8.2.2 Quantitative data collection:

Questionnaire tools were used for interviewing elders' (age above 60) people for KAP study. A knowledge, attitude and practices questionnaire document was designed to elicit information from Nepali people on climate issues. Health facility data was collected from Primary Health Care Centre (PHCC) using standard format and analyzed through log regression analysis. For preparing the recommendation guideline on vector borne diseases we had formulated advisory committee and technical working groups formed. Proposed Guidelines on vector borne diseases have been developed to recommend the l Government of Nepaal for preparing the development of action plan to address the impending problems of vector borne disease due to climate change, based on findings of this study and consultative meetings and discussions with health professional and local stakeholders.

3.9 Study Duration

The study was conducted during Shrawan 2068 to Asar 2069 (August 2011 to June 2012).

3.10 Data entry and analysis

Collected data of vector borne disease and climate were analyzed by SPSS 16 version for the log linear regression analysis. Vector borne diseases data was entered on MS excel and trend analysis was made representing in figure and graphs.

3.11 Study Variables

The study variables on Vector borne diseases, climate change (temperature, precipitation and humidity) are as given.

Dependent Variables:

Occurrence of Vector borne diseases,

Knowledge, Attitude and Practice of elderly

Independent Variables: Climate parameters: temperature, humidity and precipitation.

Confounding variables: Existing public health programs of MoHP, various health programs of GoN and other NGOs, weather, geographic variations, and socio-economic status, use of pesticides.

3.12 Limitations of the study

Health facility data are collected only from PHCCs and district. The actual range of altitudes of catchment area of PHCCs could not be assessed. Only disease data obtained, no primary data from the patients recorded. The entire required vector borne diseases statistics could not be assessed from selected PHCCs due to lacking of systematic management of data. Collection of patients personal history was only limited to health institution professionals. GPS Location of some PHCC could not be included due to technical error in GPS.The trend analysis has been done only for malaria and not for other vector borne diseases. PHC level health statistics could not be fit into the analysis with climatic parameters and only the district level health statistics of vector borne disease considered for the purpose.

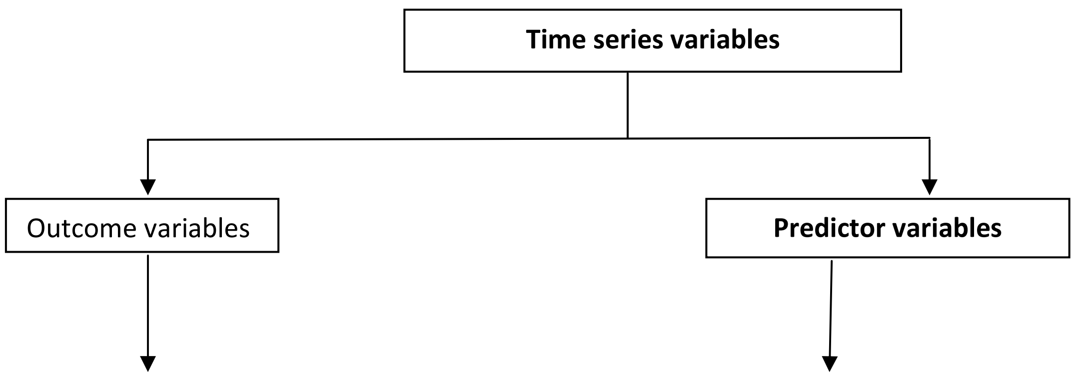
3.13 Reliability and Validity

To ensure the validity of participants' responses, the interviewers were trained on data collection technique, probing technique, skipping pattern and ethical consideration. Sample size was calculated using standard statistical methods and information were analyzed as guided by internationally accepted statistical tool. Relevant expert meetings were held during the process of tools development as well before the team moved to the field for the data collection. During field work, the interviewers were supervised and completed questionnaires were collected at the end of each day. The collected questionnaire was reviewed for missing information to ensure completeness and the problem identified on the same day. To maximize the reliability of the quantitative data, standard tool was used for individual interview. Similarly, the tools were first developed in English and later translated into Nepali to make sure that the respondents understood the questions and consistency maintained during interviewing.

CHAPTER IV

FINDINGS

Time Series Analysis



Malaria **Climatic variables**

Meteorological

Temperature (Max and Min)

Humidity (Morning and Evening)

4.1 Time Series Data Analysis

Initially, Univariate descriptive analysis of the collected data was conducted, followed by univariate and bivariate time series analysis. Results from these preliminary analyses were used for appropriate time series models and conducting further explanatory analysis.

DESCRIPTIVE ANALYSIS

This involved plotting of original (observed) data for each variable to visually check any fluctuations or increasing/decreasing trend over the selected six-year period.

UNIVARIATE TIME SERIES ANALYSIS

Univariate time series analysis consisted of three main parts.

Running of sequence plots

Initially, sequence plots for each time series was constructed.

Identification of different components of a time series

Any time series usually consists of three different components – trend, seasonal, and irregular.

Checking stationary and lag period (for autocorrelation) for each series

This was done using two approaches – plots of autocorrelation function (ACF) and partial autocorrelation function (PACF).

BIVARIATE TIME SERIES ANALYSIS

Scatterplots

Scatterplots were used to identify correlations between two time series variables on interval scale and to produce the best-fit curve. In this analysis, LOWESS curve was used that possibly better demonstrated the relationships.

Cross-correlation

Cross correlation was used as a standard method of estimating the degree to which two series were correlated (how values in one series affected the values in the other) at different time lags. The cross correlation coefficients range between -1 and +1. Cross-correlation function (CCF) of disease data (malaria) was plotted with the climate data. These plots indicated the time lags (in months) for which malaria occurrences had strongest correlation with each predictor.

TERAI REGION CLIMATIC DATA ANALYSIS

Table 1: Descriptive analysis of climatic parameters of Terai regions

Descriptive analysis of Climatic parameters of Terai region							
Year		TEM_MAX	TEM_MIN	Rainfall	RH_MOR	RH_EVE	MALARIA
2004	Minimum	19.22	8.98	0.00	76.14	57.10	21.00
	Mean	30.42	18.92	152.00	88.00	72.00	53.00
	Maximum	35.72	26.08	504.26	96.86	83.30	85.00
2005	Minimum	22.18	9.30	0.00	61.38	36.80	20.00
	Mean	31.18	20.61	138.00	83.00	63.00	51.00
	Maximum	37.80	25.80	520.94	93.96	79.98	82.00
2006	Minimum	22.48	8.72	0.00	70.10	50.60	15.00
	Mean	31.13	19.24	126.00	86.00	69.00	63.00
	Maximum	35.32	26.24	411.22	97.46	79.36	126.00
2007	Minimum	21.72	7.62	0.00	65.90	43.64	13.00

	Mean	30.47	18.89	189.00	85.00	67.00	65.00
	Maximum	36.48	25.86	729.80	94.80	80.90	144.00
2008	Minimum	22.48	9.00	0.00	64.98	42.68	19.00
	Mean	30.68	18.82	159.00	85.00	68.00	86.00
	Maximum	35.96	25.78	534.10	95.16	78.82	209.00
2009	Minimum	22.62	10.46	0.00	63.52	54.62	30.00
	Mean	31.00	19.00	138.08	84.00	67.00	83.00
	Maximum	36.62	26.20	618.50	96.46	83.24	116.00
Total	Minimum	21.78	9.01	0.00	67.00	47.57	20.00
	Mean	30.81	19.25	150.00	85.20	67.70	67.00
	Maximum	36.32	25.99	553.1	91.2	80.9	127.0

The initial data description consisted of summarizing all the variables under study. The yearly maximum, minimum and mean values of each of the variables were computed for the six years (2004–2009) under the study as shown in the above table. Apparently there were no significant changes in minimum, maximum and average value of maximum, minimum temperatures, relative humidity (morning and evening) over six years. However, maximum rainfall showed some fluctuations. Maximum malaria cases showed unusual trend, the number started decreasing from 2004 to 2005 with a peak in 2008 and again decreasing. Fluctuations in number of malaria cases were observed with abrupt rise in 2008.

Monthly averages of original (observed) data for each variable – namely, temperature (maximum and minimum), rainfall, relative humidity (morning and evening) and malaria cases are plotted to show the graphical interpretations and analysis. All variables contained monthly values from January 2004 to December 2009.

Climatic analysis of Terai region

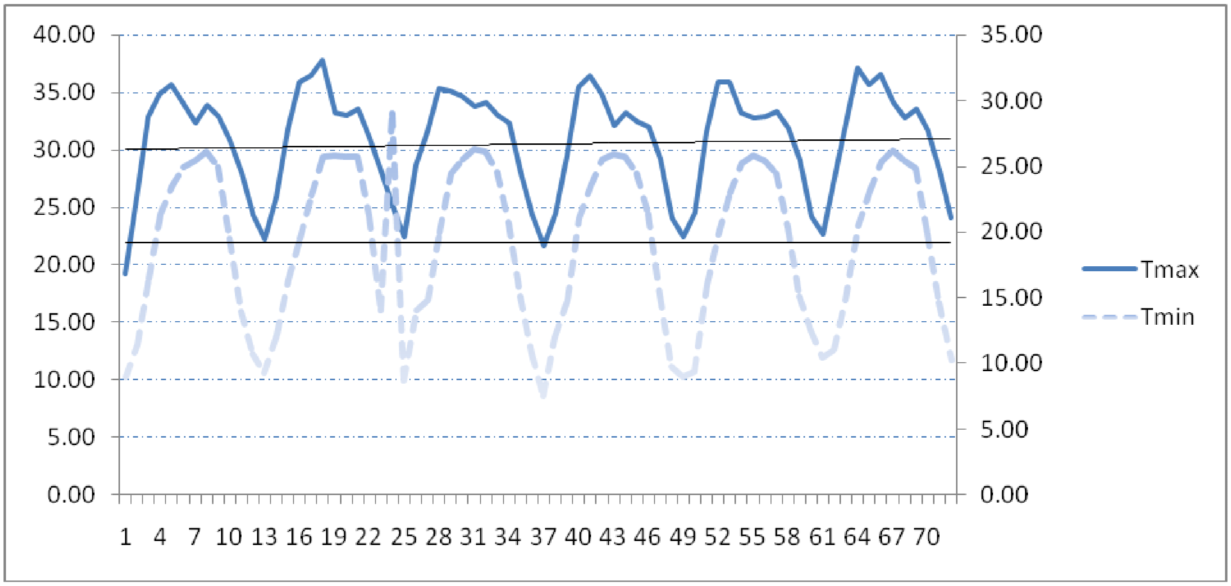


Figure 1: Monthly temperatures (maximum and minimum) from 2004 to 2009 of terai region

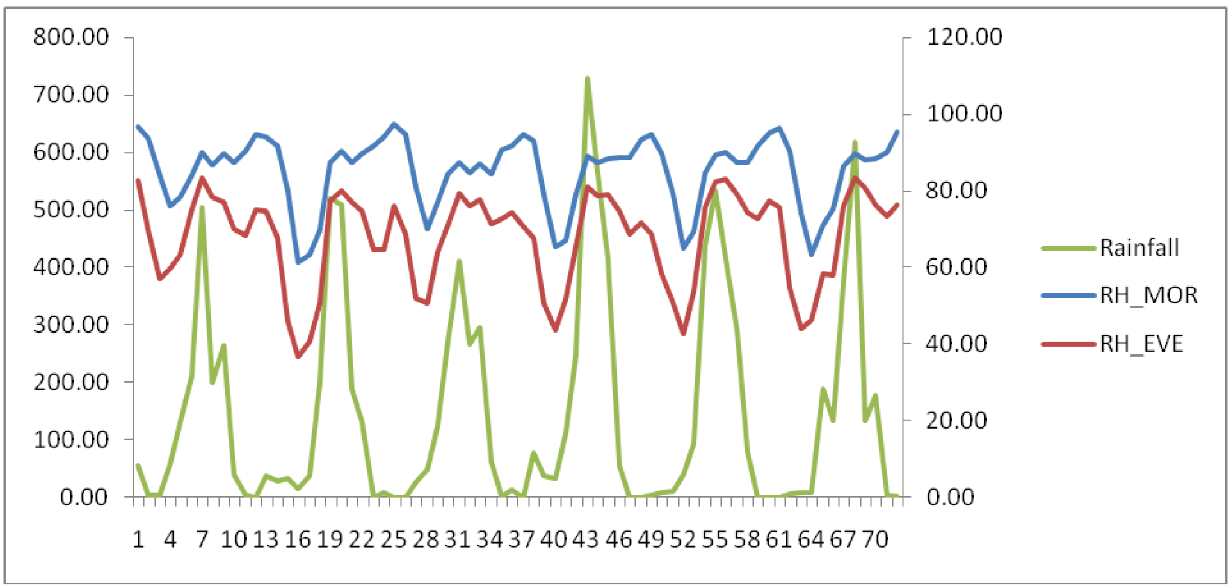


Figure 2: Monthly relative humidity of morning and evening (plotted on secondary Y-axis) and rainfall from 2004 to 2009 of terai region

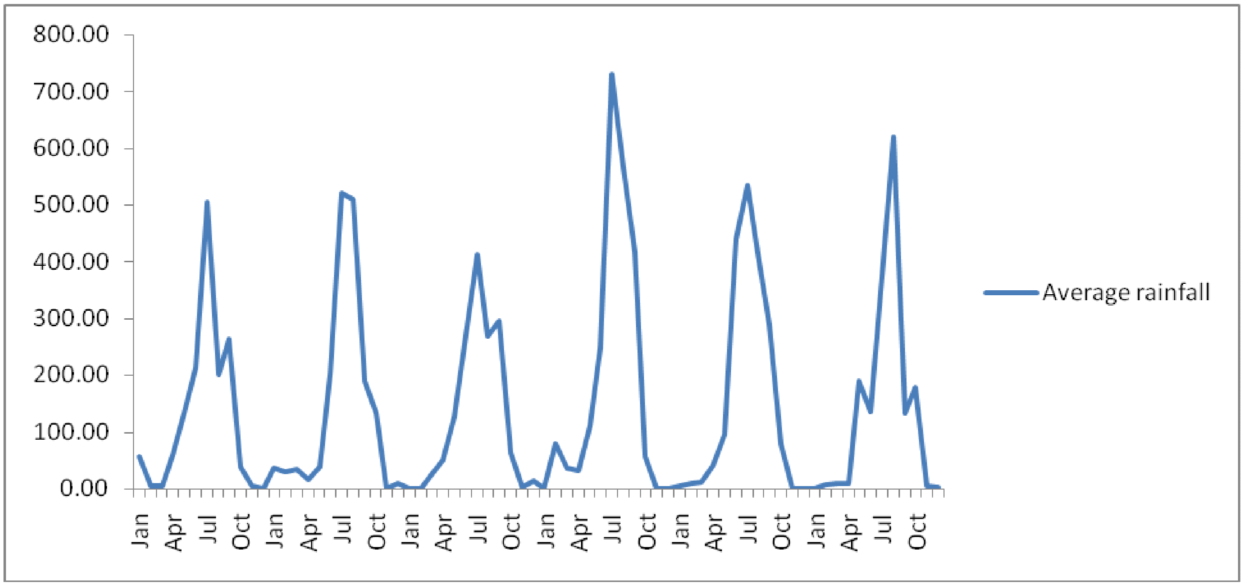


Figure 3: Monthly average rainfall during from2004 to 2009 of Terai region

In the figure above it appeared that there were no substantial changes in maximum and minimum temperature over the period. At one point of time, minimum temperature is exceeding the maximum temperature. However, relative humidity and rainfall showed a fluctuating pattern.

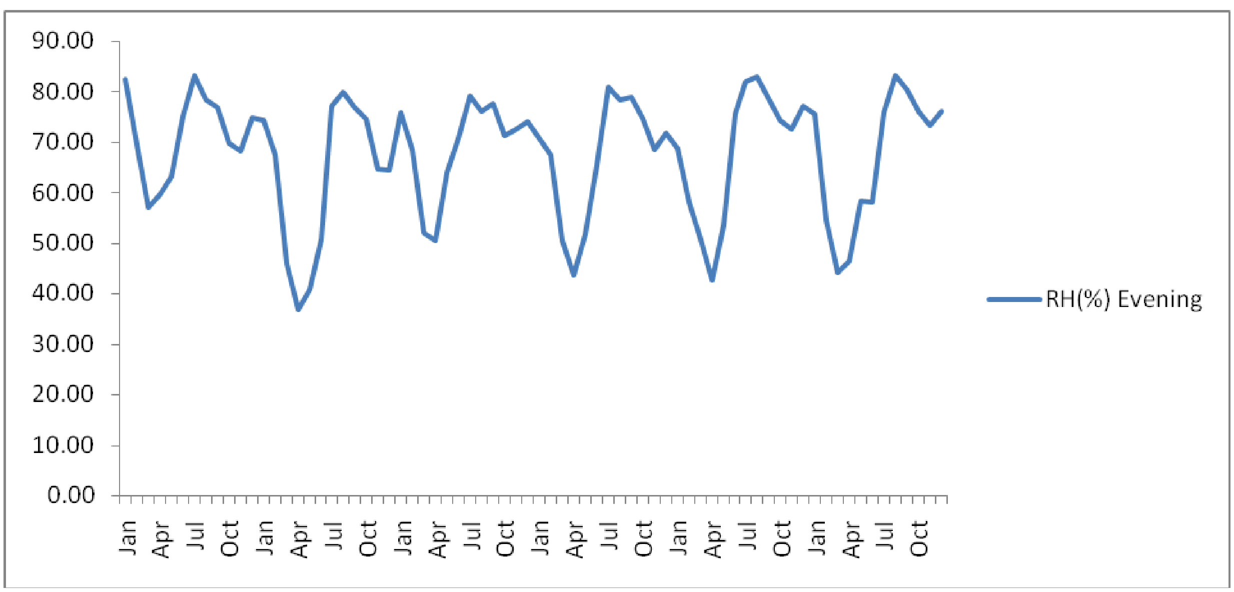


Figure 4: Monthly relative humidity (evening) from 2004-2009 of Terai region

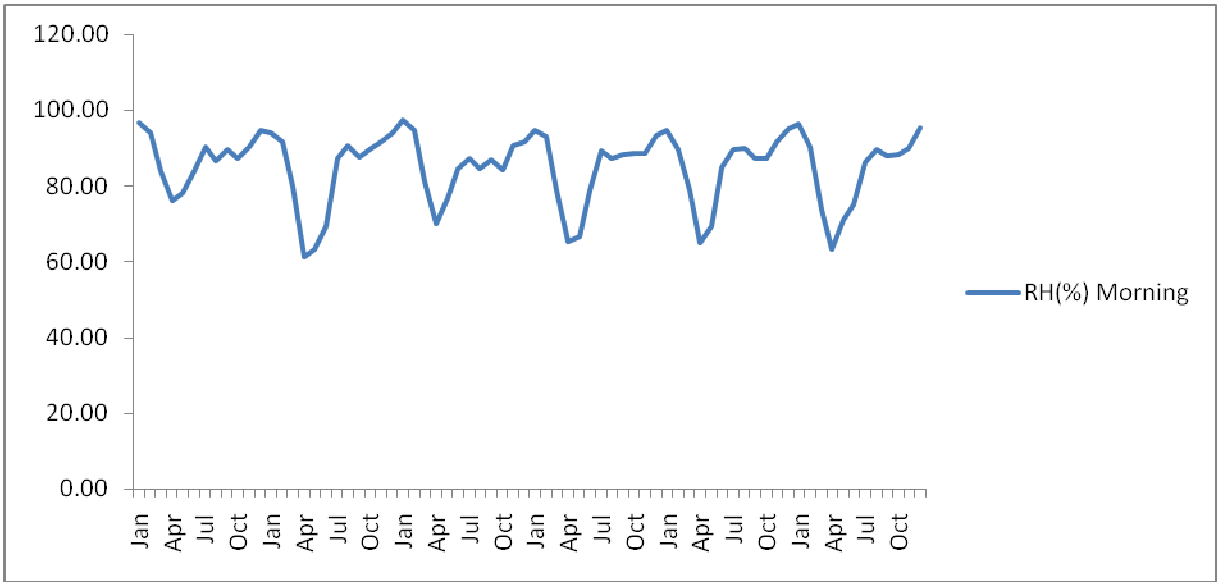


Figure 5: Monthly relative humidity (morning) from 2004-2009 of Terai region

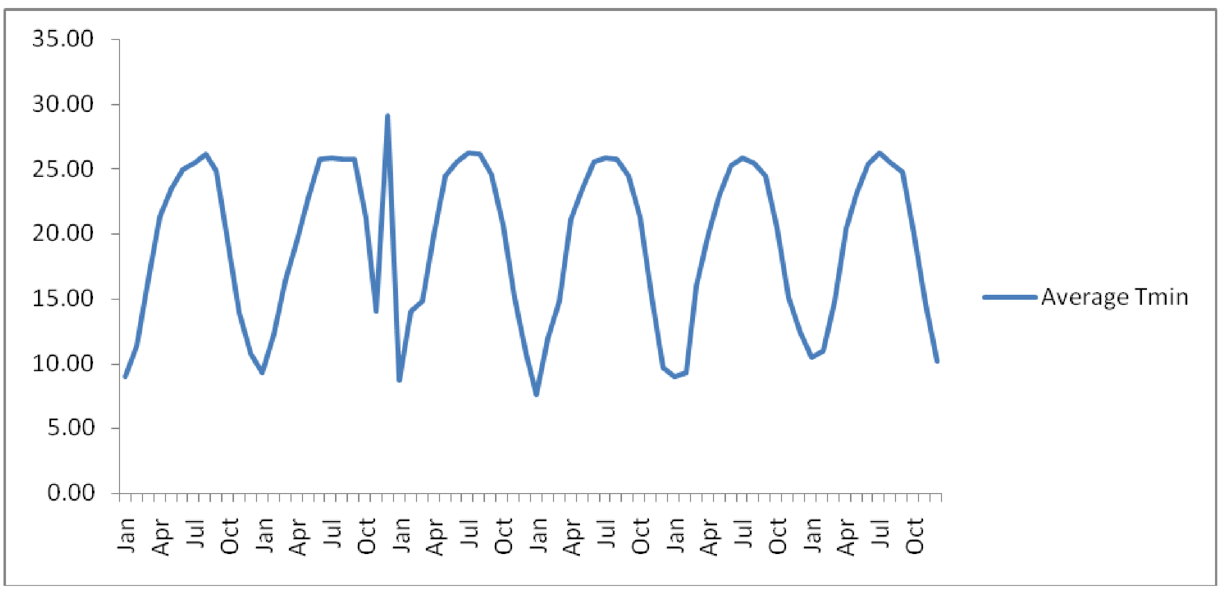


Figure 6: Monthly average minimum temperature from 2004-2009 of Terai region

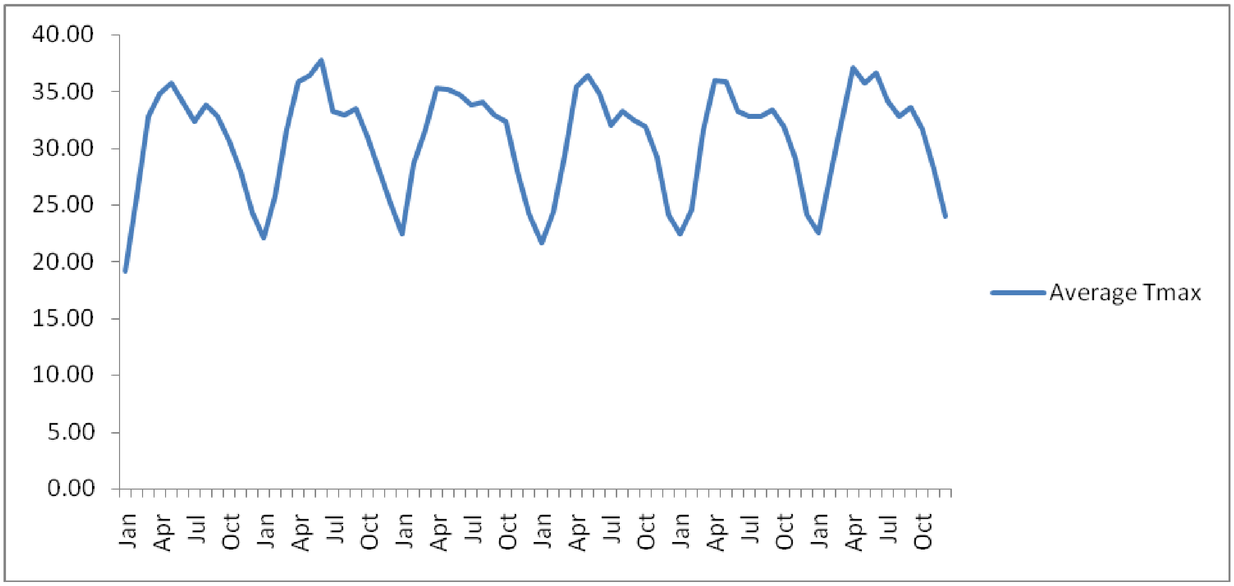


Figure 7: Monthly maximum temperature from 2004-2009 of Terai region

MAXIMUM TEMPERATURE: SEASONAL

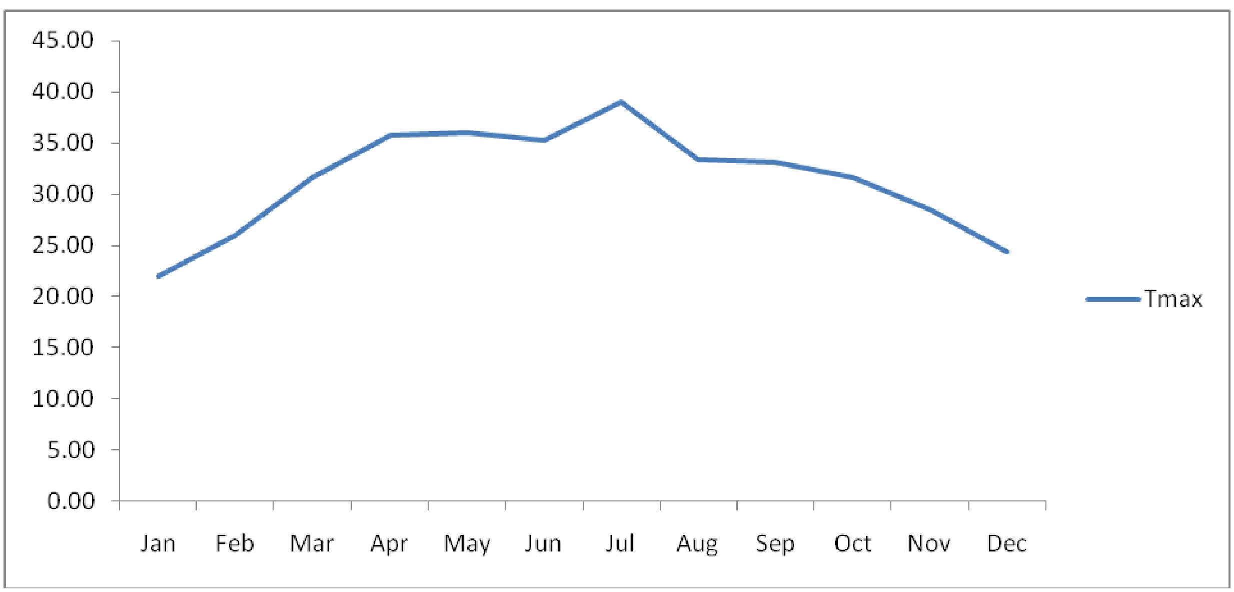


Figure 8: Overall seasonal pattern of maximum temperature from 2004-2009 of Terai region

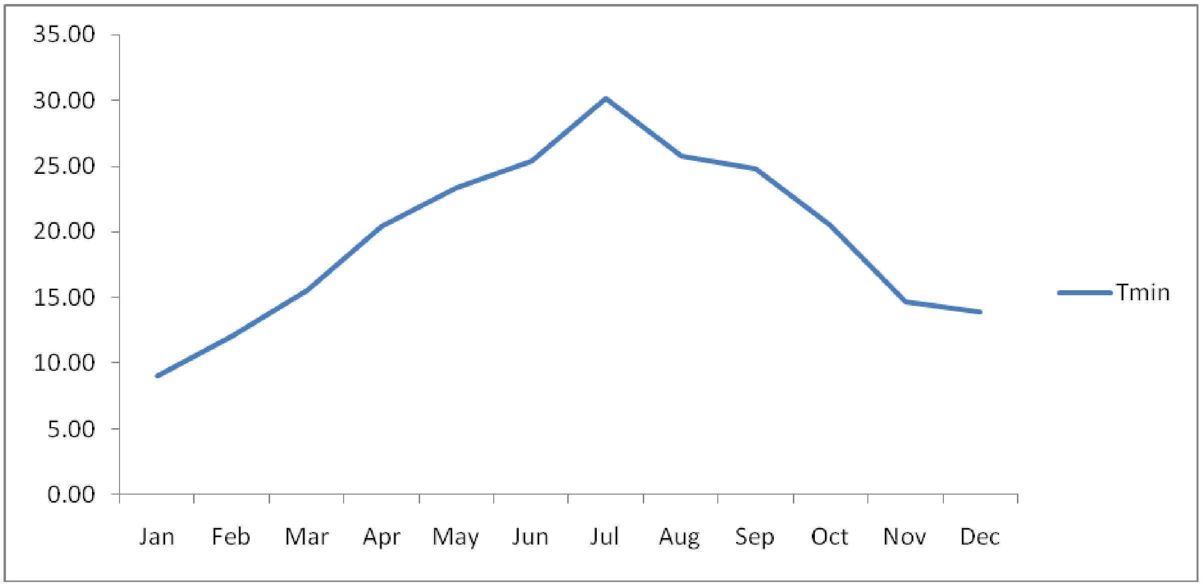


Figure 9: Overall seasonal pattern of minimum temperature from 2004-2009 of Terai region

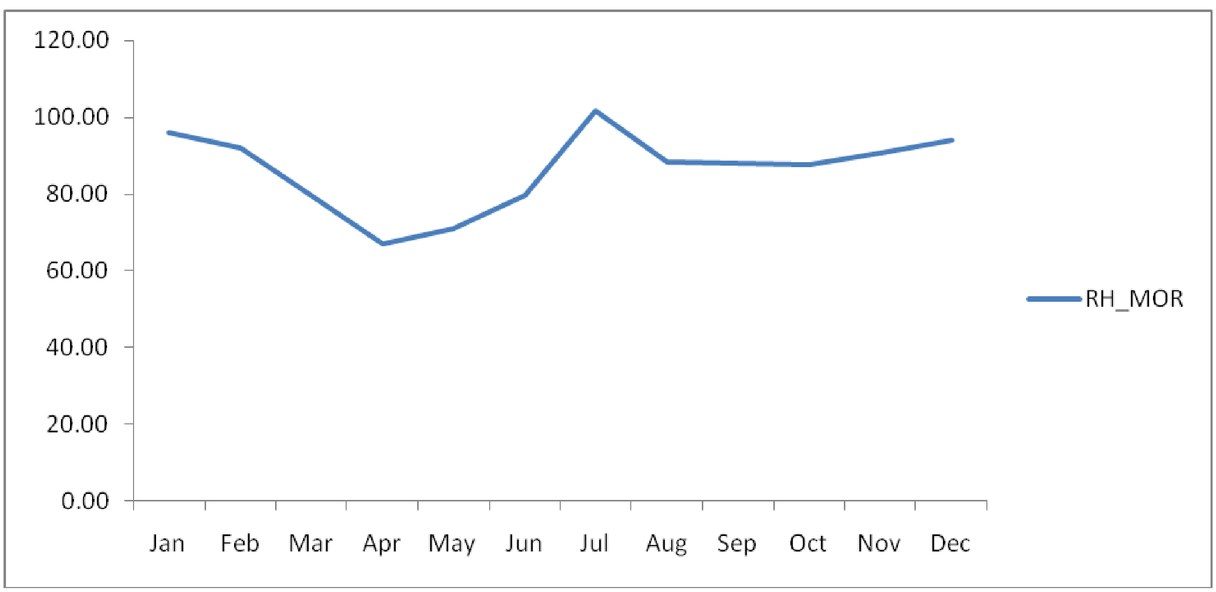


Figure 10: Overall seasonal pattern of relative humidity (Morning) from 2004-2009 of Terai region

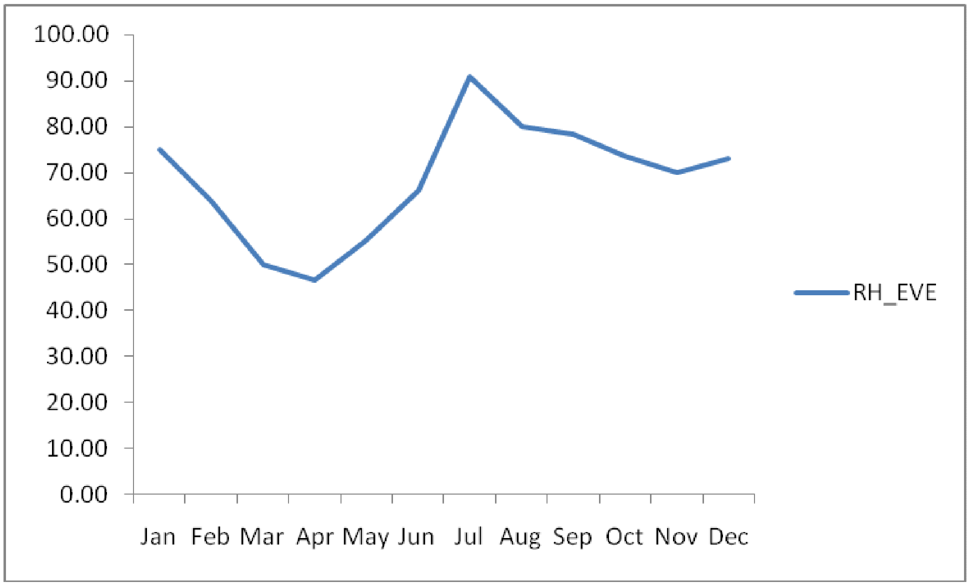


Figure 11: Overall seasonal pattern of relative humidity (Evening) from 2004-2009 of Terai region

