PERCEPTION AND TRENDS OF HEALTH RISK WITH SEASONAL CLIMATE VARIABILITY IN DISTRICT SWAT PAKISTAN

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Submitted in partial fulfillment of the requirement for the MS Degree in Environmental sciences at the faculty of Basic & Applied Sciences, International Islamic University, Islamabad

Supervisor (Dr. Islam-ud-Din)

بسم الله الرحمن الرحيم

DEDICATION

EVERY CHALLENGING WORK NEEDS SELF-EFFORTS AS WELL AS GUIDANCE OF ELDERS ESPECIALLY THOSE WHO ARE VERY CLOSE TO OUR HEARTS.

MY HUMBLE EFFORT IS DEDICATED TO MY SWEET AND LOVING

FATHER AND MOTHER

WHOSE AFFECTION, LOVE, ENCOURAGEMENT AND PRAYS OF DAY AND NIGHT MAKE ME ABLE TO GET SUCH SUCCESS AND HONOR

DECLARATION

I, Syed Ibrar Hussain S/O Muhammad Tahir, Registration No. 188-FBAS/MSES/F13, a student of MS Environmental Sciences at the Department of Environmental Sciences, Faculty of Basic & Applied Sciences, International Islamic University Islamabad(IIUI) do here solemnly declare that the thesis entitled "Perception and Trends of Health Risks with Seasonal Climate Variability in District Swat, Pakistan" submitted by me in partial fulfillment of the requirement for the MS in Environmental Sciences, is my original work, and has not been submitted or published earlier, and shall not in future be submitted by me for obtaining any degree from this or any other University or Institution.

Dated: 15 January 2016

Signature of Deponent

Acceptance by the Viva Voce Committee

Thesis Title: Perception and trends of health risk with seasonal climate variability in District Swat, Pakistan

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Finally, the errors that remain are mine.

Syed Ibrar Hussain

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LIST OF ABBREVIATION

CC	Climate change
CV	Climate Variability
KPK	Khyber Pakhtunkhwa
DHO	District Health Office
UNFCCC	United Nation Framework Convention on Climate Change
IPCC	Intergovernmental Panel on Climate Change
WHO	World Health Organization
CDC	Center for Disease Control
FGDs	Focused Group Discussion
ARI	Acute Respiratory Infections

Abstract

Climate change and variability impacts have already been investigated; various models and studies suggest that earth is warming. The present study was conducted with the objective to investigate the perceived and observed trends of health risks associated with seasonal climate variability in District Swat, which is a mountainous regions and is located in the northern temperate regions of Pakistan. The methodology of the study included questionnaire and rapid appraisal through focus group discussion and key informant interviews. Three tehsils of District Swat has been selected for the collection of primary data (Mingora, Bahrain and Matta). For the purposes of climate-health impacts analysis, number of cases of five climate sensitive diseases were correlated with monthly mean temperature and rainfall data for the period 2010-2014. The results show similar trends in relation to local perception on the climate-health risks and the observed cases of some notable diseases during seasonal changes. The results shows that the cases of malaria, diarrhea and typhoid fever increases with the increase in the atmospheric temperature and when there is less rainfall in the study area. While the cases of the pneumonia and ARI also increases in the dry cold weather and when the rainfall is reduced. In regards to local perception regarding climatic variability majority of the respondents perceived that they observed climatic variability in the area. The respondents also perceived that due to changing climate there is a negative impacts on the human health, agriculture, infrastructure and livelihoods. A separate study should conducted on each of climate sensitive disease to find a link between disease and climatic variables in the study area in more details. An early warnings system should be developed and implemented related to weather and climate forecast to protect the local people from climatic hazards. Vulnerability assessment regarding the climate change and human should be carried out, and the adaptive capacity should be enhanced to mitigate the health impacts of climate change.

Chapter 1

INTRODUCTION

Climate change means a variation of climate which is attributed directly or indirectly to man-made activity that modify the composition of the overall troposphere and which is in accumulation to natural climate variability perceived over comparable time periods, mostly 30 years of time. (UNFCCC, 1994). Any long term variation in the atmospheric temperature, precipitation, moisture content of atmosphere and other elements of climate system is called climate change (Kondratyev, 1998; Rodo, 2003). Climate variability on the other hand, refers to deviations in the mean state and other statistics such as standard deviation, the incidence of extremes, for example changes in the climate on all spatial and temporal scales beyond that of specific weather phenomenon. Climate variability can be caused due to two process the variability may be due to natural internal variability that occur within the climate system, and external variability. The main difference between the climate change and climate variability is that of duration, any short term change in the weather condition is called climate variability, while a long term constant alteration in the average weather is the climate change and this change is mostly in the decades. Climate variability is more significant than climate change because of the realities that climate change means the extended term alteration of the mean value of the climatic parameters while climate variability means the distribution around the mean i-e the extremes. The extremes affect us more than the mean climate.

There is comprehensive scientific agreement that the growing tropospheric concentration of greenhouse gases (GHGs) due to manmade activities are causing heating and other climatic variations at Earth's surface. The Intergovernmental Panel on Climate Change (IPCC), a prominent organization that issues different projection models concerning climate change, has forecasted that world average temperature would rise by 1.4-5.8^{0}C by the end of this century. The gases which contribute to warming of the earth are called greenhouse gases (GHG), which include methane (CH_4), ozone (O_3), carbon dioxide (CO_2), nitrogen oxides (N_2O), etc. The rise in tropospheric temperature is mostly due to burning of fossil fuels (petroleum and gasoline) for supporting manufacture as well as transport, for speedy economic development, and rapid growth in population, cutting of trees for agriculture, development of new cities or urbanization and infrastructure without proper planning. In a report published by the IPCC in 2001 stated that due to manmade activities the concentration of greenhouse gases has been escalated in the late half of the current century and this trend will be continue in the 20th century (Karl et al., 2006; Trenberth et al, 2007). Fossil fuels utilization has increased and due to this increased in utilization of the fossils fuel the concentration of the CO_2 in the troposphere has increased, and the devastation of forest and vegetation has reduced the environment capabilities from restoring the equilibrium. The level of other greenhouse gases (methane, nitrogen dioxide, and ozone) also increases in the atmosphere leading to gradual warming of the earth (IPCC, 2001). Karl and Trenberth (1999) termed that manmade activities are the leading causes in current rise in the tropospheric temperature and if climate mitigation actions not implemented under such situation, the consequences will be really serious in coming future. Under such situation the global reaction to reduce the impacts of climate change has been the focus of United Nations Framework Convention on Climate Change (UN/FCCC), emphasizing greenhouse gases emissions reduction goals (UN/FCCC, 1998). IPCC scientifically considered and evaluated all features of the earth climate system in collaboration with the troposphere, land surfaces, oceans, glaciers, sea ice and ecosystem, and its reports in 1990, 1995, 2001 and 2007, 2012 the main source of the scientific data came from these reports. This impacts would not be same around the globe, the global warming will be observed more in the areas located in the higher latitude and on land surfaces. Annual average precipitation will rise, while more dryness will be observed in the area falling at latitude and terrestrial areas of lower latitudes, while precipitation and flooding could become more and more extreme. It is expected that climate variability will becomes more intensify in warmer areas.

1.1. Pakistan and Climate Variability

According to climate change vulnerability index, compiled by Maplecroft Pakistan is among 10 most vulnerable countries to climate change. As the global atmospheric temperature changed Pakistan also experienced change in both precipitation and temperature. Because of temperature increase Pakistan faces variations in hydrological cycle in the form of variations in rainfall pattern, harvesting pattern, scarcities, water accessibility, incidence and intensity of heat waves, and weather persuaded natural catastrophes (Bosshard, 2006). The pattern of rainfall is changing in Pakistan, there are more rain in summer as compared to winter. As Pakistan an agricultural country, the main source of income is agriculture based products so the changed pattern in rainfall affected the wheat and other crops. Due to climate variability and change the agriculture productivity is decreasing due to extreme weathers and flooding in the country. Due to unprecedented rain and floods the rural infrastructure, communication and agricultural economy are suffering a lot. The estimated loss of the 2010 flood was $9billion. Heavy rains and winds causes severe damages to infrastructure and associated economic losses. The mini tornado that recently hit Peshawar is the third most forceful whirlwind in Pakistan history. Because of its geographical location Pakistan climate is generally extreme, and it is expected to have higher temperature than global average temperature. The rise in temperature is likely to rise by 4°C to 6°C by the completion of the century, which will eventually lead to melting of glaciers, leading to floods. Due to climatic variations and change the glaciers of Hindu Kush-Himalayan glaciers are receding fast. The Pakistan will face acute shortage of water in the coming years because of glaciers melting, which will eventually lead into a large variety of diseases.

1.2. Climate Variability and Health

Climate change and variability impacts have already been detected; various models and study suggest that earth is warming. If global warming continues at the current face, it will create a lot of problems for human being in terms maladies and deaths due to natural calamities: storms, heavy precipitation, heat waves, droughts and further climatic irregularities. Due to all of these many parts of the earth currently inhabitants by the people will be evacuated due to rise in the level of oceans or sea, and on the other hand some parts of the earth will be badly affected by the droughts and famines, and land currently used for the agriculture will be reduced, resulting in enormous increases in the food and water borne diseases as well as vector-borne diseases. Early deaths and infections will also be increased because of the atmospheric pollution (Mills, 2009; PAHO, 2008; United Nations, 2006). Several infectious diseases are sensitive to the climate variability. The population and development of certain biological vectors can increase due to change in climate related events. Each biological agents had certain environment in which their growth, survival, transport and dispersion is optimal. Each climatic factors play different role in the epidemiology of several infectious diseases. Infectious microbes have a reproduction frequency comparative to the ambient temperature. The factors which also contribute to the geographic dispersion of many infectious vectors is controlled by the factors such as minimum and maximum temperatures, moisture, and the accessibility of breeding sites. Wind can also contribute a major role in the dispersion of disease vectors as it carries it from one location to the other. The biting frequency and reproduction rate of certain blood feeding arthropods often increases when the temperature increase above certain threshold level (Gillet, 1974; Shope, 1991; Bradley, 1993). Weather and climate change alter ecosystem which causes the epidemic of diseases. The altered ecosystem caused by climatic changes increases the problem of infectious diseases. Millions of people will face ill heath due to climate change in the coming 15 to 20 years and developing countries will suffer more and the majority of the individuals will be affected (International Institute for Environment and Development (IIED), 2011). Confalonieri *et al.* (2007). The highest impacts of climate change and variability will be on those areas which contributed very little to this phenomenon and who have limited access to world resources (Ploukoi *et al* 2014). The main health effects of the climate change are disease and death due to increase in temperature, injury and death due to floods, droughts and storm surges, and the increase in the vector borne diseases, lung diseases due to pollution and various allergies, and increases in the mental diseases.

1.3. Floods Droughts and Storms

Natural disaster may directly or indirectly affect human health, the direct impacts of disaster are physical wound/damage, injury/illness and death through potentials impacts on psychological health (Ahern et al., 2005, Haines *et al.* 2006). A large number of deaths occur due to quick upswing floods as a consequence of the increase of drowning (French *et al.* 1983). Resulting floods, are likely intensifications in diarrhea and respiratory diseases (Siddique *et al.,* 1998, Ahern *et al.,* 2005). Because of the flood the economic and environmental damages will result in the increase in the psychological disorders such as anxiety and depression (Haines *et al.,* 2006). The areas with great threat of flooding and have inadequate community health arrangement is high susceptible. (Few and Matthies, 2006). Mostly the areas influenced by El Nino droughts may have extensive impacts on health comprising on nourishment and infectious diseases (Haines *et al.,* 2006; Bouma *et al.,* 1997).

1.4. Infectious Diseases

Climate variation and change may alter spreading and occurrence of communicable diseases. The other factors which influence patterns of diseases are the movement of individuals and belongings, variations in environment, changes in land use pattern, pathogens and hosts (Hales et al., 2003). The climatic features such as temperature, precipitation, soil moisture content, and humidity also play a major role in the transmission of many infectious disease agents, namely pathogens and vector-borne agents (Gubler 1997, Kovats et al., 2003, Haines et al., 2006). Furthermore, climate change may disturb the life cycle of certain arthropod vectors. Due to climate change both the vector and pathogen spreading will be affected, and in the capability of certain arthropods to transmit diseases will also be affected, the mode of pathogens to interact with both the arthropod vector and the human or animal host can also be changing (Martens et al., 1997, Patz et al., 2003, Tabachnick, 2010). Due to lack of immunity against new pathogens causes more diseases to spread in the new environment. (Tabachnick, 2010).

1.5. Climate Variability and Malaria

Malaria is parasitic disease caused by Plasmodium transmitted through bites of Anopheles mosquitoes called malaria vector. The signs of disease are temperature, nuisance, chills and nausea. The most severe type of malaria is P. falciparum malaria (WHO, 2009a). The initially study of the effects of climate change and variability on health was conducted on malaria because of its dominancy on the regional and global level (Sutherst, 2004, Githeko and Woodward, 2003). The vector, the human host and environment are the three main factors on which the transmission of malaria depends (WHO, 2009b). The environmental factors on which a malarial transmission depends are rainfall pattern, atmospheric temperature and moisture may interrupt the abundance and existence of parasites (WHO, 2009c). A lot of work had been carried out to study the link between climate change and malaria (Githeko et al., 2000, Watson and McMichael, 2001, Sutherst, 2004, Pascual and Bouma 2009). It is clear from the past studies that changes in temperature and moisture play key role in the increases or outbreak of malaria. As the temperature increases the malarial vectors reproduces at very high rate (CDC 2009a). Even a minor rise in the atmospheric temperature rises the threat of malaria. The most favorable temperature for malarial parasites is 29-33^{0}C, in this temperature range it reproduce at highest rate (Martens et al. 1997). Changes in the rainfall can also have impact on the malarial transmission. (Martens et al. 1997, Sutherst 2004). Though it is not only climate variability, but also weather events have the potential to have profound effects on the incidence of malaria (Kovats, 2000).

1.6. Climate Variability and Typhoid

Typhoid is a bacteriological contagion produced by *Salmonella typhi*. It was one of the major causes of sickness and death in the congested and unhygienic regions in the 19th century. Today it is also a key issue in the developing nations where the sanitary condition is unhygienic. Typhoid fever likely affected 21,600,000 infections and 216,500 deaths worldwide in 2000. Human is the single natural host and reservoirs, the disease is transmitted through fecal-oral communication. Mostly the disease occur in the summer time and rainy season. But, typhoid fever has been happening in winter more significantly in current years.

1.7. Climate Variability and Food and Water Borne Diseases

A large number of diseases had been caused due to food and aquatic borne pathogens. Food as well as water borne diseases remain very sensitive to climatic variability, it affect their replication rate, existence, transmission rate, and disease ranges (CDC, 2009b). There is as direct association among temperature, rainfall and the transmission of water and food borne infections (Hales et al. 2003). Due to higher temperature the gastro intestinal infections increases (Madico et al. 1997). The diseases associated with viruses bacteria, and parasites had direct relationship with precipitation i-e increase in precipitation increases the diseases burden. Outbreak of food borne and water borne infections can happen after flooding as of the contamination of the surface water (Curriero et al., 2001).

1.8. Study Area

Swat is mountainous regions and is located in the northern temperate regions of Pakistan. It is most attractive place, and for this reason it is called Switzerland of the east (Balala, 1999). People living in the swat are Pukhtuns, Kohistani and Gujars. Gujar or Gurjjar is the main clan of the swat. The Dardic people of the Kalam area in upper Swat are known as Kohistani.

1.8.1 Climate

As swat is positioned in temperate zones and the various factors which managed its climate are including latitude, altitude, summer monsoon and the cyclonic current. The winter in Swat is usually harsh, during December to March. The weather in summer is impartially adequate with a highest recorded atmospheric temperature of 34^{0}C. The yearly precipitation in district ranges from 100-120cm which are scattered between three rain bearing spells.

1.8.2 Forestry

Forest cover almost 497,968 Hectares of district as of 2007-2008 data collected by forestry department of the KPK. Including mostly of pine trees such as chir, spruce, fir, and kail. This region is distributed into resumed land (extent up to 338545 Hectares), private plantations (159082 Hectares) and mixed categories (345 Hectares).

1.8.3 Agriculture

The major source of income in District is agriculture which are 50% of the economic activity. Agriculture land is located in Barikot, Matta, Mingora, Khwazakhela and Kabal. The main source of irrigation is the river Swat which supply water to most regions through channels. Wheat, maize, vegetables, tobacco, fruits, soya bean and sun flower are main agriculture crop of the district swat.

Table 1 Agriculture department KP. 1997-1998

S.no	Land Utilization Status	Area in Hectares
1	Total area reported	506528
2	Cultivated land	98845
3	Un-cultivated area	407683

1.8.4 Health

The delivery of health facilities is directed by the district and local administration, the health amenities extending from hospitals and dispensaries to TB clinics, rural health centers, Basic Health Units, Mother and Child Health Centers and Leprosy Clinics.in District Swat there are 10 Hospitals along with 18 Dispensaries, 41 Basic Health Units I TB Clinic. For 21,330 individuals there is one health facility. This is much lower as compared to other parts of KPK and also it is not compliance with the general health care standards.

1.9. Purpose of Study

Pakistan, a country with very large population, agriculture based economy and high vulnerability index to natural disasters, it was important to ascertain climate variability and determine trends of temperature, rainfall and river flows on spatial and temporal basis. Pakistan contribution to global warming is very little but it is one of the most severely hit country which is effected by climate change related disaster. Pakistan has limited capacity, resource scarcity, and inadequate physical and institutional organization. These all are not enough to cope with the expected enormous changes in climate as to timely respond to its impacts. (Shafiq et al., 2008)

District Swat is expected to be severely hit area of Pakistan by climate change related disaster like the flood of the 2010 which severely hit the district and caused many causalities and death. There is also emergence of new vector borne diseases which were previously not present in the area like dengue outbreak in 2013. Similarly a changes in the pattern of some vector borne and water borne diseases is also observed. The main purpose of the study is to identify key climate sensitive health risks in District Swat.

1.10. Scope and Limitation

A wide range of health risks is associated with climatic variability but this study only focus on the five climate sensitive diseases which are prominent in the area. The study covers only representative town and village because of its expansiveness, remoteness and resource availability.

1.11. Objectives

The objectives of this research are:

- To investigate the perceived and observed trends of associated health risks with seasonal climate variability.
- Identification of the vulnerable community to climate variability.
- Propose a range of feasible adaptation options to avoid the most serious impacts of climate variability on public health in Swat.

Chapter 2

LITERATURE REVIEW

Jolene et al., (2015) analyzed the vulnerability to the health effects of climate variability in rural southwestern Uganda. The objective of the study was to identify key climate sensitive health risks. They Define and distinguish factors of sensitivity to these health priorities at the individual, community and regional level, and they also assess the adaptive capacity of bakiga region. The main health risks which were identified by the study communities are malaria, food insecurity, and gastro intestinal illness which were affected by the local climatic and environmental conditions, livelihoods, land use changes, and socioeconomic conditions. This study shows the significant existing vulnerabilities to the current climate related health risks and outline the importance of non-climatic process and local conditions which create sensitivity to health risks.

Steven et al., (2015) carried out a study on climate variability impacts, diseases and human health: The Case of Morogoro Municipalities, Tanzania. This study assesses the impacts of climate variability in water quality and its subsequent effects to human health through diseases in Morogoro Municipality. They assessed the standard of drinking water and find out that how climate variability affect the water quality of the study area. Data were collected through interview and questionnaire covering two hospitals of the study area namely saint Thomas and Nunge hospitals a total of 150 questionnaire were collected in the study area. The secondary data were collected from TMA and MORUWSA. The other factors which affected the water quality of the study area population density, human activities, and economic factors.

Mishra et al., (2015) carried out a study on the Climate change and adverse health events: community perceptions from the Tanahu district of Nepal. The objective of this study is to find out community perceptions of climate variability and human health risks. A cross sectional study was conducted between august 2013 and July 2014 in the Tanahu district of Nepal. A total of 258 questionnaire were collected. More than half of the respondents perceived that climate is changing, and thinks that temperature in summer is increases and they also perceived an increase in the number of diseases in the summer. 49.2% had perceived an increase in rainfall during the rainy season. 46.5% perceived an increase during the rainy season and 48.8% during winter. Only 8.9% of the respondents felt that the government was doing enough to prevent climate change and its impact on their community. Respondents living in a pakki house, super-pakki, or those who were poor were more likely to perceive health risks.

Kassa et al., (2014) carried out study on Climate variability and malaria transmission Fogera district, Ethiopia. Malaria transmission rates have been linked to temperature and precipitation; factors that will be affected by increasing climate variability. They analyzed climate and malaria data from January 2003-December 2011 in Fogera district of Ethiopia. They compared monthly rainfall and temperature data with the number of confirmed malaria cases. They identified 104,716 confirmed malaria cases, which were treated in the district from 2003-2011 (monthly cases range from 98 – 5038). The annual prevalence rate was 104 per 1000. Annual average rainfall was 1268 mm, and annually there were between four and six months with rainfall that exceeded 80mm. There was a trend, associating months with rainfall above 80mm and higher rates of confirmed malaria cases in seven of the nine years of the study period. Average monthly temperatures throughout the nine year period ranged from 180c to 280c. They that Malaria still constitutes a serious public health problem in Fogera district. Monthly precipitation greater than 80 mm was associated with increased malaria transmission rates in the district, and the temperature probably was not a limiting factor. The study recommends the development of climate prediction models to help forecast and control malaria outbreaks in the district.

Mendez-Lazaro et al., (2014) assessed climate variability effects on dengue incidence in San Juan, Puerto Rico. This study mainly emphasis on that whether climate and environmental conditions are becoming favorable for dengue transmission in San Juan, Puerto Rico. Six variables were analyzed in the study which were Sea Level Pressure (SLP), Mean Sea Level (MSL), Wind, Sea Surface Temperature (SST), Air Surface Temperature (AST), Rainfall, and confirmed dengue cases. Results showed that dry days are increasing and wet days are decreasing. Mean Sea Level is increasing, creating greater risk of dengue as the area of the San Juan Bay estuary increases and coastlines move inland. Sea surface temperature and air surface temperature becomes warmer. In San Juan the most infections causes among the teenagers.

Bamidele et al., (2014) study public perception of climate change and its impact on health and environment in rural southwestern Nigeria. A community based descriptive cross sectional study was conducted. Through multistage sampling methods data has been collected from1, 019 rural respondents. Around 911 (89.4%) of respondents perceived that there has been a change in climate in the previous 10 years. Supernatural causes were prominent amid respondent-reported causes of Climate Change. Recognized dangerous activities causative to Climate Change comprised burning (10.7%), bush burning (33.4%), and tree felling (41.0%). Reduced information of causes but good information of properties of Climate Change were found in this study. Around two-thirds of respondents had an optimistic attitude to bases of Climate Change, whereas partial had a positive attitude to the effects of Climate Change. The areas which are more vulnerable to climate change in Nigeria is rural areas. Respondents' poor information but positive attitude to Climate Change calls for distribution of suitable information on Climate Change in sustained health-promotion programs.

Bi et al., (2013) carried out a research on impact of climate variability on plasmodium vivax and plasmodium falciparum malaria in Yunnan province, china. The main aim of the study is to identify the high risk area of malaria transmission in Yunnan Province, and to evaluate the effects of climatic variability on the spread of Plasmodium vivax and Plasmodium falciparum in the identified area. They recognized spatial clusters of malaria cases using spatial cluster analysis at a county level in Yunnan Province, 2005–2010. They estimated the weekly effects of climatic factors on P. vivax and P. falciparum based on a dataset of daily malaria cases and climatic variables. To evaluate the impact of temperature, relative humidity and rainfall up to 10–week lags on both types of malaria parasite after adjusting for seasonal and long-term effects a distributed lag nonlinear model was used. Their results recommend that the China–Myanmar border is a high risk area for malaria transmission. The major factors which determinants malarial transmission in the area is the climatic factors. The likely lag effects for the link between temperature and malaria are reliable with the life cycles of both mosquito vector and malaria parasite. These results will be beneficial for malaria surveillance–response systems in the Mekong river region.

Oloukoi et al., (2013) investigates the perceived and observed trends of associated health risks with seasonal climate variability and identifies types of and preference for adaptation strategies that are available at households and community levels in Oke-Ogun region, Nigeria. The methodology adopted in the study are of household survey and rapid appraisal through focus group discussion and key informant interviews. For a short period climate–health impact analysis, cases of notable diseases were correlated with monthly mean temperature and rainfall for the period 2006 and 2008. The results illustrate that parallel trends in relation to local perception on climate–health risks and observed cases of some notable diseases during seasonal changes. Their findings also indicate that during the dry seasons Diarrhea, measles and malaria cases were increased. Whereas from the onset of Harmattan and monsoon of rainy seasons the cases of flu increases.

Moors et al., (2013) carried out study on climate change and water borne diarrhea in northern India its impacts and adaptation strategies. This study mainly focus on the effect of climate change on diarrhea as a typical of a waterborne communicable disease affecting human health in the Ganges basin of northern India. The climatic variable which were included in the study are temperature, increased/extreme precipitation, decreased precipitation/droughts and relative humidity. They applied the conceptual framework to the newest regional climate forecasts for northern India shows surges between current and upcoming (2040s), changing spatially from no change to an rise of 21% in diarrhea occurrences, with 13.1% rise on average for the Ganges basin. The main measures against diarrheal diseases which are discuss in the study are: reactive actions, preventive actions and national policy options. The most feasible options suggested in the current study is the preventive actions and it has potential to counterbalance this expected rise in the disease. Though, given the inadequate progress in decreasing rates over the past decade consorted actions and effective implementation and integration of existing policies are needed.

Tunde et al., (2012) examines the impact of climate variability on human health with the use of regression, correlation and ANOVA. The findings demonstrate that there is a very solid positive correlation between minimum temperature and typhoid (0.844), maximum temperature and malaria (0,794), typhoid (0.793), among sunshine and typhoid (0.667), malaria (0.630). While the further variables are weakly correlated with the diseases. The regression analysis reveals that 49%, 88% and 79% of the variance in asthma, typhoid and malaria can be respectively explained by the climatic parameters under study to a certain extent. This study also shows that other than this variables the other factors are also responsible for the selected diseases in the area. The main recommendation of this study proposed that meteorological conditions report must be publicized to people through the media in order for them to know variation in the climate and how to adjust and lessen the effect of the changes. Also, individuals should be educated on the effects of anthropogenic activities in the atmosphere and how to reduce these effects for sustainable development.