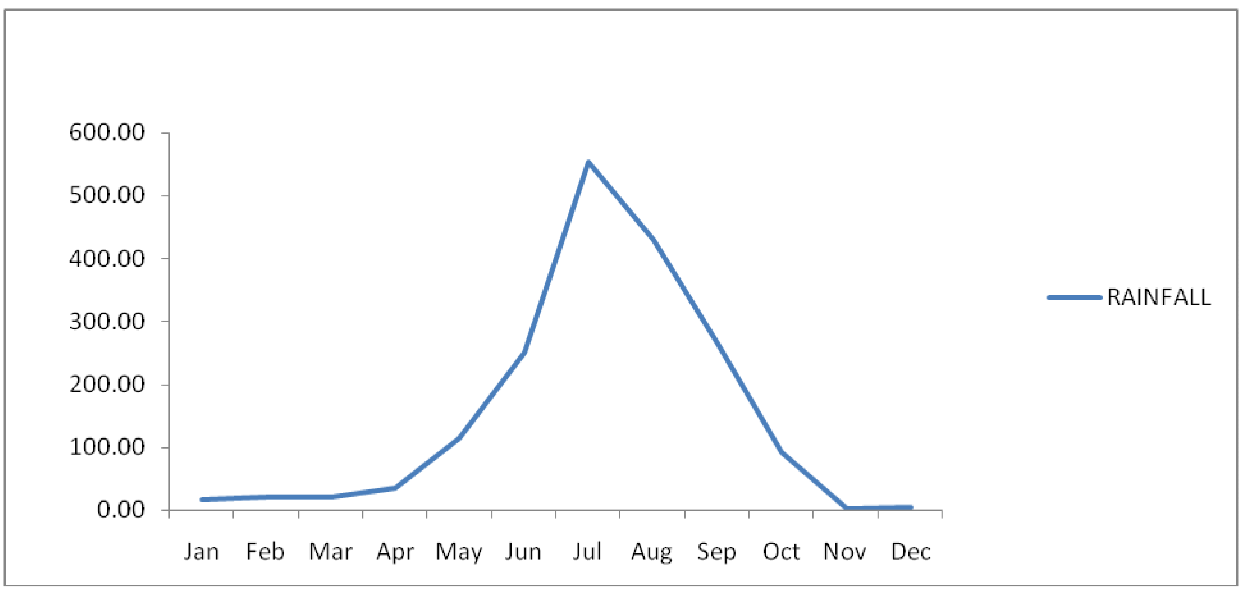


Figure 12: Overall seasonal pattern of rainfall from 2004-2009 of Terai region

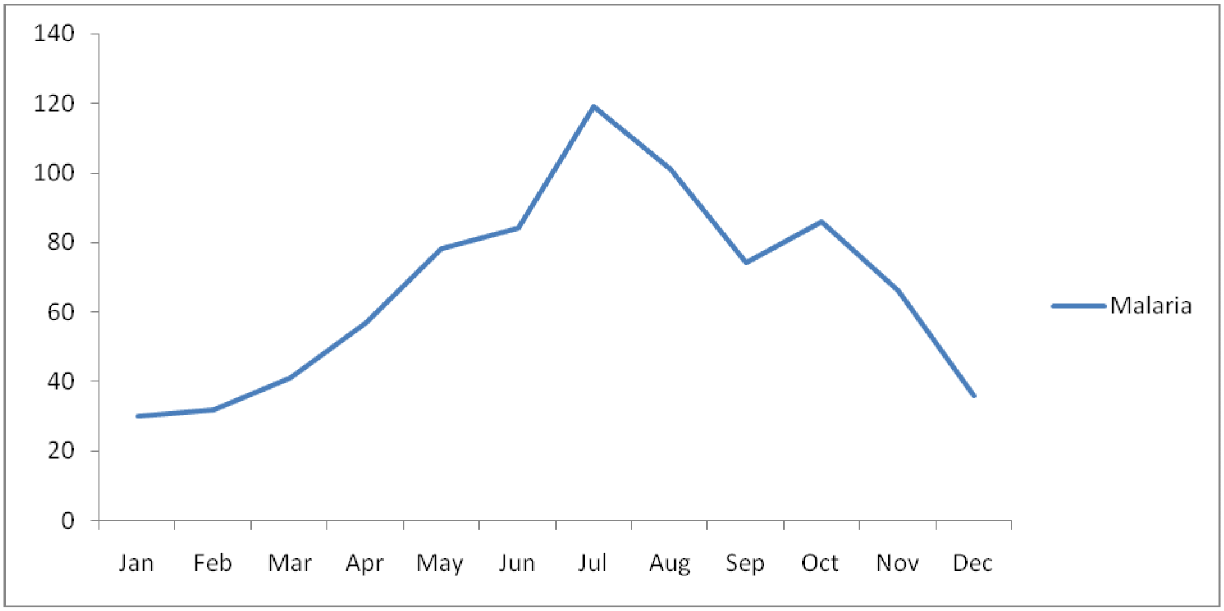


Figure 13: Overall seasonal pattern of malaria from 2004-2009 of Terai region

Table 2: Overall seasonal pattern of different variables during 2004-2009 of flat region

Variable	Months	
	Higher value	**Lowest value**
Maximum temperature	Jul	Jan
Minimum temperature	Jul	Jan
Relative Humidity (Mor)	Jul	April
Relative Humidity (Eve)	Jul	April
Rainfall	Jul	Dec
Malaria	Jul	Jan

The autocorrelation and partial autocorrelation plots of each variable are shown in Fig

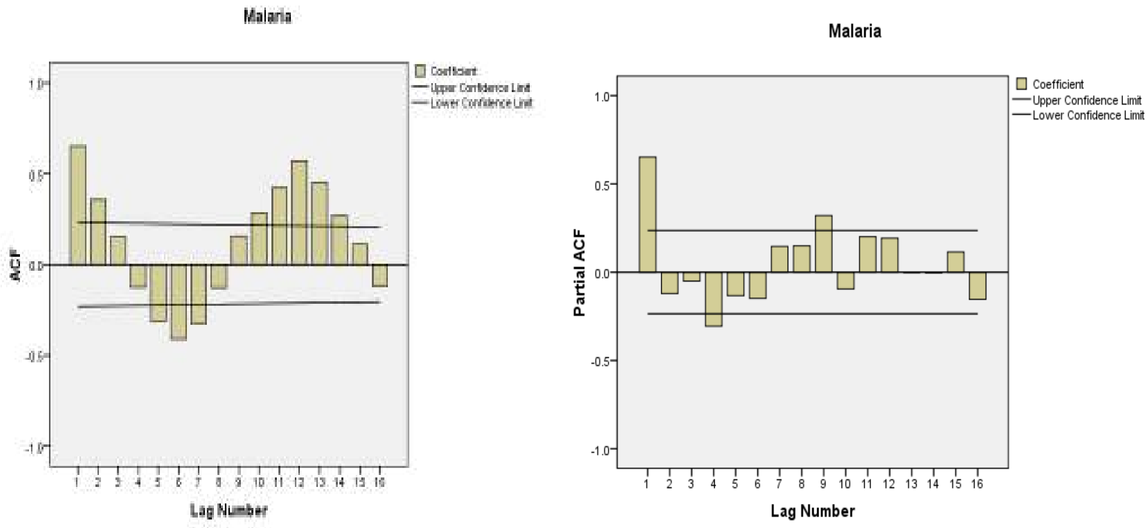


Figure 14: Auto-correlation and partial auto-correlation plot of malaria, Terai region, 2004-2009

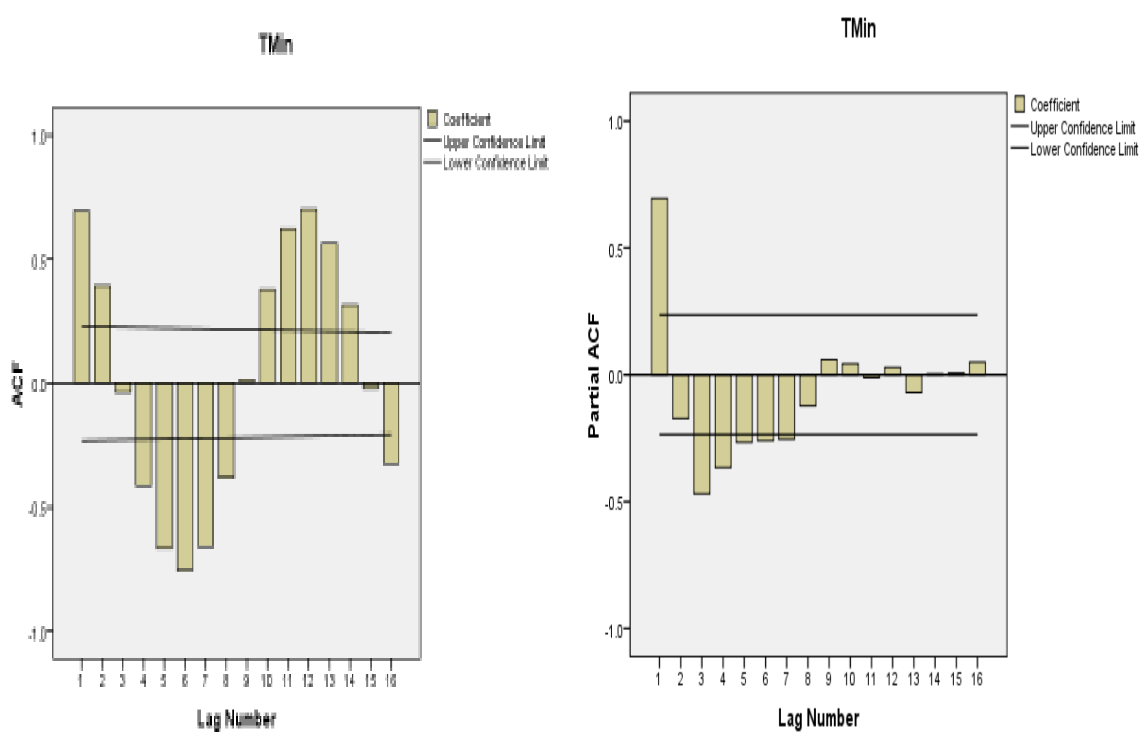


Figure 15: Auto-correlation and partial auto-correlation plot of Tmin, Terai region, 2004-2009

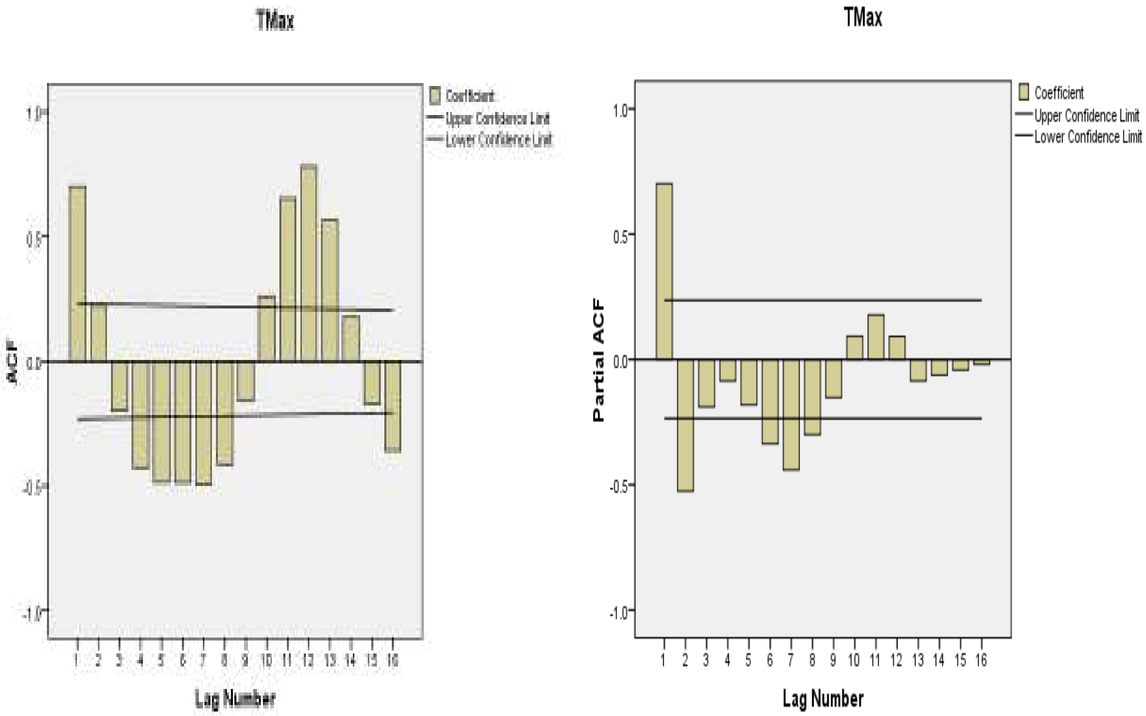


Figure 16: Auto-correlation and partial auto-correlation plot of Tmax, Terai region, 2004-2009

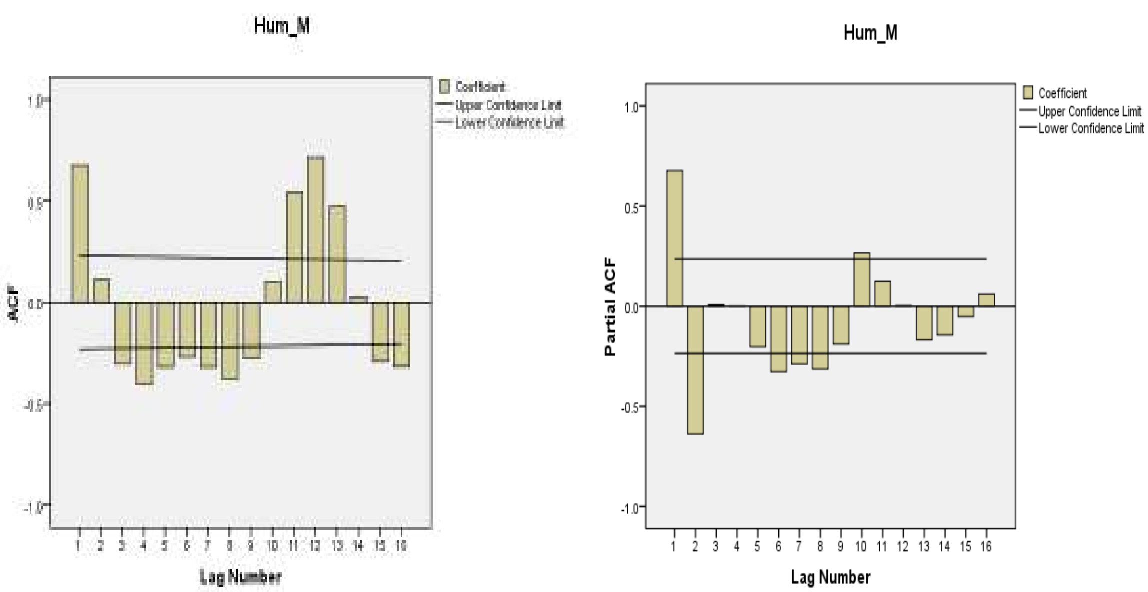


Figure 17: Auto-correlation and partial auto-correlation plot of Relative Humidity (Morning), terai region, 2004-2009

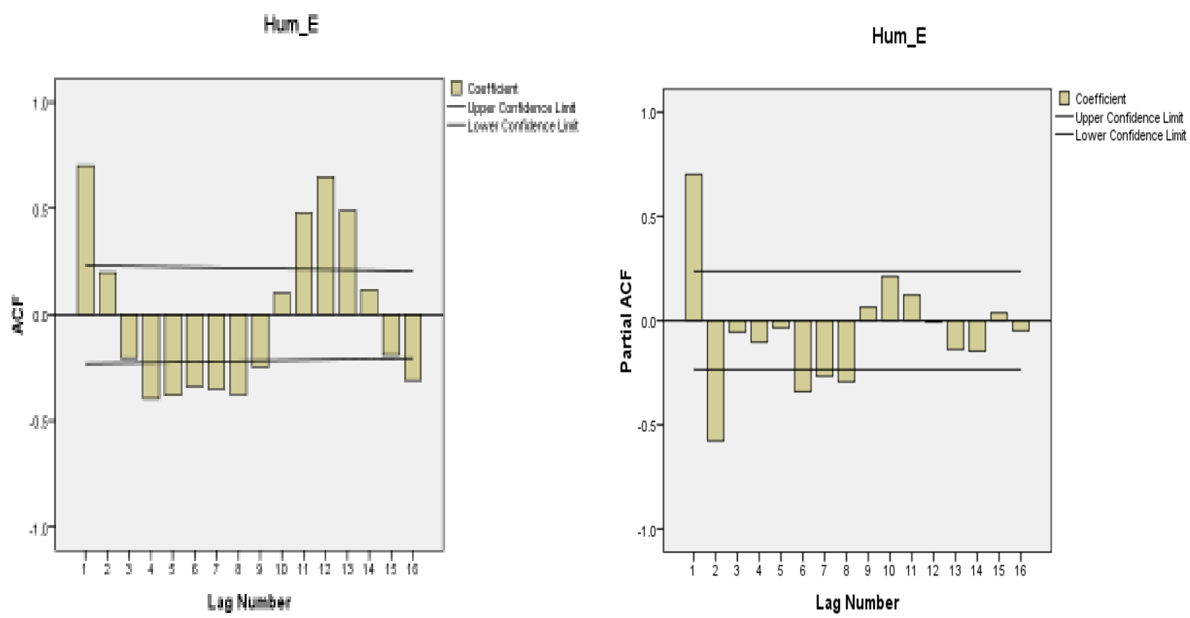


Figure 18: Auto-correlation and partial auto-correlation plot of Relative Humidity (Evening), Terai region, 2004-2009

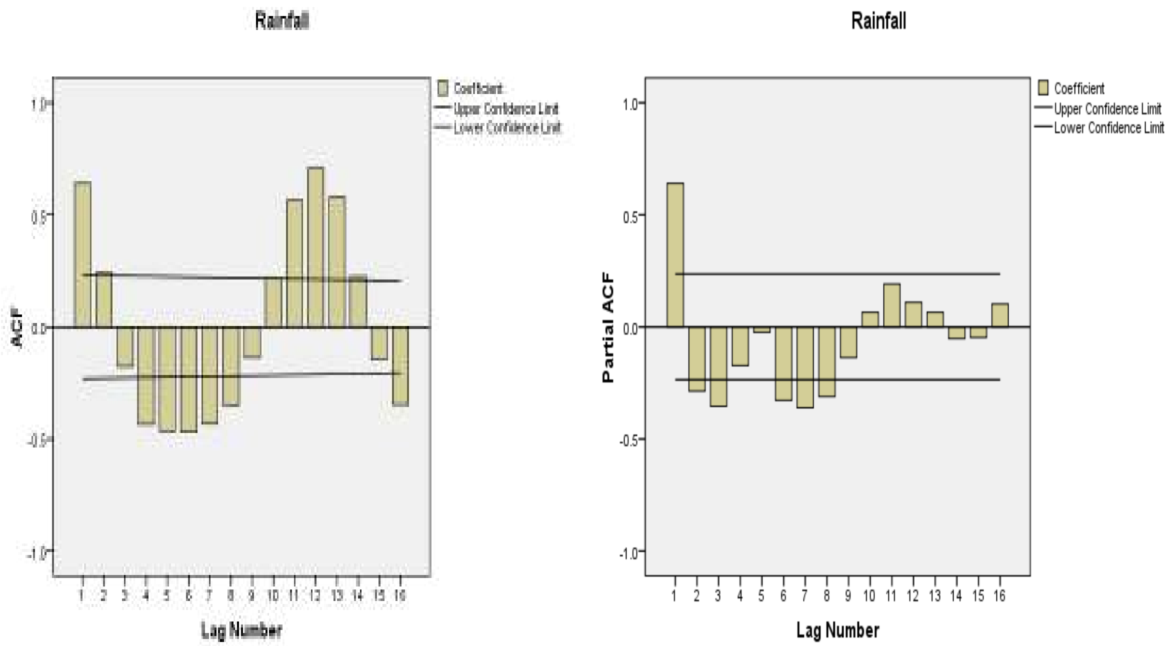


Figure 19: Auto-correlation and partial auto-correlation plot of Rainfall, Terai region, 2004-2009

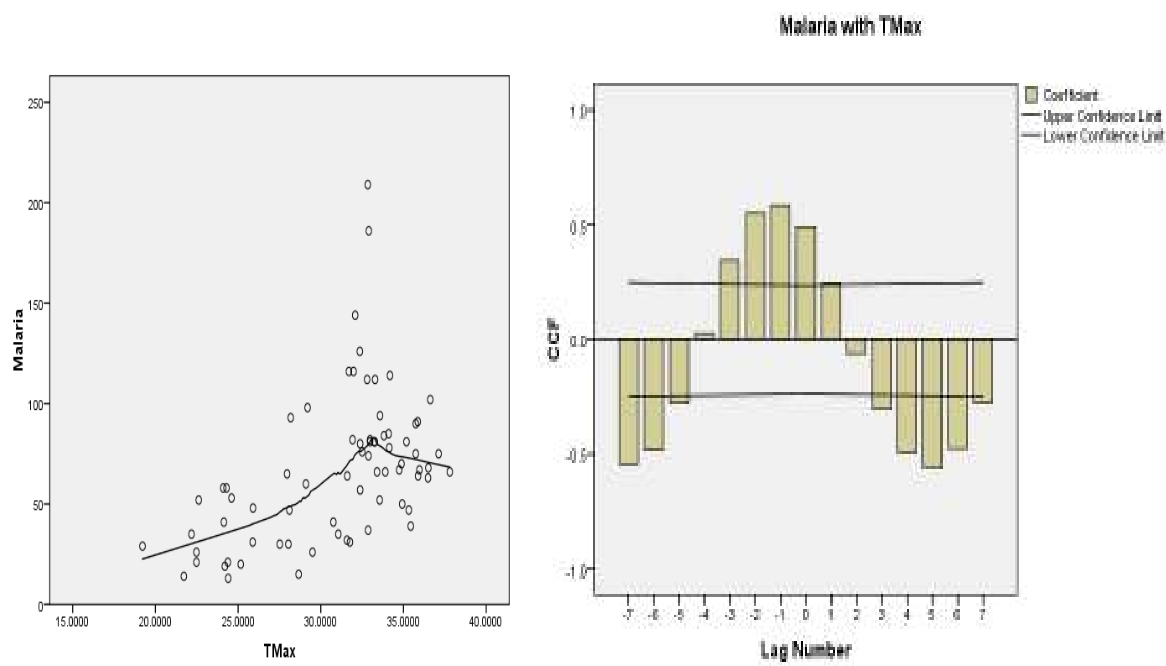


Figure 20: Scatter plots with LOWESS curve and cross-correlation plots: Maximum temperature vs. Malaria

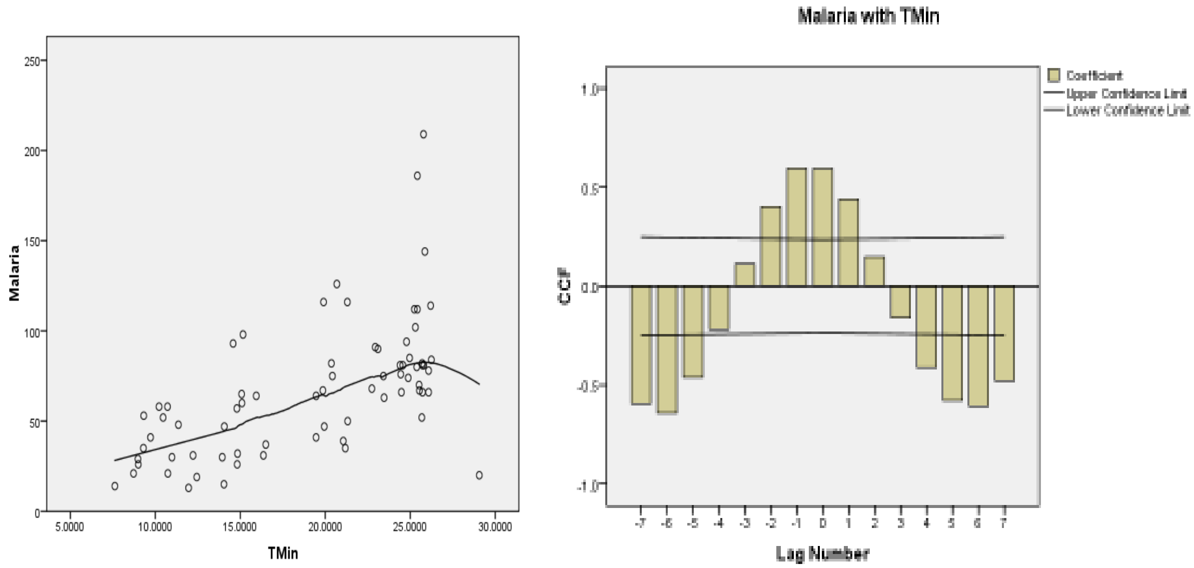


Figure 21: Scatterplots with LOWESS curve and cross-correlation plots: Minimum temperature vs. Malaria

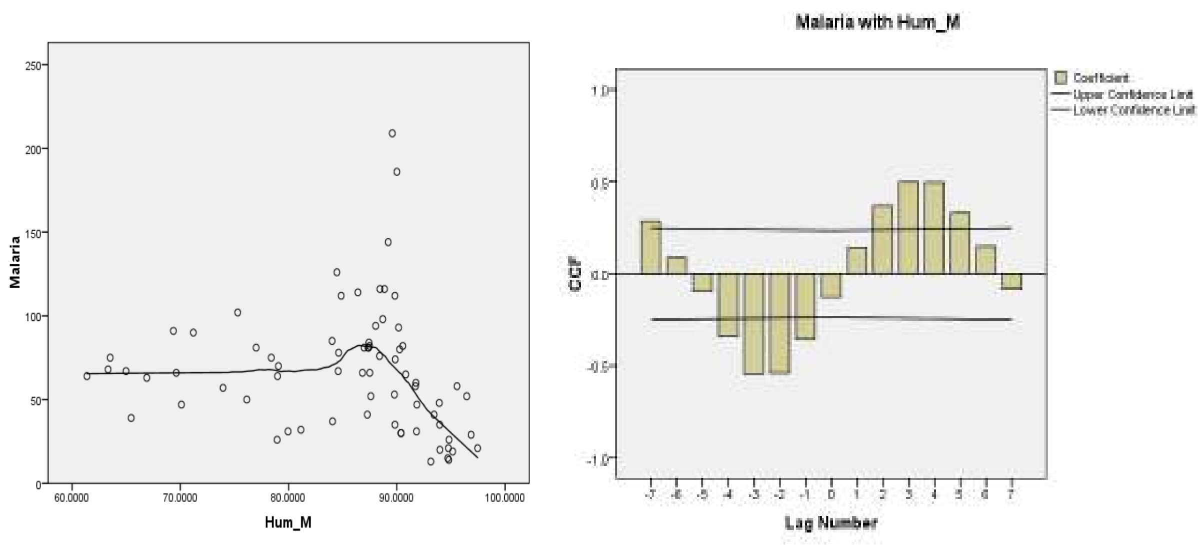


Figure 22: Scatterplots with LOWESS curve and cross-correlation plots: Humidity (Morning) vs. Malaria

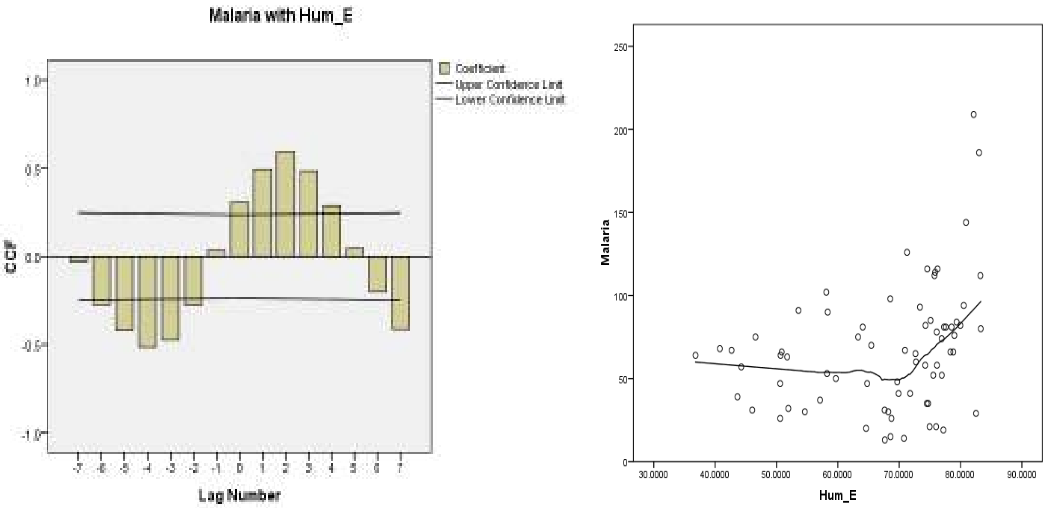


Figure 23: Scatterplots with LOWESS curve and cross-correlation plots: Humidity (Evening) vs. Malaria

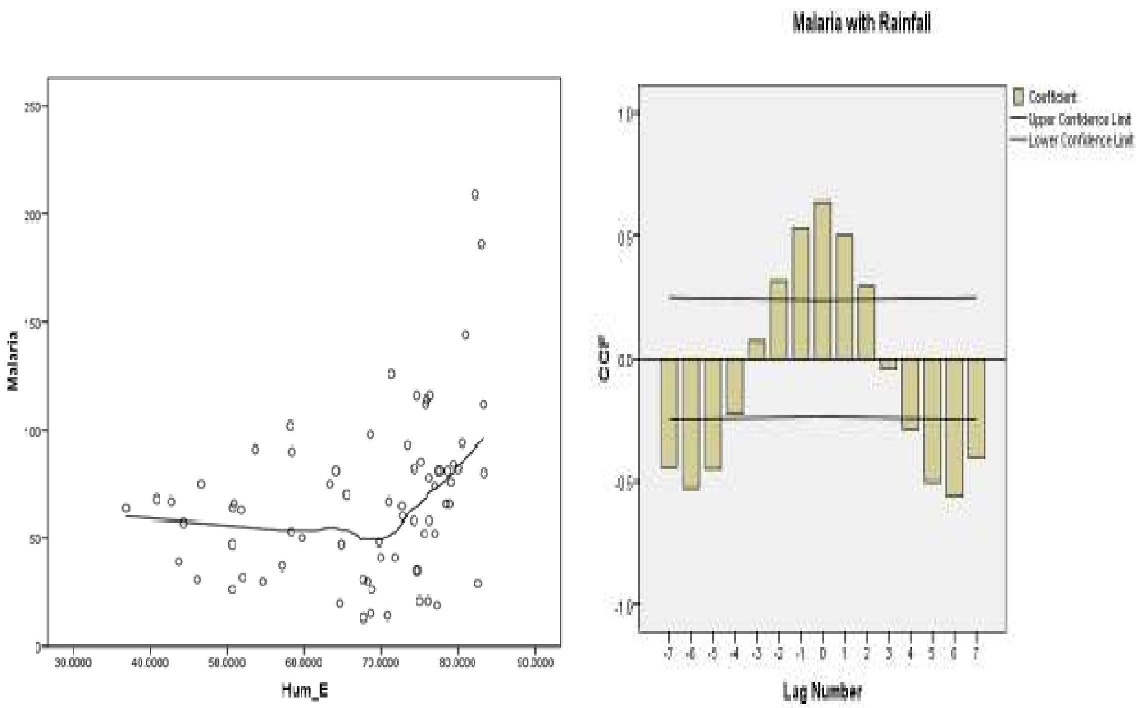


Figure 24: Scatterplots with LOWESS curve and cross-correlation plots: Rainfall vs. Malaria

Table 3: Analysis of linear regression model taking malaria as dependent variables

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Variables	-35.336	117.385		-.301	.764
	TMax	3.870	2.209	.477	1.752	.084
	TMin	-1.431	1.330	-.238	-1.076	.286
	Rainfall	.064	.029	.316	2.186	.032
	Hum_E	1.922	.697	.631	2.759	.007
	Hum_M	-1.517	1.141	-.378	-1.329	.188

The above table depicts the information on climatic factors, and its association with incidence of malaria. It is noted from the study that the occurrence of malaria is significantly associated with rainfall ($p<0.032$) and evening humidity ($p<0.007$). However, other climatic factors like maximum and minimum temperature and morning humidity are not found to be significant with malaria in Terai region.

HILL

Table 4: Descriptive analysis of climatic parameters of Hill region

Descriptive analysis of climatic parameters of Hill region							
Year		TEM_MAX	TEM_MIN	RAINFALL	HUM_M	HUM_E	MALARIA
2004	Minimum	18.73	6.68	6.30	72.25	72.90	0.00
	Mean	26.62	14.84	217.00	81.00	79.00	7.00
	Maximum	30.77	21.20	704.13	90.40	85.18	21.00
2005	Minimum	18.70	6.00	3.60	65.90	57.55	0.00
	Mean	25.74	14.16	194.00	83.00	69.00	7.00
	Maximum	30.78	20.30	586.10	90.00	82.43	21.00
2006	Minimum	20.30	6.70	0.00	71.70	43.35	5.00
	Mean	25.84	14.85	172.00	79.00	62.00	13.00
	Maximum	28.80	21.30	390.88	87.78	76.05	28.00
2007	Minimum	19.85	6.10	7.10	68.65	55.00	7.00
	Mean	25.69	14.93	215.00	83.00	69.00	23.00
	Maximum	29.50	20.97	446.70	89.73	80.05	52.00
200	Minimum	18.95	7.48	2.20	71.13	69.25	8.00

8	Mean	27.10	14.85	241.00	82.00	79.00	18.00
	Maximum	31.38	21.10	549.78	89.75	87.68	26.00
2009	Minimum	21.50	7.55	0.00	66.93	61.55	2.00
	Mean	28.29	15.70	214.00	16.00	78.00	11.00
	Maximum	31.55	20.65	474.26	87.23	84.70	23.00
Total	Minimum	19.70	6.80	3.20	69.43	59.93	4.00
	Mean	26.50	14.90	208.83	70.70	72.70	13.00
	Maximum	30.50	20.90	525.31	89.15	82.68	28.00

The above table shows the distribution of different climatic parameters and malaria cases of six years. Minimum, maximum and average value of maximum and minimum temperature, humidity, rainfall and malaria has been calculated to observe if any change in the yearly distribution.