Haque, et al (2012) carried out study on Households' perception of climate change and human health risks: A community perspective. Two villages has been selected for the study one from northern part and the other from southern part of Bangladesh and the data was been collected through cross-sectional survey of the respondents. Through multistage sampling procedure a semi structured questionnaire has been collected from 450 household. The other process through which data has been collected were focus group discussion (FGDs) a total of 12 FGDs has been collected, and 15 key informant interviews (KIIs). Above 95 percent of the respondents stated that the temperature during the summers had increased and 80.2 percent reported that precipitation had reduced, associated to their previous experiences. About 65 percent stated that winters were warmer than in previous years but they still experienced very unpredictable and severe cold during the winter for about 5-7 days, which limited their activities with very negative effect on agricultural production, everyday life and the health of people. Respondents had clear opinions about changes in temperature, cold and rainfall that had occurred over the last five to ten years. Native observations of climate variability (CV) comprised increased temperature, complete warmer winters, less rainfall and fewer floods. The impacts of CV were mostly adverse in relations to means of living, human health, agriculture and overall livelihoods. They observed that most local perceptions on CV are consistent with the evidence regarding the vulnerability of Bangladesh to CC.

Wongkoon et al., (2011) asses the impacts of climate variation on the dengue virus transmission in chiang Rai, Thailand. The data obtained were population based information on monthly variation in monthly dengue cases and climate factors. Their findings shows that precipitation and minimum temperature played an important role in the transmission of dengue in the Chiang Rai.

Niclas (2010) examined the link between climate and health, mainly focusing on the short term impacts of extreme temperatures. This study focuses on the long term relation between climate variability and health using Swedish temperature and mortality data for the period 1751-2004 using different time scales. The study find that periods with higher temperature are associated with lower mortality. The results indicate that long term climate variations in annual mean temperatures and not short term variations explain the connection between temperature and mortality. Considering annual extreme temperatures, the study find that extreme low winter temperatures are correlated with higher short term mortality. The study identify the impact of the 11-

year solar cycle on crop yields as a possible explanation for our findings. The results have besides their economic-historical merits implications for modern day policy for developing countries, especially since the correlation with solar activity implies predictability.

Hurtado-Dìaz et al., (2008). Analyzes the effect of temperature and precipitation on the incidence of acute respiratory infections and acute diarrheic disease in Veracruz, Mexico. The objective of the study was to estimate the effect of temperature and precipitation on the incidence of acute respiratory infections and acute diarrheic disease cases in the municipalities of Mexico. Weekly cases from 2005 to 2005 of acute respiratory infections, acute diarrheic diseases in children under 5 year, temperature and precipitation data of the three municipalities of Veracruz Mexico. The results show that maximum temperature was positive associated with weekly diarrhea cases in the three municipalities of study. For every Celsius degree increased in maximum temperature, adjusting by precipitation. the number of diarrheal cases per week increased by 19% (CI: 3–32%) in Acayucan with a lag of 3 weeks in temperature and precipitation of the same week; 2% (CI: 1–4%) in Coatzacoalcos with a lag of 1 week in temperature and precipitation of the same week; and 13% (CI: 1–28%) in Las Choapas, 1-week lag of temperature and 5-weeks lag of precipitation. The study shows that the acute diarrheic disease is sensitive to climate changes on municipalities of Mexico..

Bulto et al., (2006) assessed the potential effects of climate variability and change on population health in Cuba. They describe the climate of Cuba as well as the pattern of climate-sensitive diseases of primary concern, particularly dengue fever. They analyze the association between climate anomalies and disease pattern. They also highlight current vulnerability to climate variability. They suggest adaptation options to prevent diseases outbreaks.

Devi et al., (2006) studied climatic variables and malaria incidence in Dehradun, Uttaranchal, India. The aim of the study was to find out the effect of climatic factors on malaria incidence with particular emphasis to capture the essential events as a result of climatic variability. Data on malaria incidence and meteorological information were gathered in a collaborative study with the district malaria office, and forest research institute, Dehradun respectively. Higher positive correlation of association was found between monthly parasites incidence and climate variables. However highest significant correlation was found between rainfall and malaria incidence.

Amarakoo et al., (2004) analyzes climate variability and disease pattern in two south eastern Caribbean countries. The study was conducted in Barbados and St Lucia. Results of the analysis of disease data revealed that most of the diseases (Dengue, Asthma, Bronchitis, Respiratory Tract Infections, and Diarrheal illnesses) exhibited seasonal patterns. Correlations of disease data with climate data indicated significant (moderate r and low p values) associations of Dengue with temperature and rainfall; Asthma, Bronchitis and Respiratory Tract Infections with temperature, relative humidity and Sahara dust; Diarrheal illnesses with temperature and rainfall.

Singh et al., (2001) carried out two related studies to explore the relationship between climate variability and the incidence of diarrhea in the pacific islands. In the first study they examined the average annual rates of diarrhea in adults, as well as temperature and water availability from 1986 to 1994 for 18 pacific island countries. There was a positive association between annual average temperature and the rate of diarrhea reports, and negative association between water availability and diarrhea rates. In the second study, they examined diarrhea notifications in Fiji in relation to estimates of temperature and rainfall using Poisson regression analysis of monthly data for 1978-1998. There were positive associations between diarrhea reports and with previous research suggest the global climate change is likely to exacerbate diarrheal illness in many pacific island countries.

Maryam et al., (2014) carried out study on the perception of local community about the effects of climate change in upper swat, Khyber Pakhtunkhwa, Pakistan. The aim of the study is to identify the impacts of climate change on the lives of local people of the study area based on 30 years back data. The study was carried out through semi structured interview. The study recommends that the anthropogenic sources causing global warming and triggering climate change, should be reduced and government should restrict and implement the law regarding greenhouse gases emissions.

Gomoro et al., (2012) assesses major feature of climatic variability, and the local perception on its Causes, indicators and adaptation strategies in weliso wareda, Oromiya regional state, Ethiopia. For the current study Three randomly selected kebeles are used, and in these kebeles semi-structured interview with 180 sample household heads, 6 focus group discussions, 10 key informant interviews, and frequent field observations were conducted to collect primary data. To understand climatic variability the data of the rainfall and temperature from the year 2004 to 2013 are used. This study suggest that there is a slight variability in temperature and rainfall. Native people observed the occurrence of climatic variability and also recognized its signs: flooding; drying up of rivers and streams, crop destruction by pests; appearance of new human and animal disease; species shift to upper altitude, and appearance of new plant and animal species; precipitation changes in duration and amount; etc. They formulated mechanical and biological preservation procedures upon farm lands; watershed management; rain water harvest; alterations in harvesting pattern; developing short growing harvests; family planning and livelihood diversification as adaptation measures. Such activities are challenged by scarcity and food uncertainty, lack of access to land, water, market, finance, insurance, information, health, and agricultural technologies. This demands for perfection in farming production; competency building on existing knowledge and practices of the people; physical activity and awareness on rainwater harvesting technologies; strengthening access to social, institutional, financial, human and natural assets of livelihood, integrated watershed management, and sustainable environmental and livelihood development programmes.

Manyatsi et al., (2010) determine the perception of climate variability and change by the rural communities in Swaziland. The data were collected through interviews a total of 60 interviews were conducted from three different regions named midlevel, Lowveld and lubombo. The effects of climate variability felt by the community members included failure of crops, death of livestock and low crop yields. Community members did not have any adequate information on climate variability. The communities suggested an effective early warning system to operate at constituency level to minimize the impacts of climate variability related events in early stage.

Chapter 3

MATERIALS AND METHODS

3.1. STUDY AREA

Swat is an administrative district in the Khyber Pakhtunkhwa (KPK) of Pakistan, located at 34^0-40'' to 35^0-55'' North Latitude and 72^0-08'' to 74^0-6'' East Longitude. District Swat is a hilly area, positioned in the foothills of the Hindu Kush mountain range. The elevation of district varies from 600m to 6,000m above sea level towards south to north. Saidu Sharif is the headquarter of district, with Mingora the main town. The distance of Saidu Sharif from Peshawar is 131 km towards the northeast. The population of district is 1,257,602, with population density of 235.7 people per square km. with the average yearly growth ratio of 3% (District census Report, 1998). District is administratively divided into three tehsils, i.e. Mingora, Matta, and Bahrain. Present study was undertaken tehsil Mingora and tehsil Bahrain. These two tehsil have been selected because of the fact that tehsil Mingora represented the urban area of district swat while tehsil Bahrain consist of mostly the hilly and rural area.

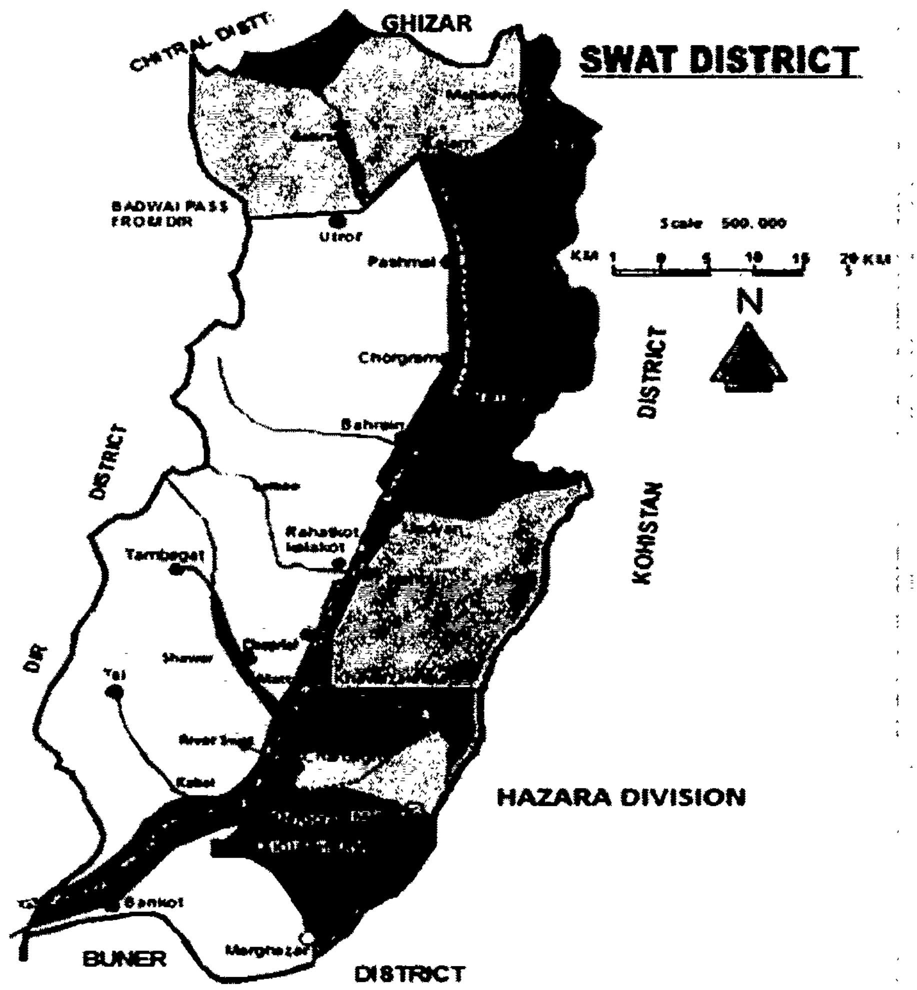

Figure 1 Map of District Swat

3.2. DATA COLLECTION

Both primary and secondary data were collected for the current study.

3.2.1. Primary data

a. Questionnaire survey

Questionnaire were design to know that perception of the local public adopting the procedure of Bardsley Liddicoat (2007). The questionnaire comprised of close ended and open ended questions. The questions were formulated to obtain data on social and economic characteristics of the region, perception on health effects of climate change and seasonal variations, perception of various notable diseases in the study area. House hold heads were respondents. A total of 200 questionnaire has been collected in both the tehsil, 100 questionnaire from each tehsil. These 100 questionnaire has been randomly collected among various villages of each tehsil.

b. Meeting and semi structured interviews

Meeting were organized with public representative to obtain their opinions of the circumstances as well as semi structured interviews were accompanied to obtain the anticipated facts following the techniques of Habiba et al (2012).

c. Observation

Another technique of gathering information is direct observation so all the condition were intensely witnessed to get the desirable information as done by Deng et al (2012).

d. Focused group discussion

Focus group discussions (FGDs) were organized in different areas so that the information which were missing in the questionnaire were captured effectively. Two FGDs were arranged where the participants included people from health departments, community leaders, and college students. The discussion were carried out in a friendly environment as recommended by Pickets et al (2012). Equal speaking opportunity was provided to all the participants in order to obtain more exact and precise opinion.

e. Maps

Maps of the study area were collected and analyzed to spot different site of the study area Akerlof et al., (2012) methodology.

3.2.2. Secondary data

a. Climate data

Monthly temperature and mean rainfall, day-to-day records of climate factors such as rainfall and temperature for a period 1994-2014 has been collected from meteorological department office which directs and manages metrological data for Pakistan as the study area is district swat so the climatic data of district swat has been collected for the said department. The data has then been classified into monthly format for the analysis decadal seasonal variation. The monthly mean precipitation and atmospheric temperature data for the period 2010-2014 had been interrelated with cases of prominent/notable diseases in swat.

b. Health data

Data of certain disease has been obtained from the district health office swat, these data has been collected on the monthly basis. Data of the five diseases ARI, typhoid, diarrhea, malaria and had been collected from DHO office. A five years data of these diseases have been collected from the said department because of the non-availability of the previous data.

Chapter 4

RESULTS AND DISCUSSION

4.1 Changes in Temperature Pattern Perceived by Respondents

The questions were asked from the respondents regarding general summer and winter temperature in the area. During last 5 to 10 years. majority 75 % of respondents feel that the that the temperature in the summer is hotter now as compared to those last 5 to 10 years ago.(figure 2) While 52% of the respondents think that the intensity of cold during winter has reduced in the area. The findings show that the temperature of the area has increased as compared to previous years. Most of the members of the FGDs and personal interviews were also reported that the summer temperature in the area has increased.(Figure 2)

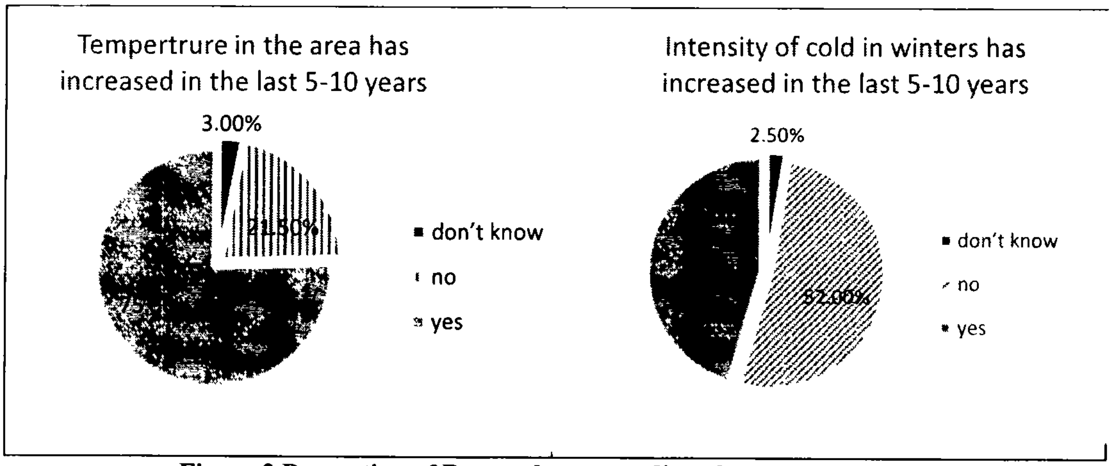

Figure 2 Perception of Respondent regarding changes in Temperature

4.2 Changes in Weather Patterns Perceived by Respondents

Questions were asked from the respondents regarding the changes in the weather pattern. Almost all the respondents answer to the questions. One question is about change in weather pattern in general, and the other question is about changes in season pattern such as (late snow, late winter or long summer). 80% respondents think that the pattern of the weather is changing, while 81% respondents think that the pattern of the seasons is also changing the winters come late and the timing of the snowfall also changing and the duration of the summer also extended. The respondents reported that there is very little or no rainfall in the months of November and December, while in the past there were a lot of precipitation in the above mentioned months.

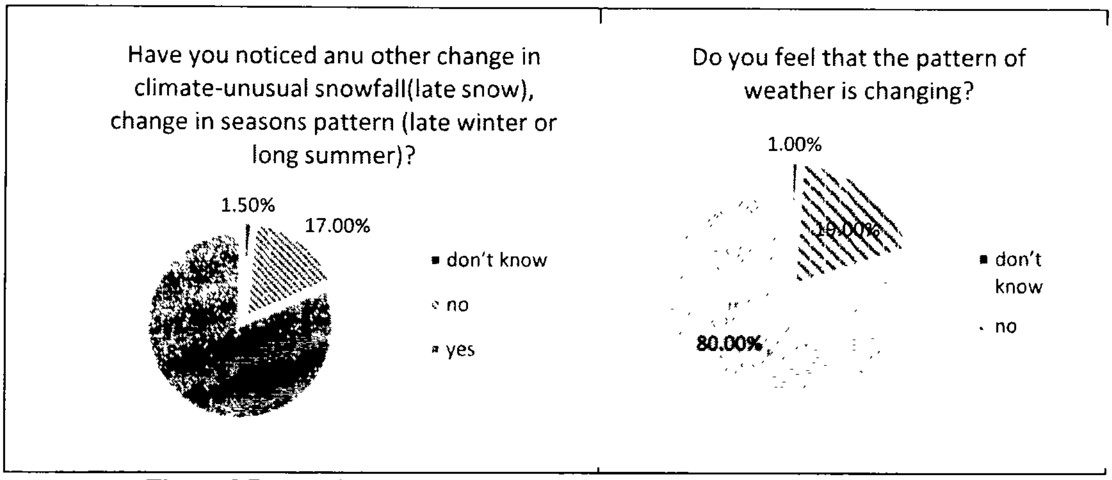

Figure 3 Perception of Respondents Regarding Changes in Weather Pattern

4.3 Perceived Health Risk Pattern in District Swat

During the data collection a number of questions were asked of the respondents regarding health risks associated with seasonal climatic variation in district swat. 67% respondents' feels that the increase in disease has been noticed in the area in the recent years. While 73% respondents think that the frequency of diseases in the summer has increased in the last decade, 71% respondents believe that the frequency of diseases during winter increases and 66% believes that the frequency of diseases during rainy seasons increases. 70% of the respondents say that he or his family member got sick in the last 12 months and the most common types of sickness or diseases are dengue, diarrhea, malaria, typhoid, and pneumonia. 76% respondents think that children is most affected by the diseases while 19% thinks that old people is more vulnerable to diseases. The following graphs show the percentage of respondents to various questions regarding the perceived health risk pattern in district swat.

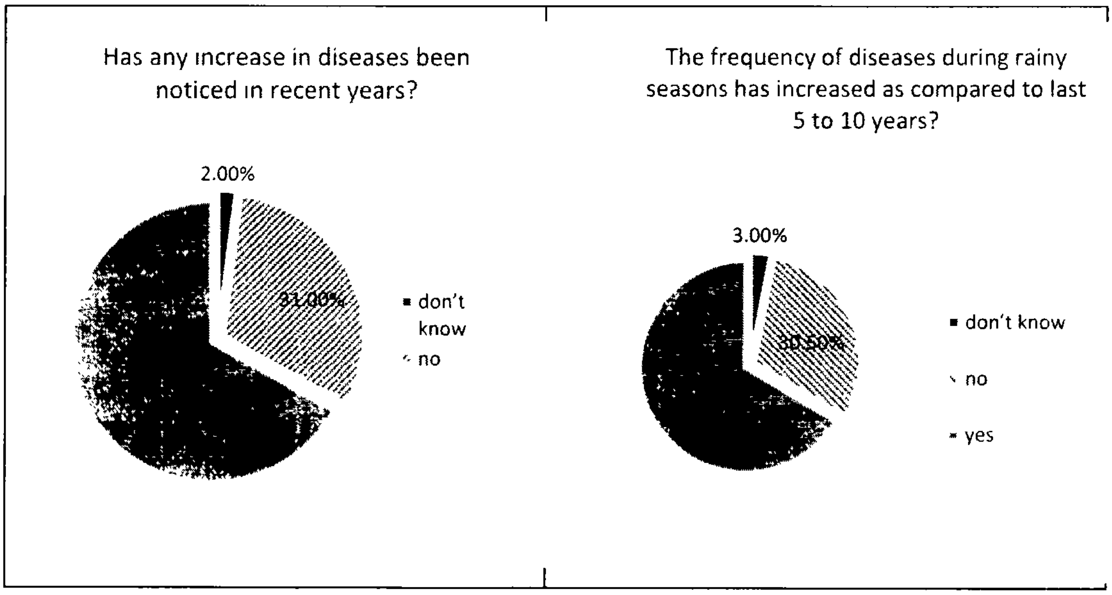

Figure 4 Perception of Respondent regarding diseases in Swat

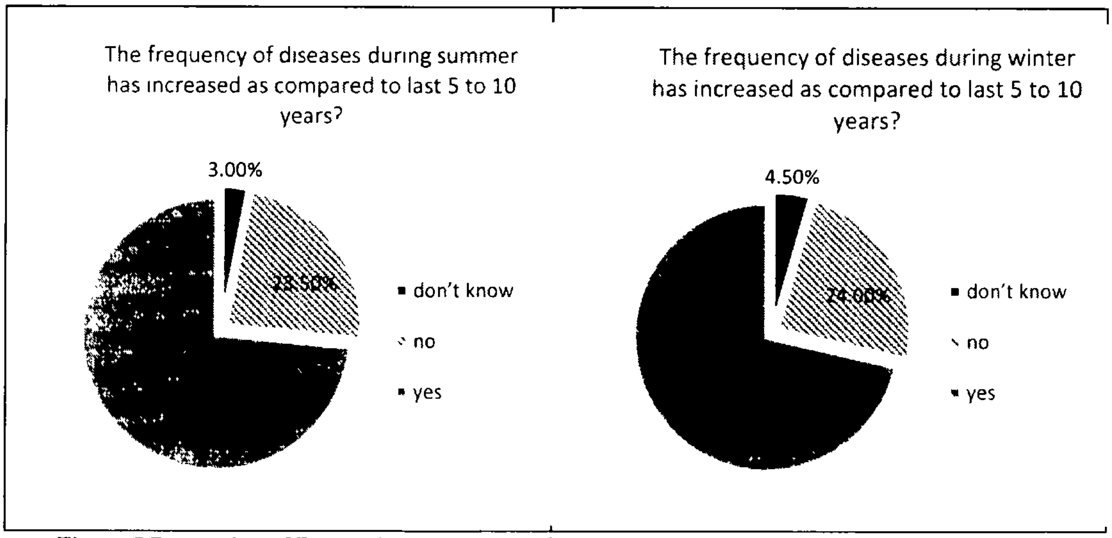

Figure 5 Perception of Respondents regarding frequency of diseases during summer and winter

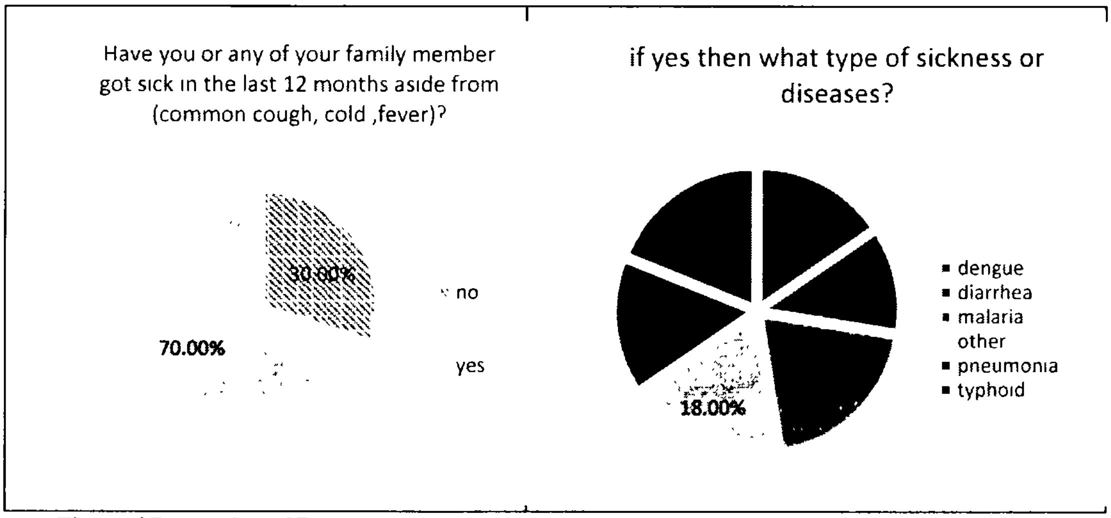

Figure 6 Perception of Respondents regarding diseases in last 12 months and type of sickness

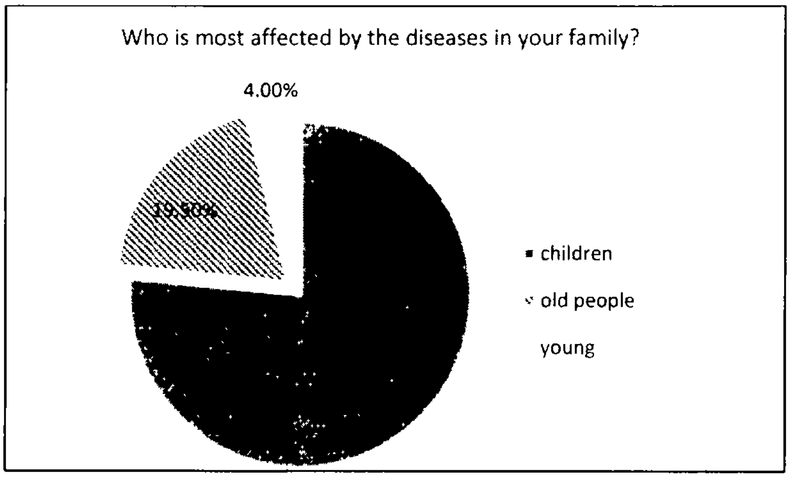

Figure 7 Perception of respondents regarding individuals most affecting by the disease

4.4 Changes in Rainfall Patterns perceived by Respondents

Questions were asked from the household head and farmers regarding changes in the precipitation pattern in the study area. The majority of respondents, 63% believes that the intensity of rainfall decreases in the area during the last decades. It was also discussed during FGDs that the timing of raining is changed and when the crops needed water, there is little or no rains and when there is little or no need of water then there is more frequent and intense raining, which severely damages crops. As a result of this the agriculture productivity in the area has been declined.