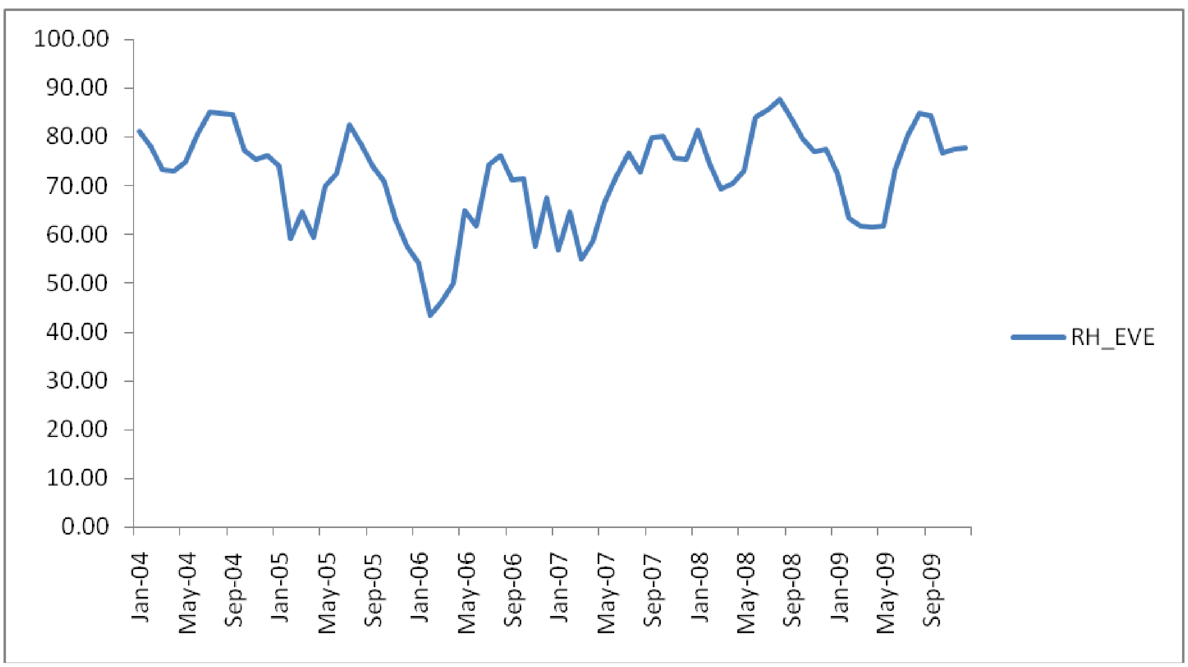


Figure 25: Monthly relative humidity (evening) from 2004 to 2009 of hill region

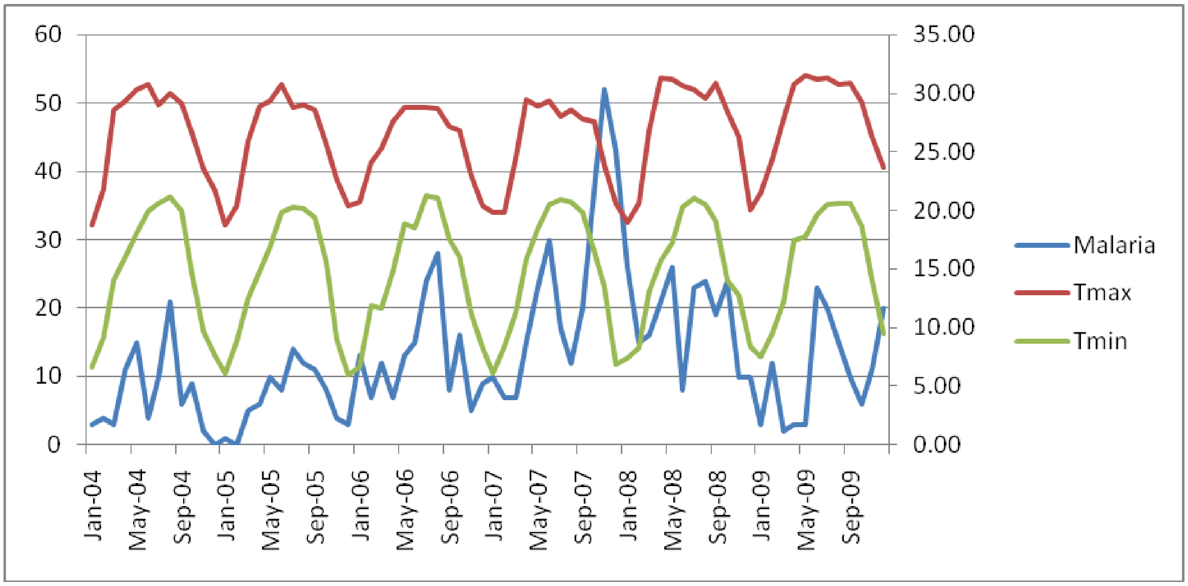


Figure 26: Monthly malaria cases (in primary axis) and maximum and minimum temperature (plotted in secondary axis) from 2004 to 2009 of hill region

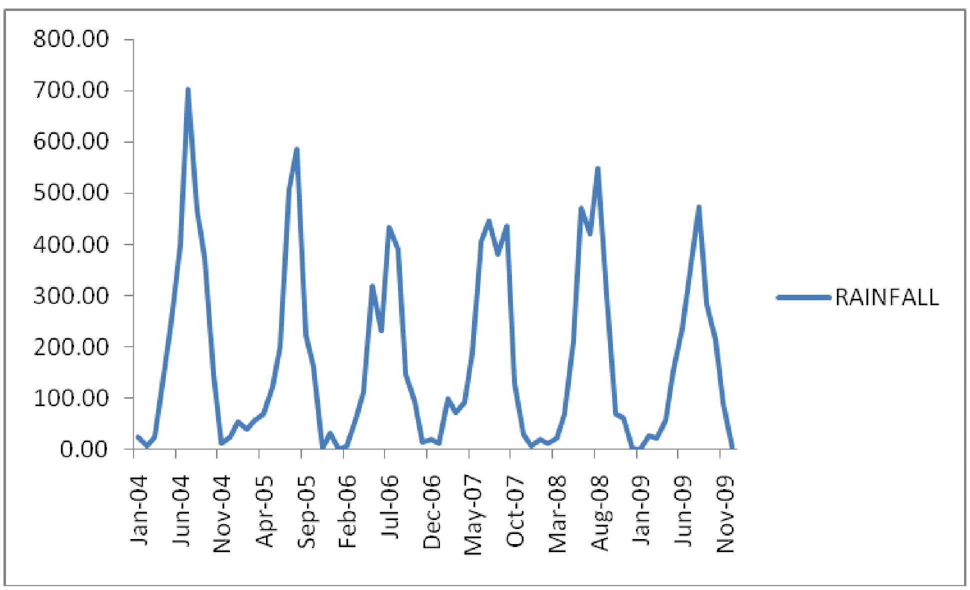


Figure 27: Monthly rainfall from 2004 to 2009 of hill region

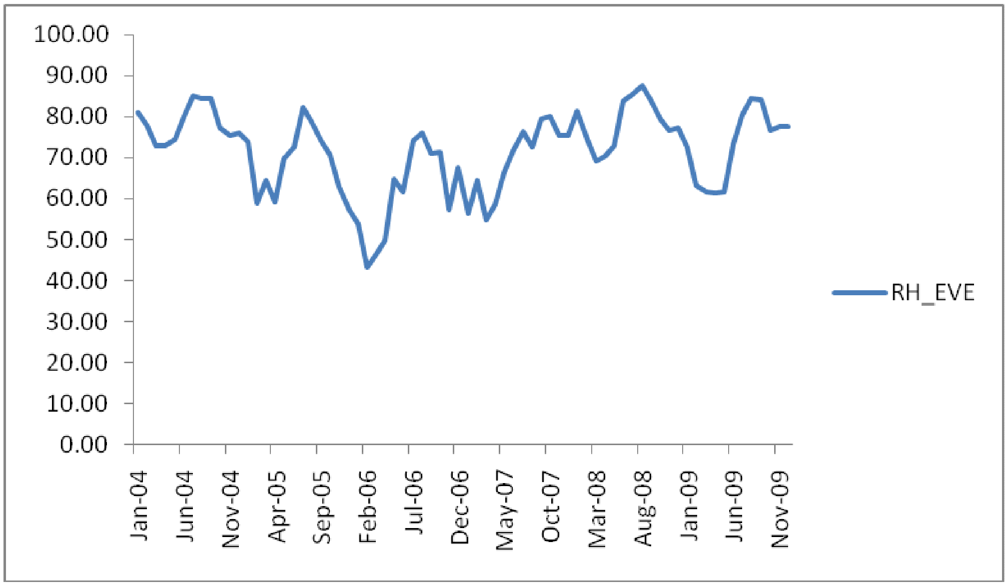


Figure 28: Monthly relative humidity (evening) from 2004 to 2009 of hill region

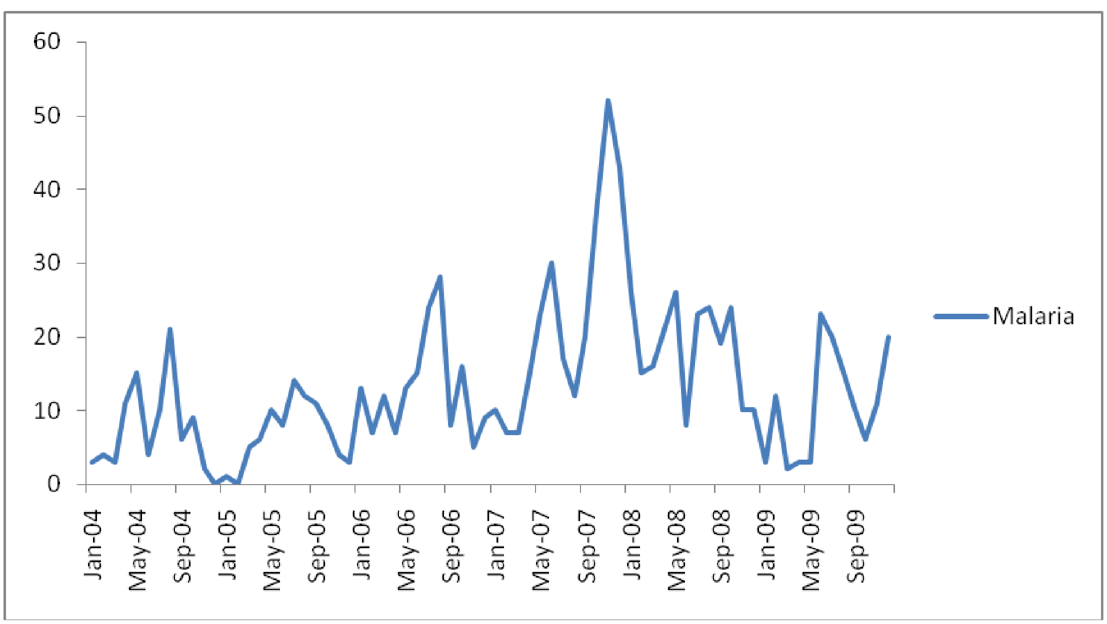


Figure 29: Monthly malaria cases from 2004 to 2009 of hill region

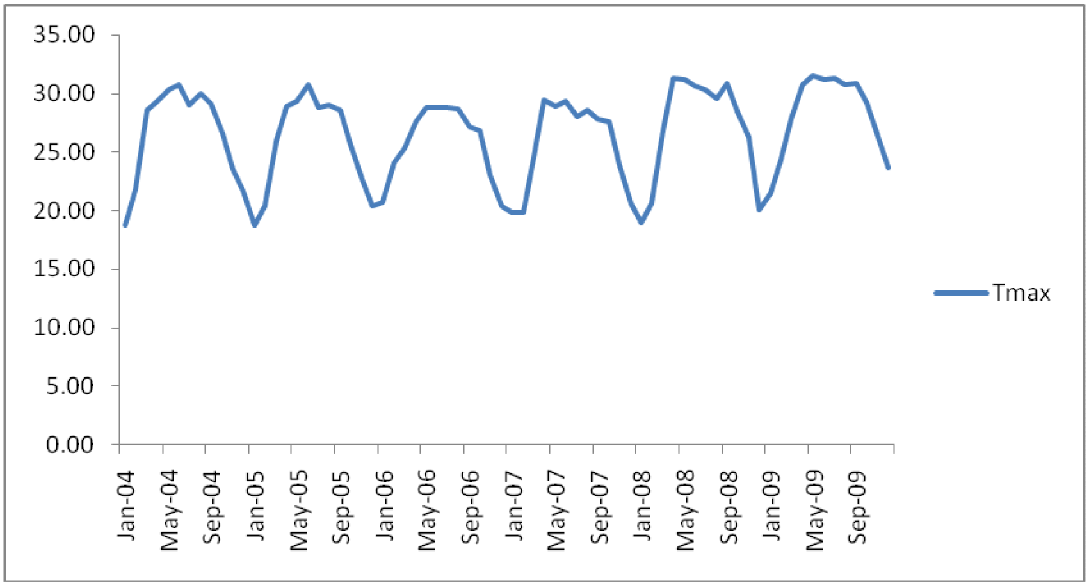


Figure 30: Monthly maximum temperature from 2004 to 2009 of hill region

SEASONAL TREND OF DIFFERENT CLIMATIC AND MALARIA INDICATORS

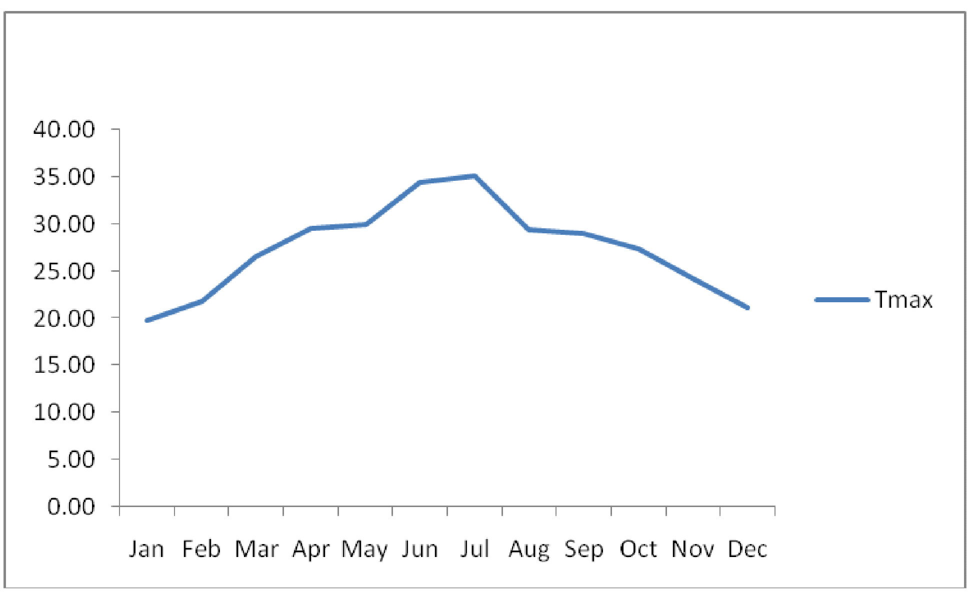


Figure 31: Overall monthly seasonal trend of maximum temperature during 2004-2009 of hill region

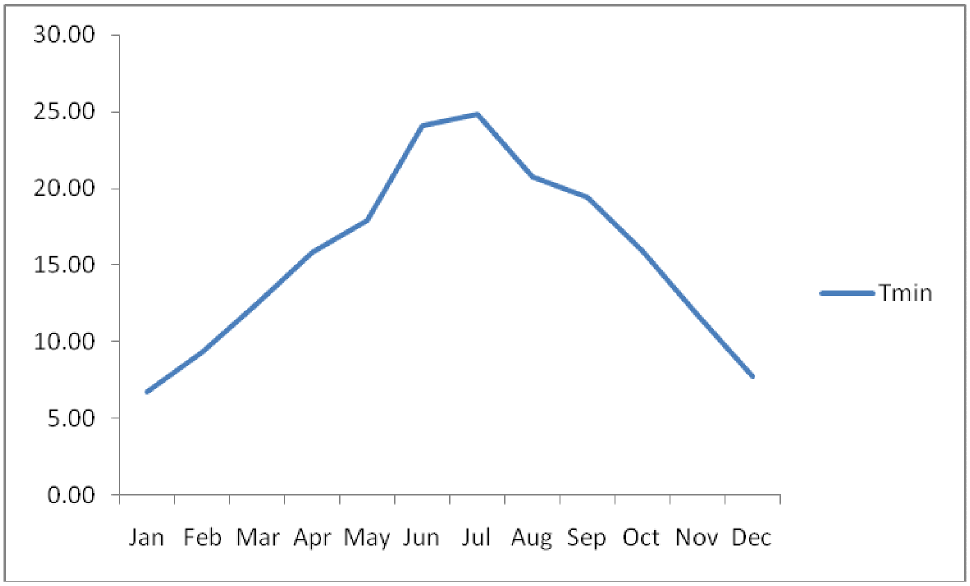


Figure 32: Overall monthly seasonal trend of minimum temperature during 2004-2009 of hill region

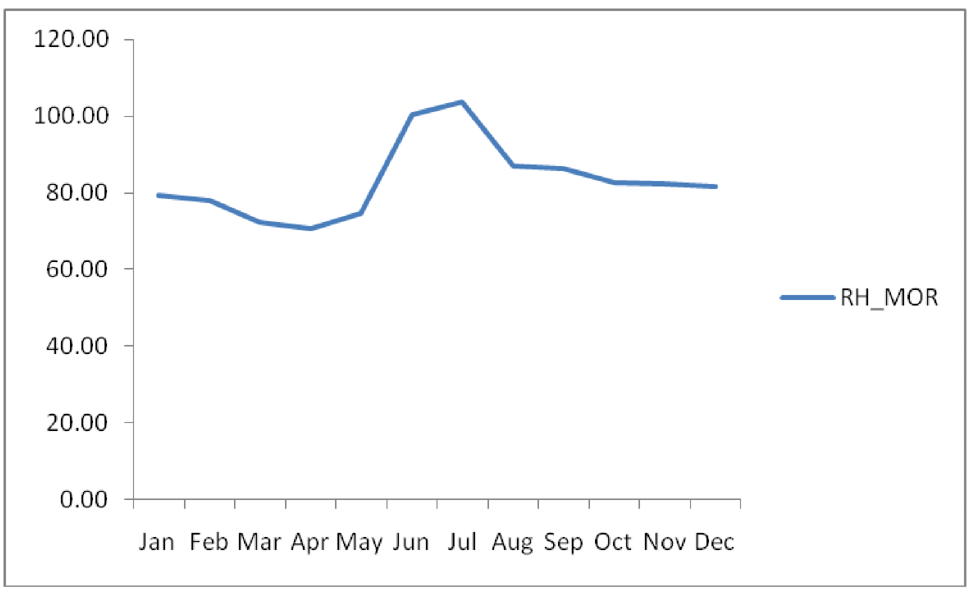


Figure 33: Overall monthly trend of Relative Humidity morning during 2004-2009 of hill region

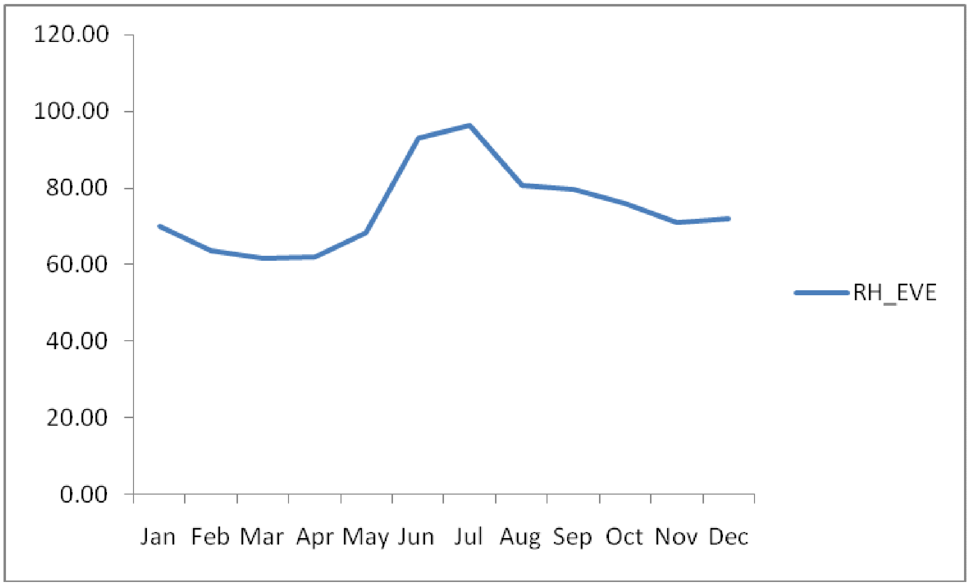


Figure 34: Overall monthly seasonal trend of Relative Humidity (Evening) during 2004-2009 of hill region

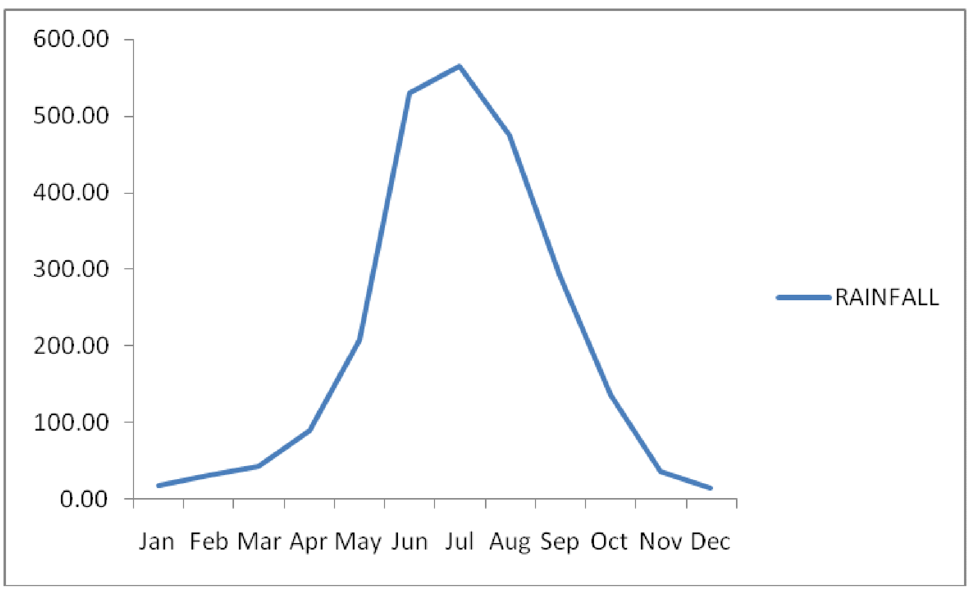


Figure 35: Overall monthly seasonal trend of rainfall from 2004-2009 of hill region

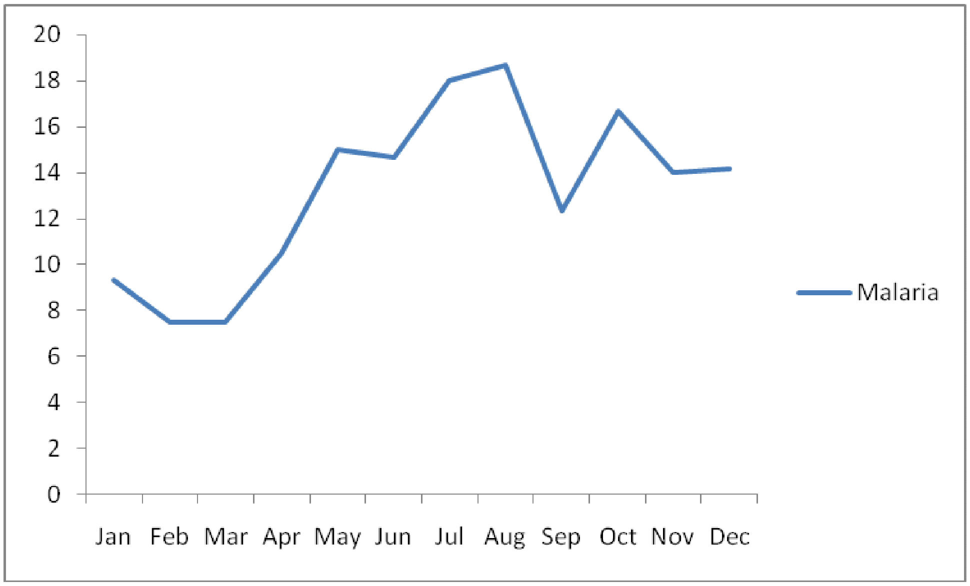


Figure 36: Overall monthly seasonal trend of malaria from 2004-2009 of hill region

Table 5:Overall monthly seasonal pattern of different variables during 2004-2009 of hill region

Variable	Months	
	Higher value	**Lowest value**
Maximum temperature	May	Jan
Minimum temperature	Jul	Jan
Relative Humidity (Mor)	Jul	April
Relative Humidity (Eve)	Jul	Mar
Rainfall	Jul	Dec
Malaria	Aug	Feb

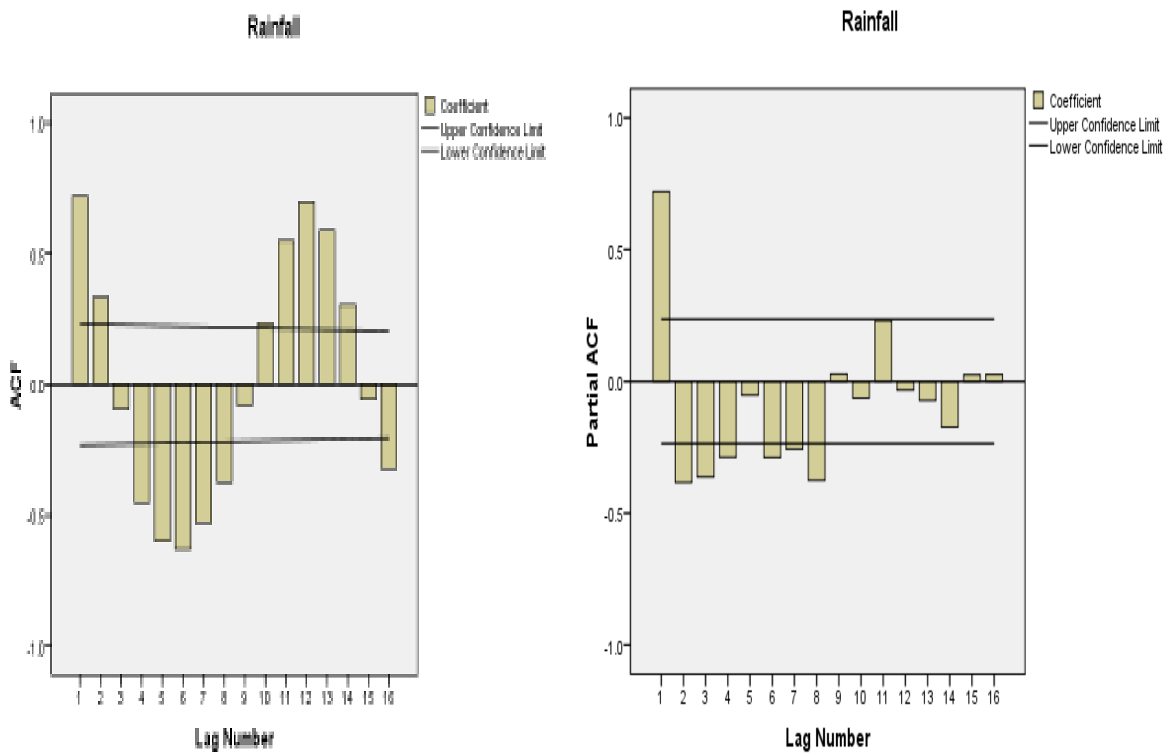


Figure 37: Auto-correlation and partial auto-correlation plot of Rainfall, hill region, 2004-2009

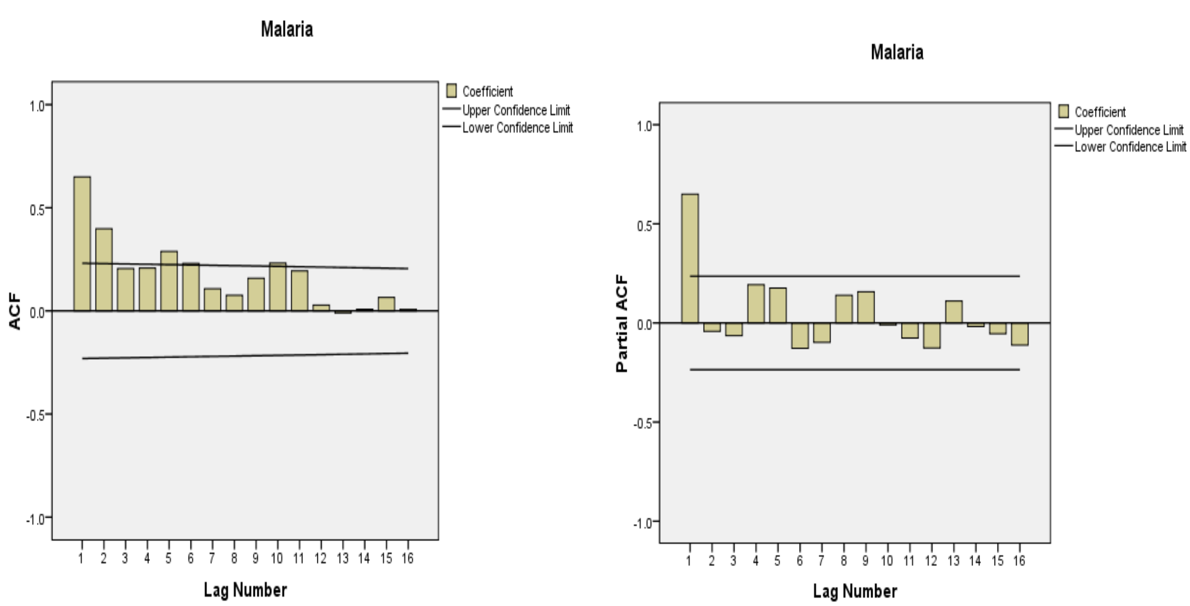


Figure 38: Auto-correlation and partial auto-correlation plot of malaria, hill region, 2004-2009

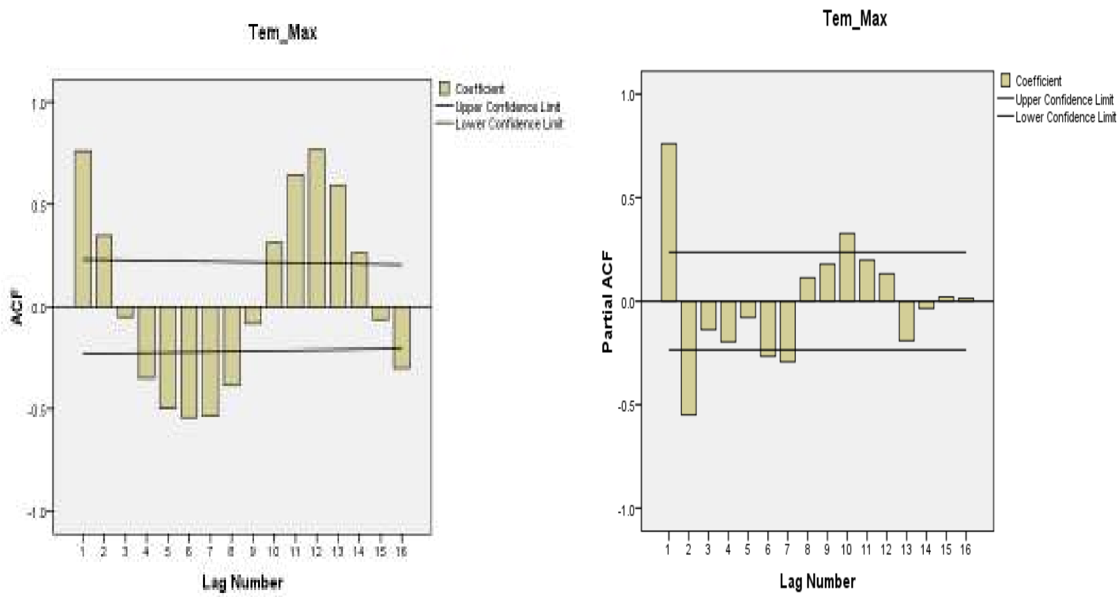


Figure 39: Auto-correlation and partial auto-correlation plot of maximum temperature, hill region, 2004-2009

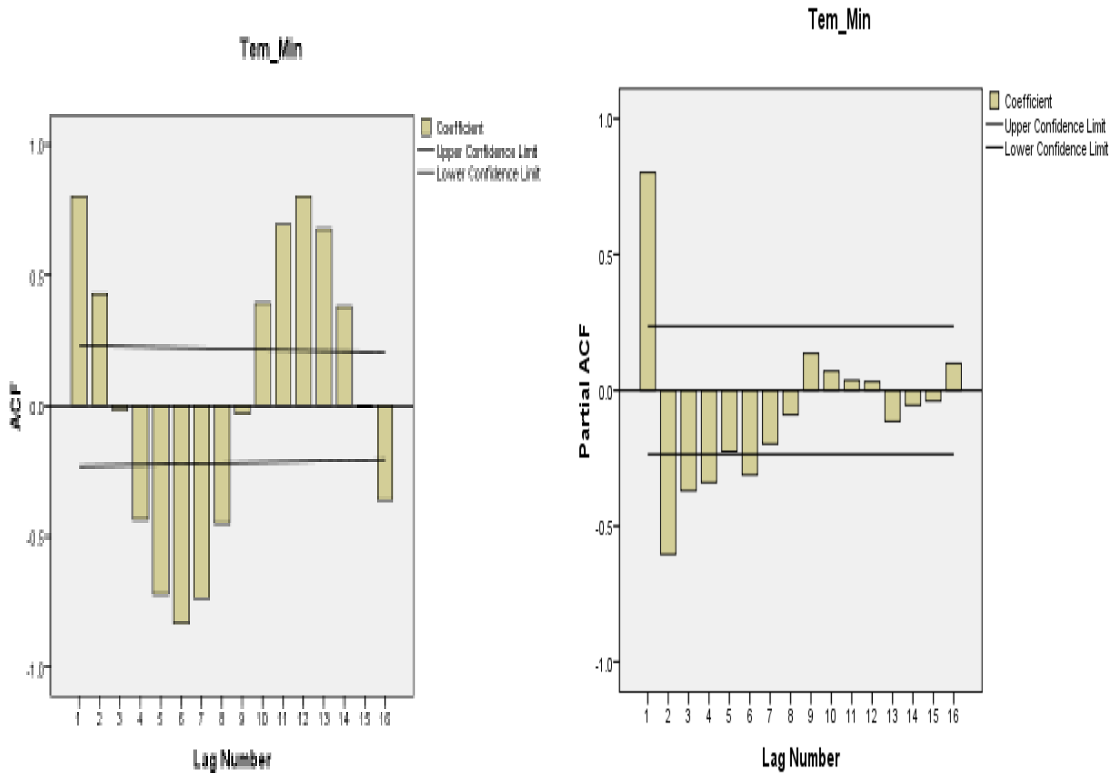


Figure 40: Auto-correlation and partial auto-correlation plot of minimum temperature ,hill region, 2004-2009