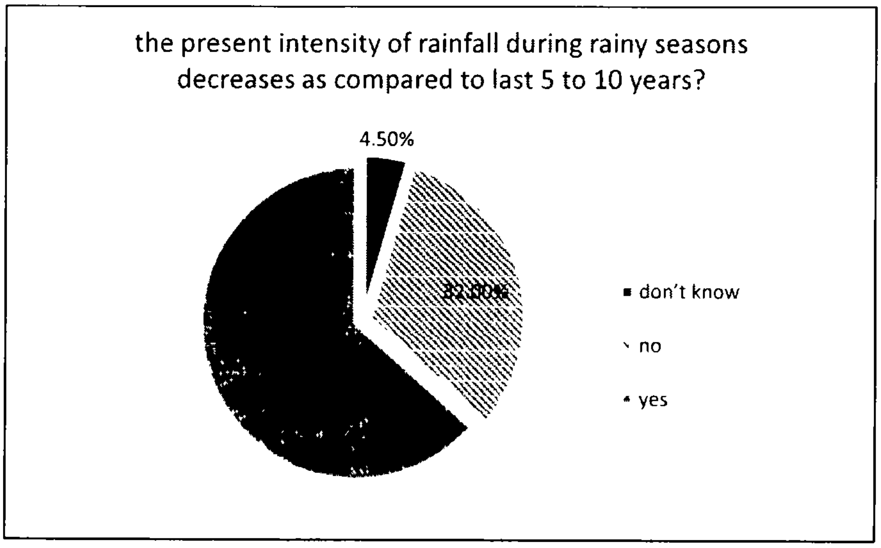

Figure 8 Perception of respondents regarding the rainfall intensity in last decade

4.5 Changes in water availability as perceived by the respondents

The quantity and quality of water play a significant role in the health of the people living in an area. If there is less amount of water present in the area or the quality of water is not fit for drinking and other purpose then there will be a large number of diseases due to this. The respondents were asked about the water availability in the area as compared to last 5 to 10 years. 55% respondents think that water availability in the area has decreased. Personal interviews and focused group discussions the participant also discusses the water availability and quality of water, many participants discussed that many diseases in the area is due to poor water quality. The water quality of the area is very poor because of the sewage water seepage through the drinking water which adhere its quality and causes diseases. The sewage system in the area is in very bad condition which affected the drinking water. The following graph shows the person's perception about the water availability in the area.

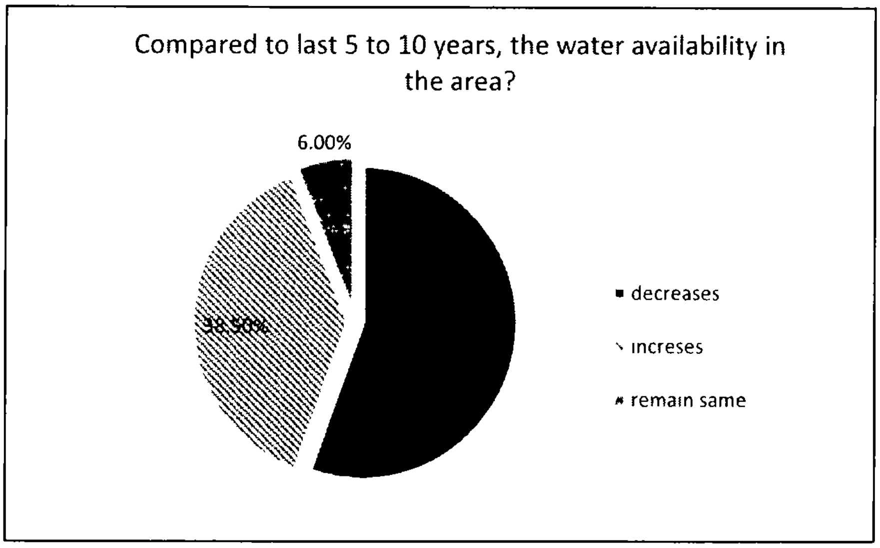

Figure 9 Perception of respondent regarding the availability of water in the last decade

4.6 Changes in Agriculture Productivity as Pragmatic by The Respondent

Farming is the chief source of income of the people in district swat. About 50% of the people depending on the agriculture in the district swat. Mainly there are two cropping seasons in the area. The respondents were asked questions regarding the agricultural productivity in the area as compared to last 5 to 10 years, 49% respondents answered that agriculture productivity is decreasing in the area while 38% believes its increases and 13% believes its remain the same. During FGDs the farmer representative says that the cropping season had been changed, the water availability for the crops also reduced, and the new pest also appears in the area. Which significantly reduced the agricultural productivity in the area. The following graphs show the person's perception about the agricultural productivity in the area.

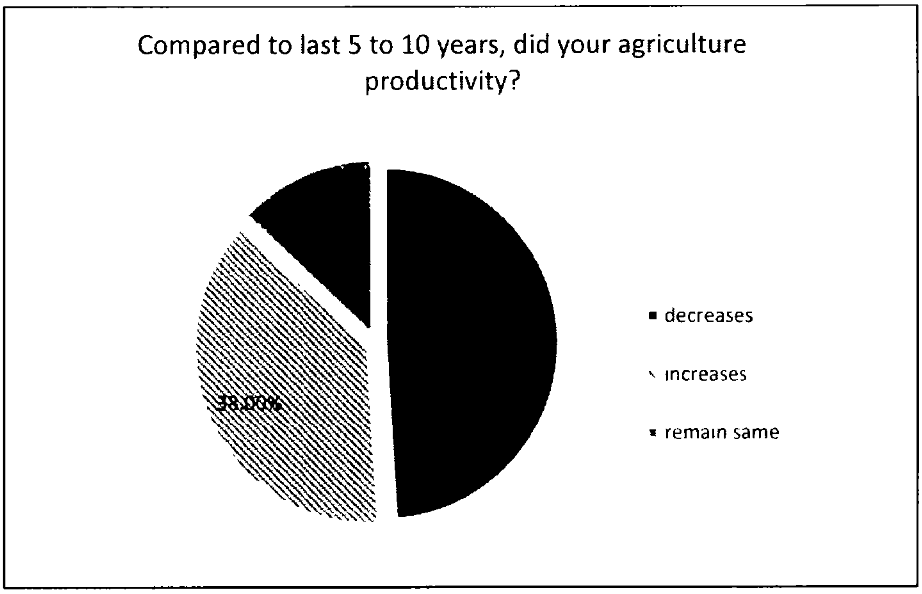

Figure 10 Agriculture Productivity in the as perceived by the respondents

4.7 Perception of Extreme Weather Events

Due to climate change and variability extreme weather events occur more frequently in an area. These events can have direct or indirect impacts on the health of the inhabitants of the area. Agricultural productivity and economy of the area can also be severely affected by the extreme weather events. The respondents were asked questions regarding the extreme weather events. Two questions were asked about the presence of extreme weather events and the one question were about coping strategies followed after the extreme weather events and the last questions were about the damages that were caused by the extreme weather events. 55% respondents believe that there are more floods in their area as compared to last 5 to 10 years, while 56% respondents thinks that there are more droughts in their area as compared to last 5 to 10 years. 56% respondent says that extreme weather events have caused damage to their property and agriculture. In regards to coping strategies 55% respondents say that they did not take any step to prepare for or respond to extreme weather events. The following graphs show the result of various questions that were asked in regards to extreme weather events.

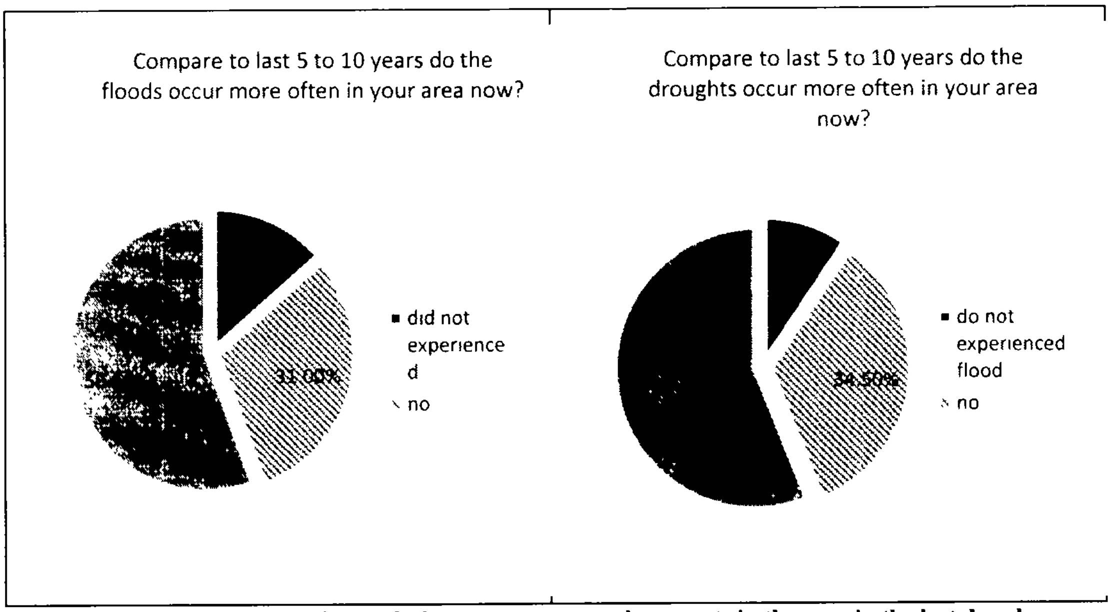

Figure 11 Respondents views relating to extreme weather events in the area in the last decade

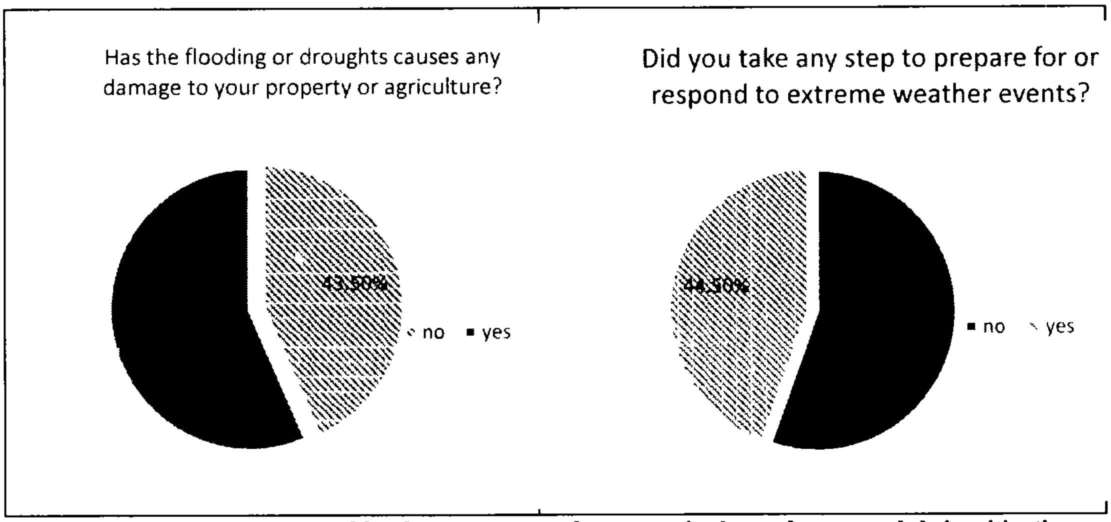

Figure 12 Damage caused by the extreme weather events in the study area and their mitigation measures

4.8 Perception on Health Care Facilities

Access to the proper health care facility is necessary to attain health impartiality and accumulating the value of healthy life in a society. Access to the health amenities means well-timed access to health, personal to attain the best health results. Poor health services affect individual and society. The questions were asked of the respondents regarding the availability of health care facility in the area and the ability of the health services to satisfy the current demands. 80% respondents say that hospital or medical facility is available in the area, while 69% believes that health services cannot satisfy the current demands of the area. The following graphs show the percentage of the people responding to each question regarding the health care facilities.