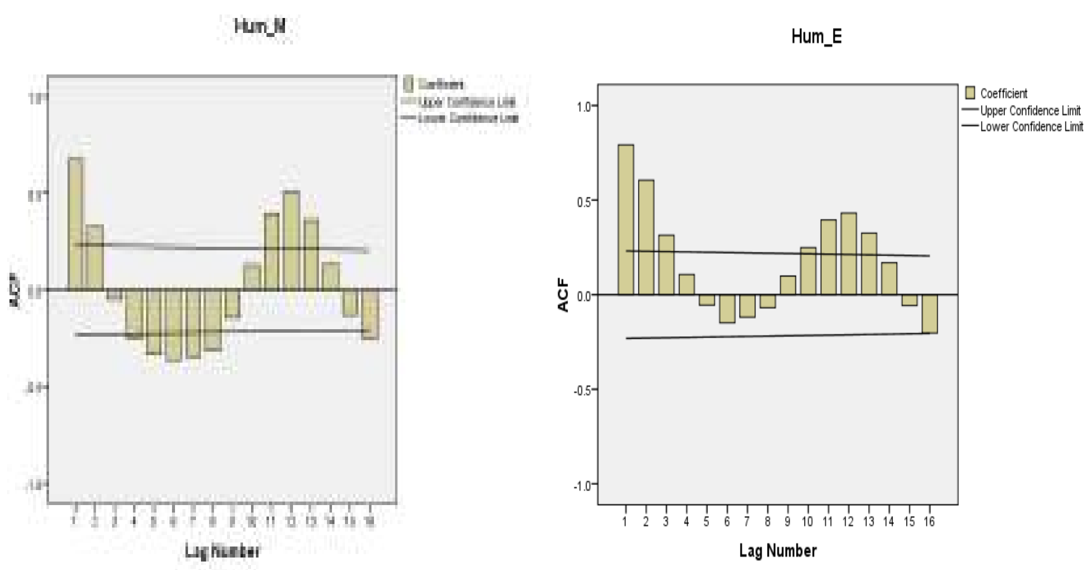


Figure 41: Auto-correlation and partial auto-correlation plot of humidity (evening), hill region, 2004-2009

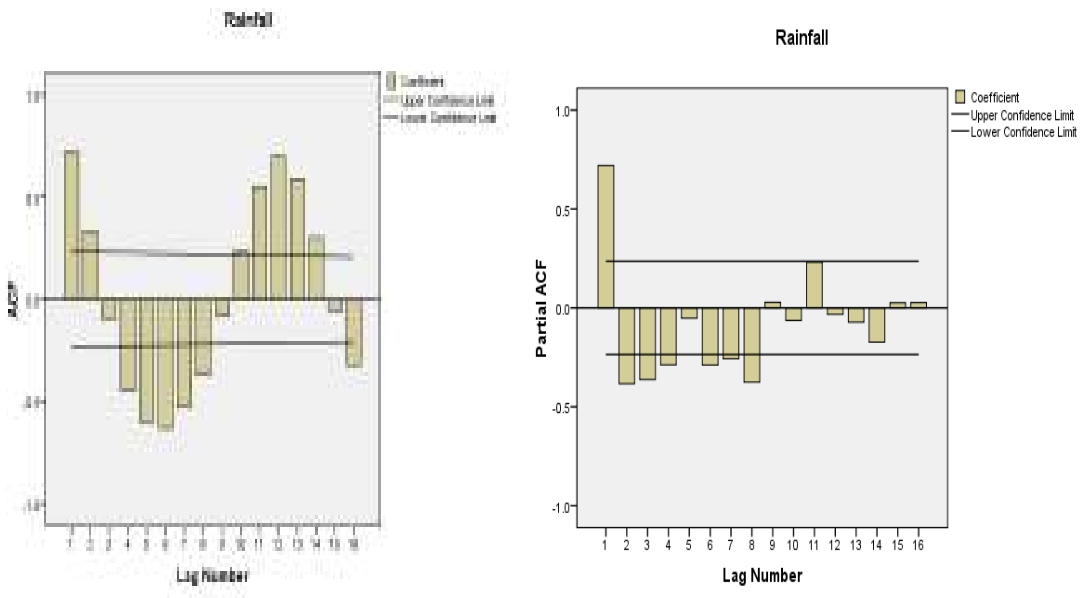


Figure 42: Auto-correlation and partial auto-correlation plot of rainfall, hill region, 2004-2009

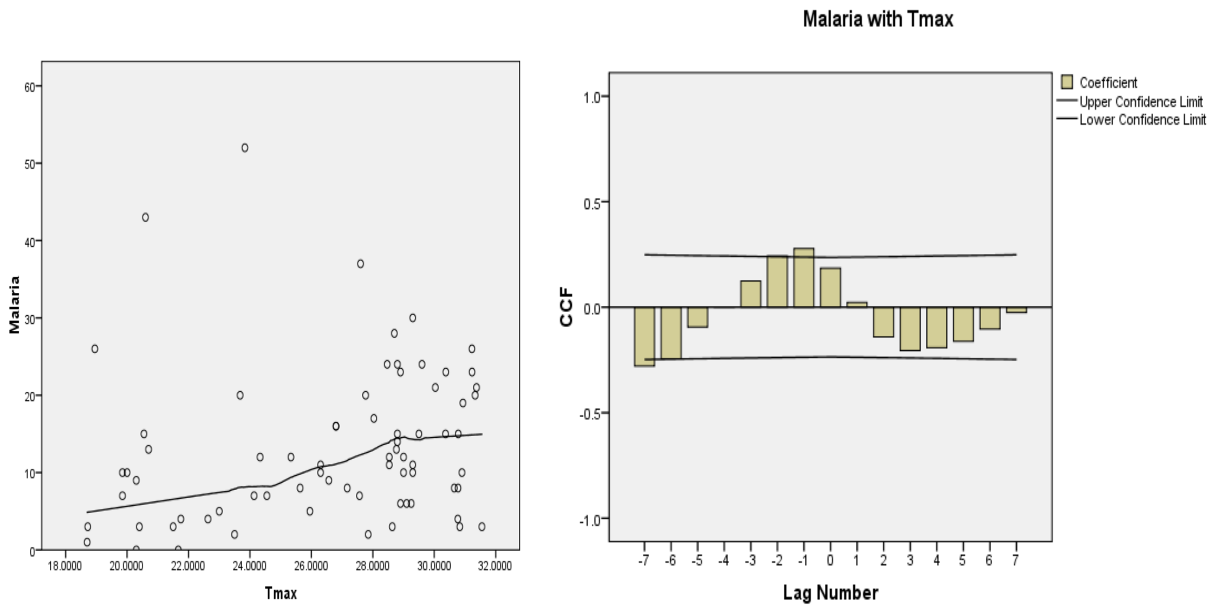


Figure 43: Cross-correlation plot of malaria with maximum temperature, hill region, 2004-2009

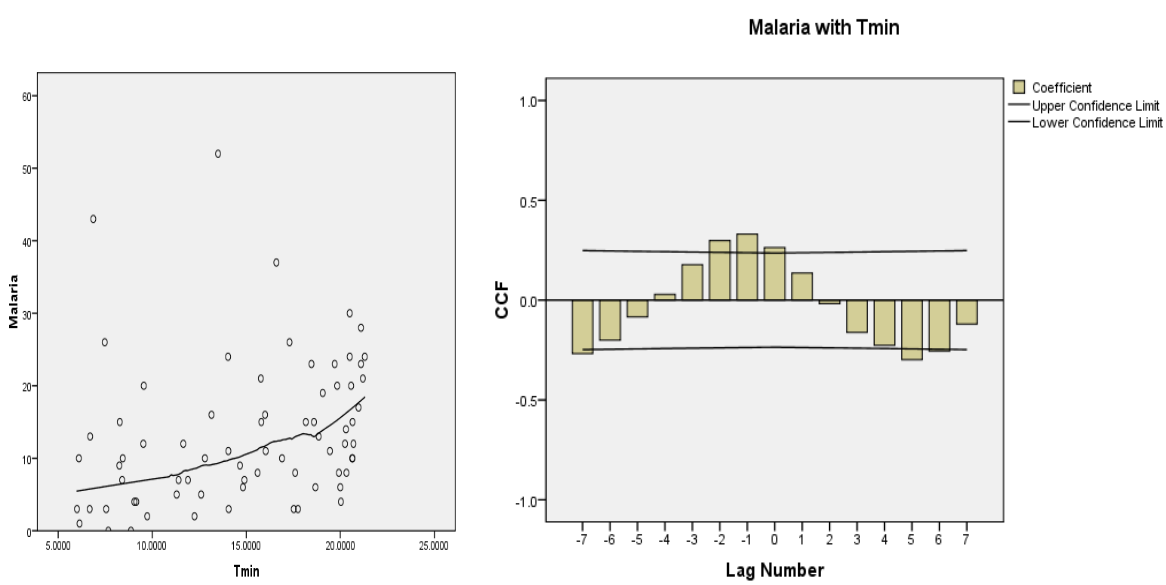


Figure 44: Cross-correlation plot of malaria with minimum temperature, hill region, 2004-2009

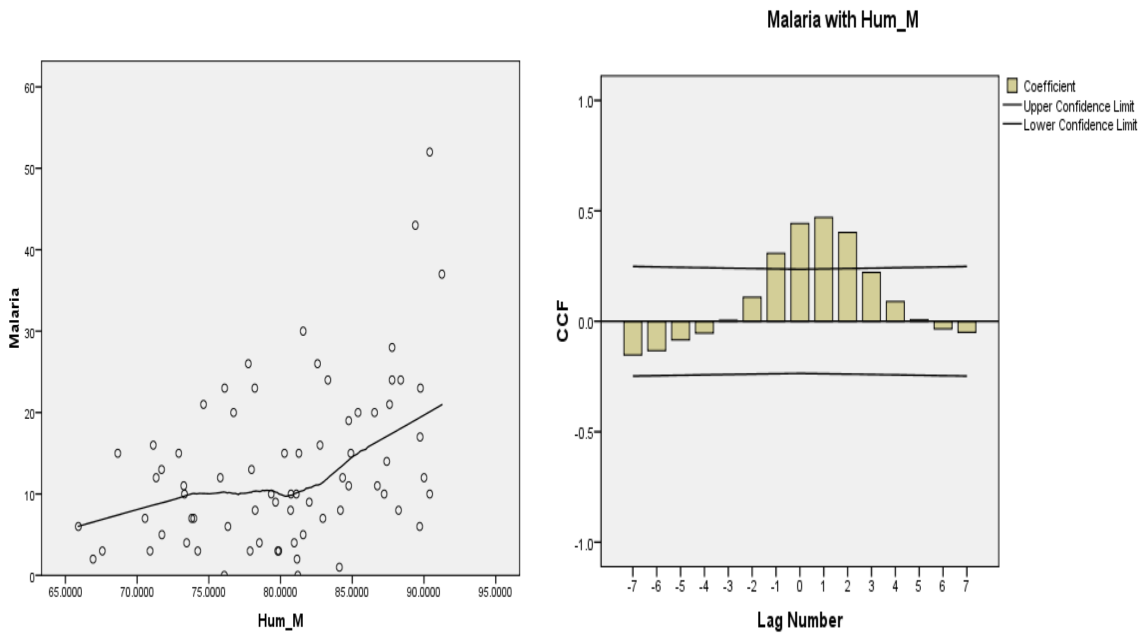


Figure 45: Cross-correlation plot of malaria with humidity (morning), hill region, 2004-2009

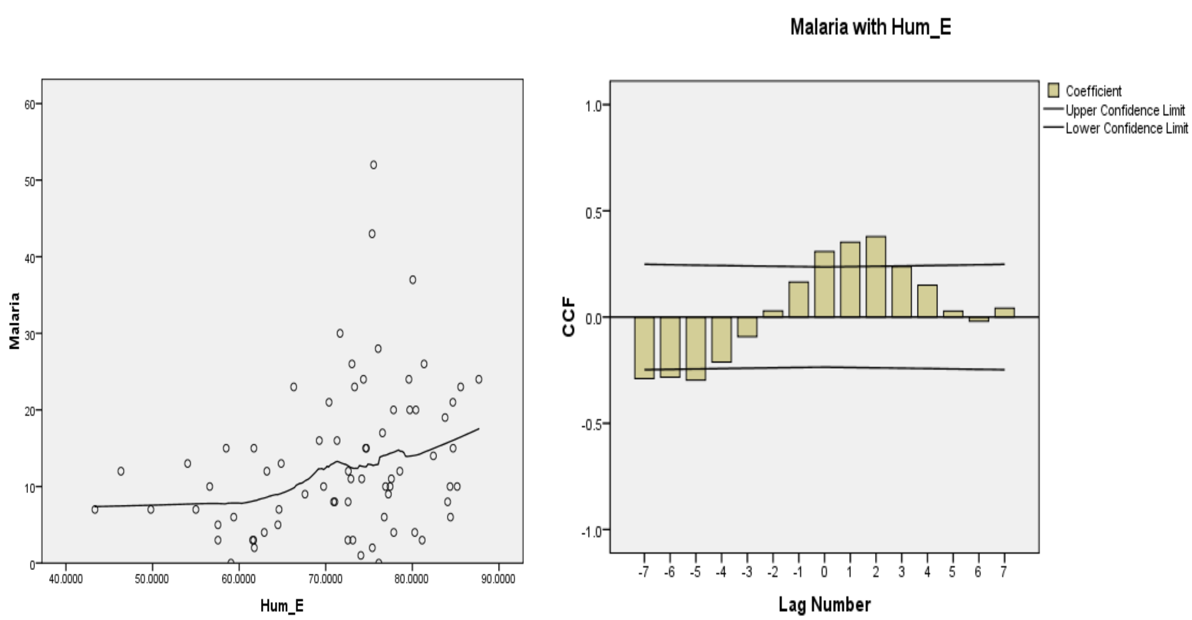


Figure 46: Cross-correlation plot of malaria with humidity (evening), hill region, 2004-2009

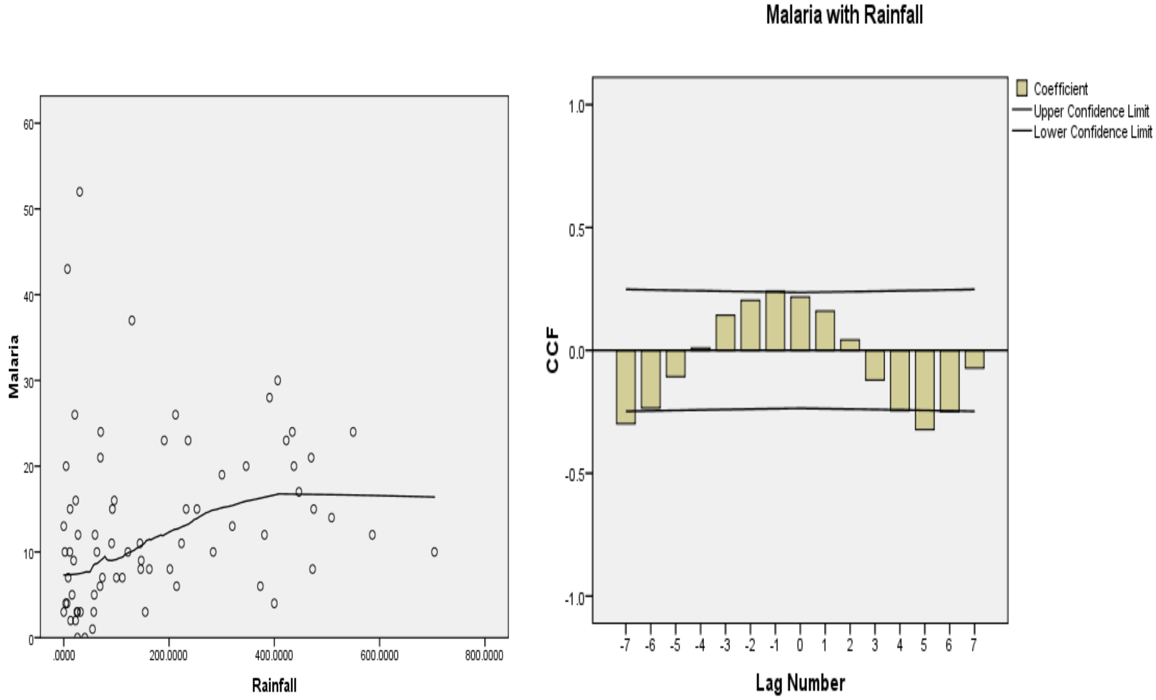


Figure 47: Cross-correlation plot of malaria with rainfall, hill region, 2004-2009

Table 6: Analysis of linear regression model taking malaria as dependent variables

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
Variables	-86.217	29.744		-2.899	.005
Tmax	.856	.991	.336	.863	.391
Tmin	.266	.964	.134	.276	.783
Hum_M	1.052	.306	.692	3.439	.001
Hum_E	-.106	.167	-.106	-.632	.529
Rainfall	-.023	.013	-.420	-1.752	.084

The above table presents the information of climatic factors and its association with malaria occurrence. It is noted from the study that occurrence of malaria and other climatic parameters has shown varying significance with each other. No significant association has been found between malaria and rainfall, evening humidity, maximum and minimum temperature. Malaria was found significant with morning humidity ($p<0.01$).

From both the topographical zone showed that significant association of humidity and malaria. So, it is noted from the study that relative humidity is major climatic determinants for the occurrence of malaria, which highly depends upon seasonality and rainfall ultimately climate change.

MOUNTAIN

Table 7: Descriptive analysis of climatic parameters of mountain region

Descriptive analysis of climatic parameters of mountain region						
Year		TEM_MAX	TEM_MIN	RAINFALL	HUM_MOR	HUM_EVE
2004	Minimum	13.75	0.98	2	65.15	54.90
	Mean	21.40	9.86	128.80	78.46	72.32
	Maximum	25.70	17.03	373.30	89.40	85.13
2005	Minimum	13.33	1	0.45	62.33	54.75
	Mean	21.66	9.44	136.13	78.13	70.64
	Maximum	27.20	17.53	358.30	89.35	86.35
2006	Minimum	17.35	1.75	0	68.63	55.35
	Mean	22.04	10.10	150.58	78.14	72.04
	Maximum	25.90	17.85	509.45	87.60	87.13
2007	Minimum	14.30	1.28	0	72.95	65.3
	Mean	21.48	10.02	153.11	79.80	72.81
	Maximum	26.13	17.60	445.90	89.30	85.08
2008	Minimum	13.98	1.20	5.55	72.33	59.93
	Mean	21.53	9.36	142.82	80.43	73.29
	Maximum	25.43	17.25	437.70	89.40	86.40
2009	Minimum	17.48	2.30	3.50	70.18	53.78
	Mean	22.18	9.63	129.86	80.48	72.03
	Maximum	26.80	17.70	380.90	90.58	87.13
Total	Minimum	15.03	1.50	9.50	346.42	289.11
	Mean	21.71	9.73	140.21	79.24	72.18
	Maximum	26.19	17.49	417.15	89.27	86.20

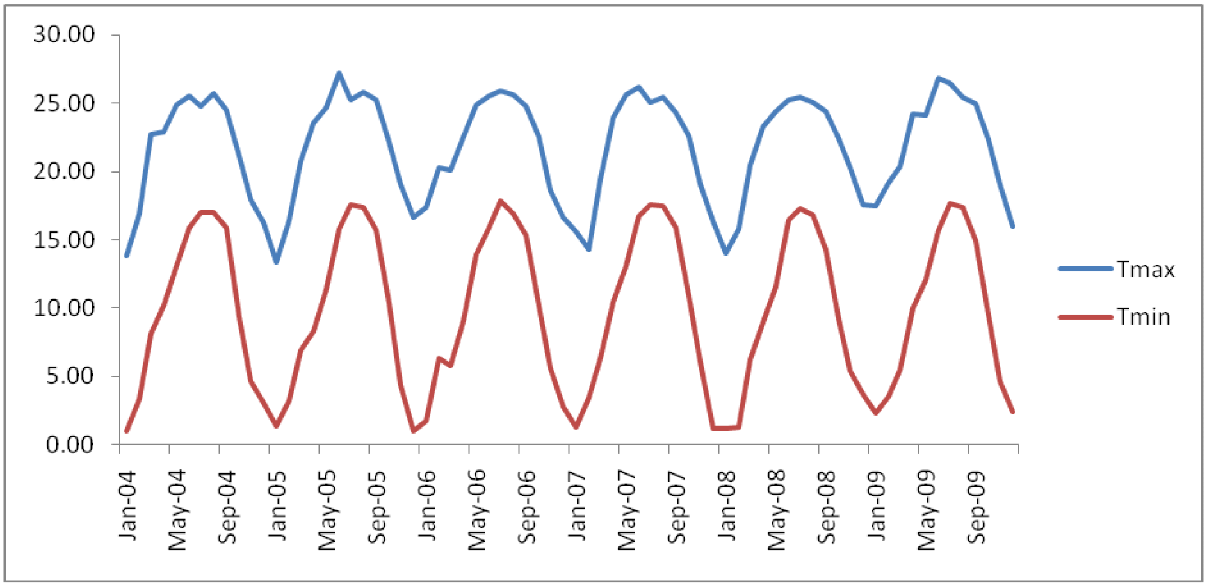


Figure 48: Monthly maximum and minimum temperature from 2004 to 2009 of mountain region

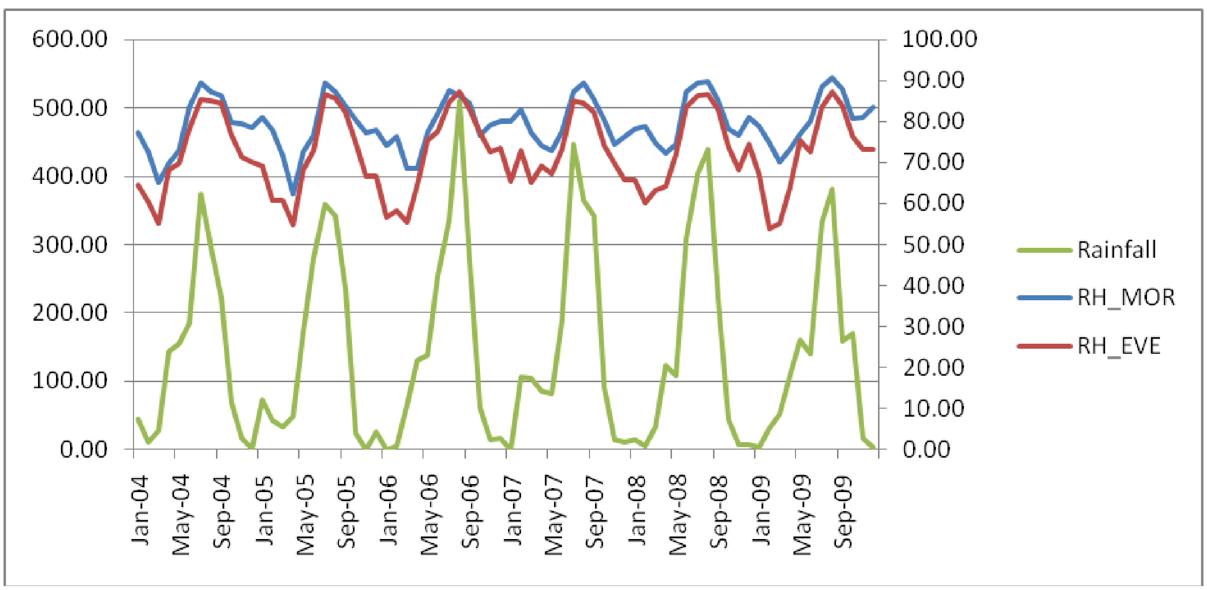


Figure 49: Monthly rainfall (primary axis) and relative humidity (morning and evening in secondary axix) from 2004 to 2009 of mountain region

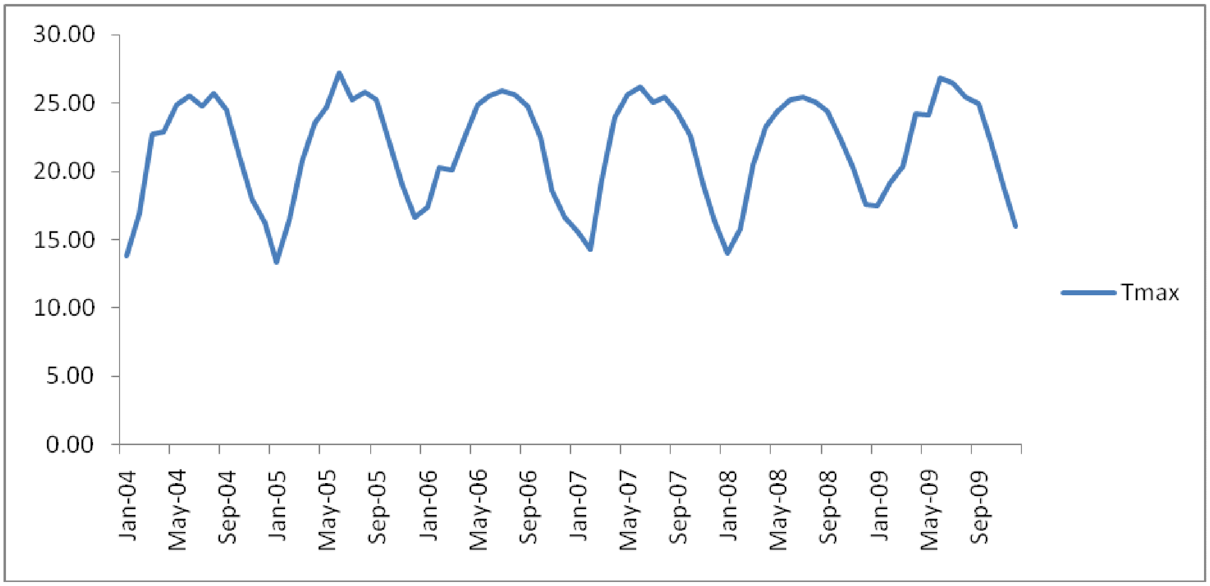


Figure 50: Monthly maximum temperature from 2004 to 2009 of mountain region

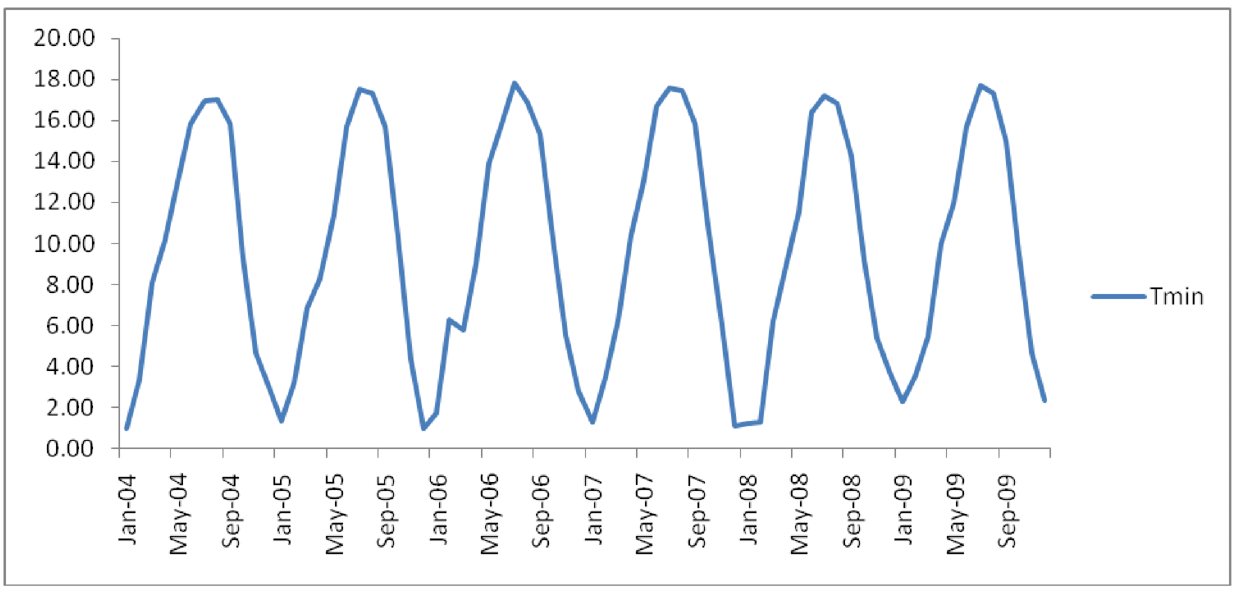


Figure 51: Monthly minimum temperature from 2004 to 2009 of mountain region

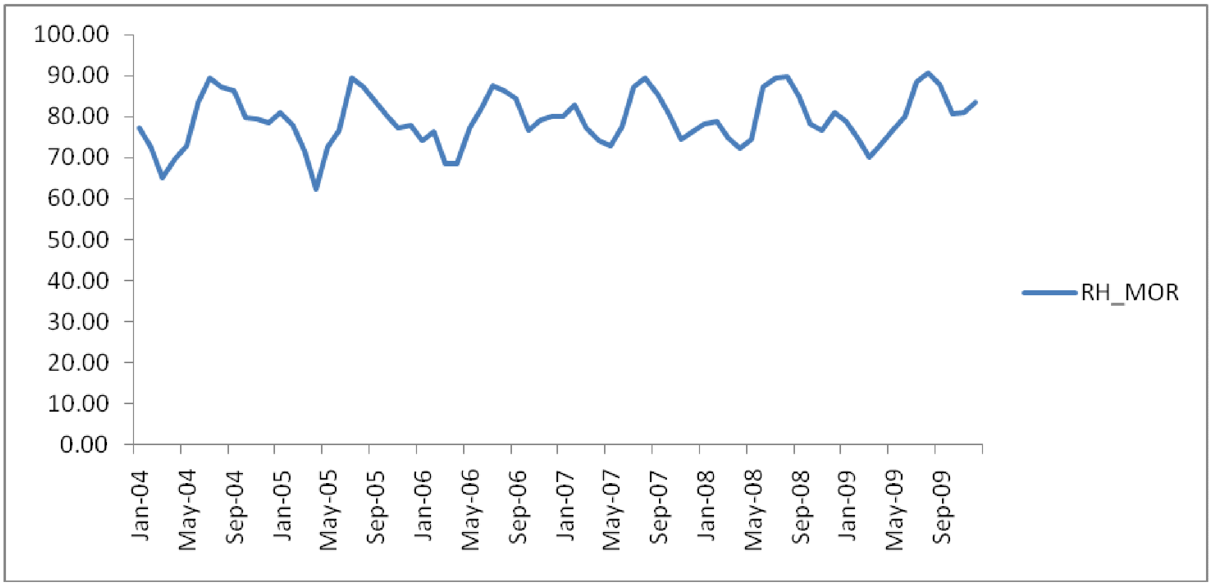


Figure 52: Monthly relative humidity (morning) from 2004 to 2009 of mountain region

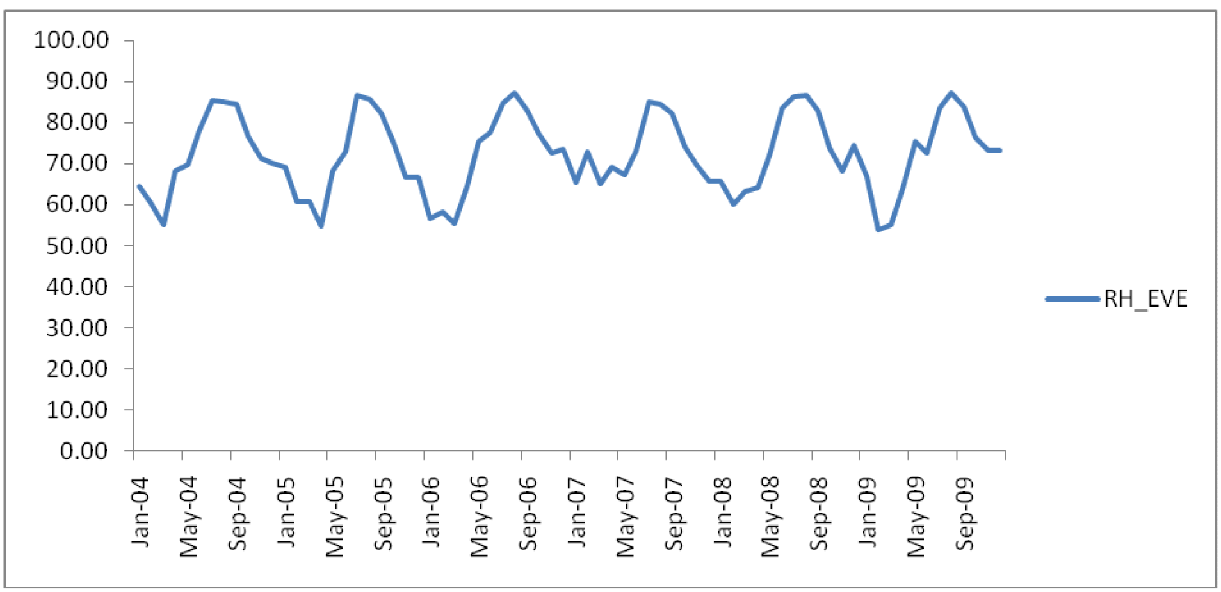


Figure 53: Monthly relative humidity (evening) from 2004 to 2009 of mountain region