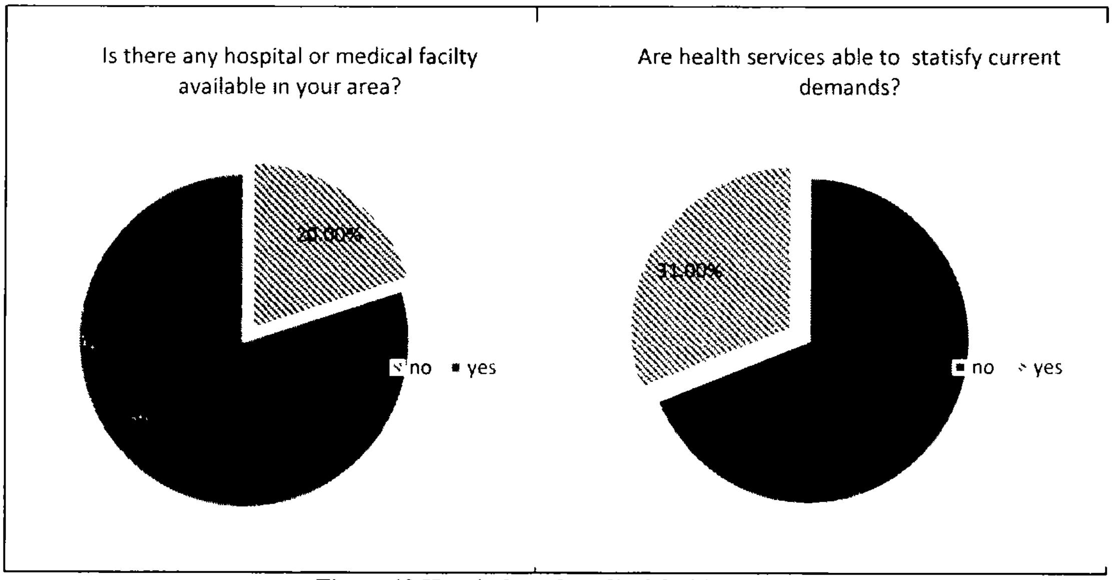

Figure 13 Hospitals and medical facility in the area

4.9 Observed Cases Of Notable Diseases During Seasonal Change

4.10 Observed Cases of Malaria During Seasonal Change

Of the many factors which play role in the distribution of malaria climate variables is one of the major factors. Rainfall play important role in the epidemiology of malaria because water play an important role in the mosquitos' life cycle (Kassa, et al., 2014). Temperature affects development period in the life cycle of mosquitoes, blood feeding rates, and longitivity. The graphical representation shows the trends of cases of malaria contrary to monthly mean rainfall and atmospheric temperature in swat. A 5 years monthly data of malaria has been co related with the mean precipitation and temperature. During the 5 year 63278 cases of malaria reported in the study area, with maximum number of cases recorded during 2010. The average cases of malaria during the 5 year period is 12655, with an average monthly case of 1054. The highest rate of the disease has been noticed in the months of August, and September, this indicates that the disease rate is higher in the monsoon seasons. With regard to monthly variation in the incidence of malaria cases the highest number of incidence has been found in the monsoon and post monsoon season July to September when the temperature and the precipitation is higher and also there moisture content in the atmosphere is higher. Although the incidence occurs in the winter, but it is less. So it is clear from the data that there direct relationship between rainfall and the incidence of malaria cases. There is the high incidence of malaria during 2010 which later on decreasing in the next successive years. A significant positive correlation found between malaria and temperature with a r and p value of (r=.605 and p=.000), while a non-significant positive correlation found between malaria and rainfall with r and p value of (r=.172 and p=.193)

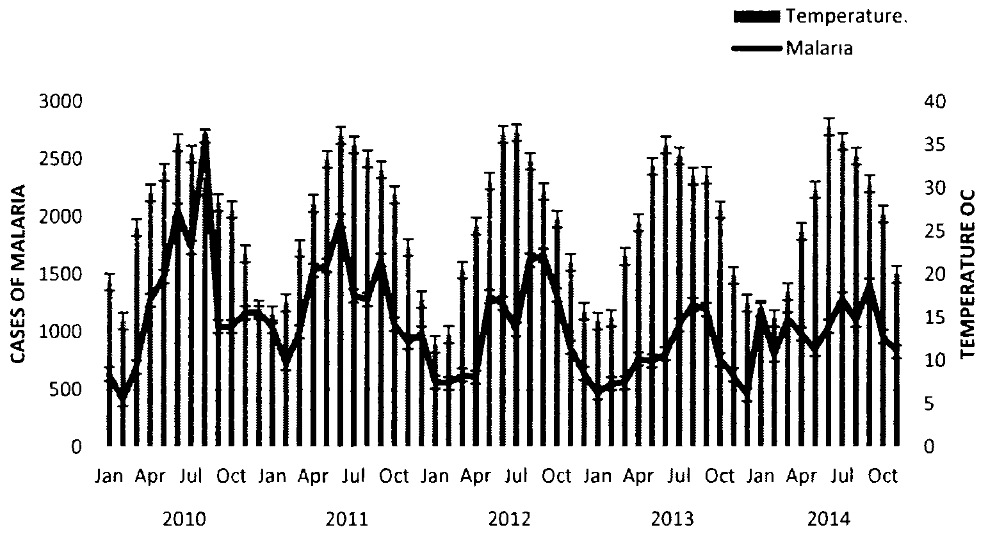

Figure 14 Cases of Malaria against temperature in Swat (January 2010-November 2014)

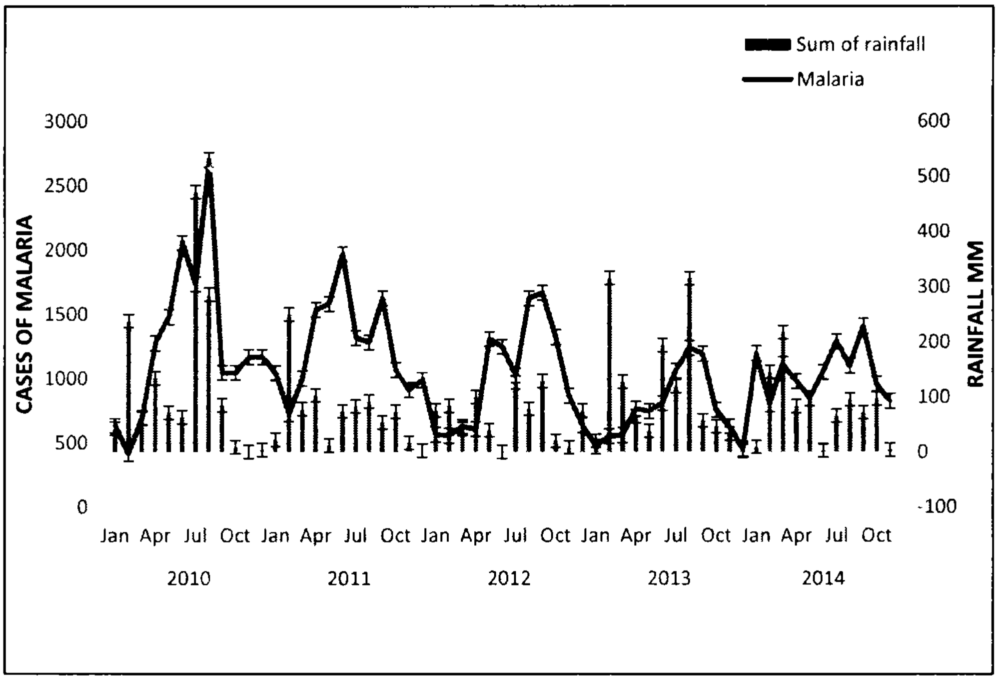

Figure 15 Cases of Malaria against Rainfall in Swat (January 2010-November 2014)

4.11 Observed Cases of Typhoid During Seasonal Change

The following figures illustrate the cases of typhoid against monthly mean temperature and precipitation. A total of 96782 cases of typhoid was reported during the 5 year time period, of which the highest number of cases was reported during 2011 which were 32624.the average number of annual cases during the 5 year is 19356, and the monthly average cases of typhoid are 1613. The highest rate of the diseases have been occurring in the May 2011 when the temperature is higher and there is less precipitation occurring in the area. The highest cases of the disease mostly appear in the month of the May and June. The May and June mostly receive little rainfall throughout the year as compared to the other months and the temperature is a bit higher that triggered the disease in the area. It is clear from the graphs that rainfall is inversely proportional to the cases of typhoid as the rainfall increases the cases of typhoid decreases, while temperature id directly proportional to typhoid as the temperature increases the cases of typhoid also increases. As mostly surface water is used for household purposes with the decrease in the rainfall the water availability decreases in the area which is a contributing factor in the increase of the disease. Typhoid is mostly activated in high temperature and increased humidity which are the proof of climate change. Burton (1993). A non-significant positive correlation found between typhoid and temperature with a r and p value of (r=.209 and p=.113), while a significant negative correlation found between typhoid and rainfall (r=-.261 and p=.046)

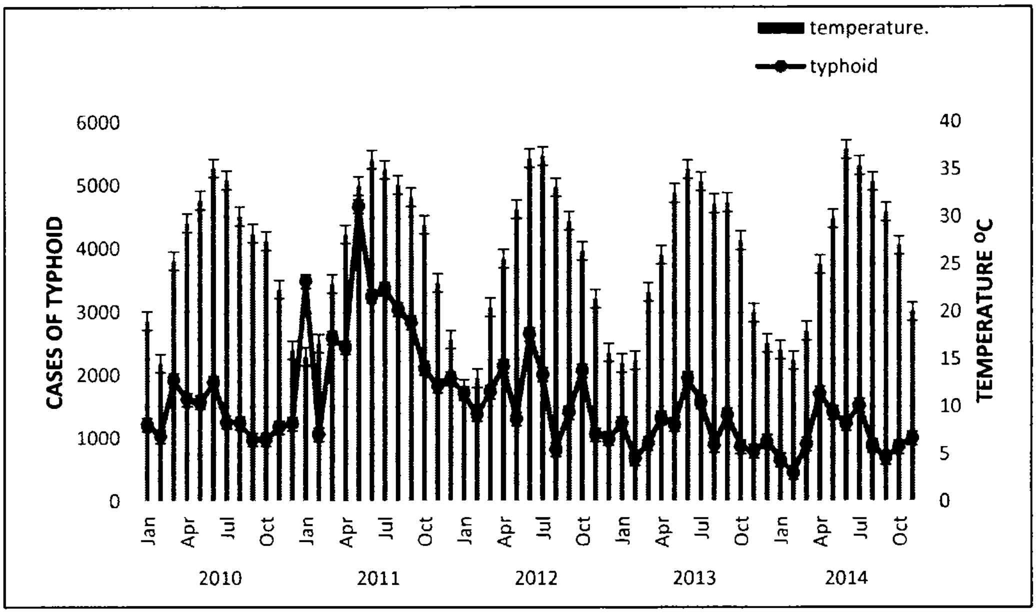

Figure 16 Cases of Typhoid against temperature in Swat (January 2010-November 2014)

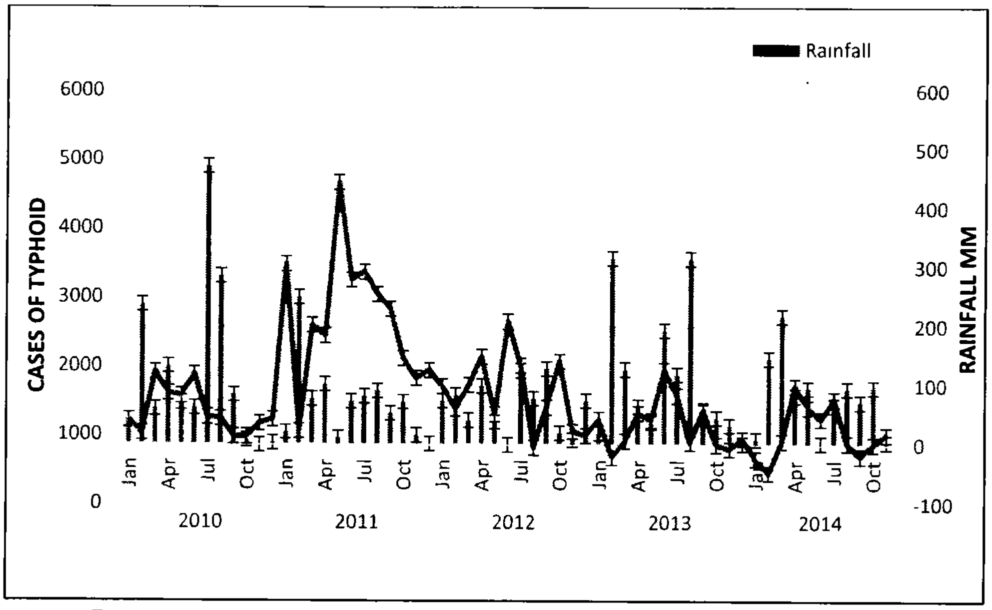

Figure 17 Cases of Typhoid against Rainfall in Swat (January 2010-November 2014)

4.12 Observed Cases of Diarrhea under Seasonal Change

The graphs show the cases of diarrhea against monthly mean temperature and precipitation. There is a complex relationship between climate and diarrhea due to the large number of variables (Mellor et al., 2012a, 2014) despite that a large number of studies have been carried to find the relationship between diarrhea and temperature and precipitation. Sanitation and hygiene condition of the area also play a major role in the outbreak of diarrheal diseases. It is clear from the literature that increase in temperature increases the replication and survival of diarrhea causing bacteria, protozoa, and food borne microorganisms. In this study the cases of diarrhea have been divided into two categories Diarrhea under 5 and diarrhea above 5. A total number of 531939 cases of diarrhea under 5 and 424768 cases of diarrhea above cases were reported during the 5 year time period. The average annual cases of diarrhea under is 106387 and of diarrhea above 5 is 84953, while the average annual cases of diarrhea under 5 is 8865 and diarrhea above 5 is7079. The highest number of cases appearing during the year 2011. A figures show that high cases of diarrhea appear in the month of July, and August. The graphs show that as the temperature increases the incidence of diarrhea also increases. During the wet or rainy months the cases of diarrhea increases. It shows that there is a direct relation between temperature and diarrhea with the highest cases are in the hottest month of the year where the temperature is above 33°C. A significant positive correlation found between diarrhea and temperature with a r and p value of (r=.839 and p=.000) while a non-significant negative correlation found between diarrhea and rainfall with a r and p value of (r=-.250 and p=.56)