Overall seasonal trend analysis of climatic variables

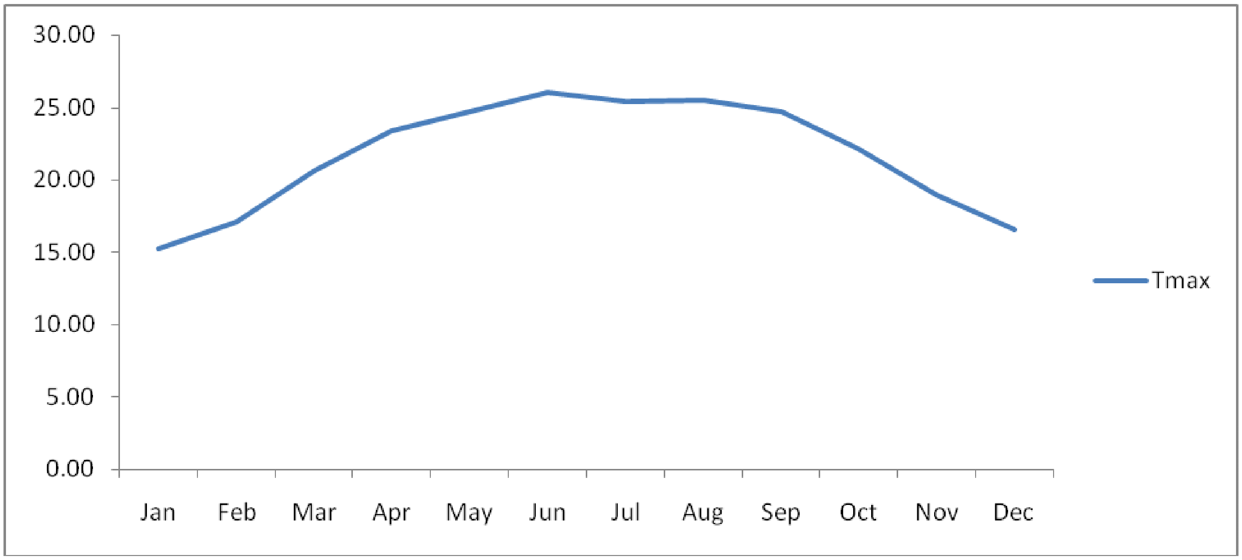


Figure 54: Monthly maximum temperature from 2004-2009 of mountain region

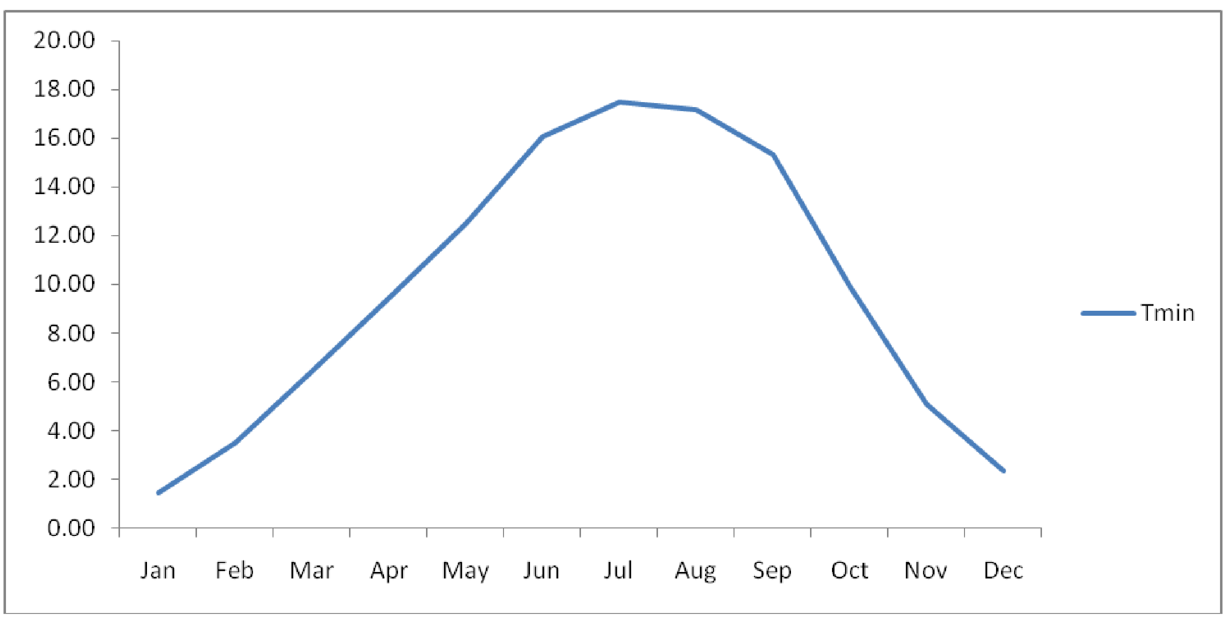


Figure 55: Monthly minimum temperature from 2004-2009 of mountain region

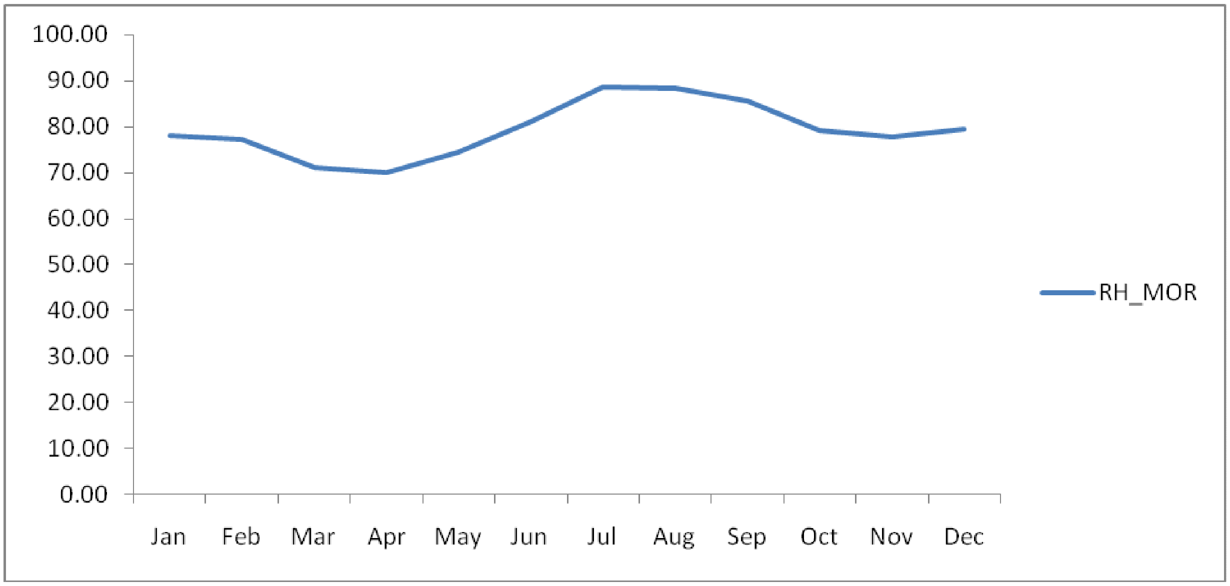


Figure 56: Monthly relative humidity (morning) from 2004-2009 of mountain region

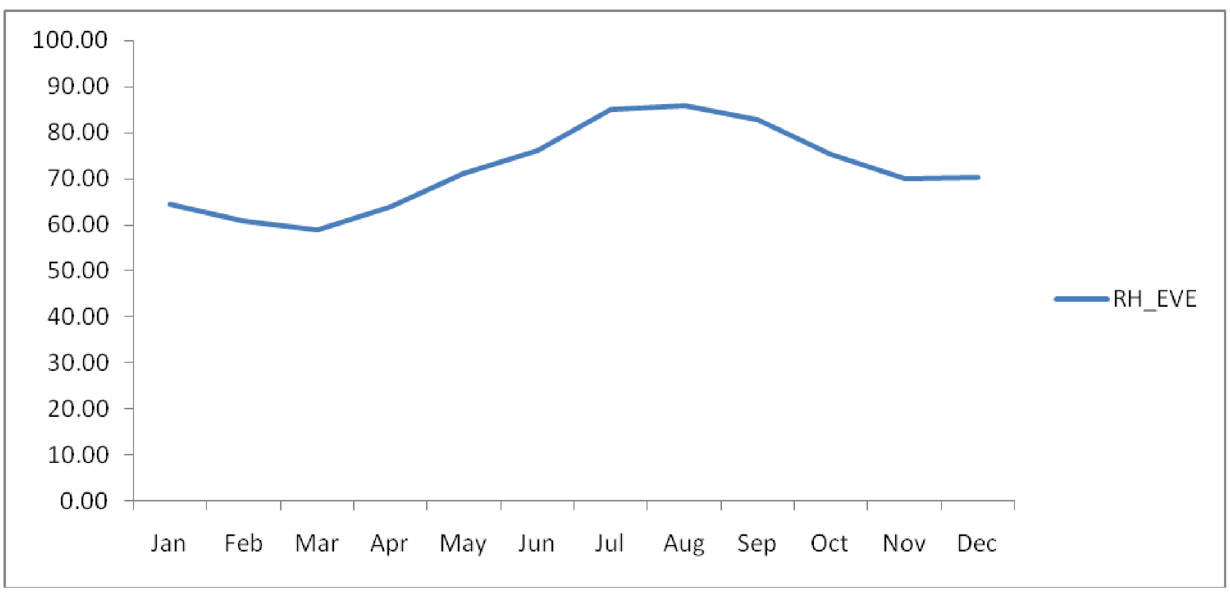


Figure 57: Monthly relative humidity (evening) from 2004-2009 of mountain region

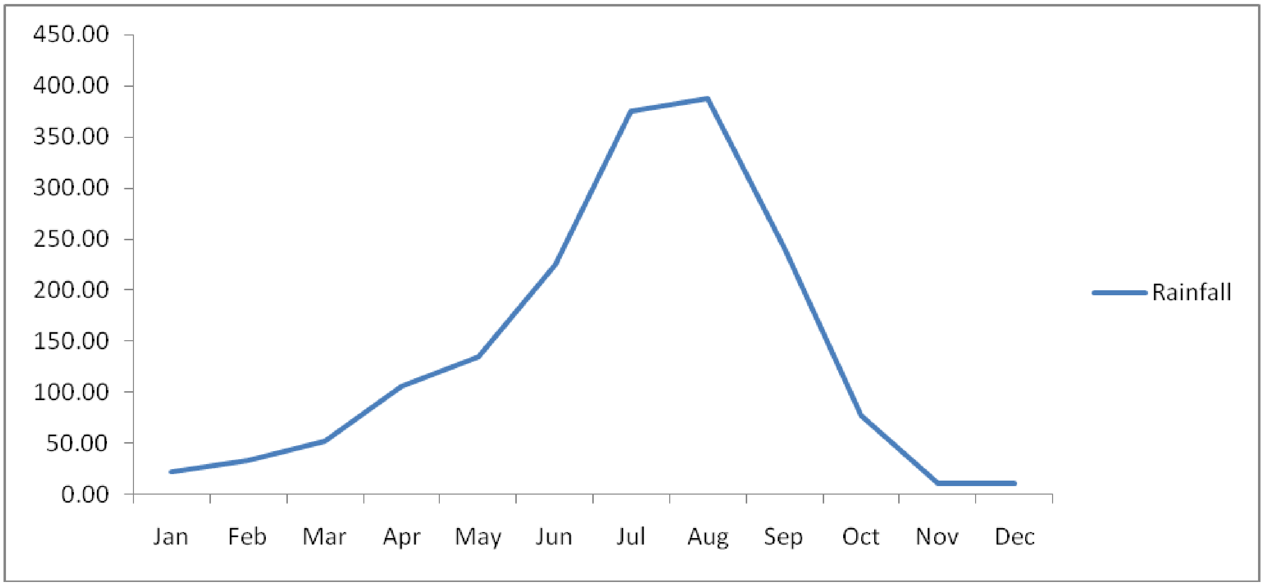


Figure 58: Monthly rainfall from 2004-2009 of mountain region

Table 8: Descriptive analysis of climatic parameters of mountain region

Variable	**Months**	
	Higher value	**Lowest value**
Maximum temperature	Jun	Jan
Minimum temperature	Jul	Jan
Relative Humidity (Mor)	Jul	Mar
Relative Humidity (Eve)	Aug	Mar
Malaria	Aug	Nov

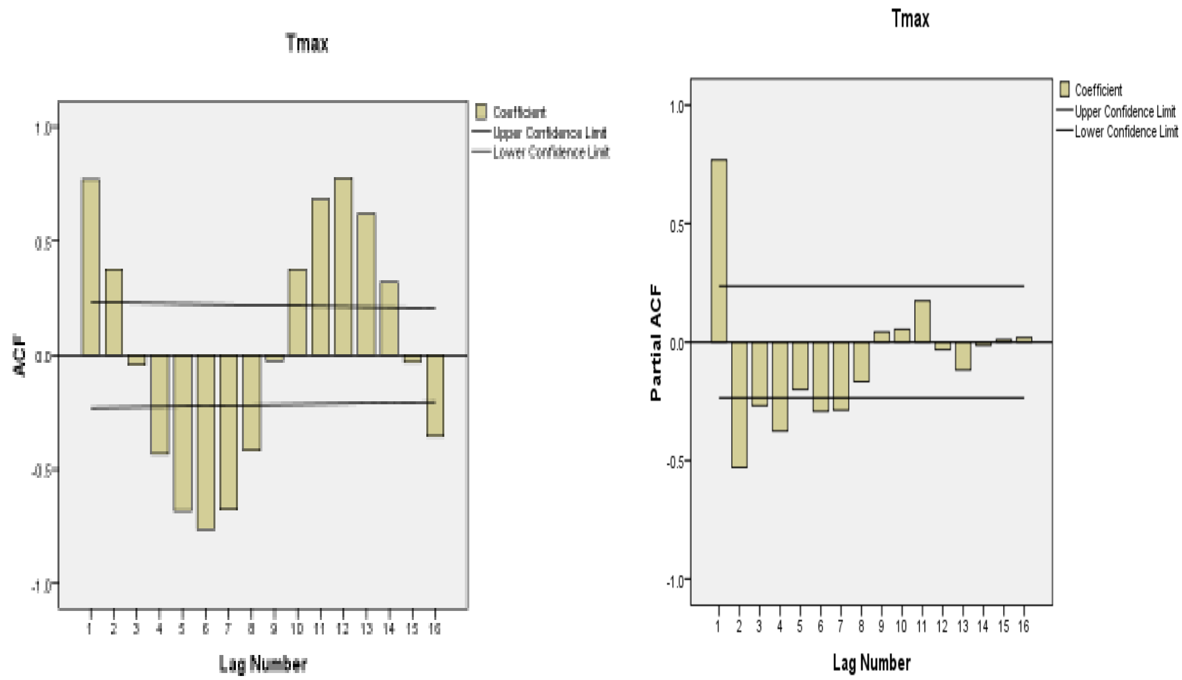


Figure 59: Auto-correlation and partial auto-correlation plot of maximum temperature, mountain region, 2004-2009

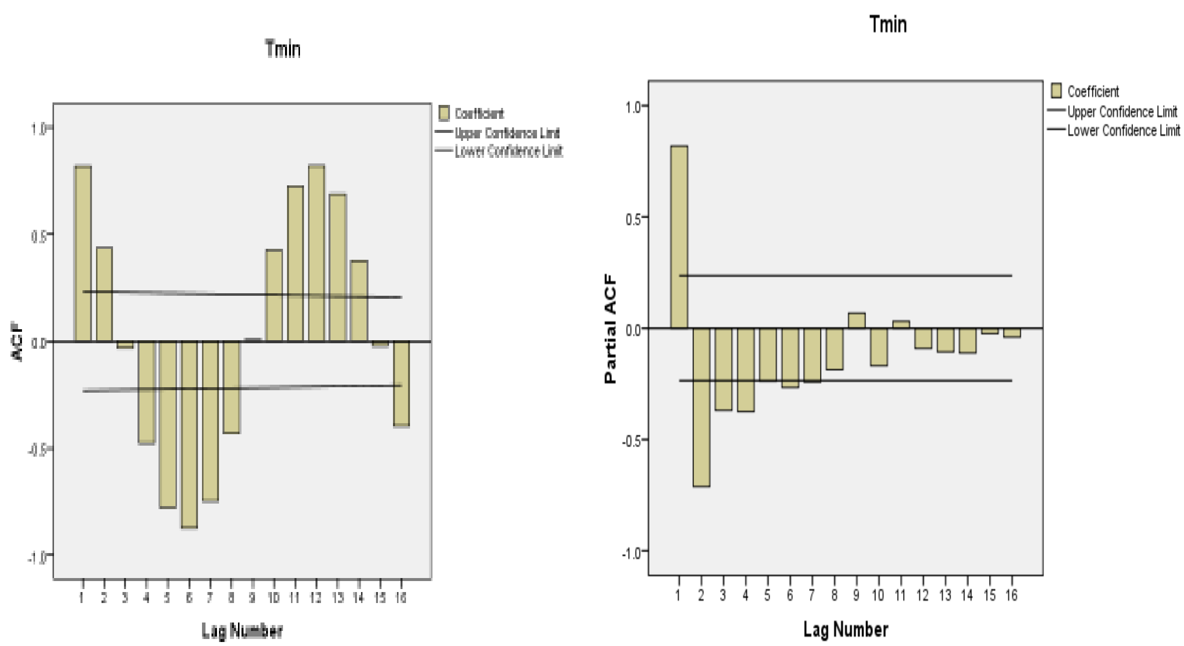


Figure 60: Auto-correlation and partial auto-correlation plot of minimum temperature, mountain region, 2004-2009

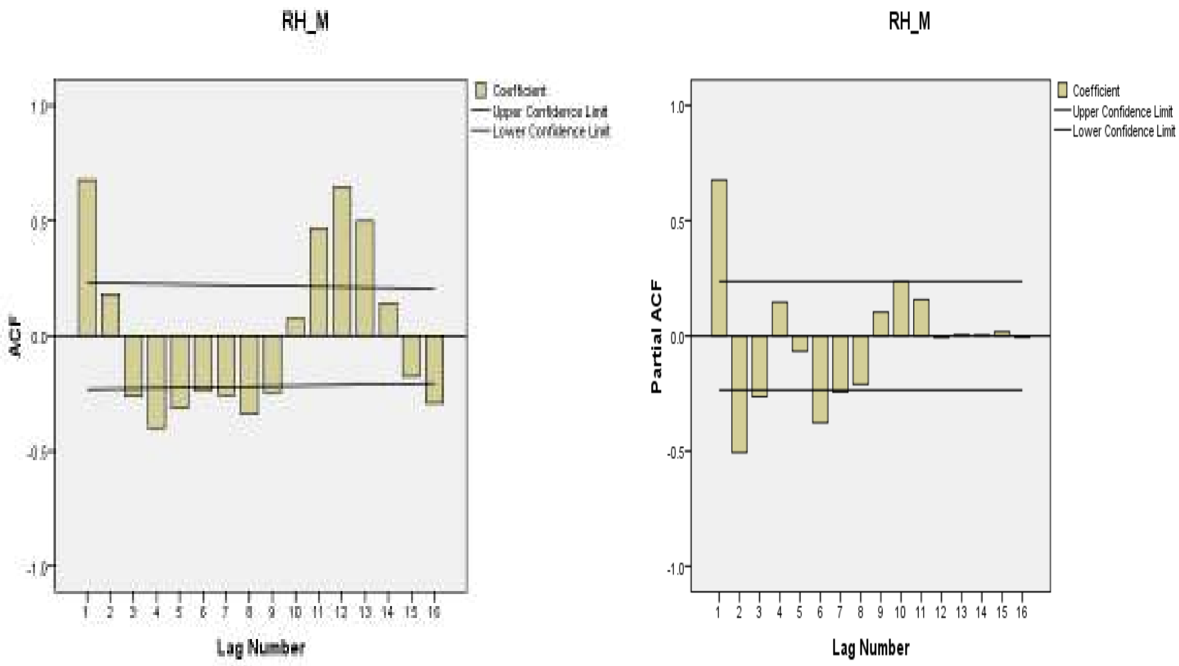


Figure 61: Auto-correlation and partial auto-correlation plot of relative humidity (Morning), mountain region, 2004-2009

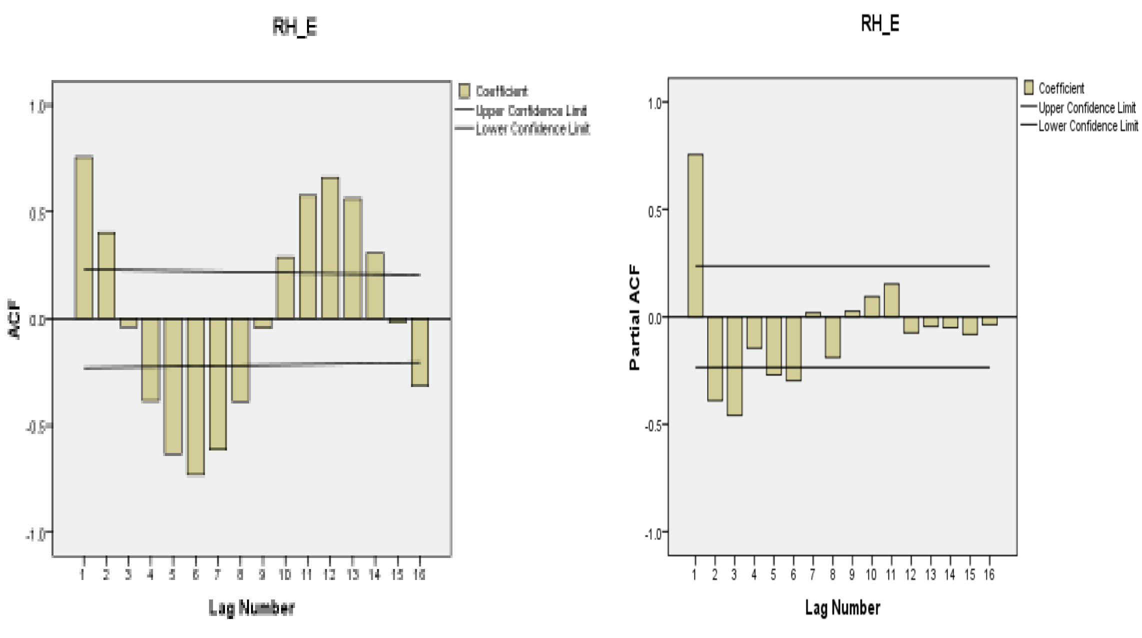


Figure 62: Auto-correlation and partial auto-correlation plot of relative humidity (evening), mountain region, 2004-2009

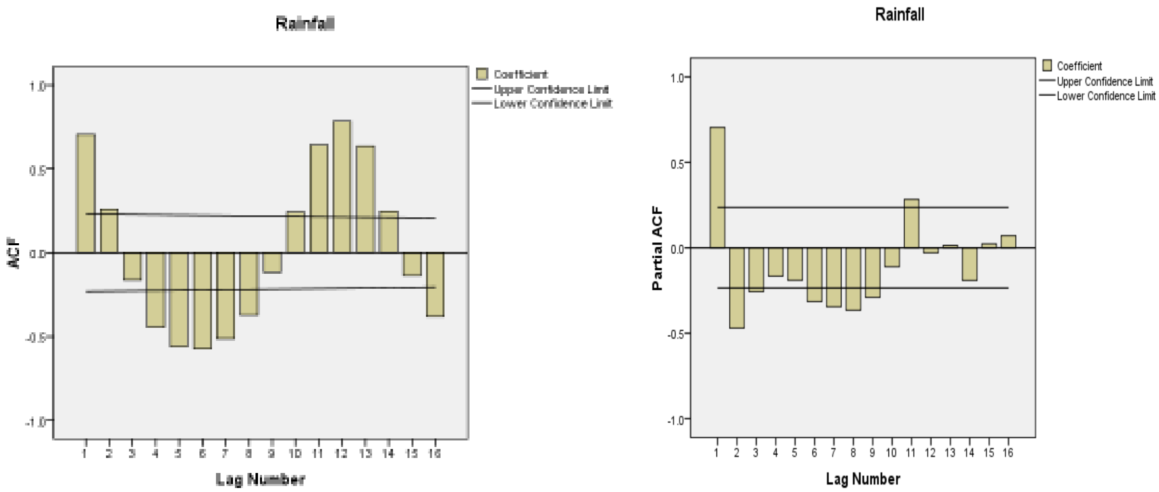


Figure 63: Auto-correlation and partial auto-correlation plot of rainfall, mountain region, 2004-2009

4.2 Research findings from Qualitative Study

KII with Health Workers

Key informants interview with the health workers was done with the chief of district health office, focal person of vector control program, malaria inspector (only in few district) and medical doctors of primary health care centers. Perception on climate change and human health was still unclear and the effect resulting from climatic events were discussed and made some conclusion based on their views.

"Climate change is a serious problem as we are hearing in news and seeing in television and greater consensus is developing to address the impending crisis resulting from adverse effect of climate change. These impacts are obvious in health sector too. There are change in precipitation and temperature this time with compare to previous year. No significant measureable impacts are seen resulting from climate change in Nepal. Vulnerability assessment needs to be conducted at national level. Mosquitoes are seen in charikot and higher elevated areas of Dolakha districts though vector borne disease burden is low, we may predict it as a climate change but not sure. Vector borne disease will have other impact to health also. Increasing temperature related morbidity may increase and the risk of new disease may also rise. Pyrexia of unknown origin is high with increased susceptible to climate induced health problems."- **HW from Dolakha district**

There are still many attempts to be done for effective functioning of the health program at district level that is governed from centre. Vector control program has many weaknesses i.e lack of diagnosis facility with only the availability of lab facility, we cannot test readily and sometimes the test may give futile result. Vector control programs are only directed towards slide collection as to only fulfill the annual slide collection target of 300.

Therefore, malaria surveillance should be strengthened to find out the actual problem of disease. Village visit and slide collection should be done more scientifically and rationally to ensure proper case detection and management. Rapid diagnostic test should be strengthened. Health facility should be equipped with technical equipments to ensure proper management of the disease in the community. Training to the health staffs should be given to make them more aware about climate change and its effect to health of the people. Timely collection of the slide, examination, feedback mechanism should be managed and developed. Reporting system of vector borne disease should be strong and should have fast track system. People are shifting from terai to Himalayan region so the program should be upgraded to the mountainous districts as well. Microscopy service, medicine, RRT team should be strengthened. He continues

"Though numbers of mosquitoes are high in number there isn't any big problem of vector borne disease. Climate change has numerous impacts to the living system and to the natural resource as well. Early flowering of plants and too much heat at summer season are the tangible effects seen from the climate change. In Dolakha many people migrate here and there, and some even work outside in India and transmit the disease. Breeding site and reservoir of mosquito are high because of which the risk of disease transmission is also soaring". Another health staff of Dolakha district states.

Climate change is spontaneous process. Common cold and viral fever are seen high in this district. We can only just feel climate change but we can't define it exactly. All kind of disease is observed in this district but relatively vector borne problem is low and is not a pubic health problem. If the cases are found here than it might be only imported cases, no any indigenous cases are diagnosed so far. Many people go to India for income and when they contract disease they return to home and those cases are recorded in district.

But in the other hand, though the burden of disease is low but the availability of the mosquitoes and its biting habit is creating nuisance to people. People are using bed nets to prevent from mosquito biting and are quite aware about the malaria. The dirty environment and poor sanitation may be the prime reason for the increased number of mosquito. I can't say blindly that all these change in the mosquito breeding are due to the climate change. Dirty environment and poor sanitation with increase in the human settlement are the major factor for increased frequency of mosquitoes. We are not known about the impact of climate change and human health. No any information is shared with us about climate change and its health impact. Obviously, temperature is increasing and mosquitoes are shifting to the higher altitude.

HW from Taplejung (DHO)

He continues to explain and interpret the strength and weakness in health program and interventions.

“System and the mechanism of disease diagnosis and treatment are well prepared and maintained. Vacant post should be fulfilled and the technical manpower should be hired immediately to address any form of epidemic and disease problem but the condition is that we are working as a watchdog by visiting the affected areas. Besides all these constraints we are working hard for good functioning of district health system. In Himalayan and hilly district there is no strong vector control program and post of vector inspector is not fulfilled and other staff should look the program.”

“Extreme heat and warmer climatic conditions at this height is calling for the urgent need of integral vector management strategy program and activities. Taplejung is highly vulnerable to earthquake as you have also heard the news about recent disaster that damaged huge property and house. Besides these fragile land systems we don’t have the mechanism to cope to any emergency and epidemic timely. Deforestation should be controlled and awareness should be raised to increase the plantation program and protect the environment then only the hazard of climate change can be tolerated. .” DHO states

Few of the imported malaria cases are only found here. When people get ill they return back to home and seek treatment which means the disease is not of the origin of Taplejung. Health is directly related to climate change. UV rays affect skin, eye and seasonal change in rainfall has induced the disease occurrence. VBD and snake bite of Terai region can be observed here in near future too. People are wealthy and educated here. We have no any specific program for vector control program at PHCC level. Training should be given to health workers about the impact of climate change and health. Awareness to the community and individual is also necessary to make people more realize on this issue.

There is no any specific program for the control of VBD but when the positive cases are identified, treatment is given and we have chloroquine and primaquine in the district. About 13 VDC are in lower belt which are at high risk of malaria and other VBD. VBD control program is passive, need to be strengthened and active program implementation is must. Program should *not only focus on treatment of the suspected cases but health education should also be promoted in the district. –**One of the health workers from health facility, Taplejung***

One of the local of Dhungesanghu VDC states "There was no mosquito in previous years but nowadays mosquito prevalence is high. There was snow at the high hills nearby but these days the snowfall are not seen in nearby hills, may be this is an impact of climate change."

*Extreme climatic and frequent seasonal change in climate is observed in Illam district. In some places there is 365 days cold season and in somewhere extreme heat affects the daily life of the people. No malarial cases so far. Mosquitoes are also rarely seen. Cold season has extended and cold related morbidity is high. COPD, Asthma, URTI, is observed many in number these days. Unfair rainfall and change in climatic parameters are observed. Malaria program is running here. We are not at risk of VBD yet. People are quite aware and are known about it. No any tangible risk of landslide here. Mutational change may occur if any form of long term climatic change happens. Lack of skilled manpower to operate health facility at grass root level is the major challenge all over the country to make result oriented activities. **One of the health workers from Illam district interprets.***

Malaria slide collections, lab diagnosis, supanet distribution, (Long lasting insecticide treated net) are the basic programs in vector control. Too many mosquitoes are seen during summer. If 37.5 ^{o}C recorded can be the risk temperature for malaria occurrence. Some months ago, one private hospital of Fikkal hospital showed Pf positive but was false due to low and false kit provided. Later upon diagnosis after collecting blood all the test were found to be negative. Slide collection is going on. Viral fever is increasing and antibiotic is not suggested to them. Climate Change is happening and certainly certain changes are happening in this area. Kanyam people are sometimes more prone and attacked by viral infection.

Transportation may be the cause of the disease occurrence. People are aware about the issue. Sub center (HP, SHP) should be strengthened and enhance their capacity to detect malaria. Special program focus on FCHV to identify more hidden case in the society can be best solution. Gorkhe, Chulachuli, Danabari are at high risk area for malaria.

Fikkal PHCC, Ilam

Summer season is expanding, temperature is extremely high during summer and winter season is also unusual. Malaria, KJ supanet distribution is running on. People are more aware about VBD and know about climate change though they don't have particular knowledge on climate change. Mosquito numbers are rising. LF campaign was also conducted in this district. Public health awareness program should be conducted. Government should also help for supanet distribution.

Slide collection is going on and spraying program is functional. Malaria is timely diagnosed and treated. Primaquine and chloroquine are given to the patients in need/ upon diagnosis of malaria cases. JE diagnos is not done yet. Two to three AES are referred to BPKIHS. Filariasis cases are seen highly during campaign. Malaria is even seen in winter and climate change may be one factor. We are definitely vulnerable. Communicable disease risk is high still. RRT should be minimized. CC control and coping mechanism should be developed and enhanced.

Morang, Mangalbare PHCC

Perception on climate change

Unusual change in the normal temperature and rainfall (e.g like change in the temperature) is observed in the country. Kathmandu city was too cold in winter and during summer the minimum temperature was only around 16-17 degree Celsius but in this year Kathmandu is getting warmer and warmer and its too hot in summer as like of Terai region.

We cannot measure climate change but is happening. The change in high and low temperature is certainly the impact of climate change. There was fear once that Cho-Rolpa lake of Dolakha district will burst and there will be heavy human loss and damage to the infrastructure.

VBD analysis

Mosquito density too high and is in increasing trend. Disease incidence is certainly low though density of mosquito high. Treatment facilities, awareness in general population about vector disease transmission may be the reason for decreasing the trend of VBD.

Favorable temperature is making mosquito livable and creating habitat for vectors. There is relation between VBD and climate change. Temperature is extremely increasing and making every human settlement risk to various health hazards. Working capacity of the people is highly reduced due to excessive heating and sweating.

Communities are not aware about the matter related to climate change and their impact to the human beings.

This is not only our problem but rather it's a global issue. Experience of other countries should also be learned regarding the coping mechanism and the steps they are taking to reduce the problem of climate change.

Recommendation

Multi-sectoral approach and inter-sectoral co-ordination is necessary. All the line agencies should work on it. Clean water should be supplied and promotion of hygiene and sanitation should be made. So being a cross cutting issue, all should work to combat the current and possible future impact of climate change.

Training to the health worker is also essential. Almost 50 % of the health workers are not trained and not technically sound. Basic qualification may be lacking to vector control officer.

Programs are enough but the skillful people are lacking. Recruitment of the staffs should be based on qualification but not through other means.

Other country experience should also be taken into consideration.

Multi approach from all other ministries is necessary

Resources should be channelized and directed all according to the need

"Health workers are not sensitized to work and I am too much confused why they do so"

VDRC training centre in Hetauda has no meaning with its halls and building only. Government is even not able to run such an institute that work on vector borne disease and research, which has the essential role to assess the pattern of climate sensitive disease like malaria, Kalazar etc. If we can't made this functional how could it is possible to address the global issue of climate change

DHO SARLAHI

Unnatural change in the climatic conditions with extremeness in the rainfall and temperature is called climate change which is a global issue. Global warming is a serious concern which we call it climate change now. During 2053/54 (1997/98) there was a heavy flood and landslides but these days only drought and low rainfall is a greater problem.

There wasn't mosquito during 2054/55 (1998/99) but nowadays we can't sleep without bed nets throughout the year. Certainly some unnatural changes are happening these days. In one of our VDC which is very cold round the clock, mosquitoes are large in number but the malaria cases are not reported so far from such region. *Kamalakhoch* VDC is malaria prone area where the burden of malaria disease is also high.

People are unaware about the matter of climate change and its possible harm and impacts. There are certain minorities who rare pigs in unhygienic way. Open defecation are prevalent in their society. Such type of environment also has exaggerated the problem of vector borne disease like malaria, JE etc. Health institution is not running properly/smoothly. Excessive dust pollution is a major problem in sindhuli district and people are at risk of developing respiratory hazards. DDC and Municipality have not worked on it." *In one way we talk about climate change and in other our system don't work in development of nation so double burden has to be faced by the innocent people who are living here"*

Proper use of pesticides and insecticides should be done to prevent the agricultural occupational health and hazard. Deforestation should be controlled and open defecation should not be done to ensure healthy environment and surrounding. If we take these simple but a very important step than we can somehow work to adapt to the climate change impacts

DHO, Sindhuli

Seasonal variation affects in the occurrence of vector borne disease. Due to this factor we found malaria even in the month of Jan-Feb. Due to such unnatural phenomenon we are finding the new cases even in winter season. Climate is changing in slow and steady though we can't measure it exactly. Rainfall and temperature are irregular now a day.

Malaria vectors and its cases are mainly recorded here. JE are less in number and we don't have kalazar. We don't have equipments which could correctly identify the cases of such diseases. There is crucial relationship between climate change and VBD. Hot temperature is necessary for breeding of vector which is increasing these days. I mean to say that favorable temperature that mosquito can survive are being identified.

Programs are functional in the districts. Surveillance, blood collection, RDT examination, early diagnosis and treatment are the programs that are functional. LLIND (Long Lasting Impregneted Net Distribution) to high risk areas are some of the continuing program of the districts. For pregnant women we supplied net last year. IRS (indoor residual spraying) is also done in some areas.

DHO, Sindhuli

The winter season is getting cooler and summer season hotter. Prevalence of diseases is heightening due to the change in climatic pattern. Trend of vector borne diseases shows increasing trend in higher altitude. The district is Malarial prone area, though, malarial infection cases may be decreasing, because of intervention programs but kalazar cases are increasing and also the probability of outbreak of vector borne diseases is high due to recurring floods, heat stroke etc. The vector-mosquito density is even rising every year. If there is no any intervention, the situation may be out of control. Even in January, and February we are bowed to sleep with bed nets to save from their bite.

Tharu is indigenous community here; their major settlement are across the Rapti river, called "Rapatipari", which is far from district head quarter and insignificant amount of government program are implemented there till now. In addition, people are not aware about life cycle of vector and its health impact and do not like to come hospital at early stage.

Female from various communities had emphasized on focus group discussion that there is urgent need of awareness activity on vector control program or community drug program on Tharu community, and they are economically and educationally under developed. Some health worker perceived that sand fly bite induced Kalaazar is increasing in Tharu community than in other community. Low level of education is the encouraging factors. Due to poor practice of sanitation habit on Muslim community, such diseases are more prevalence in them. Closely built houses, lack of sanitary toilets, drainage system are more in those communities. So, diseases like, malaria, typhoid, diarrhea are occurring more problem in them. Awareness level is poor. Even people are found seeking treatment from Dhami and Jhakri. Proper screening of mosquito breeding places should be done. Community awareness program on vector borne diseases is not effective. In other hand, Assam area induced malaria is more severe than the malaria present in our backs, it is because, and most people are working in Assam (a state in India) from here as label migrants.

Malarial spray program has not actively implemented nowadays. Self-financed spraying is not the effective alternative as the poor people cannot afford it. So government should revive the spraying program again. Lack of well managed factories, proper management of industry products and haphazard drainage is even increasing mosquitoes. Open border is even the next cause of malaria rise in this district. As the border side people have cross country relationship which causes the greater movement of people. Kitchen gardening is even creating favorable places for mosquitoes to breed and working environment is not satisfactory. So, government should conduct awareness campaign, training, workshops, as well as initiate proper monitoring and evaluation system.

HW from one of the PHCC, Banke

Focus Group Discussion with FCHV/local women's and Health Workers

Both FCHV and women said climate change is a new idea to them. They are unaware even about the term *Climate Change*.

Sand-flies are high in number here during the summer season. Jaundice, diarrhea are the common health problems. We have no idea about climate change and its relation to human health. We have seen that the production of foods and local vegetation have been affected grossly. Even though it's a cold weather area mosquitoes are seen in large number in summer season. Environment is getting polluted with increase in density of population. People domesticate pigs and drainage system get polluted with the excreta and unmanaged waste.

With FCHV/Women of Illam District

We don't know about climate change. We have not heard about it. Yes, it is getting hot these days and the number of mosquito is also increasing. Temperature is getting extreme during summer and it is very cold in winter than it was before. Temperature in summer is also increasing since 2/3 years. The trend of mosquito appearance has increased even in day time. We haven't heard about vector borne diseases. We heard about malaria, Kalazar. We know that it is caused by the bite of mosquito. Even they are increasing. People get illness with malaria frequently. The infectivity by malaria has also increased.

We don't feel so but to some extent, the food production has gone down by climatic factors like heavy rainfall at some point of time and no rainfall at others. I am aware of the temperature getting hotter, but I haven't heard of climate change. Sometimes in TV, we have heard of it but we don't pay much attention to it. Awareness raising program targeted to FCHVs like us as well as for the community is essential to get the knowledge and to take special precautions in making environment more safe and protected. Health facility should also promote the effective preventive programs rather than only treating the disease and health ailments.

With FCHV/Women's of Morang

Tropical and temperate climate dominates this catchment area. Community people of various background - including the Female Community Health Volunteer (FCHV), Health Worker (HW), teachers, community people of marginalized communities, the entire ethnic group people including male and female agree that climate change is a crucial issue to debate, discuss as well as generate appropriate ideas to save the natural resources to be jeopardized. They talked about the climate change and vector borne diseases in this way: "*The density of mosquito is going up at every year in respect to previous year. They also explained about the tolerating power of mosquito to new environmental situation become more adaptive at every place of hill region, where they had not found before it. In case of climate, there has changed into climatic parameter such as temperature, precipitation and relative humidity. Precipitation is irregular, unpredictable and off-seasonal and they also expressed there is feeling of hot climate with compared to preceding year, this may be because of deforestation*".

"The trend of vector borne disease occurrences is increasing during the summer and rainy season while few cases are even noticed in off-season as well. The Malaria cases are seen more frequently in summer season in this area. Even the malaria patient and the malarial trend are increasing since the last few years in OPD while 2 cases of Kala-azar recorded recently. I feel, most of people are unknown about the result of mosquito's biting and symptoms of malaria at hill districts. I have found the opportunity of getting work on other four similar health institution of

hill district. Patient visits the health institution for their health check after it reached more sever stage.” ***One of the health workers from Rukum district***

This is Himalayan district and it is malaria free, if any cases are appeared here it must be imported case but diarrhea and other water borne disease are prime health problem for this area. We have not diagnosed any case of vector borne disease here. Though mosquitoes are generally appearing here during the monsoon and post monsoon period. In our record there is no any case of vector borne disease till now, in last three years. Poverty is challenging issue for Jumla in the context of education, food security, and physical infrastructure and socio-economic and cultural strata. These factors are barriers for improving the health indicator for Karnali range. The status of sanitation and Hygiene is very poor; people have lac of knowledge about prevention is better than cure in terms of cultural and habitual practice. The community, local government and central government resources need to be channelized for improving these all indicators including strengthening of intra-sectoral and inter-sectoral co-ordination mechanism. ***Medical Superintendent, Karnali zonal Hospital Jumla***

The participants on Focus group discussion expressed they have not seen vectors of any vector borne diseases like malaria and other before ten years. There was dense pine and rhododendron forest at lower elevation and permanent snow and glacial covered land at higher altitudinal part. The snowfall was continuous even summer season also at above the tree line limit. There was no construction of public service center and road, nowadays everywhere; up to village development committee, also local road construction has started. The snow only the mountains coveres in the winter season at higher altitude, the amount of snowfall has also reduced now days. The intensity and duration of snowfall and amount of the snowfall has also reduced. Participant in focus group discussion highlighted the intensity of geo-physical and atmospheric hazards. Landslide, drought and wind risk has been frequently experienced in every part of district. Another significant change on life cycle of plant with changes in flowering period, seed germination and fruiting has been shown. These significant changes on environmental or climatic parameter are direct or indirect effect due to change on climatic condition, though nobody knows about the term climate change and its impact on environment and public health. Vector borne disease cases are not seen in this area till now, though there are observing the density of mosquitoes at that area in comparison to to previous years. Local participant even health worker observed mosquitoes did not appear in previous years.. The migration rate was insignificant before construction of Jumla airport and Surkhet, Jumla road, but now migration of local people for searching jobs in India is high. Therefore, there is chance of coming back with the imported cases of vector borne disease for treatment. By this reason, there is urgent need of vector control program at each PHCC in mountain district. The main problem at district in health system is absence of Medical Officer, staff nurse and trained lab technician at each PHCC in mountain districts as well as remote part of hill and Teari also,this problem makes many patients suffer many as they don't have money to go outside for treatment. . Therefore, skilled man power and technical setup are important part for providing essential health service to local people to control and prevention of vector borne disease can be done effectively even at community level..

KalikaKhetu PHHC Jumla, Karnali.

According to community people malaria has gone down because of rising in awareness and anti-malarial treatment, however number of mosquitoes has increased. Government has launched program to the spray of insecticide in each household, but mosquitoes are being more resistant to the insecticide and its biting has become more severe than that of previous biting of mosquito. The rate of malarial infection in child from Tharu community and disadvantage community is more than that of other ethnic group. The poor people from the disadvantaged community are economically weak, and they could not afford money for buying the mosquito net and on other hand, lack of education on awareness activities on community has found the cumulative risk on their health. "*Sometimes medicine is not available at Primary Health Care Center, in such situation community people will have no trust on us*" quoted one community health worker. Government had introduced a program to distribute mosquito to pregnant women, but the program could not sustain now. One of health worker told, "*One day pregnant women came to PHCC and tell us, you are corrupt. I heard you sold bed nets which are sent by the government in the name of pregnant women, but we have not got till now. Last year, Global fund provided the project to distribute bed nets to pregnant women and one to each of the household in Terai but this program has not been initiated till date and villagers always visit PHHC and talk about bed net" that condition sometime irk us. One health worker continues.*

People from India even come to Nepal for treatment after suffering from malaria and sometimes add the work load on health institution because of open border system. Though people, from majority group, are aware regarding the malaria treatment and control measures, but there is weakness on surveillance, therefore need to reinforcement at grass root level targeting at even higher altitude as well.

Community people and Health worker from Malakheti PHCC, Kailali

One of the participants present on FGD said that, "*Malaria is of Teraibased disease"* and they have not seen cases of Kala-azar and malaria in their area. Community people were found unknown about details of climate change, what are climate change and its impact.Dailekh is malaria free zone. The land has covered by snow on the winter season. Though the amount of snowfall has decreased nowadays. The health worker talked malaria; vector borne diseases are not seen in this area even now. Though the density of mosquitoes is increasing in that area with respect to previous year. One health worker observed mosquitoes did not appear before ten years ago but now, they are appearing every where. This is the globalized era, and the migration is in increasing trend. Mostly people go to major city of India for labor work. They could suffer from this tropical disease and return from there without treatment of diseases or carrying infection. Therefore, there is chance of returning with the imported cases of vector borne disease. By this reason, there is urgent need of vector control program at each PHCC, even in the Himalayan district also. The main problem at grass root of health system is absence of Medical Officer though there is sanctioned post. Doctor would not like to live most of PHCC even at good facility institution of Terai districts. District Health Office has vector control officer post, but in Deolekh PHCC, lab assistant carries thisactivity. The lab assistant told research team, "The district has not provided the training about the vector borne disease till now. He also emphasized, if technician is unknown about the procedure of blood slide collection to identification, how medical person can diagnose. There is need of training to health staff and provide necessary instruments with medicine and training on case referral and reporting system. Awareness should be raised at household level in addition the effective proper policy implementation

Community people and Health worker from Dailekh PHCC- Bajhang

People perceive nowadays that there is irregular rainfall in rainy season and excessive rising of temperature even pattern of drought is raising its original state. The density of mosquito has found raised on these days but vector borne disease are in controlled because of well developed prevention practice. Every household had revealed, they use bed net and other chemicals before sleeping and wear full cloths during working period. One of health worker-Lab assistant perceived, *"I have not seen till now indigenous vector borne disease cases and imported cases, especially malaria and kala-azar from here within two years period but, my previous staff told me the imported case were occasionally observed during the period of September and October"*. There was not any recorded case of vector borne diseases. The reporting and referring mechanism were not found well managed but neglected by the staff own self. The PHCC in charge told they had already incinerated the previous, about ten year, data sheet and he also advised research team the researcher could find reported data from district and department.

Community people and Health worker from PatanPHCCBaitadi

A summary of Case Reports from different regions

Terai	**Hill**	**Mountain**
I am 50 years old now and have been working in the health facilitiy management committee since many years in this district. Actually there has been a dramatic shift in the climatic pattern everywhere. Itsnot only the news that we heard but as we can see and observe these type of extremeness in weather and climaticparameters. Temperature seems to be rising every year. Definitely this is Terai region and it's obvious that it is too hot in summer, but the heat is in rising trend, if	I am 58 year old now and working in this PHCC since last twenty eight years. I am local resident of this place, and when I was child the place was completely covered by the dense forest. I went forest for hunting with my colleague. At that time the environment was very cool, clean and peaceful. The population density was very less around five to six hundred in total in this area. But at that time, there was weak practice of	This PHCC has not recorded any cases of vector borne diseases from it catchment area population. Temperature remains cold around all season and population density is very low. The maximum land of this district is mountain range, where most is covered by snow; it is popular for Himalayan tracking tourism. So, here is not any problem of such vector borne diseases. Yes, the situation is good but the vector of malaria is being seen in the district. There is

precautions are not taken or if proper care is not given people even fall to victim of heat related health problems. Some months ago, my neighbor was admitted to hospital, while working in the field due to extreme heat and exertion. It's not only the situation of summer season. Winter season are also very cold compared to past years. We could only cultivate 70 % of total land in this district because of inadequate rainfall and unfavorable climatic conditions. If such extremeness raises then certainly the productivity will not counterpart the increasing population. This has been affected by increasing land encroachment for housing and land planning. Agricultural land is being converted to building construction purpose. We technically don't know the literal term of climate change but we can say that climatic shift and unnatural events are putting threat everyday to our	sanitation and hygiene at household level, and by this reason there was prevalence of acute diarrhea as major killer disease. For talking about the vector borne disease, mosquito was common at basin area of Patan I also have an experience of my own. I suffered from malarial infection, which was happened about forty years ago. At that time, I did not know about the malaria. I was very sick from this infection. I know fever started mainly at evening with chills and severing and felt very cold. At that time government had lunched malaria control programme in terai and mid hill zone. Three people came in my home with searching me. They might have heard about my health condition from community people. They provided me drugs as tablet. I took that medicine	maximum increase of mosquito's vector in Jomsom. We have to put bed net every night in the summer since three years; it has been maximum increase of mosquito in this region. This might be due to transport system. The mosquito can easily come to this place through vehicle. It is seen that the mosquito reach here in the pipe, tank and other materials that are being taken here for construction. Although it is not possible to survive and continue its reproductive cycle in cold climate but can survive in inactive form, it is being seen in huge quantity. In case of climate change, we are also experiencing sometimes very cold and sometimes very hot seasons. In case of this year, still in the summer, snow has not melted in the mountain. By this time we should have felt warm but the climate is cold. It can be said that the effect of climate change has started in this region as well.

lives. There are maximum numbers of mosquitoes, but I think the numbers of malaria cases are same and its not increasing but the problems is still the same. This might be due to the net distribution program of some INGOs and NG and people awareness about malaria problem. Here the people have access to news and market is nearby so they are quite well known about health precautions and preventive measures to apply. **A health facilities management committee member from Morang district**	continuously according to their recommendation. And after a week later, I was recovered from malaria. I mean malaria was present in this region at that period also. In my feeling and experience, the climate change affected the vector borne diseases, and it is now shifting from lower altitude to higher altitude, though vector parasite may not be active in this period also. Therefore, there is very less risk of vector borne disease at higher altitude though increase on the density of mosquitoes. But the imported cases are the issue on management of vector borne disease, because of migration rate from lower altitude to higher altitude is very high at the moment. **A health worker from Patan PHCC**	There are some causes of climate change we can figure out such as, quick ripening of fruits, pest in vegetables and fruits. There has been loss of some flora and fauna as well. The government should take an initiative to handle the situation. Till this time government has not given priority on vector borne disease in Himalayan region i.e. there is no program to tackle if the case come to treat. Here we don't have lab equipment to diagnosis and drugs to treat. The government has not set Annual Blood Collection Target for Mountain region. Along with it training to the lab personnel and other staffs is also an essential part to include. **Community people and Health worker from Lete PHCC, Mustang**

A case study

I have been living here in Lete PHCC since 23 years, till date there is no reported any case of vector borne diseases. Lete PHCC is situated in about 2450 m altitude, the climate here is very cold round the year. That's why there is no possibility to survive mosquito vectors at this altitude. The common illness of this area is pneumonia, asthma, lower infection, joint pain, influenza, hypertension, and frequent gastritis and diarrhea.

In case of mosquito, it is being seen for last few years. But the mosquito is inactive and non-infective form. There is no chance of mosquito breeding here. Any suspected imported cases of mosquito have not been examined here in the PHCC. Due to construction of road, there is possibility of mosquito breeding here. The government has not set annual blood slide collection in this heath institution. We do not have lab equipments (strains and reagents) to diagnose malaria. Drugs are not supplied to treat vector borne diseases.

Incharge Lete PHCC, Mustang

According to health worker and community people they said that this area is low risk for malaria like disease, however, mosquito density had shown the increasing order. PHCC had not reported any vector borne disease case till now from its history of establishment not only indigenous but also imported cases. But district hospital and district health office has reported the cases. The major cause for lacking of data might be various regions like negligence of staff on reporting system, patient might went to hospital rather than PHCC, or PHCC c reffered patient to other hospital, because of lacking required facilities or cases are not there..

Community people and Health worker from Kristi PHCC, Kaski

A case study

Tropical diseases like malaria, filariases are prevalent in this VDC. Malaria is endemic in the area but not a public health problem. The climate here is not so hot and not so cold that is favorable for mosquito breeding. , Mosquitos can be found all year round however they are number t is less as compared to other VDCs.

Climate change is happening and its effects are this district is maximum due to its geographical diversities from low lands to upper mountains. The temperature is rising year by year and snow melting is rapid than the past few years. Climate change has direct relationship with human health. The number of OPD cases has increased and among them the cases of vector borne diseases like malaria, kala-azar, etc. Apart from vector borne diseases other diseases like respiratory infection, asthma, diarrhea are also has increased.

From the villagers view, there has been increase in the pest in the crops. Different kind of pest is damaging the crop production. Season for rice planting pattern has changed; there has been erratic rainfall pattern since last decade.

Analyzing the situation, vector control programme should be intensified and along with mass awareness program. Bed net distribution is a successful program that can be helpful in the prevention of malaria. Mass drug distribution is another program that is aimed at elimination of lymphatic filariasis. Vaccine preventable diseases in hilly areas should be given priority.

There are constrains in some issues; like irregular drug supply, laboratory equipments (reagents and chemicals). Besides these, we have appropriate facilities that are required for a primary health care center.

Incharge Kristi PHCC, Kaski

Adaptation strategies for vector borne disease and climate change (a Case study).

Terai

It has been more than 50 years of vector borne diseases control activities in Nepal which started from the Terai region. Terai region of Nepal still accounts for the most number of vector borne disease cases in Nepal. Government of Nepal has launched different vector borne diseases control activities in prioritized districts in Nepal. Climate change has aggravated the prevalence of the vector borne diseases in Terai region. Most of the prioritized districts fall in Terai region. Indicators from Malaria control program like proportion of Pf to total malaria positives (%PF), annual Falciparum incidence (AFI), slide positivity rate and slide Falciparum rate put together are remarkably higher in Terai region than that of the total country. The situation is similar to other vector borne diseases as well. Following are the adaptation strategies for vector borne disease due to climate change:

Involvement of the climate change and vector borne diseases related topics in the curriculum from primary level to the secondary level of education. Young generation need to be educated and be well aware about the climate change and its relation to the vector borne diseases. For this government must take responsibility to involve climate change and vector borne diseases in the syllabus of students from primary to secondary level.

Surveillance activities are to be strengthened from the grass root level to central level. Surveillance activity involves the effective routine reporting system, sentinel system and early warning and reporting system in the Terai of Nepal.

Early diagnosis and prompt treatment program should be made more effective in the Terai region. As Terai accounts for the maximum number of the vector borne diseases cases, health workers should be trained and equipped for the early diagnosis and prompt treatment. Laboratory facilities providing services to detect the disease in early phase should be scaled up.

Private health institutions should also be incorporated with the national reporting system of vector borne diseases control for the avoidance of the duplication and to increase the accuracy of the data. Health care institutions in the Terai are increasing in enormous numbers especially private health care institutions which need to be incorporated in the vector borne disease control program activities. Private health institutions should be encouraged to provide the information and reports timely regarding vector borne diseases. Health workers need to be trained and updated for the modern technology for the timely diagnosis of the vector borne diseases.

Hill region:

Humidity, precipitation, temperature and even current public migration pattern, at higher altitude to lower altitude and vice versa, are playing profound role in vector borne diseases. With the change in these parameters due to climate change, habitat shift of vector is reported in Hills and Mountain regions of Nepal as well. Following are the adaptation strategies for vector borne diseases due to climate change in Hill region of Nepal.

Behavior change communication and improved access to quality health services should be provided to the population most at risk. Previously it was perceived that vector borne diseases are prone only in Terai region of Nepal, but with the change in the climatic parameters vector habitat is shifting resulting increased cases of vector borne diseases in Hills region as well. Behavior change communication focusing on the vector borne diseases habitat and their breeding sites will help to cut down the effects of climate change on Habitat shift of vector.

District health laboratories of the hill districts should be strengthened for the diagnosis of the Vector Borne Diseases. District health laboratories and health institutions must be strengthened for early diagnosis and prompt treatment of the diagnosed cases.

Entomological studies need to be conducted and regular monitoring of vector(s) behavior and bionomics should be carried out. This will facilitate in better insight into the epidemiology of the disease and rational use of insecticide spraying. Vector studies must be carried out in the hills region so that the vector behavior may be timely identified and the trend of vector habitat change will be documented for the effective control of the vector borne diseases.

Environmental management approaches such as household modification and relocation, environmental manipulation in peri-domestic areas as well as biological control approaches should be promoted all over hills areas of Nepal.

Human resources requirements for the vector management and vector borne diseases control program should be find out and the gaps in the human resources should be fulfilled for the smooth functioning of the programs.

Mountain region

Vectors including vector borne diseases have been reported from some parts of the mountainous region of Nepal. Seasonal migration in mountainous region is more prevalent. Seasonal migration in lower areas and in foreign country makes the people vulnerable to the vector borne diseases, which in turn increases the possibility of the vector borne diseases spread in population of the mountain regions. Climate change has contributed significantly to the habitat shift of the vector and possibility of the vector borne diseases in higher areas in near future from the recent research findings. Following strategies can assist in vector borne diseases prevention and control in mountainous region of Nepal.

Social mobilization and coordination among different sectors for the control of vector borne diseases is necessary in mountainous region of Nepal. As a result of change in climatic parameters change in habitat of vector is seen which makes mountain region vulnerable to the vector borne diseases. Mass awareness in mountain region is inevitable for the control of vector borne disease in near future.

Environmental management approaches such as household modification and relocation, environmental manipulation in peri-domestic areas as well as biological control approaches should be promoted all over the most affected areas: environmental modification of the mountain region is necessary where vectors are prone in order to control the vector, their breeding and halt vector borne diseases in higher altitudes.

Behavior change communication activities focusing on advocacy, communication and social mobilization should be promoted incorporating areas like early diagnosis, ensure uniform and complete coverage with IRS, personal protective measures, and environmental management should be promoted: behavior change communication and advocacy for the control of vector and vector borne diseases is must. In past ,there was wide perception that vector are only found in lower altitudes but with the global warming and climate change, vectors can be found in mountains of Nepal as well so creating mass awareness but help to control vector borne diseases.

Finally, the reporting activities of vector borne diseases need to be more systematic and functionally active at grass root level to central data management unit. The research team has reported, surveyed sample health institution (PHCC and DHO) and fund not using their health statistical data. Hence, proper management of reporting system on vector borne diseases is necessary in current context of Nepal. In case of malaria free zone or Himalayan district there is chance of imported case of vector borne diseases. Therefore, lab facilities at grass root level as well as personal history of patient must be reported from this higher altitudinal region. Responsible staff of this section s needed to be trained and sensitized the importance of raw data in policy and implementation level. The case reporting and reported file of vector borne disease was not available had missed in some of studied health institutions, so we need to make proper filing and referring to concern government body. There is no proper reporting system in health institution form all ecological zones.

4.3 Findings from KAP Survey

Table 9: Socio-demographic Status

Socio demographic characteristics of the respondents		**Terai**		**Hill**		**Mountain**		**Total**	
		N	%	N	%	N	%	N	%
Sex of the Respondents	Male	137	59.30	115	50.40	50	57.50	**302**	**55.31**
	Female	94	40.70	113	49.60	37	42.50	**244**	**44.69**
Age of the respondents in group	60 to 70 years	195	84.40	139	61.00	78	89.70	**412**	**75.46**
	71 to 80 years	36	15.60	73	32.00	7	8.00	**116**	**21.25**
	> 80 years	0		16	7.00	2	2.30	**18**	**3.30**
Religion of the Respondents	Hindu	166	71.90	227	99.60	22	25.30	**415**	**76.01**
	Buddhist	8	3.50	1	0.40	63	72.40	**72**	**13.19**
	Muslim	56	24.20	0		1	1.10	**57**	**10.44**
	Christian	1	0.40	0		1	1.10	**2**	**0.37**
Occupation of the Respondents	Service	1	0.40	7	3.10	5	5.70	**13**	**2.38**
	Business	15	6.50	5	2.20	20	23.00	**40**	**7.33**
	Agriculture	211	91.30	207	90.80	61	70.10	**479**	**87.73**
	Others	4	1.70	9	3.90	1	1.10	**19**	**1.83**
Educational Status of the Respondents	Illiterate	154	66.70	155	68.00	48	55.20	**357**	**65.38**
	Literate	70	30.30	56	24.60	29	33.30	**155**	**28.39**
	Under class 5	4	1.70	8	3.50	7	8.00	**19**	**3.48**
	Class 6-10	3	1.30	9	3.90	3	3.40	**15**	**2.75**
Total		**231**	**42.31**	**228**	**41.76**	**87**	**15.93**	**546**	**100.00**

The above table shows the demographic statistics of the respondents from all the ecological regions from terai, hill and mountain.

Table 10: Mean age of respondents

Mean Age of the Respondents					
Ecological region	Frequency	Minimum	Maximum	Mean	Std. Deviation
Terai	231	60	77	65.494	4.2955
Hill	228	60	97	69.513	6.4347
Mountain	87	60	82	65	5.0532

Of the total respondents (N=546), mean age of respondents was 65.494 years in Terai region, 69.513 years in hill region and 65 years in mountain region.

4.1 Knowledge related findings

Table 11: Heard about climate change

Heard about climate change	Terai		Hill		Mountain		Total	
	N	%	N	%	N	%	N	%
Yes	4	1.73	64	28.07	14	19.18	82	15.02
No	227	98.27	164	71.93	73	83.91	464	84.98
Total	**231**	**100.00**	**228**	**100.00**	**87**	**100.00**	**546**	**100.00**

Among the total respondents of (N=546), only 1.73 %(N=4) have heard about climate change and remaining 98.27 % (N=227) have not heard about it in Terai region. In hilly region 28.07 % have heard about climate change while 71.93 % have not heard about it in hilly region. In mountain region, 19.18 % have heard and 83.91 % have not heard about climate change. Overall analysis showed that people living in hilly region have heard more about climate change in comparison relative to Terai and mountain region.

Table 12: Source of Information about Climate Change

Source of information about climate change	N	%
Friends	23	28.05
Family Members	3	3.66
Newspaper	10	12.20
Radio	46	56.10
Total	**82**	**100.00**

Among the total respondents who have heard about climate change (N=82), most of the respondents (56.10 %) have heard about it from radio while only 3.66 % have heard about climate change from family members.

Table 13: Knowledge about Climate Change

Meaning/definition of Climate Change	Terai (n=4)		Hill (n=64)		Mountain (n=14)		Total	
	N	%	N	%	N	%	N	%
Excessive Heat	4	100.00	61	95.31	14	100.00	79	96.34
Glacier melting	3	75.00	51	79.69	11	78.57	65	79.27
Reduction in production	1	25.00	45	70.31	6	42.86	52	63.41
Sudden Outbreak of disease	1	25.00	29	45.31	5	35.71	35	42.68
Large Occurrence of mosquito	1	25.00	25	39.06	9	64.29	35	42.68
	10	250						

Note: Percentage is exceeding due to the multiple response

Of the total respondents of who have heard about climate change 100% in Terai, 95.31 % in hill and 100% in mountain said excessive heat as the meaning of climate change, 75% in Terai, 79.69 % in hill and 78.57 % in mountain region said glacier melting, 25 % in Terai, 45.31 % in hill and 35.71% in mountain region said sudden outbreak of disease and 25 % in Terai, 39.06% in hill and 64.29% in mountain region said large occurrence of mosquitoes as the meaning of climate change. In total most of the respondents (96%) said excessive heat as the meaning of climate change.

Table 14: Reason for climate change

Reasons for Climate Change	Terai (n=4)		Hill (n=64)		Mountain (n=14)		Total (N=82)	
	N	%	N	%	N	%	N	%
Increase in GHG	1	25.00	53	82.81	10	71.43	64	78.05
Hole in Ozone layer	1	25.00	42	65.63	4	28.57	47	57.32
Gases produced by automobiles	2	50.00	34	53.13	9	64.29	45	54.88
Deforestation	2	50.00	39	60.94	11	78.57	52	63.41
Total								

Note: Percentage is exceeding due to the multiple response

Regarding the reason for climate change most of the respondents from all the regions ranging from terai (50%), hill (60.94%) and mountain (78.57%) said deforestation. Similarly, 25% in terai, 82.81% in hill and 71.43% in mountain said increase in GHG as a reason for climate change. Similar types of responses are seen for other reasons for climate change. Overall analysis of all the ecological regions showed that majority (78.05%) said increase in GHG as the reason for climate change.

Table 15: Sector affected by climate change

Sectors affected by Climate Change	**Terai**		**Hill**		**Mountain**		**Total**	
	N	%	N	%	N	%	N	%
Health	2	50.00	50	78.13	10	71.43	62	75.61
Drinking water source	4	100.00	42	65.63	9	64.29	55	67.07
Agriculture	4	100.00	50	78.13	11	78.57	65	79.27
Biodiversity	2	50.00	31	48.44	7	50.00	39	47.56
Weather	0	0.00	32	50.00	8	57.14	40	48.78
Total								

Note: Percentage is exceeding due to the multiple response

50% of the respondents from terai region, 78.13% from hill region and 71.43 % from mountain region said that health is the sector that is affected by climate change. Similarly, 100% from terai region, 65.63% from hill region while 64.29% from mountain region said that agriculture is the sector that is affected by climate change. In the same way, 100 %from terai, 78.13 % from hill and 78.57% from mountain said agriculture. 50% from terai, 48.44% from hill and 50% from mountain region said biodiversity whereas only few of the respondents from all the regions said weather as the sector affected by climate change viz 50% from hill and 57.14 % from mountain. Overall analysis showed that majority of the respondents (79.27%) said agriculture as the major sector affected from climate change while least of the respondents (47.56%) said biodiversity as the sector affected from climate change.

Table 16: Heard about Vector Borne Disease

Heard about vector borne disease	**Terai**		**Hill**		**Mountain**		**Total**	
	N	%	N	%	N	%	N	%
Yes	192	83.11688	160	70.18	48	55.17	400	73.26
No	39	16.88312	68	29.82	39	44.83	146	26.74
Total	**231**	**100**	**228**	**100**	**87**	**100**	**546**	**100.00**

Majority of the respondents from terai region 83.11%, 70.18% from hill region and 55.17 % from mountain region have heard about vector borne disease.

Table 17: Knowledge about Vector Borne Diseases

Heard about different vector borne disease	**Terai (N=192)**		**Hill (N=160)**		**Mountain (N=48)**		**Total (N=400)**	
	N	%	N	%	N	%	N	%
Malaria	178	92.7	153	95.63	48	100	379	94.75
JE	2	1	11	6.87	4	8.33	17	4.25
Kalazar	45	23.43	117	73.13	8	16.67	170	42.5
Elephantiasis	90	46.87	104	65	9	18.75	203	50.75
Dengue	18	9.37	48	30	7	14.58	73	18.25
Total								

Of the total respondents from the three ecological regions who have heard about vector borne disease, 92.7% from terai region, 95.63% from hill region and 100% from mountain region have heard about malaria. Similarly, only 9.37% from terai, 30% from hill and 14.58 % from mountain region have heard about dengue. In the same way, 23.43% from terai region, 73.13% from hill region and 16.67 % from mountain region have heard about Kalazar. Small percentage of respondents have heard about Japanese Encephalitis i.e 1% from terai, 6.87 % from hill while 8.33 % from mountain region. Overall analysis showed that almost 94.75% of the respondents have heard about malaria and only 4.25 % have heard about Japanese Encephalitis.

Table 18: Vectors transmitting vector borne disease

Vectors transmitting vector borne diseases	**Terai**		**Hill**		**Mountain**		**Total**	
	N	%	N	%	N	%	N	%
Mosquito	192	100	159	99.38	48	100	400	100
Sandfly	69	35.9375	41	25.63	8	16.67	118	29.5
Housefly	8	4.166667	30	18.75	1	2.083	39	9.75

Of those respondents who have heard about VBD 100% said mosquito as the vector that can transmit the disease in terai region, 99.38 % in hill region and 100 % in mountain region. Similarly, 35.93 % from terai region, 25.63% from hill region and 16.67 % from mountain region said sand fly. In the same way, 4.11 % said housefly from terai region, 18.75 % from hill region while 2.08% from mountain region said sandfly that can transmit the disease.