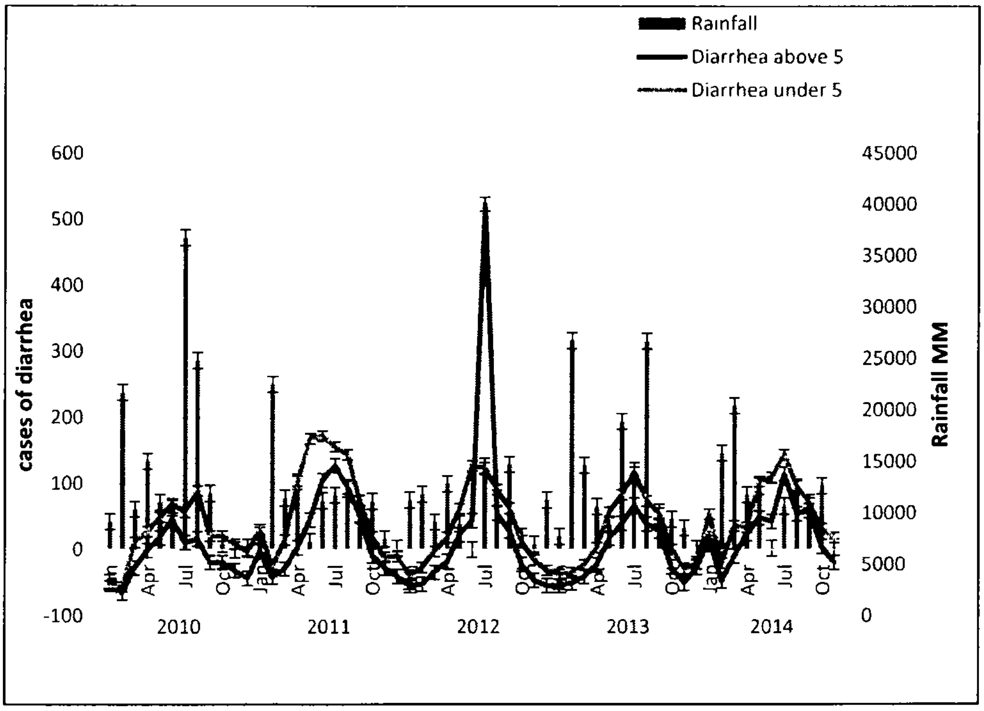

Figure 18 Cases of Diarrhea against Rainfall in Swat (January 2010-November 2014)

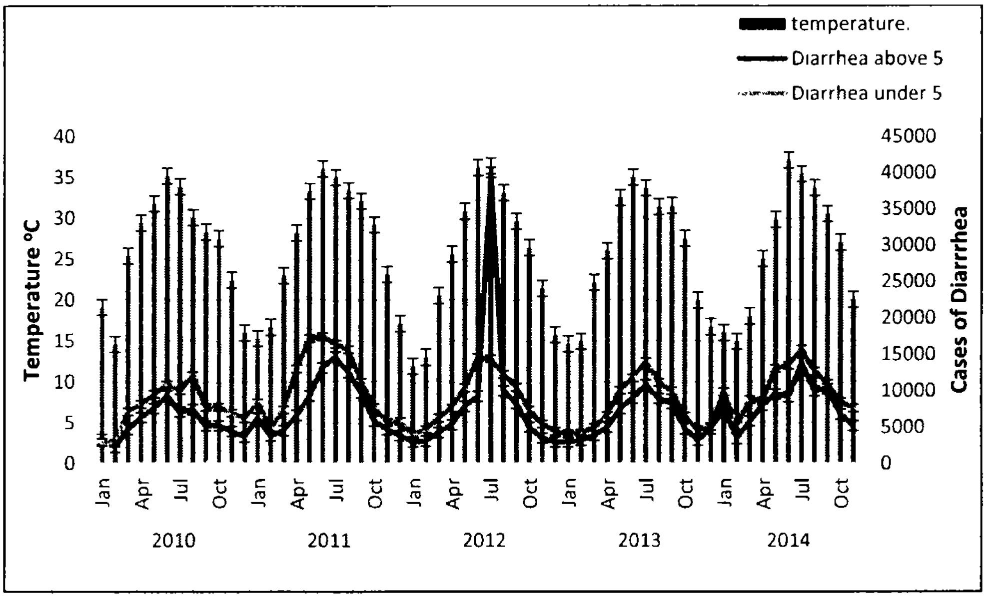

Figure 19 Cases of Diarrhea against Temperature in Swat (January 2010-November 2014)

4.13 Observed Cases of Pneumonia During Seasonal Change

A five years monthly wise data of pneumonia has been compared with the monthly mean temperature and precipitation data. The cases of pneumonia were also divided into two section pneumonia under 5, and pneumonia above 5. A total number of 52098 cases of pneumonia under 5, and 47018 cases of pneumonia above 5 were reported during the 5 year time period. The highest number of cases reported during 2011 for pneumonia under 5 and in 2013 the highest number of cases reported for pneumonia above 5. The average annual reported cases of pneumonia under 5 is 10419 and for pneumonia above 5 is 9583. The monthly average cases are 868 and 798 respectively, for pneumonia under 5 and above 5 for the 5 year time period. The graphs show that high incidence of pneumonia occurs in the month January and February when the temperature is at the lowest point of the year. Many factors are involved in the occurrence of pneumonia, which included socioeconomic, environmental and nutritional factors. A significant negative correlation correlation found between temperature and pneumonia with the r and p value of (r=-.441 and p=.000), while non-significant negative correlation found between rainfall and pneumonia with a r and p value of (r=-.250 and p=.924)

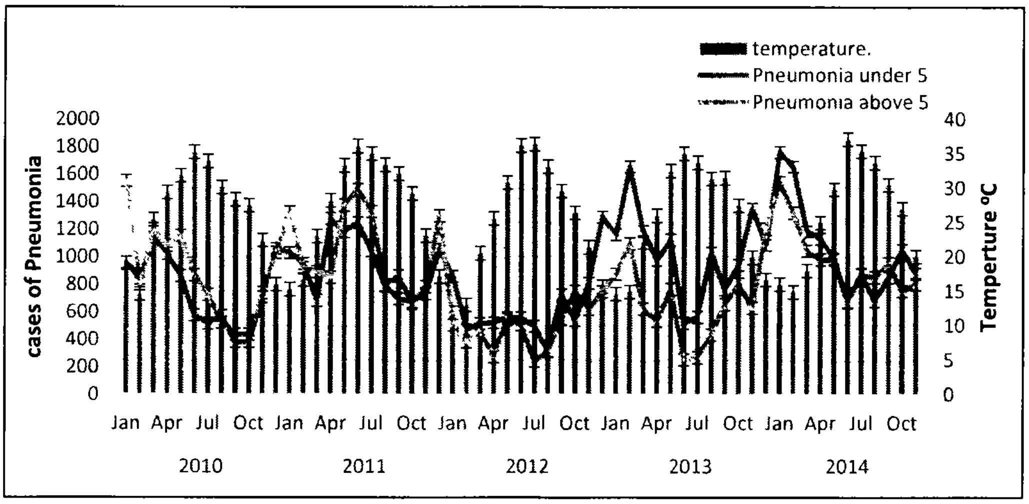

Figure 20 Cases of Pneumonia against Temperature in Swat (January 2010-November 2014)

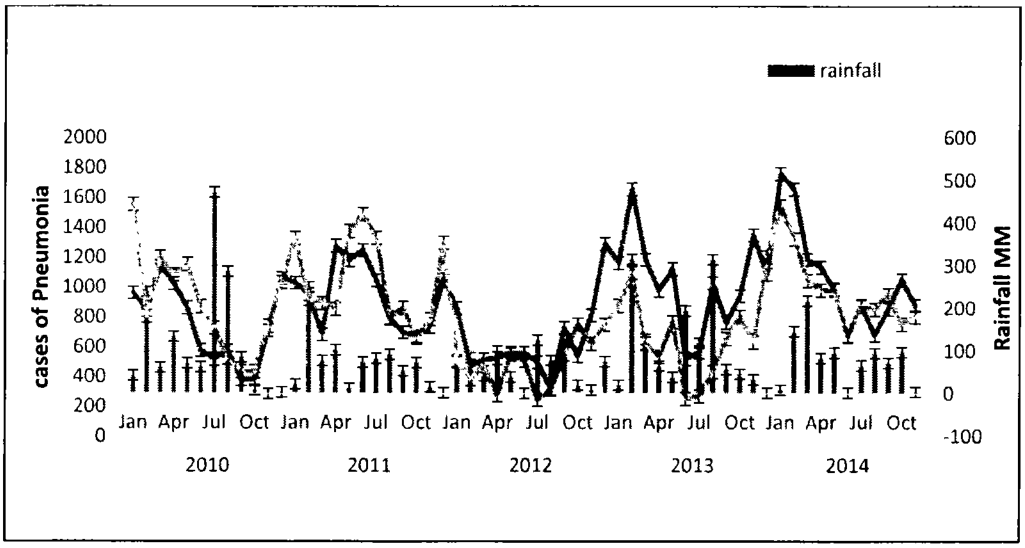

Figure 21 Cases of Pneumonia against Rainfall in Swat (January 2010-November 2014)

4.14 Observed Cases of Acute Respiratory Infections During Seasonal Change

Cases of the acute respiratory infections were compared with monthly temperature and precipitation data for the year 2010 to 2014. A total of 2087559 cases of ARI reported during the 5 year time period, of which the highest cases were observed in the 2011. The average annual cases of ARI during the 5 year time period is 417511, while the monthly average cases are 34792. The graphs show that there is a high rate of ARI during the dry and cold months, it is indicated from the graphs that December and January has the highest cases of ARI when there is little precipitation and the temperature is at the lowest point. There is a complex relation between low temperature and ARI cases, the cases of ARI increases in the winter when the temperature is low, as swat I a hilly area and its temperature is quite during the winter seasons and most of the people in the study area is poor which is more vulnerable to the low temperature increases the cases of ARI. A significant negative correlation found between temperature and ARI with the (r=-.616 and p=.011), as well as significant negative correlation found between rainfall and ARI with a r and p value of (r=-.329 and p=.000)

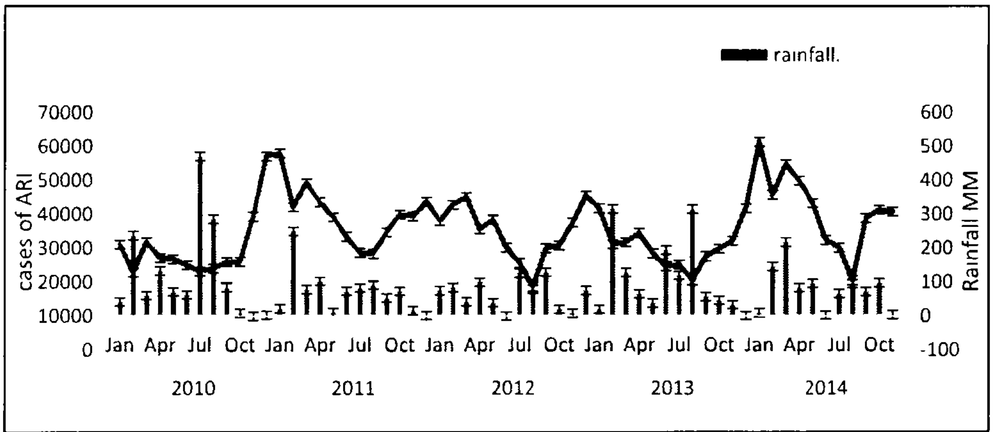

Figure 22 Cases of Pneumonia against Rainfall in Swat (January 2010-November 2014)

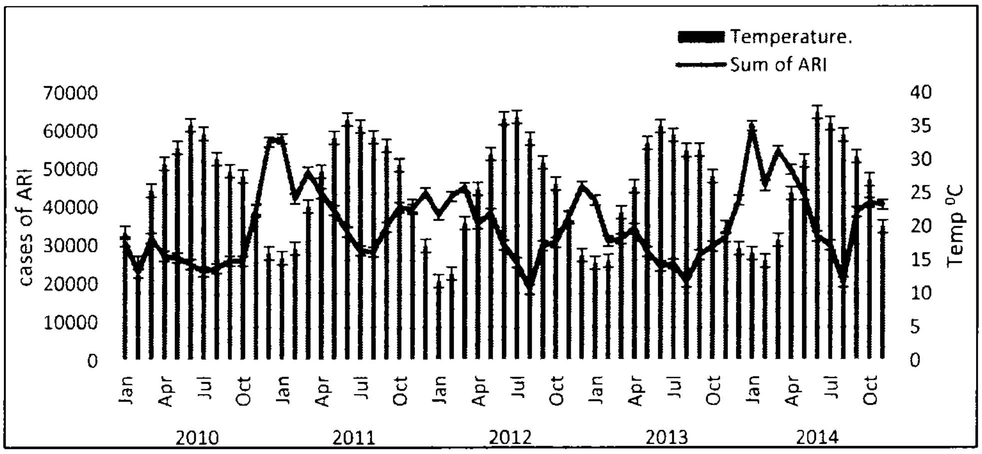

Figure 23 Cases of Pneumonia against Temperature in Swat (January 2010-November 201

Chapter 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The results of this study show a strong relation among climate change and variability and human health. The results based on local perception and observed health data in District Swat of KPK Pakistan indicated a trend of increasing health risks with seasonal climatic variation. For example, the cases of health problems like typhoid fever, malaria and diarrhea were more when the atmospheric temperature was high and rainfall was not enough in the area. The cases of pneumonia and ARI also more in dry cold weather, when pattern of precipitation reduced. The respondents also perceived that pattern of weather is changing in the area prevalence of certain diseases is increasing for that reason. The public perception about climate variability included increased in the summer temperature, changes in snowfall pattern, late winters and early summer, changes in the precipitation pattern. Majority of the respondents perceived that the impacts of the changes in climate variability are negative on human health, agriculture, infrastructure and livelihoods. The respondents also perceived that due to this changing climate the agriculture productivity in the area is reduced because of changing precipitation pattern, seasonal shift, and introduction of new pest. As a result of climatic variation the quality and the quantity of drinking water is declined which cause the emergence of several water and food borne diseases. Reduction in the agriculture productivity and loss of property and infrastructure can also affects health in several ways.