Table 19: Knowledge on prevention measures of vector borne disease

Knowledge on prevention measures of vector borne disease	**Terai**		**Hill**		**Mountain**		**Total**	
	N	%	N	%	N	%	N	%
Use of bed nets	192	100	157	98.13	41	85.42	390	97.5
Making surrounding clean	127	66.14	99	61.88	33	68.75	259	64.75
Wearing of full dress covering the exposed area	80	41.66	47	29.38	27	56.25	154	38.5
Use of medicine	92	47.91	49	30.63	9	18.75	150	37.5
Total	192	100	16	100	41	85.42	400	100

			0					

Regarding knowledge on the preventive measures of vector borne disease, 100 % from terai, 98.13% from hill and 85.42 % from mountain region said use of bed nets can prevent vector borne disease. Similarly, 66.14% from terai region, 61.88% from hill region and 68.75 % from mountain region said that making surrounding clean can prevent from vector borne disease. Some of the respondents said use of medicine and wearing of full dress covering the exposed areas can prevent the transmission of vector borne disease.

4.4Attitude Related Findings

Table 20: Attitude on climate change and vector borne disease

	Agree		Strongly Agree		Disagree		Strongly Disagree	
Dengue/malaria is a serious disease	N	%	N	%	N	%	N	%
Terai	162	84.4	NA	NA	30	15.6	NA	NA
Hill	144	90	3	1.9	13	8.1	N A	NA
Mountain	48	100	NA	NA	NA	NA	NA	NA
Dengue/malaria can be prevented								
Terai	129	67.2	NA	NA	63	32.8	NA	NA
Hill	155	96.9	4	2.5	1	0.6	NA	NA
Mountain	47	97.9	NA	NA	1	2.1	NA	NA
Climate change is a serious problem								
Terai	3	75	NA	NA	1	25	NA	NA
Hill	38	59.4	15	23.4	11	17.2	NA	NA
Mountain	14	100	NA	NA	NA	NA	NA	NA
Climate change increase the risk of vector borne disease								
Terai	4	100	NA	NA	NA	NA	NA	NA
Hill	43	67.2	9	14.1	12	18.8	NA	NA

Mountain	14	100	NA	NA	NA	NA	NA	NA

Regarding dengue/malaria as a serious disease, 84.4% of the respondents from terai region agree and remaining 15.6% disagree. In hill region, 90% agree, 1.9% strongly agrees and 8.1% disagree while in mountain region 100% agree that dengue/malaria like disease is a serious type.

Regarding prevention of dengue/malaria like disease, 67.2% agree while 32.8 % disagree in terai region, 96.9% agree, 2.5% strongly agree while 0.6% disagrees in hill region. Similarly, 97.9% agree and 2.1 % disagree in mountain region that dengue/malaria can be prevented.

Regarding climate change as a serious problem, 75% agree while 25% disagree in terai region. Similarly, 59.4% agree, 23.4% strongly agree while 17.2% disagree in hill region. In the same way, 100% in mountain region agree that climate change is a serious problem.

Of the total respondents in terai region who have heard about climate change 100% agree that climate change increase the risk of vector borne disease. Similarly, 67.2% agree, 14.1% strongly agree and 18.8% disagree in hill region but in the mountain region 100% agree that climate change increase the risk of vector borne disease.

Table 21: Reliability Statistics for attitude analysis

Cronbach's Alpha	N of Items
.723	4

The reliability of the items were also checked as they were segregated to represent our variables under study and it was found that the value of Cronbach's alpha of items standing for attitude related to climate change and vector borne disease was found to be 0.723. "A commonly accepted rule of thumb for describing internal consistency using Cronbach's alpha is; $\alpha \geq 0.9$ – excellent, $0.9 > \alpha \geq 0.8$ – good, $0.8 > \alpha \geq 0.7$ – acceptable, $0.7 > \alpha \geq 0.6$ – questionable, $0.6 > \alpha \geq 0.5$ – poor, and $0.5 > \alpha$ - unacceptable." (en.wikipedia.org, as cited on June 22, 2012) As the alpha level of the variables of consideration fall in acceptable, good, and excellent range, the study and findings can be taken as reliable.

4.5 Practice related findings:

Table 22: Practice related to diseases and vectors

Practice related to Climate Change and VBDs	**Terai**		**Hill**		**Mountain**		**Total**	
	N	%	N	%	N	%	N	%
Treatment receiving place								
Private Hospital	5	2.16	33	14.47	0	0	38	6.96
Government Hospital	226	97.84	187	82.02	85	97.70	498	91.21
Home treatment	0	0.00	7	3.07	2	2.30	9	1.65
Dhami-Jhakri	0	0.00	1	0.44	0	0	1	0.18
Activities for prevention from the vectors (multiple response)								
Use of mosquito net	218	94.37	213	93.42	2	2.30	433	79.30
Use of medicine for preventing mosquito bite	127	54.98	40	17.54	2	2.30	169	30.95
Making household and surrounding clean for preventing VBD	47	20.35	70	30.70	4	4.60	121	22.16
Wearing full dressed clothes	30	12.99	32	14.04	2	2.30	64	11.72
Total	231	42.31	228	41.76	87	15.93	546	100.00
Use of insecticides to prevent mosquito transmission								
Yes	19	8.23	59	25.88	1	1.15	79	14.47
No	212	91.77	169	74.12	86	98.85	467	85.53
Total	231	42.31	228	41.76	87	15.93	546	100.00

2.16 % from terai region, 14.7 % from hill region and none of the respondents from mountain go to private hospital to seek health service. Majority of the respondent's i.e. 97.84% from terai region, 82.02% from hill region and 97.70% from mountain region go to government hospital to seek service when they fall sick. Only few of the respondents seek dhami-jhakri and apply home based treatment when they are sick.

Regarding the preventive measures used against vectors that can transmit the disease 94.37% from terai, 93.42% from hill region while 2.30% from mountain region said that they use bed nets. 54.98% from terai region, 17.54 % from hill region and 2.30% from mountain region said that they apply medicine to prevent from mosquito bite. Whereas few of the respondents said they use full dressed clothes (12.99% terai, 14.04% hill and 2.30 from mountain region). In the same way, 20.35 % from terai region, 30.70 % from hill region and 4.60% from mountain region said that they make household and surroundings clean to prevent from any type of mosquito bite. Regarding use of insecticides to kill mosquito, 8.23 % from terai region, 25.88 % from hill region and 1.15% from mountain region said that they use insecticides to prevent from mosquito bite and kill them.

4.6 Observational Analysis

Table 23: Household Situation (Observational Analysis)

Household situation (Observation)	**Terai**		**Hill**		**Mountain**		**Total**	
	N	%	N	%	N	5	N	%
Household cleanliness								
Yes	151	65.37	212	92.98	44	50.57	407	74.54
No	80	34.63	16	7.02	43	49.43	139	25.46
Type of house								
Kachha	172	74.46	165	72.37	0	0.00	337	61.72
Pakka	11	4.76	44	19.30	13	14.94	68	12.45
Kachha-pakka	48	20.78	19	8.33	74	85.06	141	25.82
Presence of pits for Stagnant Water								
Yes	126	54.55	36	15.79	17	19.54	179	32.78
No	105	45.45	192	84.21	70	80.46	367	67.22
Total	231	42.31	228	41.76	87	15.93	546	100.00

Observation of the household cleanliness showed that 65.37% in terai, 92.98% in hill and 50.57 % in mountain has maintained cleanliness in house. 74.46 % of household in terai and 72.37 % of household in hill region have the kachha type of house, 4.76% in terai, 19.30% in hill and 14.94% in mountain region have the pakka type of house. Similarly, 20.78 % in terai region, 8.33% in hill region and 85.06% in mountain region have Kachha-pakka type of household. 54.55% of household in terai region, 15.79% in hill region and 19.54% in mountain region have stagnant water in household premises.

CHAPTER V

Discussion

Change in climatic parameters; temperature, precipitation and humidity are directly and indirectly related towards human health and effect on human health (Haines, et al, 2006). Globally, every year more than millions of population are injured and affected by the sudden change on climatic situation like drought, flood, hurricanes, landslide, fire etc. The potential health hazards of climate change have felt more severe in every year because of increasing the morbidity and mortality (McMichael et al, 2000). Science has already identified the climatic parameters influence the vector habitat and its physiological and reproductive capacity. When temperature lies range of 14–18 ºC, the rate of production of vector become minimum or too much decline order; that is lower end where as at around 30–32 ºC, vectorial capacity can increase substantially. In this period, the disease transmission of vector has been shown maximum. But the temperature range above 35–40 ºC (at the upper end) vector could not survive (Watts et al, 1987).

Nepal is ecologically and climatically diverse place where altitudinal variation starts from 65 meter to 8848 meter has recorded. This altitudinal variation reflects the presence of various degree of climatic component; that is change in degree of temperature from lower altitude to higher altitude, has existed in Nepal and it is favorable vector distribution in certain part of altitudinal geography. Climatic parameter is depended on seasonal variation and atmosphere altitudinal transect. And climatic factor and altitudinal geographical transect with seasonal variation determine the distribution and density of vector. Nepal is one of the most vulnerable mountainous countries in the world concerning the adverse effects of climate change. Its low level of development and complex topography render Nepal particularly vulnerable to climate change [MoE, 2010]. It is unequivocal that climate change is occurring and is likely to expand the geographical distribution of several vector borne diseases [Confalonieri, et al 2007]. Now, Nepal is endemic for five major vector-borne diseases (VBD) namely malaria, dengue, filariasis, Japanese encephalitis and visceral leismaniasis. Over the years, total positive cases of malaria are drastically reduced and country is planning for pre-elimination strategy (2011-2016) while as dengue has been newly emerged since 2006 and its vector are expanding rapidly in different districts of Nepal along with events of outbreak in different district of terai [DOHS 2012].

In Nepal, about 80% of the populations are at risk of malaria; approximately 25% of the total population live in high risk areas but the scale of preventive interventions has appeared limited [WHO, 2011]. Overall in the country, the proportion of P. falciparum malaria cases has increased considerably in comparison to total malaria cases although there were no outbreaks with many geographically clustered cases in any part of the country [DOHS 2011 and, DOHS 2012]. This implies the possibility of a gradual shift in the Plasmodium parasite population possibly due to the rising temperature trends. At current study trend analysis have shown there is optimum case of malaria and appearing few other vectors borne disease like kala-azar, JE and dengue. In a previous cross sectional study has shown the association between climatic parameter to vector borne disease prevalence cases. The studies from United States, Canada and Europe, have revealed the warmer temperature, elevated humidity, and heavy precipitation increased the rate of vector-borne diseases. An increase in temperature, rainfall and humidity in some months in the Northwest Frontier Province of Pakistan has been associated with an increase in the incidence of P. falciparum malaria (Bouma 1996). In Asia, vector borne disease (Bouma et al., 1996; WHO Fact Sheet No. 192 rev.) have been associated with positive temperature and rainfall anomalies. Urban developments in Asia and the surrounding regions may have a substantial impact on trends in the transmission of dengue fever. And a study conducted from Nepal has reflected the trend of malaria had increased from 1998 to 2007, with the trend of diseases found fluctuating in nature. The cases of malaria is associated with both maximum ($P< 0.01$) and minimum ($P< 0.01$) temperature. Rainfall has positively correlated with malaria ($r = 0.202$), which is also statistically significant ($P< 0.05$) however its strength is low. Another cross sectional study conducted across Nepal has revealed the occurrence of malaria being significantly associated with rainfall ($p<0.032$) and morning humidity ($p<0.007$). The cases of malaria decreased by 1.12 in number per month ($p<0.05$) with maximum temperature and when minimum temperature increase by 10C than the total number of malaria also increases by 1.17 in number per month and is statistically significant in the terai and every increase in 10 C of maximum and minimum temperature there is increase and decrease of malaria in number respectively from hill part. In case of mountain region the regression analysis shows no significant relation with the occurrence of malaria with respect to the climatic conditions. Rainfall has no relation with the occurrence of malaria. In the current study the occurrence of malaria is significantly associated with rainfall ($p<0.032$) and morning humidity ($p<0.007$) in terai region. However, other climatic factors like maximum and minimum temperature and evening humidity are not found to be significant with malaria. But there has not shown any significant association between climatic parameter to malaria from hill region. It is noted from the study that occurrence of malaria and other climatic parameters has shown varying significance with each other. No significant association has been found between malaria and rainfall, evening humidity, maximum and minimum temperature. Occurrence of malaria was found significant with morning humidity ($p<0.01$). The reason for this may be due to creation of favorable environmental condition.

Here, we could not asses the trend analysis of other vector borne disease like kala-azar, JE, and dengue from Nepal therefore unable to justify their previous situation with perspective to climatic parameter compare to current situation. Even in the current study researcher could not analyze the trend analysis of these vectors borne diseases probably due to absence of diseases or less common appearance of these diseases on annual basis or lack of good reporting system. The current study reveals that people are less aware about the effect of climate change and environmental factor. People from Terai region have shown somewhat poorer knowledge about the climate change and its impact on public health with comparison to hill and mountain part of district. All of them are unknown about significant poor environmental and public health impact due to direct or indirect way of climate change. People in Terai are less aware of impact of climate change than hill and mountain. This may be due to lacking of priority program on both planning and implementation on climate change. Radio has been found a major component of information sharing tool community.

The drought, heat, storm, stress and heavy flood are foremost problem in terai, and glacier and snow melting in mountain part where mixtures of problem are raising in the hill part of Nepal. This is obvious fact that, when changing on an environmental factor can automatically affect other factors that might change the existing environment of vector habitat and its physiological adaptation.

More than seventy five percent population from hill region and 50 percent of the respondents from terai region perceived climate change, and its impact on health as reduction in agricultural production. Overall analysis showed that majority of the respondents (79.27%) said agriculture as the major sector affected from climate change while least of the respondents (47.56%) said biodiversity as the sector affected from climate change.

It is obvious fact that, environmental condition is more favorable at low land area for vector breeding and parasite replication. This finding of this study also reflects the malaria is more prevalent disease in context of Nepal, than other vector borne diseases. People from the two altitudinal regions are found to have known about the malaria and kala-azar except mountain region of Nepal.

A Survey of NPS Employees In 2008, VBDS and NPS collaborated to design, implement, and evaluate a survey of NPS employees at 24 NPS units in California and the Pacific West Regional Office. 257 NPS staff from 18 NPS units and the Pacific West Regional Office completed the survey. Most NPS employees believed that reducing the risk of vector-borne diseases in the workplace is important or extremely important. Various natural and artificial instruments have been applied for prevention protection from vector biting characters, like mosquito coil, bed net and some smelling chemicals (VBDS and NPS, 2010). In current study, people have recorded various types of preventive measures of vector borne disease in all altitudinal transect by using bed nets, making surrounding clean, use of medicine and wearing of full dress covering. But this mechanism is stronger in terai with comparison to hill and mountain part of Nepal. The populations from terai found more aware about all of the vector borne diseases, but in case of hill and mountain part, little knowledge found on all of vector borne diseases. Current study also suggest that people from all of transect, are highly concerned on climate change and vector borne diseases are taking seriously. This study also shows that government service is broadening to community level, where private medical service has not taken broad field at remote part of country. That is because more than ninety percent of populations are dependent on government health service in the remote part of Nepal. Some sample population found dependent on dhami-jhakri for getting the health service and apply home based treatment when they are sick. This response is from minority of service receivers that signify the people still now believe on orthodox cultural practice.

Human settlement patterns also influence disease trend and in Asia spans tropical and temperate regions. Disease reservoirs for vectors can increase when favorable shelter and food availability lead to population increases, in turn leading to disease outbreaks. Malaria, dengue fever, dengue hemorrhagic fever, filariasis, Japanese encephalitis, Kala-azar etc are endemic in parts of tropical Asia. In the past 100 years, mean surface temperatures have increased by 0.3–0.8 ºC across the continent and are projected to rise by 0.4–4.5 ºC by 2070 (Watson et al., 1996). In the current study the observation check list of house hold cleanliness showed that more than fifty percent of sample household respondents are aware of the maintenance of cleanliness in premises of house and within the house. They are found to be aware of the issues that there should not be open pit left at circumference, settlement and applying various types of practices for managing good environmental factor.

CHAPTER VI

Conclusion and Recommendations

6.1 Conclusion

Change in the climate and its effects on the humans of the world have now been a known fact. The effects are both way direct and indirect, in long run of which its immediate impacts are being observed as increase in the number/ occurrence of vector borne diseases.

The existing drivers of vector-borne diseases, such as seasonal weather variation, socioeconomic status, vector control programmes, environmental changes and drug resistance, climate change and variability are highly likely to influence current vector-borne disease epidemiology.

The time series analysis of vector borne disease with respect to climatic parameter shows there is seasonal distribution of vector borne disease in different altitudinal transect but impact of vector is more prevalent on lower altitude with respect to higher altitude. The occurrence of malaria has been significantly associated with temperature, rainfall and humidity. . In hill region, no significant association has been found between malaria and rainfall, humidity and temperature. Both the topographical zone (terai and hill) showed that significant association of morning humidity and malaria. Findings also suggest relative humidity is prime climatic determinants for the occurrence of malaria, which highly depends upon seasonality and rainfall and ultimately climate change. Malaria was not found in mountain region in recent past, so no association could be ascertained in this region.

Knowledge attitude and practice survey and focus group discussion among local people and health professional shows the perception of people in such a way that climate change is significantly affecting the habitat distribution of vector and vectors are generally seen in higher altitude where they were not seen previously in that area. Most of the health workers are focusing on the need of strengthening of the existing health programs. They even said that the running programs in the district level are not sufficient and need to be expanded with the availability of proper service and manpower. The reporting system of vector borne diseases has not been found satisfactory at every level of organizational structure. Health workers from Himalayan region also feel the importance of vector control officer in these regions as well because they presume that the problems of vector are alarming and they are at risk of malaria.

The fraction of changes in vector-borne diseases attributable to climate change is therefore still unknown. This is a serious obstacle to evidence-based health policy change. Although the impacts of climate variability on vector-borne diseases are relatively easy to detect, the same cannot be said of climate change because of the slow rate of change. Furthermore, it is possible that human populations may adapt to climate change thus minimizing the impacts. Adaptation to climate change and variability will depend to a certain extent on the level of health infrastructure in the affected regions. Moreover, the cost and efficacy of prevention and cure will be critical to disease management. Furthermore, climate variability, unlike any other epidemiological factor, has the potential to precipitate simultaneously multiple disease epidemics and other types of disasters. Climate change has far-reaching consequences that go beyond health and touch on all life-support systems. It is therefore a factor that should be rated high among those that affect human health and survival.

6.2 Recommendations and Action Plans

Prevention, control and treatment related recommendations and action plans for the climate change and Vector Borne Disease are:

1. Research for the assessment of climate change impact and its adaptation strategies. Engage the Public: Share climate research findings with groups most affected—social service agencies.
2. Create public awareness for environmental modification and environmental management techniques. Develop and build commitments from all the stakeholders involved in climate change field.
3. Involvement of the climate change and vector borne diseases related topics in the curriculum from primary level to the secondary level of education.
4. Surveillance activities to be strengthened from the grass root level to central level which involves the effective routine reporting system, sentinel system and early warning and reporting system.
5. Early diagnosis and prompt treatment should be made more effective.

6. Private health institutions should also be incorporated with the national reporting system of vector borne diseases control for the avoidance of the duplication and to increase the accuracy of the data.
7. Advocacy, communication and social mobilization activities should be done on the regular basis for mass awareness and community participation in the vector borne diseases control program.
8. Health workers need to be trained and updated for the latest knowledge, skills and technology for the timely diagnosis of the vector borne diseases.
9. Update a standard recording and reporting format to public and private health sector should be developed.
10. Data management training should be given to the health staffs working in the vector borne disease control programs in all level.
11. VBD Training to DHO, DPHO and the grass root level health worker should be organized.
12. The BCC strategy and the guidelines should be developed and revised.
13. District health laboratories of the endemic districts should be strengthened for the diagnosis of the VBD
14. Entomological studies need to be conducted and regular monitoring of vector(s) behavior and bionomics should be carried out. This will facilitate in better insight into the Epidemiology and disease control division. This division should be done regular Bioassay and insecticide susceptibility test to monitor rational use of insecticide spraying.
15. Integrated vector management and effective disease surveillance should be implemented at the community level.
16. Create coordination mechanism among different sectors for the control of vector borne diseases.
17. Human resources requirements for vector borne diseases control program and vector management should be fulfill in districts for the smooth functioning of VBD programs.
18. New emerging VBD like Dengue control, environmental management approaches such as household modification and relocation; environmental manipulation in peri-domestic

areas as well as biological control approaches should be promoted all over the most affected areas.

19. Behavior change communication activities focusing on advocacy, communication and social mobilization should be promoted incorporating areas like early diagnosis, ensure uniform and complete coverage of Indoor residual insecticide spraying (IRS), personal protective measures, and environmental management should be promoted.
20. Malaria, kala-azar diagnostic facility should be provided up to PHCC level.

References

1. Ady Wirawan, I.M (2010). Public health responses to climate change health impacts in Indonesia. Asia Pac J Public Health 22 (1): 25-31

2. Akerlof K., Debono R. et al., (2010). "Public perceptions of climate change as a human health risk: surveys of the United States, Canada and Malta." Int J Environ Res Public Health7(6): 2559-606)

3. Anthony J McMichael, Rosalie E Woodruff, Simon Hales., (2006). Climate change and human health: present and future risks. Lancet 367: 859–69

4. APN report (2007), Climate profile and observed climate change and climate variability in Nepal

5. Confalonieri, U., Menne, B., Akhtar,R., Ebi,K.L., Hauengue,M., Kovats,R.S., Revich,B., Woodward, A., Human Health in Climate Change (2007). Impacts,Adaptation and Vulnerability. Contribution of Working Group II to the FourthAssessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, Canziani,O.F., Palutikof, J.P., van der Linden, P.J., Hanson,C.E.,, Editor 2007, Cambridge University Press: Cambridge, UK. p. 391-431.

6. Dennekamp, M. and Carey M., (2010). Air quality and chronic disease: why action on climate change is also good for health. Public Health Bull21(5-6): 115-21

7. Department of Health Service. (2011). Annual Report 2066/67 (2009/2010), Department of Health Services, Ministry of Health and Population, Government of Nepal: Kathmandu p. 581.

8. Department of Health Survey (2009), Annual Health Report 2008/2009, Kathmandu: Department of Health Services, MOHP

9. Department of Health Survey (2012). Annual Report 2067/68 (2010/11), Department of Health Services, Ministry of Health and Population, Government of Nepal, Kathmandu. p. 222.

10. Devkota, L. P., Baidya, S. K., Khan, A. Q., (2006). "Climate variability of Nepal", SMRC Report No. 23.

11. Dhimal M., (2008). Climate Change and Health: Research Challenges in Vulnerable Mountainous Countries like Nepal. Switzerland: Global Forum for Health Research. Oct 2008; 66-9.

12. DOHS (2007), Annual Health Report 2007/2008, Kathmandu: Department of Health Services, MOHP

13. DOHS, (2010). Annual Report 2008/2009. Kathmandu: Department of Health Services, MOHP

14. Ebi KL, Balbus J, Kinney PL, et al., (2008). Effects of global change on human health. In: Gamble JL, editor. Analyses of the effects of global change on human health and welfare and human systems. A report by the U.S Climate Change Science Program and the Subcommittee on Global Change Research. Washington, DC: US Environmental Protection Agency, pp. 2-1 to -2-78.

15. Ebi KL, Paulson JA. (2010). Climate Change and Child Health in the United States. Curr Probl Pediatr Adolesc Health Care 40:2-18.

16. Gage KL, Burkot TR, Eisen RJ, et al. (2008). Climate and vector borne diseases. Am J Prev Med 35:436-50.

17. Gale P, Brouwer A, Ramnial V, et al. (2010). Assessing the impact of climate change on vector-borne viruses in the EU through the elicitation of expert opinion. Epidemiol Infect 138:214-25.

18. Gautam I., Dhimal M., Shretha SR., & Tamrakar AS., (2009). First Record of Aedes Aegypti (L.) Vector of Dengue Virus from Kathmandu, Nepal. Journal of Natural History Museum, 24:156-64.

19. Intergovernmental Panel for Climate Change., (2001). Third assessment report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.

20. Kristie L., Ebi Jan., Semenza C., (2008). Community-Based Adaptation to the Health Impacts of Climate Change. Am J Prev Med 35(5):501–507.

21. Maibach, E. W., M. Nisbet, et al., (2010). Reframing climate change as a public health issue: an exploratory study of public reactions. BMC Public Health10: 299

22. Ministry of Environment (2010). National Adaptation Program of Action to Climate Change (NAPA), Government of Nepal, Ministry of Environment Kathmandu.

23. National Park Service and California Department of Public Health. (2010). Preventing Vector-Borne Diseases in National Parks in California. Page 1-28. Assessed from: http://www.cdph.ca.gov/programs/vbds/Documents/PreventingVBDinNationalParksinCA.pdf.

24. Nayava, J. L. (1974). Heavy monsoon rainfall in Nepal, Weather, Roy. Met. Soci., U. K., Vol. 29, 443-450.

25. Nepal Health Research Council and World Health Organization (2009). Final Report of Review of Emerging Health Risks due to Climate Change and Develop an Inventory of Good Practice and Adaptation Measures to Reduce the Adverse Health Implications of Climate Change in the context of Different Ecological Conditions in Nepal. Nepal Health Research Council, Kathmandu.

26. PATZ, JA, & OLSON, SH 2006, Climate change and health: global to local influences on disease risk. Annals of Tropical Medicine & Parasitological, Vol. 100, pp. 535–549.

27. Shea KM., (2007). American Academy of Pediatrics Committee on Environmental Health. Global climate change and children's health. Pediatrics 120:1359-67.

28. Shrestha, M. L; 2000, Interannual variation of summer monsoon rainfall over Nepal and its relation to Southern oscillation Index, Meteorology and Atmospheric Physics, vol. 75, 21-28.

29. Soverow JE, Wellenius GA, Fisman DN, et al., (2009). Infectious disease in a warming world: how different weather influenced West Nile virus in the United States (2001-2005). Environ Health Perspect 117:1049-52.

30. Strand, L. B., S. Tong, et al., (2010). "Vulnerability of eco-environmental health to climate change: the views of government stakeholders and other specialists in Queensland, Australia." BMC Public Health10: 441.

31. Tong, S., P. Mather, et al., (2010). Assessing the vulnerability of eco-environmental health to climate change." Int J Environ Res Public Health 7(2): 546-64

32. WHO (2005), Using climate to predict infectious disease epidemics. http://www.who.int/globalchange/publications/infectdiseases/en/index.html

33. World Health Organization. (2011). World Malaria Report: 2011, World Health Organization Geneva.

Annex

Annex I
KII guidelines for Health Workers

1. Perception on climate change (with reference to temperature, rainfall etc)
2. Vector borne disease analysis
3. Relation of VBD with climate change
4. Mosquitoes availability and trend of vector borne disease
5. Present status of VBD
6. Effectiveness of Vector Control Program (In terms of Strength and Weakness and Discussion)
7. Public awareness on climate change and health
8. Health system vulnerability
9. Country's adaptation mechanism and response
10. Need of new program and activities at community level and national level
11. Suggestion for new coping mechanism at grass root level

Annex II
Focus Group Discussion Guidelines

1. Perception on climate change (with reference to temperature, rainfall etc)
2. Meaning of climate change
3. Major health problems
4. Relation of VBD with climate change
5. Flood/Landslide occurrence
6. Availability of mosquito and its presence
7. Public awareness about climate change

Annex III

Questionnaire

Data Collection Tools

Study on Vector borne diseases and Climate Change along Altitudinal Transect in Nepal

Nepal Health Research Council

Nepal Government, Ministry of Health and Population

Questionnaire have covered the following components:

Part I

Socio-demographic characteristics of respondents

Sex: Male: ☐ Female: ☐

Age (in completed years):

Number of family members:

Family Type: Single ☐ Joint ☐ Extended ☐

Religion: Hindu ☐ Buddhist ☐ Islam ☐ Others ☐

Christianity ☐ Others (Specify)…………………

Education Status:

Literate……….1 Illiterate……..2

No of schooling (in years)………..3

Occupation:

Service…………1 Business……..2

Agriculture…….3 Labor………..4

Others (specify)…………….5

Part II

Knowledge related questionnaire

S.N	Questions	
1.	Do you know about climate change? (If No go to Question4	Yes………1 No………..2 Don't know……3 No response……4
2.	What do you mean by climate change? In addition that, how you now feel deference on environment at factors; such as temperature, precipitation, snow melting, Flowering period in plants, drought/floods with comparison to 30 years back.	Extreme heat and warm Yes…..1 No….2 Melting of Himalayan glaciers Yes…1 No…2 Limited productivity Yes….1 No…2 Increase in disease Yes…..1 No….2 Early flowering and drought/floods Yes…..1 No…2 Others (specify)……………………………………….3 List out individual experience to environment in this text as well as separate copy……………………..
3.	What are the possible causes of climate change?	Increase Green house gases Yes…..1 No….2 Holes in the ozone layer Yes…..1 No….2 Burning vegetation Yes…..1 No….2 Vehicular exhaust fumes Yes…..1 No….2 All of the above ……………………………………….3 None of the above ……………………………………..4 Other Causes (Unspecified)…………………………....5 Don't know……………………………………………6 No response……………………………………………7

4.	Do you know that mosquitoes, sandfly and other vectors can transmit disease?	Yes………1No……….2 Don't Know……3 No response…….4
5.	Do you know some of the diseases?	Malaria 1.Yes 2.No JE 1.Yes 2.No Kalazar 1.Yes 2.No Elephentasis 1.Yes 2.No Dengue 1.Yes 2.No HIV/AIDS 1.Yes 2.No …………………………………
6.	Areas in which CC/CV affect	Health Yes……1 No……..2 Water resources Yes…....1 No……..2 Agriculture Yes……1 No……..2 Biodiversity Yes……1 No……..2 Land degradation Yes…...1 No…….2 Vector-borne disease Yes…..1 No….2 All of the above…………………………3 None of the above………………………4 Don't know………………………………5 No response……………………………..6
9.		
7..	Source of information on climate change/variability	Peers Yes…..1 No….2 Family Yes…..1 No….2 Print media Yes…..1 No….2

		Electronic media Yes…..1 No….2 All of the above…………………………....3 None of the above ………………………..4
11.		
12.		
8.	Best ways to reduce virus transmission using CC/CV information	Reducing the number of habitats Yes…..1 No….2 Pesticide usage at CC/CV Yes…..1 No….2 Use of biological control tools Yes…..1 No….2 Others ………………………………………………3 Don't know …………………………………………4
14.		
Knowledge related questionnaire		
9..	Have you heard about Malaria, Dengue and other vector borne disease?	Yes…………1 No…………..2 Don't know……3 No response……4
10..	If Yes, Which is the vector that transmits those diseases?	Mosquito Yes…..1 No….2 Sandfly Yes…..1 No…..2 Housefly Yes…..1 No…..2 Others…………………………………3 Don't know……………………………4
11..	Knowledge on Sign and Symptoms	Chill and high fever Yes…..1 No…..2 Headache, nausea, vomiting Yes…1 No…..2 Sweating Yes…..1 No….2 Gland enlargement Yes…..1 No….2 Anemia Yes…..1 No….2 Diarrhea Yes…..1 No….2

		Swelling of limbs Yes…..1 No….2 Hydrocele Yes…..1 No….2 Chyulria Yes…..1 No….2 Fever, headache Yes…..1 No….2 Nuchal rigidity/convulsion Yes…..1 No….2 Sweating sensation Yes…..1 No….2 Others………………………………………3 Don't know…………………………………..4
12..	Knowledge on Mode of transmission	Bite of mosquito Yes….1 No….2 Eating of tasted food Yes….1 No….2 Droplet infection Yes…1 No….2 Flies transmit Dengue fever Yes…..1 No….2 Ticks transmit Dengue fever Yes…..1 No….2 Ordinary person to person contact transmit Yes…..1 No….2 Dengue fever transmitted through food and water Yes…..1 No….2 Transmitted by blood transfusion Yes…..1 No….2 Don't know…………………………………3
13..	Knowledge on preventive and control measures	Residual Spraying Yes…..1 No….2 Promotion of hygiene and sanitation Yes…..1 No….2 Early treatment Yes…..1 No….2 Control of mosquitoes Yes…..1 No….2 Removal of stagnant water sites Yes…..1 No….2 Use of bed nets Yes…..1 No….2 Use of chemicals and repellent Yes…..1 No….2

		Use of bed nets Yes…..1 No….2 Wear long sleeves clothes Yes…..1 No….2 Use of mat/repellents Yes…..1 No….2 Maintenance of hygiene and sanitation Yes…..1 No….2 Others……………………………………………………..3 Don't Know…………………………………………….4
Attitude related Questionnaire		
1.	Is vector borne disease a serious public health problem?	Yes…….1 No……..2 Don't Know………..3
2.	Can vector borne disease be prevented?	Yes……….1 No………..2 Don't Know……..3
3.	Do you think that mosquito control is only the best alternative to control the problem of vector borne disease?	Yes………1 No………2 Don't Know………3
4.	Do you think that maintenance of clean surrounding can prevent disease?	Yes ……….1 No…………2 Don't Know……..3 No Response……4
5.	Do you think that climate change is happening?	Yes ……….1 No…………2 Don't Know……..3 No Response…….4
6.	Is increasing vector borne disease problem an effect of climate	Yes ……….1

	change?	No...........2 Don't Know........3 No Response......4
7.	Can vector borne disease be prevented responsive to climate change?	Yes ....1 No...........2 Don't Know........3 No Response......4
Practice related questionnaire		
1.	Prevention practice	
1.1	Use of bed nets	Yes ....1 No...........2
1.2	Removal of stagnant water	Yes ....1 No...........2
1.3	Use of mosquito coils	Yes ....1 No...........2
1.4	Use of mosquito repellents	Yes ....1 No...........2
1.5	Cleaning of garbage	Yes ....1 No...........2
1.6	Covering body with clothes	Yes ....1 No...........2
1.7	Use screen windows to reduce mosquitoes	Yes ....1 No...........2
2.	Do you immediately visit health institutions if you are suffering from any health problems?	Yes ....1 No...........2

3.	Do you complete your medications directed by physician?	Yes ……….1 No…………2
4.	Do you make your household surrounding clean?	Yes ……….1 No…………2

Observation checklist:

1.Sanitation condition around household. 1.Yes 2.No

2. Distance between household and cowshed1.Yes 2.No

3.Type of house 1.Mud house 2.Concrete house 2. Mixed type

4.Stagnant water collection pit 1.Yes 2.No

Annex IV

Vector Borne Disease reported lists and trend from three ecological zone and administrative district of Nepal