5.2 Recommendation

1) More specific research work is required to indicate specific climate related health risk in different seasons of the year for different people and demographic structure.
2) Further analysis of prevalence of diseases in the adjoining areas should also be examined to find out the association disease occurrence with social and economic status of inhabitants.
3) Proper monitoring of variations in the atmospheric temperature, precipitation and other climate factors in order to predict the occurrence of certain diseases and to take proper mitigation measures.
4) Develop a nationwide agenda for the assimilated assessment of the climate change and variability impacts on the human health. The main focus of the framework should be the pointing out of significant secondary relations, and the identification of research gaps.
5) Government should start a programme to bring awareness among people regarding likely health effects of climate change and proper mitigation measures to lessen the possibility of negative health consequences.
6) The water and sanitation system of the area must be improved so that the problem of the food and water borne diseases should be reduced.

7) Early warning systems should be developed which provide weather and climate forecast and the system should be properly implemented to provide information to the people and certain organisation in case of any climatic hazards in order to protect themselves and their property.
8) For the reduction of vulnerability and to enhance the adaptive capacity of people from the health effects of climate change and variability crucial steps are needed

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APPENDIX 1 MONTHLY CASES OF DISEASES IN DISTRICT SWAT FROM THE PERIOD 2010-2014

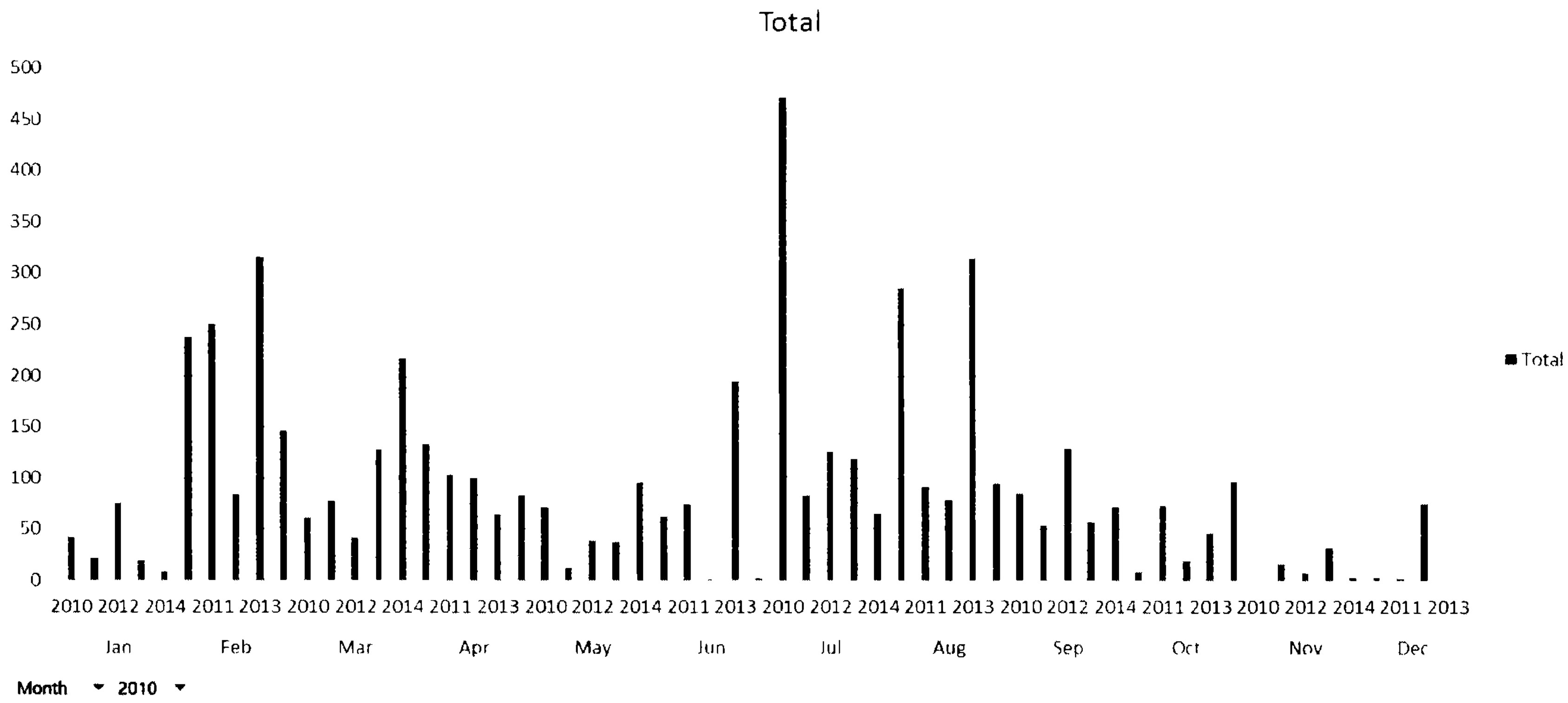
Year	Month	ARI	Pneumonia. U5	Pneumonia A5	Diarrhea U5	Diarrhea A5	Typhoid	Malaria	HYP
2010	Jan	31087	960	1553	2920	3341	1215	632	1804
2010	Feb	22903	841	803	2806	2221	1028	413	1583
2010	Mar	31899	1139	1201	7131	4681	1919	693	2611
2010	Apr	27190	1023	1082	8165	6351	1610	1274	3239
2010	May	26832	860	1152	9568	7584	1571	1479	3109
2010	Jun	25110	576	868	10887	9319	1881	2056	3620
2010	Jul	23200	516	726	10073	7112	1263	1734	2558
2010	Aug	24030	572	523	12145	7459	1240	2702	2317
2010	Sep	25998	381	435	7762	5193	978	1045	2725
2010	Oct	25998	381	435	7762	5193	978	1045	2725
2010	Nov	39373	708	739	6968	4419	1170	1167	3102
2010	Dec	57054	1060	1031	6214	3648	1229	1168	3392
2011	Jan	58033	1028	1327	8398	6255	3483	1042	4193
2011	Feb	42107	951	919	4750	3794	1059	723	3679
2011	Mar	49220	683	891	7373	4555	2596	1001	4806

2011	Apr	43618	1277	851	13086	6628	2442	1535	5181
2011	May	39176	1180	1374	17215	9321	4666	1581	6112
2011	Jun	33511	1247	1488	17476	13163	3251	1968	5477
2011	Jul	28682	1045	1330	16435	14612	3367	1316	5194
2011	Aug	28384	787	796	15672	12543	3044	1281	4720
2011	Sep	34792	696	861	11208	9715	2833	1625	4648
2011	Oct	39928	671	663	7697	5846	2112	1067	4387
2011	Nov	39416	733	784	5679	4651	1828	910	3356
2011	Dec	43734	1052	1298	5778	3815	1943	988	3794
2012	Jan	38047	857	503	3961	2920	1709	563	4957
2012	Feb	42822	471	382	4681	3070	1377	554	3685
2012	Mar	45119	515	468	6252	4237	1728	625	4978
2012	Apr	35667	522	275	7624	5289	2138	605	4933
2012	May	38337	558	547	10401	7876	1301	1307	3902
2012	Jun	30146	558	506	14568	9246	2646	1247	4905
2012	Jul	25596	496	243	14375	40031	2008	1023	4275
2012	Aug	18572	318	313	12272	9960	817	1623	3958
2012	Sep	30008	726	549	10451	8269	1401	1666	4313

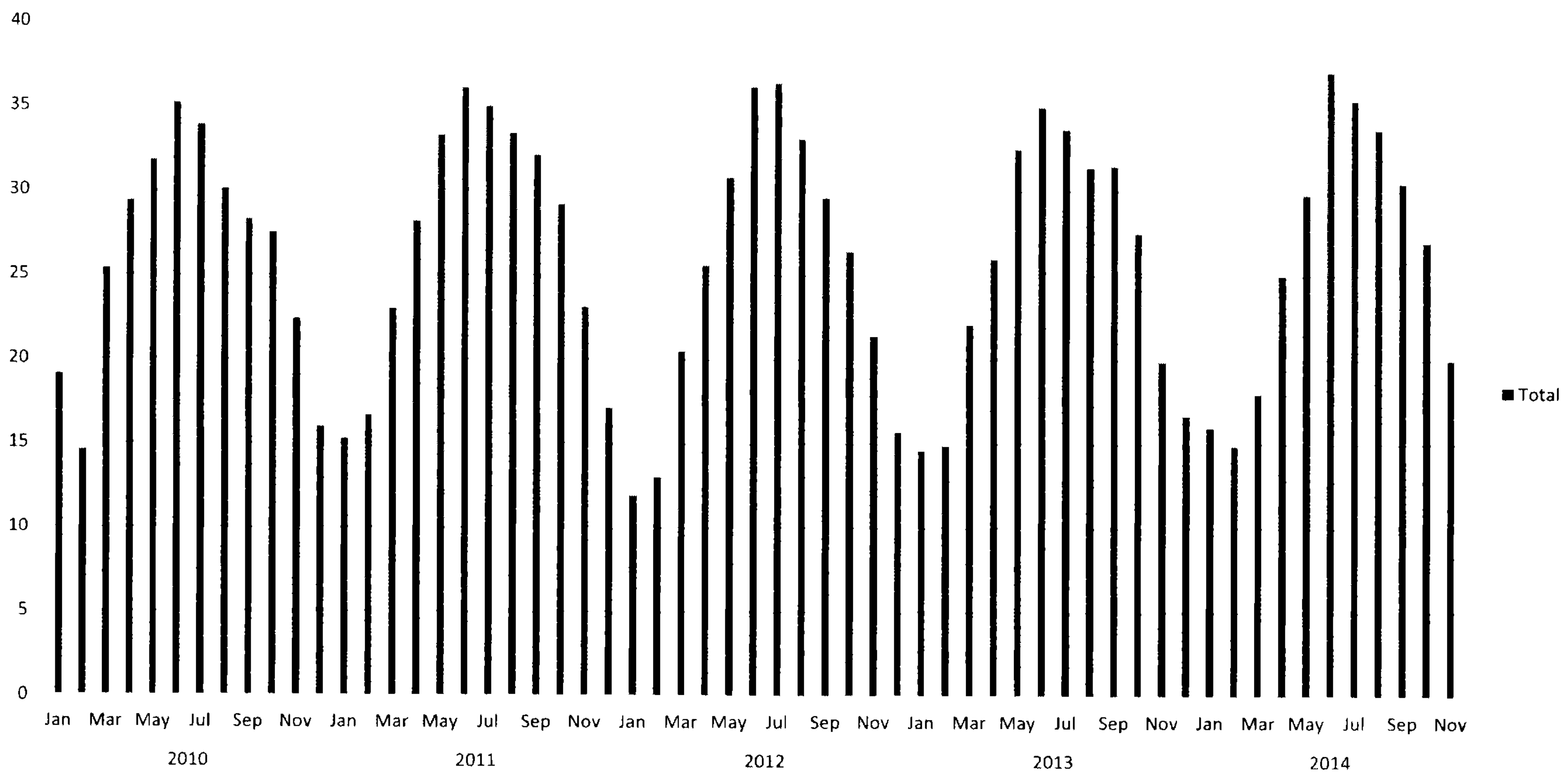
2012	Oct	30822	538	749	7317	4994	2068	1322	3666
2012	Nov	37557	810	620	5428	3454	1053	865	3397
2012	Dec	45468	1291	747	4426	2927	990	638	3419
2013	Jan	41813	1162	874	4058	2911	1231	470	2417
2013	Feb	31124	1656	1096	4198	3188	673	550	3289
2013	Mar	31798	1185	623	4933	3805	914	559	3271
2013	Apr	34473	976	532	6596	4967	1318	764	3676
2013	May	28433	1122	763	10071	7512	1213	746	3559
2013	Jun	24680	518	252	11758	8973	1942	808	3528
2013	Jul	25179	563	267	13992	10781	1570	1060	3860
2013	Aug	20495	1028	433	11142	8918	888	1238	3548
2013	Sep	27592	761	654	9987	8230	1363	1193	3991
2013	Oct	29787	940	802	6459	4734	858	757	3750
2013	Nov	32142	1349	629	4590	3163	795	627	3632
2013	Dec	41791	1086	1203	5005	4712	946	453	4213
2014	Jan	61324	1760	1543	9867	7511	4483	1197	2350
2014	Feb	45687	1656	1321	5123	3388	450	799	3389
2014	Mar	54789	1185	1043	8741	5805	906	1113	3471

2014	Apr	49871	1132	980	8596	7967	1711	980	3876
2014	May	43234	987	980	13071	9512	1400	846	3687
2014	Jun	32451	675	670	13458	9173	1230	1050	3821
2014	Jul	30123	876	870	15692	13781	1520	1290	4034
2014	Aug	20495	678	850	12642	9918	880	1099	3758
2014	Sep	38843	850	951	10987	10230	690	1409	4123
2014	Oct	41234	1050	750	8459	6734	860	960	3950
2014	Nov	40765	876	800	7590	5163	999	827	3832

rainfall.



ANNEXURE 2 Rainfall data of district Swat from period 201-2014 (MET Department Islamabad)



ANNEXURE 3 Monthly temperature data of District Swat for the period of 2010-2014 (MET Department Islamabad)