Table A: List of Malaria reported cases from all over the Nepal

Malaria											
	056/57	057/58	058/59	059/60	060/61	061/62	062/63	063/64	064/65	065/66	066/67
MOUNTAIN	155	92	39	91	83	158	77	8	44	19	6
HILL	4,675	2,611	1,339	1,172	880	740	766	861	1,338	547	577
TERAI	4,483	3,485	9,068	10,823	5,402	3,659	4,848	4,424	3,192	2,977	2,216
National	9,313	6,188	10,446	12,086	6,365	4,557	5,691	5,293	4,574	3,543	2,799
BHOJPUR	494	123	224	38	18	6	25	21	14		90
DHANKUTA	162	71	23	22	10	13	4	1	0	1	0
ILAM	19	2	0	39	44	3	12	58	67	66	50
JHAPA	415	460	511	696	1,145	967	2,289	1,711	679	411	495
KHOTANG	0	1	0	23	4	3	1	1	0	2	0
MORANG	154	62	46	158	171	113	141	316	315	214	94
OKHALDHUNGA	13	12	6	7	3	3	22	31	11	5	3
PANCHTHAR	52	33	50	31	42	177	191	328	483	32	6
SANKHUWASABHA	14	11	12	14	0	3	1	0	23	19	2
SAPTARI	114	120	35	38	29	22	313	12	13	234	12
SIRAHA	5	4	2	0	0	6	20	64	106	94	47
SOLUKHUMBU	0		0	0	0	0	0	0	0	0	0
SUNSARI	20	9	1	1	6	207	17	15	18	15	19
TAPLEJUNG	3	0	3	12	2	78	7	3	12	0	1
TEHRATHUM	59	62	29	25	32	36	5	8	0	4	15
UDAYAPUR	17	2	14	5	59	23	16	22	45	7	15
EASTERN	1,541	972	956	1,109	1,565	1,660	3,064	2,591	1,786		
BARA	2	0	0	2	0	0	14	24	11	128	21
BHAKTAPUR	0		0	0		0	0	0	0	0	0
CHITWAN	65	53	66	12	7	18	20	38	14	19	25

DHADING	0	0	26	3	6	3	2	29	17	0	1
DHANUSHA	1,395	563	659	362	220	89	46	282	654	295	181
DOLKHA	0	11	0	0	0	0	0	0	0	0	0
KATHMANDU	0		0	0		0	0	0	0	0	0
KAVRE	2,735	1,664	356	489	339	212	104	12	1	7	2
LALITPUR	81		15	97	0	6	6	11	11	0	0
MAHOTTARI	14	0	6	142	14	101	75	458	73	359	92
MAKWANPUR	100	45	27	30	34	41	17	35	174	112	84
NUWAKOT	1	0	0	0	0	2	0	0	25	0	0
PARSA	27	22	8	1	0	5	2	0	0	0	0
RAMECHHAP	2	1	3	2	1	4	0	0	0	1	0
RASUWA	0		0	0		0	0	1	0	0	0
RAUTAHAT	0	13	0	0	0	6	0	6	3	1	11
SARLAHI	136	36	88	80	5	5	9	58	184	121	113
SINDHULI	188	223	71	67	62	50	70	65	87	103	71
SINDHUPALCHOWK	70	32	7	48	60	53	38	0	0	0	0
CENTRAL	4,816	2,663	1,332	1,335	748	595	403	1,019	1,254		
ARGHAKHANCHI	1	8	76	13	16	12	115	12	13	11	1
BAGLUNG	1	0	7	0	3	6	4	4	43	6	4
GORKHA	8	5	3	4	1	1	2	1	0	5	6
GULMI	0	0	7	2	2	0	0	0	0	12	4
KAPILVASTU	55	27	17	224	54	43	30	43	7	182	33
KASKI	32	13	7	3	7	11	16	3	16	3	29
LAMJUNG	15	4	4	34	0	1	1	0	92	0	7
MANANG	0		0	0		0	0	0	0	0	0
MUSTANG	0		0	0		0	0	0	0	0	0
MYAGDI	0	0	0	0	3	1	2	25	7	0	0
NAWALPARASI	156	69	45	32	52	60	76	110	66	59	98
PALPA	40	41	32	23	20	14	14	19	22	18	22
PARBAT	3	4	6	2	24	21	11	19	30	14	1
RUPANDEHI	128	58	71	67	74	86	61	72	60	38	0
SYANGJA	0	3	3	0	0	2	4	4	5	2	1
TANAHU	22	30	4	2	3	0	52	0	1	2	5
WESTERN	461	262	282	406	259	258	388	312	362		
BANKE	68	88	50	22	182	19	26	420	124	14	36

BARDIYA	632	865	882	336	391	232	127	97	170	79	158
DAILEKH	16	1	0	0	8	1	0	1	14	7	6
DANG	97	155	264	119	112	99	93	63	30	133	6
DOLPA	0		0	2	0	0	0	0	0	0	0
HUMLA	0		0	0		0	0	0	0	0	0
JAJARKOT	0	0	0	0	0	0	0	0	0	0	0
JUMLA	13	21	5	8	13	6	3	0	0	0	0
KALIKOT	0	0	0	0	0	15	5	2	0	0	2
MUGU	24		0	0	0	0	5	0	0	0	0
PYUTHAN	5	0	2	0	0	1	4	17	4	4	0
ROLPA	0	23	27	8	9	2	2	4	0	0	0
RUKUM	2	2	2	0	1	0	3	5	26	0	2
SALYAN	38	1	7	3	0	3	7	3	0	0	0
SURKHET	368	90	120	74	22	36	5	29	39	81	88
MID-WESTERN	1,263	1,246	1,359	572	738	414	280	641	407		
ACHHAM	35	15	7	8	12	8	1	8	25	5	6
BAITADI	18	32	9	25	8	12	11	33	3	3	3
BAJHANG	0	0	12	0	5	3	12	2	9	0	0
BAJURA	0		0	3		0	6	0	0	0	1
DADELDHURA	134	90	162	74	64	7	17	42	54	32	53
DARCHULA	31	17	0	4	3	0	0	0	0	0	0
DOTI	14	10	10	19	23	19	20	10	9	2	2
KAILALI	293	335	361	818	545	355	375	378	379	428	618
KANCHANPUR	707	546	5,956	7,713	2,395	1,226	1,114	257	286	153	157
FAR WESTERN	1,232	1,045	6,517	8,664	3,055	1,630	1,556	730	765		

Trend analysis of Malaria in ecological context

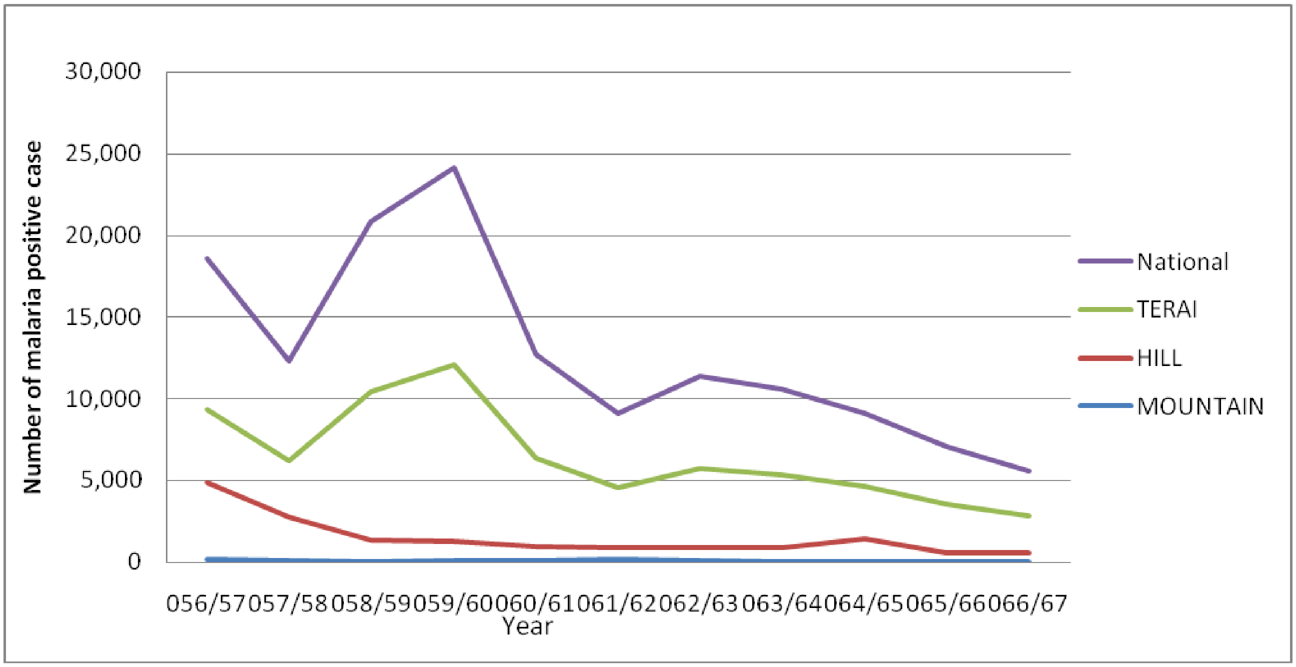


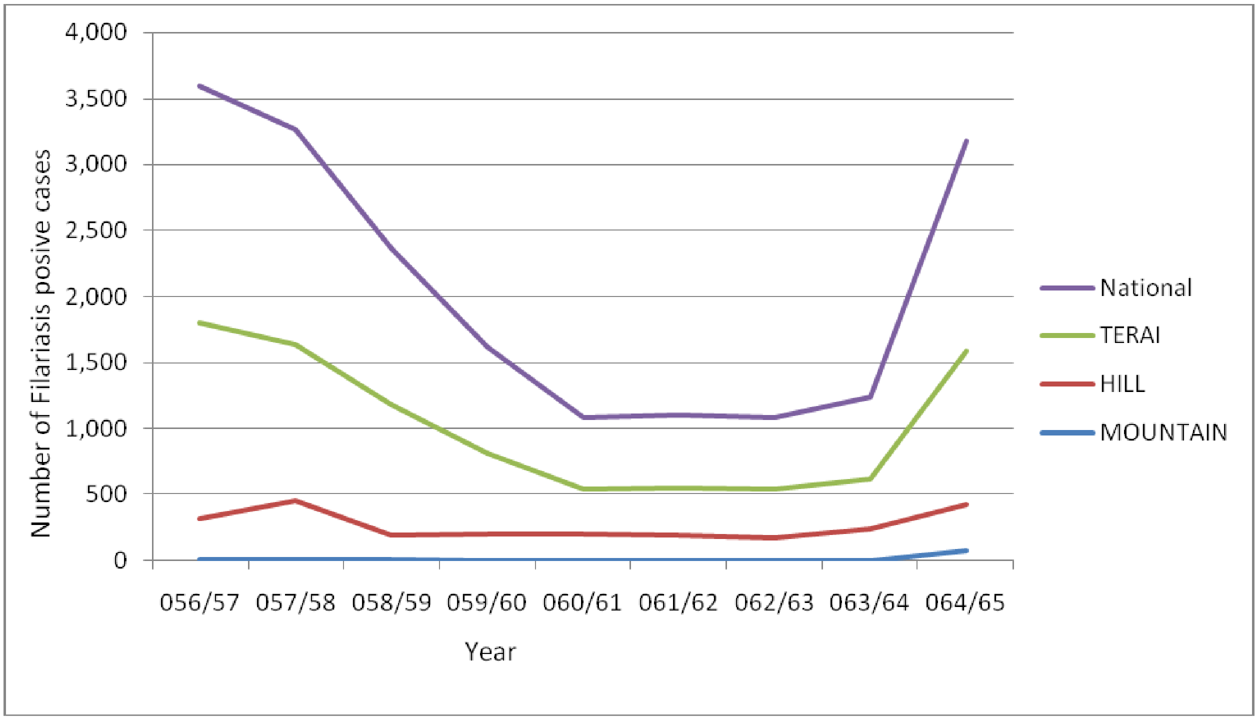
Table B: List of Filariasis reported cases from all over the Nepal

Filariasis									
	056/57	057/58	058/59	059/60	060/61	061/62	062/63	063/64	064/65
MOUNTAIN	5	11	5	1	4	4	1	0	80
HILL	312	441	194	208	198	192	176	240	348
TERAI	1,480	1,180	984	600	338	353	365	380	1,160
National	1,797	1,632	1,183	809	540	549	542	620	1,588
BHOJPUR	20	4	3	1	0	1	0	0	0
DHANKUTA	5	3	0	0	1	1	0	0	1
ILAM	0	0	0	0	0	0	0	0	38
JHAPA	0	0	87	47	29	13	33	1	9
KHOTANG	0	0	0	0	0	0	0	0	0
MORANG	7	21	35	12	7	0	4	135	79
OKHALDHUNGA	0	0	1	2	1	0	0	0	1
PANCHTHAR	0	0	0	0	0	0	0	0	0
SANKHUWASABHA	2	3	2	0	0	0	0	0	5
SAPTARI	9	6	0	0	8	0	1	0	77
SIRAHA	164	8	12	0	1	8	25	0	76
SOLUKHUMBU	0	0	0	0	0	0	0	0	0
SUNSARI	0	26	2	0	0	2	19	0	18

TAPLEJUNG	2	1	0	0	0	0	0	0	0
TEHRATHUM	0	0	0	0	0	0	0	0	0
UDAYAPUR	0	190	0	1	0	0	0	0	2
EASTERN	209	262	142	63	47	25	82	136	306
BARA	29	44	5	43	7	22	14	26	37
BHAKTAPUR	4	2	0	0	1	0	0	1	3
CHITWAN	0	1	0	0	1	1	9	4	0
DHADING	11	6	6	26	22	21	17	60	46
DHANUSHA	13	3	2	2	0	0	6	14	47
DOLKHA	0	0	0	0	0	0	0	0	64
KATHMANDU	7	10	5	6	6	2	1	0	97
KAVRE	7	1	2	3	2	0	0	5	18
LALITPUR	1	18	3	4	0	1	3	0	18
MAHOTTARI	261	0	5	2	22	56	1	6	151
MAKWANPUR	8	10	5	6	6	29	8	1	6
NUWAKOT	48	72	74	130	97	100	97	98	45
PARSA	50	86	11	0	3	4	0	1	9
RAMECHHAP	1	0	1	1	0	0	0	0	1
RASUWA	0	0	0	0	0	0	1	0	1
RAUTAHAT	55	98	24	49	54	25	11	28	72
SARLAHI	211	184	18	25	2	6	25	5	38
SINDHULI	12	7	9	4	20	3	0	17	23
SINDHUPALCHOWK	0	4	3	1	3	4	0	0	2
CENTRAL	718	546	173	302	246	274	193	266	678
ARGHAKHANCHI	1	1	0	0	0	0	0	0	5
BAGLUNG	0	48	0	0	0	0	0	0	0
GORKHA	6	10	4	1	2	2	0	0	4
GULMI	0	0	0	0	0	0	0	0	20
KAPILVASTU	384	386	273	221	148	142	91	107	192
KASKI	83	0	0	0	0	0	0	0	1
LAMJUNG	0	0	4	1	7	0	2	7	12
MANANG	0	0	0	0	0	0	0	0	0
MUSTANG	1	0	0	0	0	0	0	0	0
MYAGDI	0	0	0	0	0	0	0	0	1
NAWALPARASI	15	15	356	14	4	4	5	5	25
PALPA	38	28	16	2	12	17	17	3	0
PARBAT	0	0	0	0	2	0	0	0	0
RUPANDEHI	102	203	76	94	32	14	60	38	65
SYANGJA	2	1	4	1	4	1	0	44	1

TANAHU	0	0	0	0	0	0	0	0	0
WESTERN	632	692	733	334	211	180	175	204	326
BANKE	14	9	3	9	6	2	3	0	32
BARDIYA	125	19	56	1	4	46	56	3	4
DAILEKH	0	0	1	3	1	0	0	0	0
DANG	10	70	12	41	5	2	0	5	12
DOLPA	0	0	0	0	0	0	0	0	0
HUMLA	0	0	0	0	0	0	0	0	1
JAJARKOT	0	0	0	0	0	0	0	0	0
JUMLA	0	0	0	0	0	0	0	0	0
KALIKOT	0	0	0	0	0	0	0	0	0
MUGU	0	0	0	0	0	0	0	0	0
PYUTHAN	1	0	0	0	0	0	0	0	0
ROLPA	0	9	0	1	0	0	30	0	0
RUKUM	4	3	7	7	4	0	0	0	0
SALYAN	0	0	0	0	0	0	0	0	0
SURKHET	41	13	0	2	0	0	0	4	0
MID-WESTERN	195	123	79	64	20	50	89	12	49
ACHHAM	6	3	5	3	2	6	0	0	2
BAITADI	6	2	4	3	8	2	1	0	0
BAJHANG	0	3	0	0	0	0	0	0	1
BAJURA	0	0	0	0	0	0	0	0	6
DADELDHURA	0	0	40	0	0	6	0	0	0
DARCHULA	0	0	0	0	1	0	0	0	0
DOTI	0	0	0	0	0	0	0	0	3
KAILALI	23	1	2	1	3	3	0	1	214
KANCHANPUR	8	0	5	39	2	3	2	1	3
FAR WESTERN	43	9	56	46	16	20	3	2	229

Trend analysis of Fliariasis in Ecological Context



4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Number of Filariasis posive cases
056/57
057/58
058/59
059/60
060/61
061/62
062/63
063/64
064/65
Year
National
TERAI
HILL
MOUNTAIN

Table C: List of Kala-azar reported cases from all over the Nepal

	056/57	%	057/58	%	058/59	059/60	060/61	061/62	062/63	063/64	064/65
MOUNTAIN	-		-			-	-	-	-		-
HILL	231	18.7	120	9.3		32	38	15	11		104
TERAI	1,003	81.3	1,170	90.7		1,017	756	1,154	1,330		1,267
National	**1,234**		**1,290**		**832**	**1,049**	**794**	**1,169**	**1,341**	**1,531**	**1,371**
BHOJPUR	-		-		-	-	-	-	-	-	-
DHANKUTA	-		-		-	-	-	-	-	-	-
ILAM	-		-		-	1	-	-	-	-	-
JHAPA	-		38		34	17	23	19	15	22	36
KHOTANG	-		-		-	-	-	-	-	-	-
MORANG	70		23		41	48	55	97	46	63	55
OKHALDHUNGA	-		-		-	-	-	-	-	-	9
PANCHTHAR	-		-		-	-	-	-	-	-	-
SANKHUWASABHA	-		-		-	-	-	-	-	-	-
SAPTARI	64		397		149	141	350	53	217	255	197
SIRAHA	15		85		66	12	-	216	197	142	109
SOLUKHUMBU	-		-		-	-	-	-	-	-	-
SUNSARI	261		62		62	178	89	74	137	117	86
TAPLEJUNG	-		-		-	-	-	-	-	-	-
TEHRATHUM	-		-		-	-	-	-	-	-	-
UDAYAPUR	217		102		70	21	33	12	8	42	35
EASTERN	627		707		423	418	550	471	620	641	527
EASTERN	67		42		64	1	40	93	65	37	34
BHAKTAPUR	-		-		-	-	-	-	-	-	-
CHITWAN	-		-		-	-	1	-	-	-	-
DHADING	-		-		-	-	-	-	-	-	-
DHANUSHA	198		75		54	168	113	139	76	109	112
DOLKHA	-		-		-	-	-	-	-	-	-
KATHMANDU	-		-		-	-	-	-	-	-	-

KAVRE	-		-		-	-	-	-	-	-	-
LALITPUR	-		-		-	-	-	-	-	-	-
MAHOTTARI	34		151		107	126	73	147	299	328	162
MAKWANPUR	-		-		-	-	5	2	-	-	60
NUWAKOT	-		-		-	-	-	-	-	-	-
PARSA	16		51		29	4	-	-	10	14	1
RAMECHHAP	-		-		-	-	-	-	-	-	-
RASUWA	-		-		-	-	-	-	-	-	-
RAUTAHAT	33		94		76	42	10	14	37	38	26
SARLAHI	245		152		77	280	2	302	231	364	449
SINDHULI	-		-		-	-	-	-	-	-	-
SINDHUPALCHOWK	-		-		-	-	-	-	-	-	-
CENTRAL	593		565		409	621	244	697	718	890	844
ARGHAKHANCHI	-		-		-	-	-	-	-	-	-
BAGLUNG	-		-		-	-	-	-	-	-	-
GORKHA	-		-		-	-	-	-	-	-	-
GULMI	-		-		-	-	-	-	-	-	-
KAPILVASTU	-		-		-	-	-	-	-	-	-
KASKI	-		-		-	-	-	-	-	-	-
LAMJUNG	-		-		-	-	-	-	-	-	-
MANANG	-		-		-	-	-	-	-	-	-
MUSTANG	-		-		-	-	-	-	-	-	-
MYAGDI	-		-		-	9	-	-	-	-	-
NAWALPARASI	-		-		-	-	-	-	-	-	-
PALPA	13		15		-	-	-	1	2	-	-
PARBAT	-		-		-	-	-	-	-	-	-
RUPANDEHI	-		-		-	-	-	-	-	-	-
SYANGJA	-		-		-	-	-	-	-	-	-
TANAHU	-		-		-	-	-	-	-	-	-
WESTERN	13		15		-	9	-	1	2	-	-
BANKE	-		-		-	-	-	-	-	-	-
BARDIYA	-		-		-	-	-	-	-	-	-
DAILEKH	-		-		-	-	-	-	-	-	-
DANG	-		-		-	-	-	-	-	-	-

DOLPA	-		-		-	-	-	-	-	-	-
HUMLA	-		-		-	-	-	-	-	-	-
JAJARKOT	-		-		-	-	-	-	-	-	-
JUMLA	-		-		-	-	-	-	-	-	-
KALIKOT	-		-		-	-	-	-	-	-	-
MUGU	-		-		-	-	-	-	-	-	-
PYUTHAN	-		-		-	-	-	-	-	-	-
ROLPA	-		-		-	-	-	-	-	-	-
RUKUM	1		3		-	-	-	-	1	-	-
SALYAN	-		-		-	-	-	-	-	-	-
SURKHET	-		-		-	1	-	-	-	-	-
MID-WESTERN	1		3		-	1	-	-	1	-	-
ACHHAM	-		-		-	-	-	-	-	-	-
BAITADI	-		-		-	-	-	-	-	-	-
BAJHANG	-		-		-	-	-	-	-	-	-
BAJURA	-		-		-	-	-	-	-	-	-
DADELDHURA	-		-		-	-	-	-	-	-	-
DARCHULA	-		-		-	-	-	-	-	-	-
DOTI	-		-		-	-	-	-	-	-	-
KAILALI	-		-		-	-	-	-	-	-	-
KANCHANPUR	-		-		-	-	-	-	-	-	-
FAR WESTERN	-		-		-	-	-	-	-	-	-

Table D: List of Viral Encephalitis reported cases from all over the Nepal

Viral Encephalitis									
	056/57	057/58	058/59	059/60	060/61	061/62	062/63	063/64	064/65
MOUNTAIN	17	10	0	9	105	1	1	2	166
HILL	161	340	73	160	32	35	54	54	205
TERAI	708	567	408	136	207	224	574	631	372
National	886	917	481	305	344	260	629	687	743
BHOJPUR	0	0	0	0	0	0	0	1	0
DHANKUTA	0	0	0	13	0	0	2	0	16
ILAM	0	0	0	0	0	0	0	0	1
JHAPA	0	6	0	0	3	0	1	2	0

KHOTANG	0	0	0	0	0	0	0	0	0
MORANG	11	0	31	8	0	16	146	380	97
OKHALDHUNGA	3	2	1	0	0	0	0	0	0
PANCHTHAR	0	0	0	0	0	0	0	0	6
SANKHUWASABHA	1	0	0	0	0	0	0	0	0
SAPTARI	16	0	0	0	0	17	0	0	20
SIRAHA	18	18	4	12	4	1	12	10	10
SOLUKHUMBU	0	0	0	0	0	0	0	0	100
SUNSARI	2	17	0	0	0	0	21	0	24
TAPLEJUNG	1	0	0	0	0	0	0	0	0
TEHRATHUM	0	0	0	0	0	0	0	0	0
UDAYAPUR	0	105	4	21	0	0	0	0	3
EASTERN	52	148	40	54	7	34	182	393	277
BARA	1	17	0	0	0	0	13	13	2
BHAKTAPUR	0	0	0	0	1	0	0	0	2
CHITWAN	4	1	0	1	0	0	0	0	32
DHADING	0	0	0	0	0	0	0	13	24
DHANUSHA	0	3	0	0	8	4	44	46	11
DOLKHA	15	0	0	0	0	0	0	2	56
KATHMANDU	0	0	0	113	6	2	2	0	16
KAVRE	0	0	0	0	2	0	0	0	2
LALITPUR	8	0	9	0	0	4	4	1	9
MAHOTTARI	10	0	0	23	0	0	0	0	3
MAKWANPUR	0	1	1	0	0	0	7	0	0
NUWAKOT	1	1	0	0	6	0	0	0	4
PARSA	117	95	45	13	28	0	0	0	0
RAMECHHAP	0	0	0	0	0	0	0	0	3
RASUWA	0	0	0	0	0	0	0	0	0
RAUTAHAT	0	0	0	0	2	10	20	5	1
SARLAHI	9	23	0	0	12	0	1	1	9
SINDHULI	2	0	17	5	7	2	15	3	39
SINDHUPALCHOWK	0	10	0	2	2	1	1	0	1
CENTRAL	167	151	72	157	74	23	107	84	214
ARGHAKHANCHI	0	0	0	0	0	0	0	8	5
BAGLUNG	0	48	1	0	0	0	0	0	0
GORKHA	28	6	0	0	1	5	0	0	0
GULMI	0	0	1	0	1	0	0	1	4
KAPILVASTU	81	28	38	44	9	2	1	10	0

KASKI	92	14	2	0	0	0	0	0	14
LAMJUNG	0	0	1	0	0	4	0	1	5
MANANG	0	0	0	0	0	0	0	0	0
MUSTANG	0	0	0	0	0	0	0	0	0
MYAGDI	0	0	0	2	0	0	0	0	0
NAWALPARASI	19	37	1	1	4	0	0	64	7
PALPA	15	8	20	1	6	11	20	6	9
PARBAT	0	0	0	2	0	0	0	0	0
RUPANDEHI	6	50	86	7	27	61	48	77	85
SYANGJA	0	0	9	1	0	0	0	16	11
TANAHU	0	0	0	0	2	0	0	2	11
WESTERN	241	191	159	58	50	83	69	185	151
BANKE	0	0	1	0	0	0	2	0	2
BARDIYA	15	28	83	6	26	36	48	2	27
DAILEKH	0	0	0	0	0	0	0	0	0
DANG	37	23	27	19	53	33	65	17	15
DOLPA	0	0	0	0	0	0	0	0	0
HUMLA	0	0	0	0	0	0	0	0	0
JAJARKOT	0	0	0	0	0	0	0	0	0
JUMLA	0	0	0	7	0	0	0	0	0
KALIKOT	0	0	0	0	0	0	0	0	0
MUGU	0	0	0	0	0	0	0	0	0
PYUTHAN	0	0	2	0	0	0	0	0	1
ROLPA	0	1	0	0	0	0	3	0	13
RUKUM	1	0	1	1	0	1	0	0	0
SALYAN	0	0	0	0	0	0	0	0	0
SURKHET	4	154	4	0	0	0	0	0	0
MID-WESTERN	57	206	118	33	79	70	118	19	58
ACHHAM	7	0	0	0	0	0	0	0	0
BAITADI	0	0	0	0	0	0	0	0	7
BAJHANG	0	0	0	0	0	0	0	0	9
BAJURA	0	0	0	0	103	0	0	0	0
DADELDHURA	0	0	0	1	0	6	1	0	0
DARCHULA	0	0	0	0	0	0	0	0	0
DOTI	0	0	0	0	0	0	0	2	0
KAILALI	315	219	86	1	31	44	150	3	22
KANCHANPUR	47	2	6	1	0	0	2	1	5
FAR WESTERN	369	221	92	3	134	50	153	6	43
Note: FY 064/65 include acute									

encephalitis like syndrome									

Annex V

List of PHCC and its catchment area based on altitudinal transect

Development Region	**Altitude range (population catchment area according to altitudinal base)**		
	Tentative catchment below 500 meter	**500 to 1500 meter**	**1500 meter above**
Eastern Development Region	MangalbarePHCC, Morang	Phikal PHCC, Ilam	Dungeshangu PHCC, Taplejung
Central Development Region	Lalbandhi PHCC, Sarlahi	Kapilakot PHCC, Sindhuli	Dolakha PHCC, Dolakha
Western Development Region	Basantpur PHCC, Rupandhehi	Kristi PHCC, Kanski Altitude: 1085 meter	Lete PHCC, Mustang Elevation: 2489m
Mid-Western Development Region	Khajura PHCC, Banke Altitude: 151mete	TopJari PHCC Rukum Altitude: 695 meter	Kalikhakhetu PHHC Jumla, Altitude; 2235 meter
Far Western	Malakheti PHCC, Kailali	Patan PHCC, Baitadi Altitude: 1206 meter	Deolekh PHCC, Bajhang

Development Region	Altitude, 266		Altitude; 2529

Western Development Region (Name PHCC and VDC)		
Basantpur PHCC, Rupandhehi	Kristi PHCC, Kanski	Lete PHCC, Mustang (PHCc coverage is limited only two VDC)
Padasari	Bharatpokri	Late
Basantapur	Kristi	
Hattibangai	Nirmalbasti	Kunj

Annex IV

Total Positive case of malaria reported from terai region

Malakheti PHCC, Kailali

Month	Fisical year (FY)					
Month	63/64	64/65	65/66	66/67	67/68	68/69
Asar	5	12	11	6	9	22
Shrawan	3	12	5	5	12	17
Bhadra	4	16	2	4	14	17
Asoj	1	5	2	7	20	17
Kartik	3	1	1	1	18	9
Mangsir	1	2	0	2	15	5
Poush	3	2	1	3	6	9
Magh	3	3	4	6	8	10
Falgun	4	10	4	8	18	0
Chaitra	6	8	2	0	19	0
Bhaishak	5	18	6	0	11	0
Jestha	4	7	1	0	19	0
Total cases	35	56	19	42	169	106

Khajura PHCC, Banke

Month	Fisical year (FY)					
Month	63/64	64/65	65/66	66/67	67/68	68/69
Asar	0	0	1	2	1	0
Shrawan	0	0	0	0	1	0
Bhadra	0	0	0	3	0	0
Asoj	0	0	0	0	1	0
Kartik	0	0	0	0	1	0
Mangsir	0	0	0	0	1	0
Poush	0	0	0	0	0	0
Magh	0	0	0	0	0	0
Falgun	0	0	0	0	1	0
Chaitra	0	0	0	1	0	0
Bhaishak	0	0	0	1	0	0
Jestha	0	0	3	1	1	0
Total cases	0	0	4	8	7	0

Banke District Public Health Office

Month	Fisical year						
	2002	2003	2004	2005	2006	2009	2010
Asar	.	1	2	0	5	16	0
Shrawan	.	0	4	0	10	2	8
Bhadra	.	0	0	7	9	4	3
Asoj	.	0	1	18	10	0	6
Kartik		0	0	6	310	7	4
Mangsir		1	0	2	87	2	0
Poush		0	0	0	4	9	2
Magh		0	0	1	2	0	1
Falgun		0	0	4	0	0	2
Chaitra		0	0	0	1	2	2
Bhaishak		0	0	6	0	1	4
Jestha		0	2	0	0	0	14
Total cases		2	9	44	437	16	46

We could not find any reported cases from other selected PHCC from terai region

Total Positive case of malaria reported from Hill region

		Patan PHCC, Baitadi				
Month	Fisical year (FY)					
Month	63/64	64/65	65/66	66/67	67/68	68/69
Asar	0	0	0	0	0	0
Shrawan	0	0	0	0	0	0
Bhadra	0	0	0	0	0	0
Asoj	0	0	0	0	0	0
Kartik	0	0	0	0	0	0
Mangsir	0	0	0	0	0	0
Poush	0	0	0	0	0	0
Magh	0	0	0	0	0	0
Falgun	0	0	0	0	0	0
Chaitra	0	0	0	0	0	0
Bhaishak	0	0	0	0	0	0
Jestha	0	0	0	0	0	0
Total cases	0	0	0	0	0	0

No cases were reported from patan PHCC

Top Chari PHCC

Month	Fiscal year (FY)					
Month	63/64	64/65	65/66	66/67	67/68	68/69
Asar	0	0	0	0	0	0
Shrawan	0	0	0	0	0	0
Bhadra	0	0	0	0	0	0
Asoj	0	0	0	0	0	0
Kartik	0	0	0	0	0	0
Mangsir	0	0	0	0	0	0
Poush	0	0	0	0	0	0
Magh	0	0	0	0	0	0
Falgun	0	0	0	1	0	0
Chaitra	0	0	0	0	0	0
Bhaishak	0	0	0	0	0	0
Jestha	0	0	0	0	0	0
Total cases	0	0	0	0	0	0

Mision Hospital Rukum Elevation: 695

Month	Fisical year (FY)					
Month	63/64	64/65	65/66	66/67	67/68	68/69
Asar	0	0	0	0	0	0
Shrawan	1	0	0	0	0	0
Bhadra	3	13	0	0	0	0
Asoj	1	9	0	0	0	0
Kartik	0	0	0	0	0	0
Mangsir	0	0	0	0	0	0
Poush	1	2	0	0	0	0
Magh	1	0	0	0	0	0
Falgun	2	2	0	1	0	0
Chaitra	12	0	0	0	0	0
Bhaishak	3	0	0	0	0	0
Jestha	0	0	0	1	0	0
Total cases	0	0	0	0	0	0

One case of Dengue was reported from Rukum Mission Hospital in Baishakh

We could not find any reported cases from other selected PHCC from Hill region

Total Positive case of malaria reported from Mountain region

Deolekh PHCC

Month	Fisical year (FY)					
Month	63/64	64/65	65/66	66/67	67/68	68/69
Asar	0	0	0	0	0	0
Shrawan	0	0	0	0	0	0
Bhadra	0	0	0	0	0	0
Asoj	0	0	0	0	0	0
Kartik	0	0	0	0	0	0
Mangsir	0	0	0	0	0	0
Poush	0	0	0	0	0	0
Magh	0	0	0	0	0	0
Falgun	0	0	0	0	0	0
Chaitra	0	0	0	0	0	0
Bhaishak	0	0	0	0	0	0
Jestha	0	0	0	0	0	0
Total cases	0	0	0	0	0	0

No cases were reported from Deolakh PHCC

We could not find any reported cases from other selected PHCC from mountain region